

**The social acceptance of energy storage in Canada and the United Kingdom:
Media and public framing of an energy transition technology**

by

Sara Ganowski

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Environmental Studies
in
Social and Ecological Sustainability

Waterloo, Ontario, Canada, 2019

© Ganowski 2019

AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

Growing climate and energy security pressures call for more ambitious deployment of transformative low-carbon energy technologies worldwide. By supporting renewable energy integration and evolving power grids, energy storage (ES) technologies (e.g., pumped-hydro, batteries) are expected to help enable improved lower-carbon electricity systems. Yet, commercial deployment to date has been slow and geographically variable largely due to the practical and socio-political barriers in 'locked-in' fossil fuel regimes that currently inhibit wide adoption of low-carbon energy solutions. A growing literature suggests that social factors, such as public awareness and acceptance, will have a steering influence on the extent to which ES is deployed at various scales (local, national) as part of an energy transition agenda. News media will play a key role in this process, given the 'agenda-setting' influence that framing and issue salience are known to have on actors involved in alternative energy development. However, very little is currently known about these often-overlooked social dynamics in the context of ES, even in jurisdictions where the technology is outpacing incumbent energy policy and regulatory conditions, such as in Canada and the United Kingdom (UK). Further analysis on the social dimensions of ES is needed to help bridge this gap and support effective public communication and deployment strategies for meeting national sustainability and energy security challenges.

Taking a sustainability perspective, this thesis compares social perceptions of ES in Canada and the UK, in order to explore the socio-political factors informing the technology's trajectory in two national settings. Using a comparative, exploratory approach, the project examines: (1) the salience and representation of ES in news media (2008-2017); (2) public awareness and perceptions of ES (2018); and (3) the extent to which media and public perceptions of ES align in both countries (2016-2018). Merging various frameworks for studying energy system change, the thesis comprises a comparative: (1) mixed methods media content analysis of national newspaper coverage on ES (2008-2017; $n = 494$ articles); and (2) secondary analysis of nationally representative public survey data (2018; $n = 2066$). The study reveals cross-national differences in media and public perceptions of ES (2016-2018) and explores possible drivers and implications of such variations for ES uptake in the two countries. Overall, ES is found to be favourable in both public spheres, with UK media and survey respondents demonstrating greater attention/awareness, more favourable benefit/risk perceptions, and positive emotional affect towards ES than their Canadian equivalents. Varying frames and narratives, as well as levels of techno-optimism and hype dynamics suggest that ES is contextualised differently in the two countries in order to appeal to domestic audiences and energy priorities. National socio-political issues and values, as well as certain demographic factors also appear to be linked to varying levels of public acceptance for ES. By exploring how ES is socially constructed in the two countries, the study aims to inspire effective public communication, policy design, and implementation strategies for democratic energy technology deployment as part of a sustainability imperative. The case study thus provides a rich empirical foundation for understanding ES in a socio-political context, while offering practical avenues for supporting its uptake in society as an energy transition tool.

Acknowledgements

I would like to sincerely thank my supervisor Dr. Ian Rowlands for providing me with invaluable insight, endless support, and unforgettable personal and professional growth opportunities over the course of my studies. Ian has instilled in me a true appreciation for international research and collaboration, and the value of striving for excellence in my work and in my character – all while reminding me not to make mountains out of molehills (I need that sometimes). I also wish to express my gratitude to my committee member, Dr. Robert Gibson, who agreed to come along on this journey, offering nothing short of his great wisdom and advice, thoughtful feedback, and comic relief along the way. I am so grateful to have had the opportunity to work with you both over the last several years.

I would like to thank Dr. James Gaede for his continuous mentorship during my time on the Project 4.6 team, and specifically for his support with inter-coder reliability testing for this project. I am also indebted to Dr. Christopher Jones from the University of Surrey, for his support and hospitality during my research trip to the United Kingdom. Thank you, Chris, for enriching what was a wonderful learning opportunity for me by encouraging me to present my research in the UK and allowing me to contribute to your research program. I am also grateful to the wonderful Brownyn Lazowski for always offering me wise and encouraging advice for navigating the nebulas of graduate school.

I would like to acknowledge the generous support of various funders, including the Natural Sciences and Engineering Research Council of Canada (NSERC) and the NSERC Energy Storage Technology (NEST) Network which allowed me to undertake this project and participate in research activities that contributed deeply to my growth as a researcher. Similarly, I must thank the Social Sciences and Humanities Research Council of Canada (SSHRC), the University of Waterloo, the Faculty of Environment, and the School of Environment, Resources and Sustainability for their support.

I owe my deepest gratitude to my parents, Eve and Marian. Words cannot express how grateful I am to for their love, support, and encouragement throughout my studies. Finally, I would like to thank my dearest James and Isabella, whose moral support got me through the best and bumpiest parts of this journey.

Dedication

I would like to dedicate this thesis to my parents, who inspire me in more ways than they know.

Table of Contents

AUTHOR’S DECLARATION	ii
Abstract.....	iii
Acknowledgements.....	iv
Dedication.....	v
Table of Contents.....	vi
List of Figures.....	viii
List of Tables	iv
List of Abbreviations.....	x
Chapter 1 – Introduction.....	1
1.1 Problem context.....	1
1.2 Research goal and questions	4
1.3 Structure of thesis	5
1.4 Case study background	5
1.4.1 ES and the energy transition.....	5
1.4.2 ES in Canada and the UK: A comparison.....	8
1.4.3 ES and national media contexts: Canada vs. UK.....	10
1.5 Summary	13
Chapter 2 – Literature Review	14
2.1 Overview.....	14
2.2 Introduction.....	14
2.2.1 Socio-technical transitions and energy technology change.....	15
2.2.2 Social acceptance of energy innovation	21
2.2.3 Social representation and framing theory	25
2.4 Summary	32
Chapter 3 – Methodology and Methods	33
3.1 Overview.....	33
3.2 Research design	33
3.2.1 Exploratory and case study research.....	33
3.2.2 Case studies.....	34
3.2.3 Scope and scale.....	35
3.3 Methods.....	36
3.3.1 PH1 – Comparative Mixed Methods Media Content Analysis (MCA).....	36
3.3.2 PH2 – Comparative Secondary Survey Analysis (SSA).....	41
3.4 Strengths and Weaknesses of Methodology	42
3.4.1 PH1 – Comparative Mixed Methods Media Content Analysis (MCA).....	42
3.4.2 The SPEED framework	44

3.4.3	Other considerations	45
3.4.4	PH2 – Comparative Secondary Survey Analysis (SSA)	46
3.5	Data collection	47
3.5.1	PH1 – Comparative Mixed Methods Media Content Analysis (MCA)	47
3.5.2	PH2 – Comparative Secondary Survey Analysis (SSA)	51
3.6	Population and sample size	51
3.6.1	PH1 – Comparative Mixed Methods Media Content Analysis (MCA)	51
3.6.2	PH2 – Comparative Secondary Survey Analysis (SSA)	53
3.7	Data analysis	54
3.7.1	PH1 – Comparative Mixed Methods Media Content Analysis (MCA)	54
3.7.2	PH2 – Comparative Secondary Survey Analysis (SSA)	62
3.8	Summary	62
Chapter 4	– Results	63
4.1	Overview	63
4.2	PH1 – Comparative Mixed Methods Media Content Analysis (MCA)	63
4.2.1	Quantitative findings – ES in Canadian and UK newspapers (2008-2017)	63
4.2.2	Qualitative findings – ES in Canadian and UK newspapers (2016-2017)	69
4.3	PH2 – Comparative Secondary Survey Analysis (SSA)	80
4.3.1	Overview	80
4.3.2	News readership and public exposure to ES in the media	82
4.3.3	Public awareness of ES	83
4.3.4	Public benefit and risk perception of ES	84
4.3.5	Public affect toward ES	89
4.3.6	Other findings – Personal narratives and technology favourability	90
4.4	Summary	94
Chapter 5	– Discussion	96
5.1	Overview	96
5.1.1	Issue salience	96
5.1.2	Framing	102
5.1.3	Narratives	107
5.1.4	Valence	115
5.2	Summary	120
Chapter 6	– Conclusions and Recommendations	121
6.1	Overview	121
6.1.1	Research conclusions	121
6.1.2	Broader conclusions and implications	123
6.1.3	Research outcomes and significance	125
6.1.4	Research and practical recommendations	127
6.2	Final statement	131
Appendix A	– Definitions	156
Appendix B	– Codebook	158
Appendix C	– Data Appendices	164

List of Figures

Figure 1. ES technologies and their various suitability for grid-scale applications.....	7
Figure 2. The Multi-Level Perspective framework.....	17
Figure 3. Annual reporting of ES in national newspapers: Canadian vs. UK (2008-2017)	63
Figure 4. Valence of news articles reporting on ES: Canada vs. UK (2016-2017)	71
Figure 5. SPEED framing of ES: Benefits vs. Risks (2016-2017)	72
Figure 6. Percentages of articles containing four ES narratives: Canada vs. UK (2016-2017)...	79
Figure 7. Publics' perceived valence of ES reporting in newspapers: Canada vs. UK (2018)....	83
Figure 8. Initial public benefit-vs-risk perceptions of ES: Canada vs. UK (2018).....	85
Figure 9. Public preferences for various ES technologies: Canada vs. UK (2018).....	93
Figure 10. Downs' (1972) 'issue attention' and Gartner Group's (1995) 'hype cycle'	98

List of Tables

Table 1. Comparing Canada and the UK: National contexts for ES.....	10
Table 2. Overview of MCA techniques: frequency, framing, and narrative analyses.....	38
Table 3. Newspaper sample: Circulation, ownership, political leanings, and other notes.....	49
Table 4. Key demographic details of national samples.....	54
Table 5. The Landis & Koch (1977) kappa (κ) benchmark scale for inter-coder reliability.....	60
Table 6. Inter-coder reliability results: Four key media variables analysed in PH1.....	60
Table 7. Inter-coder reliability results: SPEED frames analysed in PH1.	61
Table 8. Distribution of ES articles in Canadian and UK newspapers.....	64
Table 9. ES representations in Canadian and UK newspapers: Text-search query results	66
Table 10. Frequences and percentages of ES technology mentions: Canadian vs. UK.....	68
Table 11. National SPEED frame benefit-to-risk ratios: Canadian vs. UK.....	73
Table 12. SPEED framework applied to ES coverage in Canadian and UK newspapers	74
Table 13. Comparable variables from MCA and UW-UNIS survey data	81
Table 14. Comparative mean/significance scores for general benefit/risk perceptions of ES.....	86
Table 15. Mean evaluations of public risk perceptions of ES: Canada vs. UK	87
Table 16. Mean evaluations of public benefit perceptions of ES: Canada vs. UK.....	88
Table 17. Comparative mean/significance scores for general positive/negative public affect	89
Table 18. Mean evaluations of public affect toward ES: Canada vs. UK.....	89
Table 19. Comparative mean/significance scores for energy security and climate concerns	91
Table 20. Mean evaluations of public affect perceptions toward ES: Canada vs. UK	91
Table 21. Public favourability of specific ES technologies	93
Table 22. Summary of key findings from PH1 and PH2.....	95

List of Abbreviations

BEIS – Department for Business, Energy and Industrial Strategy
BTM – Behind-the-meter
CAD – Canadian Dollar
CCS – Carbon capture and storage
ES – Energy storage
EU – European Union
EV – Electric vehicle
GW – Gigawatt
IESO – Independent Electricity System Operator
MCA – Media content analysis
MLP – Multi-Level Perspective
MW – Megawatt
MWh – Megawatt hour
NRCan – Natural Resources Canada
Ofcom – The Office of Communications
Ofgem – The Office of Gas and Electricity Markets
RD&D – Research, development, and demonstration
Solar PV – Solar photovoltaic
SPEED – Socio-Political Evaluation of Energy Deployment
SSA – Secondary survey analysis
TW – Terawatt
TWh – Terawatt hour
UK – United Kingdom
UW-UNIS – University of Waterloo-University of Surrey
USD – US Dollar

Chapter 1 – Introduction

1.1 Problem context

Amidst growing global climate and energy security threats, the deployment of low-carbon energy technologies is imperative for addressing the ‘energy trilemma’ – the challenge of shifting to cleaner, more reliable, and cost-effective energy systems (Gunningham, 2013; Geels et al., 2016). By supporting national decarbonisation and energy security goals, grid-scale and behind-the-meter (BTM) energy storage (ES) technologies are said to play a key role in this transition (Gallo et al., 2016; Wade et al., 2010). However, as with many alternative energy innovations (e.g., renewables, smart grid), large-scale ES deployment faces various socio-political and economic barriers (Geels et al., 2014; Taylor et al., 2013). Technical advancements in market-leading countries such as Canada and the United Kingdom (UK), are currently outpacing socio-political contexts required for the commercial success and system integration of ES (Gallo et al., 2016; Devine-Wright et al., 2017; Gaede & Rowlands, 2018a). Yet, while there is no shortage of techno-economic feasibility studies on ES (Chen et al., 2009; Wade et al., 2010; Kittner et al., 2017), little is currently known on how social representations and public perceptions of storage are unfolding to affect its trajectory in evolving energy systems. Socio-political dynamics of energy technology and system change, such as social acceptance and public engagement, have been vastly overlooked in the context of ES (Devine-Wright et al., 2017; Batel et al., 2018). This is problematic, given the steering influence (particularly when resistant) that public stakeholders, through their awareness of and engagement with unfamiliar technologies, can have on the uptake of energy innovation in society (Sovacool, 2014; Peterson et al., 2015; Wüstenhagen et al., 2007). Further research on these dynamics is thus warranted for leveraging ES as an energy trilemma tool in countries such as Canada and the UK.

Here, the term ‘energy storage’ (ES) refers to a suite of technologies (e.g., batteries, flywheels, and compressed-air storage), which can be used for storing and recovering electricity – at both the supply and end-user levels – for later use on power networks (Chen et al., 2009). By providing a range of system benefits (e.g., improved power quality, voltage support, and load-shifting) (Gallo et al., 2016), ES technologies can help stabilise grids fed by intermittent energy sources, in turn enabling renewable energy integration on power networks. ES can also support national climate and energy security mandates by improving system efficiency, increasing energy access (e.g., off-grid electrification) and end-use sector electrification (e.g., transport), and enabling non-fossil fuel energy options (IEA, 2014; Gaede & Rowlands, 2018a).

At the same time, advancements in ES pose challenges for some system actors, particularly since the technology's dual nature of both consuming and discharging electricity restricts it from fitting neatly into existing business and regulatory models. More broadly, the large-scale deployment of low-carbon technologies pose risks to the conventional fossil fuel sectors and processes upon which national economies – such as Canada and the UK – rely considerably (Devine-Wright et al., 2017; Geels, 2014). For these reasons, experts both observe and debate the transformative potential of ES for catalysing more desirable 'next generation' energy grids (McPherson et al., 2018; Wicki & Hansen, 2017; Gaede & Rowlands, 2018a).

Nonetheless, since the late 2000s, growing interest in ES has led to supportive policy and electricity market responses in various jurisdictions currently pursuing energy transition pathways (e.g., United Kingdom, California, Alberta, Ontario) (Winfield et al., 2018). As costs and policies for the technology continue to become more favourable, the global ES market is expected to double six times by 2030 to reach 125 GW of installed capacity (compared to the 2 GW existing in 2016) (Eller & Gauntlett, 2017; Navigant Research, 2017; McKinsey & Company, 2016). Yet, despite progress to date, large-scale ES deployment remains slow and geographically variable (Devine-Wright et al., 2017). According to transitions literature, this lag between technological innovation and its diffusion in society is a result of various interrelated, but often overlooked socio-technical and socio-political factors that inform energy system change (Geels, 2002; 2005; Winfield et al., 2018; Negro et al., 2016).

The fate of ES remains particularly uncertain in industrialised nations that have become 'locked' into fossil fuel energy regimes that inhibit diffusion of carbon-saving technologies – despite growing national climate change efforts (Klitkou et al., 2015; Geels, 2005; 2014). Dominant market players, incumbent institutional structures, and social factors in such economies create inertia for alternative energy deployment, particularly when innovations threaten powerful regime actors and established revenue streams (Smith et al., 2005; Negro et al., 2012). Accordingly, even in Paris Agreement signatory countries like Canada and the UK, technical advancements are outpacing the socio-political conditions required for regime-level adoption of ES (REA, 2016; Winfield et al., 2018; Devine-Wright et al., 2017; Wicki & Hansen, 2017). Many argue that research, development, and demonstration (RD&D) processes are moving the technology faster than expected, and thus faster than current policy landscapes and key stakeholders can 'contain it' (Gaede & Rowlands, 2018a; Wicki & Hansen, 2017). As a result, ES is often referred to as a 'disruptive' technology, which does not align with existing

fossil fuel-based, centralised energy regimes. Addressing this misalignment to advance ES at the regime level (i.e., where system transformation often best occurs) will require closer attention to the social underpinnings of energy transition processes (Stephens et al., 2008; 2013; Meadowcroft et al., 2009; Miller et al., 2013).

A growing literature suggests that social representation and public acceptance of energy innovation can inform the pace and direction of alternative energy development, both at local and national scales (Wüstenhagen et al., 2007; Devine-Wright, 2011; Batel et al., 2013; Walker et al., 2014). For instance, by actively supporting or protesting against energy projects (e.g., wind farms) or policies (e.g., feed-in-tariffs), publics can influence investors and decision-makers involved in advancing transformative energy technologies (Rip & Kemp, 1998; Heras-Saizarbitoria et al., 2011). The implementation of grid-scale ES solutions, for example, will be driven largely by assumptions of domestic support and/or resistance to storage at institutional and socio-political levels (Devine-Wright et al., 2017; Geels, 2014).

While many factors can inform public acceptance of new technologies (e.g., personal values, firsthand experiences), news media often play a pronounced role in this process (Gamson & Modigliani, 1989). Since publics typically first experience new energy technologies through media coverage rather than directly (Mallett et al., 2018), it is important to consider how media portray innovations like ES, and how publics are engaging with this discourse in order to form their own perceptions. Issue salience and framing in newspapers has been particularly known to shape industry and policy debates, investment decisions, innovation processes, and public support for new energy developments (Dusyk et al., 2018; Stephens et al., 2013; Mallett et al., 2018; Ruef & Mackard, 2010). This is due, in part, to the dual role that media play in reflecting and informing public opinion of and action toward societal issues (i.e., 'reporting and setting the agenda') (Protess & McCombs, 2016; Luhmann, 2000). Agenda-setting in mass communication has important implications for energy transition processes, particularly since news stakeholders (e.g., media owners, editors, and journalists) are often inclined to reflect and reinforce incumbent realities and existing social opinions in order to avoid challenging current audiences, subscribers, and especially, advertisers (Shaw, 1979; Protess & McCombs, 2016). Through a transitions lens, the extent to which media operate within (or challenge) the boundaries (i.e., belief systems and regime rules) set by their communities of interest, can determine whether they serve as nurturers of social complacency or enablers of transformative system change (Lyytimäki et al., 2018).

Early probing of social representations of ES can thus help advance appropriate ES market and policy strategies that proactively consider public concerns and national priorities within evolving energy systems. In the same way, failure to consider and respond to societal framing of ES can lead to project failures, deadlocked policies, and financial costs, which may result in further regime resistance to low-carbon development (Upreti & van der Horst, 2004; Geels, 2014). Finally, today's politicisation of energy provides an opportunity to explore the dynamics among media, public perception, and technology deployment – particularly since the nature of ES inherently challenges existing high-carbon, growth-oriented energy regimes. Thus, as ES technologies mature, a greater understanding and control of this interplay in the public sphere (i.e., where public discourse and social learning takes place) (Habermas et al., 1974) may help to smooth ES development in Canada, the UK, and other emerging markets.

1.2 Research goal and questions

Taking an energy sustainability perspective, the goal of this research is to explore and compare media representations and public perceptions of ES in Canada and the UK in order to better understand the socio-political factors surrounding social acceptance and deployment of storage in two different national settings. To achieve this, I consult (1) Devine-Wright et al.'s (2017) conceptual framework for understanding social acceptance of ES; and apply (2) Stephens et al.'s (2013) Socio-Political Evaluation of Energy Deployment (SPEED) framework as a media content analysis (MCA) and secondary survey analysis (SSA) of public opinion data from a corresponding cross-national project on public perceptions of ES in Canada and the UK. While this work is tied to a parallel project led by senior researchers from the University of Waterloo (UW) and University of Surrey (UNIS) (hereafter referred to as the UW-UNIS survey study), this thesis was developed as an independent undertaking entirely by me, under the supervision of Dr. Ian Rowlands and Dr. Robert Gibson. The study poses the following research questions:

- **RQ1:** How does the salience and representation of ES in news media discourse compare between Canada and the UK (2008-2017)?
 - (b) What are the most prominent 'frames' and 'narratives' around ES in top-circulating national newspapers within each country (2016-2017)?
- **RQ2:** How does the general public's awareness and perception of ES compare between Canada and the UK (2018)?
- **RQ3:** How do national media representations and public perceptions of ES compare between the two countries (2016-2018)?

1.3 Structure of thesis

This thesis is presented in six chapters and three appendices. Chapter 1 introduces the research goal and questions, outlines key case study information, and conveys the parameters of this research. Chapter 2 reviews the three key bodies of literature informing this work, draws upon previous research aimed at understanding the social dynamics of energy system change, and identifies the knowledge gaps that this project aims to address. By examining socio-technical transitions, social acceptance, and social representation literatures, the review illustrates the insufficient attention given to ES in energy social research and the opportunity for exploring social perceptions of storage at the nexus of these three theoretical domains. Chapter 3 describes the methodological framework and methods used to collect and analyse data in each phase of the thesis (i.e., PH1 and PH2). This chapter also describes and justifies sample selection and discusses strengths and limitations of the research design, including the validity and reliability measures that were taken. Chapter 4 presents results from both phases of the project and summarises comparative insights on media and public framing of ES in each country to set the stage for the subsequent discussion. Chapter 5 discusses study results in respect to the research goal, questions, and relevant findings from the literature. The discussion chapter uses four dimensions (i.e., issue salience, framing, narratives, and valence) as the organising structure for comparing social perceptions of ES in Canada and the UK. Finally, Chapter 6 presents conclusions and recommendations based on research findings, discusses implications for academia, industry, and government, and highlights opportunities for future research emerging from this work. Appendices follow with supplementary information, including key definitions, coding schemes, data tables, and statistical results.

1.4 Case study background

Before further describing the study, the following section provides an overview of ES as a case technology for examining the social dynamics of alternative energy deployment in a transition context. It compares Canada and the UK as national case studies, reviews the drivers and barriers for ES in each country, and describes the national media contexts likely informing social representation of ES in each jurisdiction.

1.4.1 ES and the energy transition

By 2050, the world population is expected to grow from 7.6 billion (2018) to 9.8 billion, with global energy demand expected to double (Reilly et al., 2018). This trend, alongside climate and energy security concerns have initiated systemic shifts away from traditional fossil

fuel-based, centralised power systems towards renewable-based, distributed generation (Abdo & Kouhy, 2016). Systems of the latter kind are said to be the most promising way forward for a sustainable, affordable, and equitable energy future (Vezzoli et al., 2018). However, the deployment of renewable energy continues to be hampered by technical and economic barriers. For example, the variable nature of renewable generation threatens voltage stability on power grids, reducing reliability of secure energy supply, and thus limits the capacity to fully adopt renewables in the place of fossil fuel generators. Overcoming these challenges will be critical to increasing the share of zero and low-carbon sources in national energy portfolios (IEA, 2014).

ES technologies are believed to offer a solution. While some conventional storage applications (such as pumped-hydro storage and lead-acid batteries) have been used for over a century, the past decade has seen major progress in advanced ES innovations that can offer stacked benefits to power grids, institutional stakeholders and end-users, and help to decarbonise energy economies (Wade et al., 2010; Kittner et al., 2017). New mechanical systems, including compressed-air and flywheels, as well as advanced lithium ion batteries and thermal or gas-based (e.g., hydrogen) ES technologies are gaining traction in energy and transport sectors worldwide (Winfield et al., 2018). At the electricity 'bulk system' level, these innovations can provide important ancillary services, such as load-peak-shaving, real-time voltage regulation (helping to ensure grid stability), and reserve capacity for long-term storage of energy (e.g., from renewable sources) (Aneke & Wang, 2016). At the transmission and distribution levels, ES technologies can provide grid congestion relief (i.e., discharging electricity during hours of high congestion) and reduce energy consumption by relieving feeder voltage when needed. In this way, large-scale ES applications (e.g., batteries, pumped-hydro) are expected to help defer costly transmission and distribution upgrades, while facilitating the integration of other distributed energy resources to support grid modernisation (Winfield et al., 2018). Figure 1. below provides a summary of the various grid-scale applications for ES. Behind-the-meter (BTM) residential and non-residential ES (e.g., rooftop solar PV battery storage) are also growing as energy users are seeking more security, reliability, and self-sufficiency (i.e., via on-site energy generation, demand-side management) as well as financial benefits (i.e., via time-of-use charge reduction) (Balducci, et al., 2018). While this thesis focuses primarily on grid-scale applications, phase one (PH1) of the project also considers BTM and to a lesser extent, transport applications for ES.

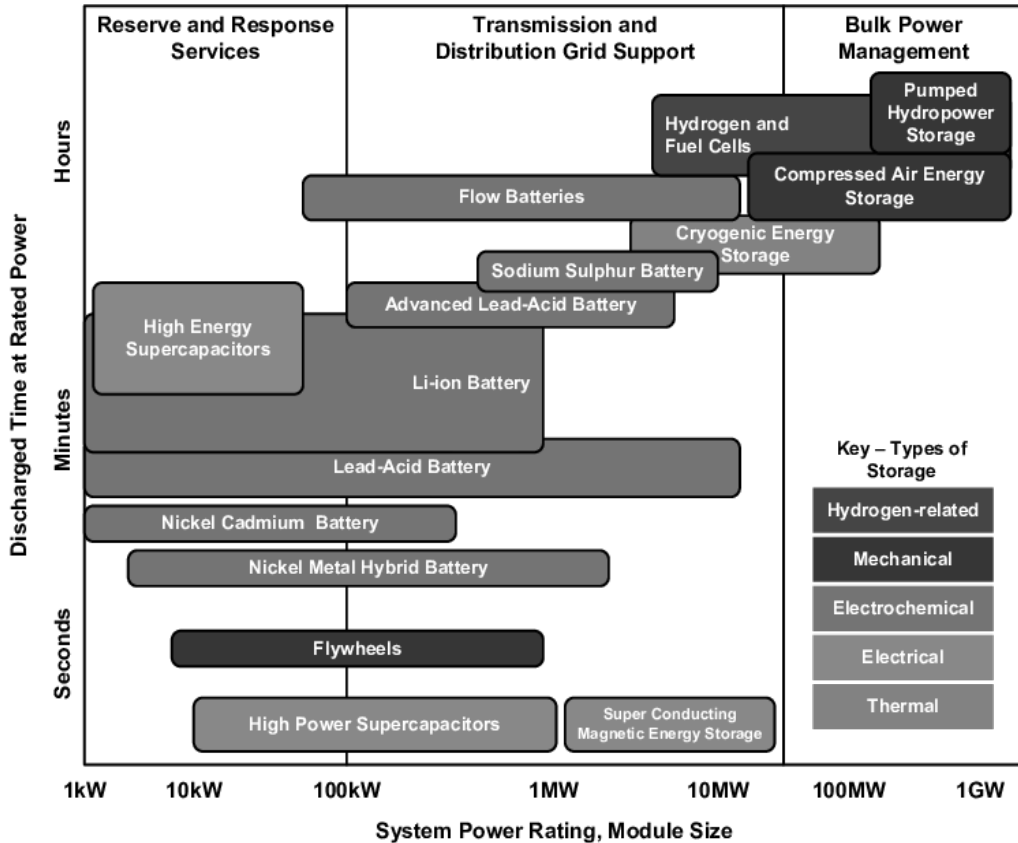


Figure 1. ES technologies and their various suitability for grid-scale applications. Adapted from Taylor et al., 2012; p.22).

For the reasons above, experts believe both grid-scale and BTM ES paired with renewables will be pivotal in an era of rising electricity cost and peak demand, aging infrastructure, and growing climate imperatives (Deloitte, 2018; Vezzoli et al., 2018). ES innovation is also creating national economic opportunities and international partnerships in science and technological development. For example, the UK’s Department for Business, Energy and Industrial Strategy (BEIS) recently (January 2019) launched a £20 million competition for advancing three ES projects (with a minimum output of 30 MW or capacity of 50 MWh) to help advance the commercialisation of emerging storage technologies (BEIS, 2019). The Government of Canada also continues to announce new investments in ES deployment through initiatives such as Natural Resources Canada’s (NRCAN) three-year \$49 million Energy Innovation Program, which aims to support clean energy technologies for advancing a lower-carbon economy. Furthermore, the countries recently announced their cross-national collaboration in a \$20 million transatlantic ‘Smart Energy Systems’ challenge with similar energy innovation objectives (see [Section 3.2.2](#) for comparative case study rationale).

Indeed, Canada and the UK are among the top countries (alongside Australia, Chile, Germany, Japan, and India) that are actively pursuing ES as an ‘energy trilemma’ solution (Deloitte, 2018; Navigant Research, 2017). Although differing in energy profiles and market structures, the two countries share some similar motivations for advancing ES. Renewable energy development and grid modernisation, technology cost and performance improvements, evolving wholesale electricity markets, climate policies and targets, and national energy security are driving the push for ES deployment at both grid and BTM scales (Deloitte, 2018). Nonetheless, national economic and socio-political contexts will continue to shape each countries’ progress in ES and related transition processes (e.g., coal phase-out plans, cleantech investments). Table 1. compares the two countries in these respects.

1.4.2 ES in Canada and the UK: A comparison

	Canada	UK
General		
Overview	A culturally and geographically-diverse Western country located north of the United States (US); Second largest country in the world after Russia; Nearly 90% of population lives within 200km of the US border, leaving vast areas of wilderness in the north; close political and economic ties with the US (each other’s largest trading partner)	An island nation in northwestern Europe, comprised of England, Wales, Scotland and Northern Ireland; Historically a major player in international affairs with important role in the European Union (EU), United Nations and NATO; Despite impact of world wars and end of empire, the UK remains a major economic and military power, with considerable political and cultural influence around the world
Population (2017)	36.7 million	66 million
Surface area	9,984,670 km ²	243,610 km ²
GDP (2017)	USD 1.7 trillion	USD 2.6 trillion
Government type	A parliamentary democracy, a federation, and a constitutional monarchy	A parliamentary democracy, a unitary state (with some devolution), and a constitutional monarchy
Energy and environment		
Electricity generation profile by source (2016)	59% hydro; 15% nuclear; 10% gas/oil/others; 9% coal; 7% non-hydro renewables = 648.4 TWh	42% gas; 21% nuclear; 24% renewables; 9% coal; 3% oil and others = 338.6 TWh
Renewable energy production (2017)	Ranked 4 th in the world (418,679 GWh)	Ranked 14 th in the world (87,083 GWh)

CO ₂ tonnes per capita (2016)	18.62	5.59
Energy's nominal GDP contribution (2017) (incl. crude oil, electricity, construction, other)	10.6% (USD 159 Bn)	2.3 % (USD 60 Bn= £47.3 Bn)
Electricity market structure	Under provincial jurisdiction; Federal role in system planning, regulation, and operation very limited; Provincial market structures range from monopoly (e.g., Quebec, Manitoba), to semi-liberalised (e.g., Ontario) and liberalised markets (e.g., Alberta); Technological innovation, market competitiveness, and decarbonisation targets currently driving provincial electricity market and policy changes (2015-2018)	Liberalised market regulated by Gas and Electricity Markets Authority (GEMA) and operated through the Office of Gas and Electricity Markets (Ofgem); Market dominated by six major companies (i.e., "The Big Six"); Technological innovation, low-carbon priorities and consumer protection concerns currently driving market reform (2016-2018)
Price of electricity (2018) (USD per kWh)	0.6-0.11 (varies by province)	Approximately 0.22

Energy storage

Drivers and opportunities	Economic development, technological innovation, and climate targets	
	Coal and nuclear phase-out plans; Increasingly favourable regulation and policy; Government RD&D funding; Falling costs and technical improvements; Improved opportunities to tap into multiple revenue streams; Growing contribution from renewable energy generation	Energy security and national independence priorities; Reforming electricity market and emerging energy flexibility plans; Expanding roles for distributed and diverse energy sources; Strong push for customer-led and BTM applications
Risks and challenges	Potential consequences for other energy sectors (e.g., natural gas, oil) and electricity sub-sectors (e.g., grid deflection, stranded assets)	
	Regulatory uncertainties (e.g., rate classes); Stakeholder acceptance of new projects; Technical and geological constraints (e.g., grid connection requirements); Unfavourable market conditions; Difficulties applying cost/benefit analysis to existing grid components; Increasing competition for funding and investment capital; Political and economic influence of oil industry; Uncertain commitment to climate change	Historical reliance and economic commitment to gas plants; Unclear market rules and inconsistent policy signals; Asset classification and financing uncertainties; Supply chain risks; Current political contention and uncertainty in EU affecting energy planning (e.g., Brexit)

mitigation

Use cases	Improved grid sustainability, reliability, and flexibility; Energy infrastructure upgrade deferral (transmission and distribution)	Frequency regulation, reactive power support and voltage control (e.g., Ontario); Technology and economic development around in niche markets (e.g., batteries and EV infrastructure in Quebec); Increased security and connectivity in remote communities (e.g., Manitoba); Optimising transmission and distribution assets; ‘Firming’ renewable energy capacity and reducing need for new fossil fuel infrastructure (e.g., Alberta)	Managing system stability (e.g., difficulties with load balancing on 50hz grid); Arbitraging energy prices and providing national level ancillary services; Increased baseload generation support and network reinforcement; Addressing grid-congestion due to electrification of heat and transport; End-user protection against emerging Time-of-Use tariffs
Supportive policies, programs, and deployment strategies	R&D funding (Natural Resources Canada, NRCan; Sustainable Development Technology Canada, SDTC); NSERC Energy Storage Technology Network, NEST Network), NRCan Energy Storage Roadmap, Pilot and demonstration projects, procurement targets (e.g., 50 MW for Ontario), Market and regulatory changes (e.g., Alberta’s ISO Rule Changes – Technical Requirements)	National Smart Systems and Flexibility Plan (2017); RD&D funding and government support (Department of Energy & Climate Change, DECC; Innovate UK; Department for Business, Energy and Industrial Strategy, BEIS; etc.); Energy Entrepreneurs Fund (EEF); University research programs (EPSRC Centre for Doctoral Training in Energy Storage)	

Table 1. Comparing Canada and the UK: National contexts for ES (Pepermans et al., 2005; Tuck et al., 2017; Strbac et al., 2012; Richardson & Harvey, 2015; Winfield et al., 2018; Ravenhill, 2017; Country Economy, 2018; NationMaster, n.d.; Statista, 2018a)

1.4.3 ES and national media contexts: Canada vs. UK

As agenda-setters for society (Shaw, 1979), national media systems are central to public opinion and political processes concerning energy and the environment (Luedecke & Boycoff, 2017) (discussed in [Section 2.2.3](#)). News journalism both influences and is greatly influenced by national ideologies, elite opinions, economic interests, and media ownership structures (Hallin, 2004; Boycoff, 2007). As such, energy news is often ‘domesticated’ to reflect consensus from national elites and dominating ideologies in government and industry (Shehata & Hopmann, 2012; Djerf-Pierre et al, 2016). This has an impact on the salience and framing of key issues in news discourse, and thus on the ways that audiences interpret and respond to them. In view of this, it is important to consider how national media contexts are ‘setting the agenda’ for ES.

Canada and the UK both possess a liberal media-political model (referred to as the 'North Atlantic model') (Hallin & Mancini, 2004; 2017), which combines a strong public broadcasting ethos with a considerably liberal ('progressive') press. Countries possessing this model typically have a long tradition of democracy, widespread press freedom, and strong individualism (Färdigh, 2010). This also means that Canadian and UK media spheres share a generally low political parallelism (i.e., the extent to which media reflect political divisions) and have a relatively high journalistic professionalism (as compared to other media models – e.g., 'democratic corporatist'). Both countries also have a concentrated commercial newspaper market, often limited journalistic autonomy (due to commercial political pressures), minimal state intervention, and strong public broadcasting regulation (Hallin & Mancini, 2004; 2017).

In addition to these factors, economic pressures and media industry structures impact energy news reporting in Canada and the UK (Carvalho, 2005; Vessey, 2016). Both countries face increasing capacity challenges (i.e., limited time, resources, and personnel) to collectively cover complex and dynamic stories at the economy–environment–technology nexus (Luedecke & Boycoff, 2017). Decreased news media budgets for investigative journalism have adversely affected communication of scientific topics in that complex technical and environmental issues (e.g., climate change) are often oversimplified, dramatised, or omitted altogether in news reports (Listerman, 2010). Growing pressures for efficiency under tight-deadlines have also resulted in less-factual and less-balanced reporting, and greater valuation of 'novelty' and 'conflict,' which is often evident in today's 'techno-optimism' surrounding new innovations such as artificial intelligence, blockchain, and increasingly, ES (Skjølsvold, 2012; Caprotti, 2012; Govia, 2018).

There are also differences in the two countries' media contexts, which create unique conditions for energy-related discourse. For instance, nearly 45% of Canada's newspaper market (consisting of 98 publications in 2016) is owned by the Postmedia Network Inc./Sun Media, which continues to face declining revenue streams and labour issues (leading to the capacity issues noted above) (Vessey, 2016). The Canadian news media industry currently struggles with market convergence, foreign control of free press, and declines in print media (Einsiedel, 1992; Phillips, 2018). The country's two national newspapers, *The Globe and Mail* and *The National Post* continue to feel impacts from ownership concentration and a declining number of reporters, which has led to reduced quality and diversity of news coverage in the country (Blidook, 2009; Phillips, 2018). Some even suggest that, in the traditional media sphere (newspapers, television), these pressures are creating a 'homogenising effect,' which has

resulted in less accurate information for public audiences to monitor and/or influence their decision-makers' activities (Baum & Zhukov, 2018). Of course, the rise of the digital media sphere (Facebook/Twitter, news apps) presents other issues altogether (e.g., homogenising replaced by diverse and often conflicting echo-chambers for public discourse) (Iggers, 2018).

The UK market is more diverse, with over 1000 newspapers including 15 national dailies, divided into broadsheet (i.e., large-format quality press) and tabloids (i.e., smaller-format popular press). Historically, UK newspaper ownership has been dominated by individuals such as Rupert Murdoch and Lord Rothermere, whose political inclinations have led to debate on the country having the most right-leaning media orientation in the EU (Curann, 2016). The current market, however, also belongs to the Barclay Brothers' Press Holdings (*The Daily Telegraph*), Nikkei Inc. (*The Financial Times*), and Scott Trust Limited's Guardian Media Group (*The Guardian*). Like Canada, the country faces capacity issues and negative impacts of market ownership structures. For example, following the departure of James Murdoch Jr. (who was generally dedicated to quality climate change reporting) from his parent company, *News International* (later known as *News UK*), several UK nationals (e.g., *The Times*, *The Telegraph*) were accused of pushing unscientific climate denial and downplaying risks associated with fossil fuel use. Some believe this was part of a 'slow slide' in UK national coverage of environmental issues between 2015 and 2016, from which the industry is still recovering (Ward, 2016).

Despite these circumstances, national newspapers continue to be important sites for engagement among laypersons, decision-makers, and other stakeholders, and serve as key information sources for other media and social networks reporting on scientific developments in both countries (Iggers, 2018). A 2017 Ofcom study on UK news consumption found that despite increasing concerns on the rise of 'fake news' (Lazer et al., 2018), newspapers still represent one of the most trusted news sources (e.g., compared to social media), which influence democratic processes, particularly on environmental issues (Ofcom News Consumption Survey, 2018). Similarly, in Canada, the 2018 Edelman Trust Barometer surveyed 1700 Canadians on their trust in news media to find that traditional news outlets are faring much higher at present than in recent years (Edelman, 2018). It is thus important to consider how these news platforms portray potentially transformative technologies to affect public responses to energy system change.

Both countries' news reporting on energy innovation today focuses mainly on RD&D, policy issues, financing, as well as opinion pieces related to economic and environmental contexts. Industry advocates and consumer interest in ES technology – perhaps due to high-profile figures such as Elon Musk and projects like Tesla's Gigafactory in Australia (Gaede & Rowlands, 2018a) – have made ES a salient item in public discourse on the energy transition. Indeed, with recent news headlines like "*Electricity storage the missing link for renewable energy*" [*The Toronto Star*, September 21, 2012] and "*Energy storage vital to keep UK lights on, say MPs*" [*The Guardian*, October 15, 2016], there appears to have been an emerging hype around ES in both countries. And, since media representations help shape public opinion and political discourse around contemporary energy issues (Luedecke & Boycoff, 2017), exploring how these representations unfold will be important for the fate of ES in the two countries.

1.5 Summary

This chapter has introduced the problem context, research goals, and case study details for the following comparative cross-national media and public perception study on ES in Canada and the UK. Having outlined research parameters and background information, the next chapter provides a literature review that situates this project within a broader research context.

Chapter 2 – Literature Review

2.1 Overview

The goal of this chapter is to provide a review of the relevant literatures that informed the aim and research design of this thesis. The review begins with a general overview, then follows with three sections that represent the theoretical domains within which this work is situated. By reviewing relevant aspects of literatures on: (2.2.1) socio-technical transitions; (2.2.2) social acceptance; and (2.2.3.) social representation theory, the chapter illustrates the need for more comparative and multi-dimensional social analyses of ES in current energy research. Each section reviews contributions within these fields that shape the theoretical and methodological bases of this thesis, as well as the existing knowledge upon which this work aims to build. Sections also include brief reflections on how the project aims to bridge specific knowledge gaps in each domain. Finally, the chapter concludes with a broader integration that reflects upon how these literatures support the research and potential work emerging from it.

2.2 Introduction

There is a long, cross-disciplinary history of research that poses that successful social movements (particularly those concerning socio-technical systems) are mutually dependent on the coherence between public (e.g., social activities, policy) and technical (e.g., science, innovation) spheres (Gitlin, 2003; Gamson & Modigliani 1989; Vliegthart & Walgrave, 2012). This thesis draws upon three bodies of literature which explore this argument as it relates to low-carbon energy development, and ES specifically. These domains include: (1) socio-technical transitions and energy technology/system change (Geels, 2002; 2005; 2011; Rip & Kemp, 1998; Dosi, 1982; Kern, 2011); (2) social acceptance of energy innovation (Rogers, 1995; Wüstenhagen et al., 2007; Batel et al., 2013; Devine-Wright et al., 2011; 2017); and (3) social representation and framing theory (Moscovici, 1976; 1984; Goffman, 1974; Gamson & Modigliani, 1989; Entman, 1993; Luhmann, 2000; Marková, 2008). While these areas help define my broad (transitions) and intermediate (acceptance) research scopes, I apply ES (using social representation theory) specifically to examine the intersection where media, people, and energy change meet. In doing so, this thesis responds to several recent calls from social energy researchers:

- (a) Devine-Wright et al. (2017) – for more social scientific assessments of ES;
- (b) Stephens et al. (2008; 2013) – for more comparative socio-political analyses on energy technology deployment;

- (c) Sovacool (2014) – for more insight on how social and technical elements of energy system change interact; and
- (d) Others (e.g., Roberts et al., 2018; Köhler et al., 2017; Meadowcroft et al., 2009) – for more research on non-technical drivers of and barriers to low-carbon energy transitions.

The following sections review these literatures as they relate to the social dynamics around ES and identify overlapping areas and gaps within which this thesis is situated.

2.2.1 Socio-technical transitions and energy technology change

This thesis applies socio-technical transitions (Geels, 2002; 2005; Geels & Schot, 2007) and energy technology change theory (Rip & Kemp, 1998) as theoretical bases for examining ES development in an energy sustainability context. These fields are at the nexus of broader social transition and transformation studies, which explore the complex, interrelated dynamics (economic, social, political, etc.) of systemic shifts from current undesirable states (costly, unsustainable, etc.) towards desirable end states (efficient, sustainable, etc.) in response to societal pressures (climate change, energy demand, etc.) (Scoones, 2015; Dryzek & Stevenson, 2011). In this context, the term ‘transition’ refers to the socio-technical shift from one ‘regime’ configuration (e.g., fossil fuel-based centralised energy economies) to another (e.g., renewable-based decentralised energy economies). This process is often triggered by interactions among ‘niche’ (protected spaces for new innovations), ‘regime’ (incumbent system practices and institutional rules), and ‘landscape’ (exogenous environment) system components (see discussion on the MLP and [Appendix AA.1](#) for clarification). Such interactions take form, for instance, when incumbent actors (e.g., oil and gas companies) and technologies (e.g., natural gas plants) within a system are displaced by new innovations (such as ES) emerging out of a niche (e.g., RD&D stage, early market phase) (Geels, 2007). Given that energy systems are fundamentally ‘socio-technical’ (i.e., comprised of social and technological components), ‘energy transitions’ are more broadly understood as dynamic processes of presumably positive change in energy generation and use (Geels & Schot, 2007; Smith & Stirling, 2010). Nonetheless, as energy systems grow more complex and problematic (e.g., due to resource limitations, aging infrastructure), transitions literature continues to offer different types of analyses (e.g., technical, cultural) and strategies (e.g., modelling, participatory) for realising pathways to more desirable energy futures (Negro et al., 2012; Chappin & Ligtoet, 2014).

Originally coined in Germany during the 1980’s Anti-Nuclear movement, the ‘energy transition’ (in German, the ‘Energiewende’) denoted a shift to a nuclear-free energy supply that

could support a competitive economy without dependence on fossil fuels as energy infrastructure was replaced with low-carbon-emitting energy technologies (Hennicke et al., 1985; Morris & Pehnt, 2012; Gullberg et al., 2014). Rooted in the theoretical contributions of Meadows et al. (1972) (e.g., on 'The Limits to Growth') and Lovins (1977) (e.g., on 'soft energy paths'), the energy transition movement has evolved since the anti-nuclear era (Tugwell, 1980). The 21st century shift to lower-carbon energy systems is now more often characterised by: (1) the large-scale use of renewable and low-carbon energy sources and technologies that offer increased system efficiency, capacity, and adaptability (Gullberg et al., 2014); (2) new, contracted, yet competitive energy economies operating within planetary boundaries (Jackson et al., 2009; Raworth, 2012; Smith & Stirling, 2010); and (3) greater provision of socio-economic benefits, energy democracy, and public engagement in energy system change (Dryzek, 2013; Miller et al., 2013). Of course, this package of components is not a mutually consistent or agreed upon agenda for all actors involved in energy system change. It does, however, reflect widely recognised steps for addressing the 'energy trilemma' (Gunningham, 2013). Broadly speaking (and arguably for those with competing interests), the shift to this new state (driven largely by a growing global community concerned with energy and climate issues) is an urgent and desirable one (IEA, 2014; Vezzoli et al., 2018; Jasanoff, 2018). However, as Stephens et al. (2013) note, this shift remains a complex undertaking that will require greater consideration of the socio-political factors (i.e., conditions and dimensions related to both social/cultural and political facets of society) that inform system change. Indeed, energy transitions encompass not only the deployment of emerging low-carbon technologies, and the policies and regulatory changes required for their deployment, but also the interrelated shifts in the political economy, and public perceptions and activities concerning energy (Stephens et al., 2013; Millet et al., 2014).

As previously mentioned, energy generation and use make up a 'socio-technical system,' which links both technical and human elements to fulfil societal functions (Geels, 2005; Geels & Kemp, 2007). These systems consist of interrelated elements (e.g., actors, institutions, technologies, user practices, markets, cultural meanings, and infrastructure) and processes (e.g., policymaking and technology development), which together, form various dimensions, or more specifically, 'levels,' for conceptualising energy system change. In transition studies, this topography is often expressed using the 'Multi-Level Perspective' (MLP) framework (Rip & Kemp, 1998; Geels, 2002; 2007), which contends that transitions come about through dynamic processes across three levels: (1) 'niches' (protected spaces for new 'niche' innovations); (2)

'regimes' (existing institutional settings and processes that reinforce incumbent system structure); and (3) 'landscape' (the exogenous conditions and socio-technical environment). Figure 2 below provides a schematic of the MLP topography.

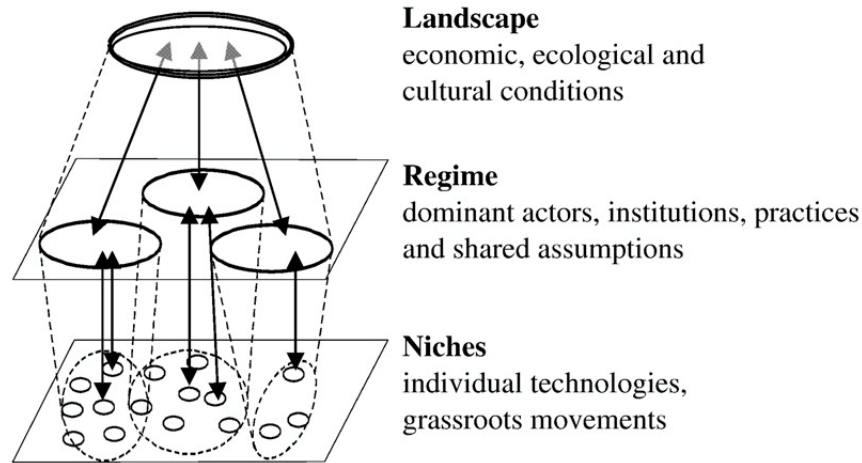


Figure 2. The Multi-Level Perspective framework for socio-technical transitions. Adapted from Geels (2002; p.1261).

The MLP framework, along with technology change and co-evolutionary theory (Rip & Kemp, 1998; Foxon et al. 2010; Foxon, 2011), suggests that in order for fundamental system change to occur, 'transformative' niche-innovations (e.g., system altering technologies, policies) must align with existing regime and landscape conditions (e.g., markets, policy development, public knowledge, user practices, cultural norms) to create pathways for 'more desirable' system states (Geels, 2002; Geels & Kemp, 2007). In other words, system transformations depend not only on the emergence of niche-innovations (Geels, 2002; 2007) – which alone are insufficient for a transition to occur – but also on regime-level activities (e.g., RD&D, regulatory change) and external landscape pressures (e.g., political support, lack of resources, destabilising power of dominant actors). This understanding emerges from technology change theory (Rip & Kemp, 1998), which offers that the “diffusion of new technologies is connected not only with improvements in the technology [...] but also with the costs and availability of complementary technologies and with institutional changes in organisation, ideas, norms, and values” (p.328). Thus, the notion of 'alignment' between niche-innovations and existing system dynamics (regimes, landscapes) – which Gaede & Rowlands (2018) and Grünewald et al. (2012) began to explore in their stakeholder perception studies on ES in Canada and the UK, respectively – offers an entry point for examining ES in an energy transition context.

Since regimes and landscapes function as selection environments for emerging technologies, innovations that align with existing regime ‘rules’ (e.g., institutional structures, regulations) are more likely to diffuse into or alter those regimes (i.e., leading to transformation), while innovations that do not (e.g., ‘disruptive’ technologies), may fail to ever emerge past their niche stages (e.g., RD&D, early market phase) (Taylor et al., 2013; Geels et al., 2004). For instance, niche-innovations, such as less mature ES technologies in end-user electricity sub-sectors (e.g., BTM) (Gaede & Rowlands, 2018a; Geels et al., 2004) will require favourable consumer and public opinion in order to unlock their socio-technical potential for transforming the existing energy regime (e.g., dominant institutional configuration around centralised energy systems) (Foxon et al., 2010; Foxon, 2011; Geels, 2005). However, given the insufficient social scientific attention given to ES to date (Devine-Wright et al., 2017), and the fact that many ES innovations (e.g., residential batteries) are only beginning to diffuse at the end-user level, little is currently known about how these exogenous factors are unfolding to enable (or inhibit) the socio-technical trajectory of ES.

While there has been some recent attention to ES in this literature (e.g., Gaede & Rowlands, 2018a; Grünewald et al., 2012) – suggesting that storage is currently at “at a niche to regime cusp” (p. 574) (Winfield et al., 2018) – our understanding of the non-technical factors informing its MLP trajectory remains limited. As these technologies continue to move from niche to regime spaces, a more comprehensive understanding of the social dynamics surrounding this innovation would help pave appropriate pathways for ES in jurisdictions such as Canada and the UK. However, this will require us to move beyond the current techno-economic (Becherif et al., 2015) and policy focus (Winfield et al., 2018) in MLP literature, and towards socio-political and cultural analyses of ES development (Mackard et al., 2016; Geels et al., 2016).

This can be done by marrying transitions literature with other social science frameworks for a more holistic understanding of how alternative technology deployment continues to inform (and be informed by) the socio-political factors that underpin energy regimes. Markusson et al. (2011) for instance, explore socio-political complexities and innovation dynamics of carbon capture and storage (CCS) to find that the processes of building public support and project ‘framing’ are critical to the success of pilot projects. Others have examined the role that public understanding and culture play in low-carbon pathways through discursive analyses (Hermwille, 2016; Geels et al., 2018). For example, Hermwille’s (2016) case study on nuclear power (in relation to the Fukushima disaster) used ‘narratives’ as analytical entities to unpack how

disturbances at the landscape level contribute to energy transformation at the regime scale. Two other noteworthy examples of this approach include Chilvers & Longhurst's (2016) use of the MLP with constructivist Science and Technology Studies (STS) to examine public participation in transitions, and Rosenbloom et al.'s (2016) discursive study on public framing and niche-regime interactions of solar energy technology in Canada's province of Ontario.

Yet, most ES case studies continue to focus on technical feasibility and system modelling within market and institutional contexts (Wilson & Hughes, 2014; Amrouche et al., 2016; Gallo et al., 2016; Kittner et al., 2017). As noted by Taylor et al. (2013), this form of transition modelling analyses fail to consider real-world issues (e.g., stakeholder interests and power relations, public awareness, and user experience) that will inform the pace and outcome of ES development. Grünewald et al. (2012) explore some of these issues in their stakeholder study to find that distributed ES in the UK faces challenges associated with technology 'lock-in' resulting from poor stakeholder and regulatory regime alignment. Gaede & Rowlands (2018) recently build on this in a Canadian context, suggesting that the 'poor alignment' argument does not entirely hold for storage in Ontario's hybrid (government/market-led) and multi-sectoral electricity system, since ES is currently well-aligned (i.e., facilitative) in some electricity sub-sectors (i.e., bulk system), yet less-aligned (i.e., more disruptive) in others (e.g., distribution, end-user). However, the latter study also suggested an ongoing narrative shift around ES, in which industry is now promoting the technology less as "the golden ticket" to lower-carbon grids, and more as a facilitative "Swiss Army Knife" for optimising existing (centralised) grid assets and functions. This appears to be, in part, due to incumbent regime actors struggling to maintain control over the innovation, which is leading them to reframe it in ways that align with existing interests and provincial energy objectives (Gaede & Rowlands, 2018a). Indeed, going forward, the transformative potential of ES in Ontario's energy system may vastly depend on these complex niche-actor-regime interactions (Winfield et al., 2018).

Taylor et al.'s (2013) transition analysis (despite its narrow focus on pumped-hydro technology) elaborated on Grünewald et al.'s (2012) work by exploring how roles of technology, institutions, business practices, and users are influencing ES diffusion at the regime level. Using the coevolutionary framework (Foxon et al., 2010; 2013) – which complements the MLP – the authors analysed these contextual factors for ES deployment in the UK and developed three pathways (user led, decentralised, and centralised) which illustrate potential trajectories and roles for ES technologies in the UK's decarbonising energy system. However, as the authors

note, further research is needed to analyse how these pathways are unfolding in real-time (i.e., what are their convergence and tension points), as well as the interaction of end-users with ES and public perceptions of both centralised and decentralised applications (Taylor et al., 2013). From a policy and market standpoint, Winfield et al. (2018) address this gap by exploring the emergent niche-regime transition processes for ES as energy policy regime change in Canada, the US, and Europe. The authors conclude that both monopolised and liberalised market systems offer routes for niche-to-regime ES transitions, despite their unique trade-offs, but contend that such pathways will remain jurisdictionally uneven until decarbonisation commitments are strengthened.

Despite their significance to the field, these expert-based market and policy-focused studies have a tendency to glaze over the role of other critical actors (e.g., citizens, media) and socio-psychological factors (e.g., discursive processes) in ES transition pathways. While Grünewald et al. (2012) acknowledge some of these issues as 'landscape pressures' for ES deployment, and Taylor et al. (2013) note the importance of 'customer acceptance' in potential user-led ES pathways, much of the transitions literature on ES fails to explicitly examine these issues. As far as is known, no studies to date have explored the socio-political dimensions of ES, in a transition context or otherwise. Neglecting public engagement, acceptance, and cultural repertoires in the study of ES development echoes Geels et al.'s (2018) concern that the social dimensions of energy (Miller & Richter, 2014) remain overlooked in transitions research. Ignoring this knowledge gap, and perhaps more importantly, failing to fully understand and integrate these elements in practical transition processes may not only deter pathways for potentially transformative innovations like ES, but may also hinder broader national environmental policy objectives. For instance, in the UK, insufficient attention to these issues in government and industry scenario modelling has contributed to various challenges for clean energy development. Top-down policy approaches and neglect for public acceptance have been known to stall and inhibited initiatives such as onshore wind development, residential energy conservation, zero-carbon home projects, and smart meter programs (Geels et al., 2018).

A review of this literature thus suggests the need for further examination of: (1) the social actors (e.g., consumers, publics, media) and processes (e.g., psychological, cultural, socio-political) with which niche-innovations are interacting (Geels, 2011; Geels et al., 2018); as well as (2) how these variables are and may continue to influence ES (policy, market) transition pathways, specifically (Winfield et al., 2018; Taylor et al., 2013). The socio-technical frameworks

discussed here provide conceptual and analytical mechanisms for examining these issues. While this thesis does not explicitly model ES transition pathways in this respect, it does draw upon the MLP as a ‘middle range theory’ (Geels, 2007), linking it to other social science theories in order to empirically explore the “discursive struggles over problem framings and social acceptance” of ES (Geels et al., 2018; p. 227). A key motivation for this is to move beyond the techno-economic and policy-centric focus on ES in order to capture wider socio-political contexts influencing ES deployment in two evolving national energy systems. This marks an entry point for a connecting literature on the social acceptance of energy innovation.

2.2.2 Social acceptance of energy innovation

The social acceptance of energy innovation is an ever-growing field, fixed between two larger areas of study: (1) technology change and diffusion; and (2) the social science of energy and policy (Gaede & Rowlands, 2018b). In this research, I approach ‘social acceptance’ using Upham et al.’s (2015; p.9) general definition:

a favourable or positive response (including intention, behaviour and – where appropriate – use) relating to a proposed or in situ technology or socio-technical system, by members of a given social unit (country or region, community or town and household, organisation).

Social acceptance and public engagement with energy, particularly in democratic societies, have been known to both support and slow innovation and deployment of low-carbon technologies (Peterson et al., 2015). Researchers have studied social perceptions of energy technologies (both individually and in comparison), since the 1980’s ‘Alternative Technology’ era (Carlman, 1982; Wolsink, 1987; Furby et al., 1988; Poumadère et al., 1994; Van Alphen et al., 2007). This research has focused largely on how factors related to ‘identity,’ ‘place,’ and (to a lesser extent) ‘process,’ inform public opinion on energy innovations, in turn influencing their development (Peterson et al., 2015; Fast, 2013). For instance, many have examined ways in which spatial, social, and historical ‘identity’ contexts (e.g., land-use, demographics) influence perceptions of energy projects (Wolsink et al., 2014; Walker et al., 2014; Devine-Wright, 2011).

In this context of ‘identity,’ various socio-demographic correlates have been found to be potential predictors of public acceptance of low-carbon energy development (although with considerably mixed results). Age, for example, has been a significant factor in some studies, with younger individuals often exhibiting more ‘pro-environmental’ attitudes and often (but not necessarily) more favourable opinions of renewable energy technologies (Dunlap et al, 2000;

Jones & Dunlap, 1992). Gender has also been shown to play a role in acceptance levels of such issues (Dietz et al., 2002; Jones & Dunlap, 1992), with females often reporting stronger support for new renewable energy initiatives than males (Pierce et al., 2009; Devine-Wright, 2008). Political orientation has proved to be a more consistent factor for predicting levels of public environmental concern and support for government spending on energy sustainability. Many have found liberal (left-leaning) publics to support new renewable energy technologies more than conservative (right-leaning) publics (Devine-Wright, 2008; Robertson, 2017). There is rather strong evidence that social acceptance of certain alternative energy technologies (e.g., biofuels, wind turbines) is becoming increasingly polarised in many North American and European jurisdictions (Robertson, 2017; Karlstrøm et al., 2014; Clarke et al., 2015; McCright et al., 2014; Dragojlovic & Einsiedel). Still, despite partisan divides in many regions, some researchers suggest that political ideology is a weaker predictor of attitudes towards low-carbon energy development when compared to other factors such as environmental beliefs, community contexts, and economic drivers (Wolsink, 2007). Much of this research suggests that individuals who identify as environmentalists or have strong concerns for climate change tend to be more supportive of alternative energy deployment (Johnson et al., 2011). Yet, others pose that despite the tendency (of policymakers, media, activists) to frame low-carbon energy technologies as an environmental imperative, environmental concern is not necessarily a determinant of public acceptance – in fact, some studies have found the opposite to be true (Warren et al., 2005; Brannstrom et al., 2011). Amidst these mixed findings, perceived economic benefits of alternative energy (e.g., job creation from local wind energy development) stand to be the most consistently recognised predictor of social acceptance (Cherry et al., 2014; Bidwell, 2013).

In addition to 'identity' factors, others observe how acceptance is manifested through 'processes' (e.g., psychological, socio-political) (Batel et al., 2013; Sovacool & Ratan, 2012). For instance, public access to information, community participation, and other social-psychological factors have been known to influence public responses (e.g., apathy, acceptance, opposition, etc.) and outcomes of energy innovation at various scales (e.g., local, regional). This has been evidenced by research on wind energy (Wolsink, 2012; Walker et al., 2014), nuclear technology (Poumadère et al., 1995; 2011), CCS (van Alphen et al., 2007; Feldpausch-Parker et al., 2015), biofuels (Upreti & van der Horst, 2004), and smart grid systems (Langheim et al., 2014; Mallett et al., 2018). While these works have revealed some mixed results regarding technology preferences and acceptance variables, they suggest that social processes are significant (yet

underexplored) conditions for informing public acceptance of energy innovation (Peterson et al., 2015; Batel, 2018). As such, social acceptance studies have more recently begun to consider the role of social intermediaries, such as innovation developers and media, in these ‘process’ dynamics (Devine-Wright, 2012). Indeed, since participants in energy development often enter such processes within contexts that are constructed by the media (e.g., via agenda-setting, issue framing), several have noted the opportunity to enrich acceptance literature by using public discourse as an empirical platform (Corbett & Durfee, 2004; Schirmeister, 2014; Peterson et al., 2015). I explore this notion further in [Section 2.2.3](#).

Many conceptual frameworks have emerged and since evolved to examine the acceptance factors mentioned above. Perhaps the most foundational has been Wüstenhagen et al.’s (2007) three-dimensional framework, which organises social acceptance into various levels: *market* (e.g., consumers, investors, business-decision makers), *socio-political* (e.g., public, key stakeholders, policy makers), and *community* (e.g., local municipalities, community members). Sovacool & Ratan (2012) later separated political and community dimensions by proposing a set of nine criteria for acceptance of renewable energies (e.g., political commitment, strong public image). Around the same time, Walker et al.’s (2014) framework allowed for closer examination of interactions between publics and other energy stakeholders, over time. Huijts et al. (2012) took a comprehensive approach, introducing an individualist ‘socio-cognitive’ framework for explaining psychological factors affecting acceptance (often used in studies concerning ‘identity’ factors), which later inspired Upham et al.’s (2015) ‘cross paradigmatic’ analytical framework. These latter contributions address oversimplified assumptions concerning public acceptance (e.g., NIMBYism) by drawing upon social science theories to explain the processes by which people come to understand and respond to alternative energy innovation (Devine-Wright, 2005; 2011).

The above frameworks have helped demonstrate how various actors perceive energy technologies, what variables help shape these perceptions, and what implications these dynamics may have on technology deployment and change. For example, Fytli & Zabaniotou’s (2017) review of public perceptions on bioenergy concluded that community-level acceptance is strongly influenced by local value systems, which are proving to influence market share of bioenergy production systems. Others have studied market-level acceptance of smart grid technologies (Wolsink, 2012; Meadowcroft et al., 2017) to find that institutional factors (e.g., regulatory frameworks, incentive programs) are key determinants of acceptance, and will be

crucial for the success of more distributed energy systems (e.g., the future of renewable micro-grid communities). Accordingly, these contributions have advanced both our social understanding of energy technology change, as well as our knowledge of how epistemological frameworks can help inform more appropriate energy policy development (e.g., Batel et al., 2016; Shwom & Lorenzen, 2012).

At the broader level, this thesis aims to address various gaps in social acceptance studies, which Batel (2018) and others (Winfield et al., 2018; Meadowcroft et al., 2017) note need to be addressed in order to support greater commitments to low-carbon policy and technology deployment. These gaps include: (1) an overly local focus (i.e., community acceptance) which has led to inattention to social acceptance at regional and national/international scales; (2) a limited collection of comparative inter-jurisdictional analyses that consider integrated socio-political and cultural influences of acceptance; and (3) a focus on the individual and related positivist assumptions (i.e. demographics, NIMBYism) rather than on social processes and implications of 'collective' acceptance (e.g., domestic/national apathy or resistance toward new technologies).

More specifically, this project addresses the current lack of attention given to ES in social acceptance literature (Devine-Wright et al., 2017). Indeed, as far as is known, with the exception of Jones et al.'s (2018) paper on lay-public perceptions of ES in the UK (an early publication from our UW-UNIS collaboration), there have been no published works on public perceptions of ES in Canada or the UK to date. The thesis particularly builds on Jones et al.'s (2018) early contribution in order to bridge this gap. For instance, in their preliminary report on UK national survey findings, the authors found that publics are favourably disposed towards all four technologies examined in the study (i.e., pumped-hydro, flywheels, compressed-air, lithium-ion batteries), yet have a clear preference for pumped-hydro. Using Hujits et al. (2012) acceptance framework, the authors also found that intentions to support ES technologies in the UK were positively predicted by attitudes, emotional orientation, perceived benefits, trust in developers, awareness of ES, and the belief that government spending on the technology is warranted for addressing current issues (e.g., cost, unsustainability) with the UK's existing grid (many of these factors are considered in this thesis and compared to findings on media framing of ES in both countries). Interestingly, similar to what others have found on public attitudes about alternative energy technologies (e.g., see Fergen & Jaquet, 2011 on wind energy and Corner et al., 2011 on nuclear power), pro-environmental values were found to be a negative

predictor of people's 'intention to support' ES deployment in the UK (perhaps reflecting Warren et al.'s (2005) 'green on green' argument, or the possibility that ES might currently be perceived as a more 'industrial' than 'green' energy innovation). Since Jones et al. (2018) provide only preliminary findings from the UW-UNIS survey project, this thesis pursues some of the 'next steps' mentioned in the preliminary paper. These steps include a comparison of survey findings between UK and Canadian samples, and an analysis of media-related survey findings on ES representation in both countries (a component which was omitted from the UK article).

In doing so, this work serves as one of the first empirical assessments – alongside Gaede & Rowlands (2018b) and Ganowski et al. (2018) – on the social acceptance of ES and thus responds to Devine-Wright et al.'s (2017) call for further analysis of ES acceptance using various social science frameworks. Specifically, by comparing cross-national representations and perceptions of ES, this thesis addresses a key point on Devine-Wright et al.'s (2017) agenda: "understanding which socio-cultural [and political] aspects shape the public acceptance of storage technologies implies examining communication at different scales in terms of content and process" (p. 30). Accordingly, this work also aims to address two further limitations of acceptance literature: (1) the tendency to examine only one of the Wüstenhagen et al.'s (2007) dimensions at a time, and to overlook ways in which the dimensions interrelate across geographical (e.g., local, national, international) and temporal scales; and (2) a limited focus on the importance of 'social processes' in the context of public awareness and perceptions of niche technologies (Devine-Wright et al., 2017). I now turn to social representation and framing theory as a final body of literature informing this work.

2.2.3 Social representation and framing theory

This chapter opened with the notion that successful social movements depend on the synergy between public and technology spheres. Emerging from social movement literature, 'social representation theory' is concerned with "how individuals, groups, and communities collectively make sense of socially relevant or problematic issues, ideas, and practices" (Marková, 2008; p.483). Originally theorized in 1961 by French sociologist, Serge Moscovici, 'social representations' are systems of perceptions, knowledge, and beliefs particular to a culture or social unit with regard to objects in the social environment (Moscovici, 1976). Relatedly, 'framing theory' (a similar yet more individualist approach) conceptualises 'framing' as a form of meaning construction "to locate, perceive, identify and label" a phenomenon

(Goffman, 1974; p.21). Here, 'framing' refers to the expression of an interpretation which influences experience and informs action (Goffman, 1974). In other words, the ways in which information is 'represented' or 'framed' (i.e., via language, words, symbols, ideas) can influence how receivers process and respond to that information (e.g., reject it, act on it, circulate it, etc.). Accordingly, 'narratives' – i.e., discursive storylines or imaginaries that often use 'frames' to describe a problem, its consequences, and potential solutions (Roe, 1994; Hermwille, 2016) – also underpin social representation theory in that they allow individuals "to draw upon various discursive categories to give meaning to specific physical or social phenomena" (Hajer, 1995; p.56). Levidow & Upham (2017) argue that both frames and narratives in media communication can be analysed as 'social representations,' bringing together various regime rules (e.g., regulatory, institutional, market, etc.) into shared or competing views of 'what is feasible and desirable.' Linking these social theories with transitions literature is thus prudent (yet seldom done in empirical contexts) in energy research, since together, the frameworks can provide rich insight on how system actors and processes are interacting with technology to affect socio-technical change (Geels & Schot, 2007; Devine-Wright et al., 2017). Hermwille (2016), for example, views social representations as "action guidelines for regime actors" (Byrne et al., 2011; p. 9), and observes that narratives, such as those which emerged around nuclear power following the Fukushima disaster, help to determine policy responses and change processes in power sectors.

Crucially, these social constructionist perspectives argue that media discourse is a key part of the complex process by which individuals construct meaning around important issues (Shaw, 1979; Gamson & Modigliani, 1989; Luhmann, 2000; Protess & McCombs, 2016). Based on these assumptions, research shows that media can shape public opinion and acceptance of certain topics in various ways, three of which are explored in this research. First, media can help control issue 'salience' (i.e., attention, interest, concern) in the public sphere by reporting on and emphasising certain issues over others over time (and/or omitting topics altogether). Second, they can 'frame' issues, by focusing on perceived benefit and risks or constructing compelling narratives around them that influence audience responses (Heras-Saizarbitoria et al., 2011; Hermwille, 2016). Finally, the use of 'valence' – i.e., the positive, negative, or neutral representation of an issue or topic (Levin, 1987) – can also influence public attitudes and decision-making regarding issues covered in the media (e.g., by evoking stakeholder emotional affect and behaviour concerning the topic in question) (Issac & Poor, 2016). There is increasing evidence that together these media effects can shape public responses and policy pathways for

system change within various dimensions of society (e.g., technical, economic, environmental) (Delshad & Raymond, 2013; Cross et al., 2015; Bolson & Shapiro, 2018). Key examples include media case studies on issues related to: (1) science and technology, e.g., see Skjølsvold (2012) on framing of bioenergy; (2) public policy, e.g., see Entman & Rojecki (1993) on anti-nuclear movements; (3) public health and security, e.g., see Wallis & Nerlich (2012) on the SARS epidemic; and (4) and sustainability, e.g., see Shehata & Hopmann (2012) on climate change.

Despite some critique (e.g., on methodological reliability) and theoretical debate (e.g., on the suitability of psychology vs. sociology frameworks) (Scheufele, 2004; Macnamara, 2005) (see [Section 3.3.1](#)) media framing research provides valuable insight on public engagement with societal change – including energy development (Flew & Waisbord, 2015; Stephens et al., 2013) – and is thus a key pillar for understanding social acceptance and transition pathways for energy innovations like ES. Examining media in this context is thus important, particularly given their role in disseminating information with potential implications for democratic and policy processes (Olausson, 2009), as well as the reality that most public stakeholders first experience niche-innovations through news coverage rather than directly (Mallett et al., 2018; Peterson et al., 2015). In other words, given the currently limited public engagement with novel ES technology, early public exposure to media representations of storage may likely shape their perceptions and experiences with ES moving forward (Mallett et al., 2018; Perdan et al., 2016). For example, current techno-optimistic narratives around ES as the ‘holy grail’ for lower-carbon grids – which stem largely from eager cleantech lobbyists and the technology’s association with figures like Elon Musk (Gaede & Rowlands, 2018a) – may either facilitate positive public experiences with storage in the future, or lead to frustrations and potential resistance (e.g., community protests, institutional inertia) should the innovation fail to live up to the hype – e.g., see Asayama & Ishii (2017) on techno-optimism around CCS in Japanese media.

In these ways, media can influence various transition processes for ES at both the micro- and macro-levels (e.g., by destabilising or reinforcing regime and landscape conditions for its deployment) (Levidow & Upham, 2017). Specifically, as key venues for public knowledge and meaning construction (Gamson & Modigliani, 1989; Iggers, 2018), media can: (1) create awareness of landscape-level mega-trends affecting ES deployment (e.g., decentralisation, push for grid optimisation); (2) influence and represent public and policy agendas for ES at the regime level (e.g., support for RD&D policies and investment tax credits); and (3) motivate or discourage key actors to adopt the niche-innovation (e.g., at the bulk, distribution, or end-user

system levels) (Lyytimäki et al., 2018; Gaede & Rowlands, 2018a). Such effects have been observed for other novel technologies, including CCS in the Netherlands (van Alphan et al., 2017), geothermal technology in Australia (Romanach et al., 2015), biofuels in the United States (Chang, 2009; Wright & Reid, 2011), and smart grids in Canada (Mallett et al., 2018).

These examples conclude that news media play an important role in public acceptance and engagement processes related to new energy technology deployment (e.g., siting, investment, technology use) and system change. Specifically, they demonstrate how media framing can: (1) shape the social representation and meaning of energy innovations across varying cultural contexts; (2) influence public preferences for and consumer adoption of specific innovations; and (3) affect public and policy debates by providing new echo chambers for discussing new innovations and understanding interrelated issues in the public sphere (Habermas et al., 1974). Overall, these contributions have enriched our understanding of stakeholder perceptions of new technologies and associated matters (e.g., financing, siting, market trends), the level of importance certain actors assign to new innovations, as well as their perceived feasibility for large-scale deployment.

With increasing industry and consumer attention on ES in Canada and the UK (Taylor et al., 2013; Gaede & Rowlands, 2018a), there is opportunity to enrich this literature with a comparative media case study on storage technology. With the exception of our Canadian pilot study (which took a sub-national comparative approach), there has been no known empirical research on the social representation of ES in this context. Although preliminary in scope, Ganowski et al.'s (2018) use of Stephens et al.'s (2013) SPEED framework for examining news coverage on ES in two Canadian provinces provides direction for this research path and has been particularly informative to this thesis. Key findings from the pilot included: (1) a generally optimistic national perspective on ES, despite regional variance in benefit and risk framing; (2) greater attention paid to high-profile, smaller-scale ES technologies; (3) a prominence of sustainability and transition narratives around ES; and (4) a positive temporal shift in ES discourse, reflecting changing regional energy priorities and Canada's increasing commitment to low-carbon development between 2007-2017 (Ganowski et al., 2018). In building upon several aspects of this work, this thesis aims to also address various limitations of current media and energy framing research. This again includes the neglect of ES in public communication studies, the tendency to focus only on single (sub-national) case studies and specific technologies at a time, and the methodological limitations of relying on one or few analytical

techniques for examining societal framing of energy innovation.

To address these limitations, we can turn to the various approaches used to study energy topics in single-case study contexts, including: critical discourse (Heras-Saizarbitoria et al., 2011; Asayama & Ishii, 2017) and thematic analysis (Asplund et al., 2013), both of which involve the use of formal framing (e.g., episodic vs. thematic) (Oltra et al., 2014), and topical framing (e.g., generic and issue-specific) approaches to unpack meanings attributed to issues in public discourse (Hall & Taplin, 2008). We can also look to salience and frequency analysis for cataloguing media attention on energy technologies over time (Weaver, 1991). For example, many have used Downs' (1972) 'issue attention cycle' and Gartner Group's (1995) 'hype cycle' for understanding how media perpetuate cyclical patterns of public interest around innovative technologies (e.g., 3D printing, blockchain), and the implications that such trends have on their trajectories in society (Holt & Barkemeyer, 2012; Farstad, 2018; Listerman, 2010).

While these approaches can be applied as inter-jurisdictional case study comparisons, few studies have done so, and even fewer have simultaneously assessed multiple dimensions of media representation (e.g., salience, framing, etc.) of energy innovation. Since both media and public framing are informed by contextual factors (e.g., national resources, economic priorities) (Protest & McCombs, 2016), this literature can be enhanced with more comparative empirical analyses on niche-innovation framing among different jurisdictions. There have been some attempts (although seldom at the niche level) using various techniques to fill this gap. For instance, many researchers use generic and thematic frames such as 'conflict,' 'control,' 'economic consequences,' 'social/human impact,' 'morality,' and 'fairness' to compare media framing of climate change, energy, and other technologies (e.g., Stoddart et al., 2016; Listerman, 2010; Good, 2008). Others have applied Dryzek's (1998) 'environmental discourses,' as well as 'multiple streams' (Kingdon, 1984) and 'institutional theory' (Jepperson, 1991) to explore media's use of discourses (e.g., environment vs. economy) and 'narratives' (e.g., renewables are the path forward) to describe such topics (e.g., Cross et al., 2015; Liu et al., 2011; Schäfer et al., 2016; Barkemeyer et al. 2017). However, few studies have applied these approaches at the cross-national comparative scale.

In this media framing context, some have explored the concept of 'domestication' – i.e., the argument that social representations of global issues are often predicated in national contexts – to understand how and why portrayals of energy technologies vary cross-culturally

and internationally. For example, Skjølsvold (2012) presumes that Swedish and Norwegian news media inadvertently ascribe diverging meaning to bioenergy technology, offering audiences clearly varied framings of bioenergy and its role in national economic and environmental contexts. Djerf-Pierre et al. (2016) build on this in their comparative analysis of media framing of bioenergy in Sweden and Australia. The authors use similar deductive frame approaches (as mentioned above) to find that the framing and attention given to different types of renewable energy technologies in two national newspapers is contingent on the domestication of renewable energy issues in the two countries (reflecting the effects of state political pressures, national energy priorities, etc.). These studies provide insight on how energy technologies are domesticated (i.e., nationally contextualised) in public discourse, suggesting that media coverage plays a role in national energy innovation and technology deployment. However, there is opportunity to build on the scope and comprehensiveness of these contributions. For instance, despite considering several dimensions of media coverage (e.g., issue salience, actors, framing) in their analysis, Djerf-Pierre et al. (2016) do not elaborate on benefit and risk perceptions of the technology – which could have provided richer insights on the domestication of renewables in these countries.

In view of this state of literature, this thesis applies Stephen et al.'s (2013) SPEED framework (see [Section 3.4.2](#) for full rationale) as it is currently one of the most suitable tools for comprehensive, comparative media assessments of emerging energy technologies. Based on Luhmann's (1989) theory of society – which observes society as comprised of interactive, self-organising, subsystems with unique ways of meaning-making and understanding – the SPEED framework lends itself to systematic media analysis and allows researchers to capture geographically varying and interrelated factors associated with technology deployment and energy system change. It moves beyond typical techno-economic analyses in energy policy research and decision-making (Scrase & Ockwell, 2010; Ockwell & Bryne, 2016; Kittner et al., 2017) to illustrate the role that socio-political factors (e.g., political will, social values) play in shaping public acceptance and technology development. Furthermore, it fits within the theoretical foundation of this thesis, as it integrates insights from the literatures on technology diffusion, social acceptance, risk perception, transitions management, and framing theory.

Indeed, of the comparative media studies conducted on energy technologies to date, some of the most comprehensive works have used the SPEED framework to showcase complex, interrelated factors informing benefit/risk perception across various dimensions (e.g.,

environmental, cultural, economic etc.). Comparative SPEED assessments of CCS (Feldpausch-Parker et al., 2015) and wind power (Stephens et al., 2009), for example, demonstrated variation in public benefit and risk perception across various regions in the US. Few, however, have applied SPEED to early 'disruptive' niche-innovations, and even fewer have done so at the international scale (with the key exception of Mallett et al.'s 2018 Canada-US smart grid comparison). This again reinforces concerns that both acceptance and framing literatures are limited by local and individualist approaches which tend to overlook collective public engagement with new technologies across MLP levels and jurisdictions. SPEED researchers thus encourage comparative media analyses for richer insight on energy technology acceptance and deployment (Stephens et al., 2008; 2013). Such research could support more suitable policy and regulatory implementation which proactively considers public concerns and understanding of energy system change. As such, I use Stephens et al.'s (2013) work as both a conceptual and a methodological tool for comparing ES representations in two countries currently undergoing energy system change.

In sum, social representation and framing theory can help explain the complex linkages among media discourse, public acceptance, and the uptake of transformative technologies in society. Tugwell (1980) recognised this nearly four decades ago, posing that energy studies that focus on such concepts serve as invaluable "analytical window[s]" to the workings of advancing industrial societies and can thus provide rich insights on the relationship among "technology, politics, and social change" (p. 104). Indeed, it is believed that the socio-technical and socio-political processes described in this chapter will have major implications for our path towards a lower-carbon energy society, and thus deserve greater attention in energy social science (Devine-Wright et al., 2017; Stephens et al., 2013). This third knowledge domain effectively bridges energy transitions and social acceptance literatures, in turn presenting new opportunities for examining energy system change in a sustainability context. Finally, in addition to the literature gaps identified in this section, this thesis also responds to Fischer's (2003) argument that any consideration of media influence on deliberative public and policy processes in energy system change calls for analysis of: (1) how emerging technologies are framed in media discourse; and (2) how publics perceive and respond to these representations. This is central to the case of ES, particularly given the technology's increasing salience and potential in evolving national energy systems, yet our currently limited understanding of public perceptions of ES.

2.4 Summary

To summarise, this thesis draws upon the knowledge domains of socio-technical transitions, social acceptance, and social representation theory in an effort to help enrich our social understanding of low-carbon energy technologies (in this case, ES) and their transformative potential within decarbonising energy systems. This chapter has illustrated the ways in which these literatures support the analyses of complex, interacting social factors and processes that underlie energy technology and system change. It has also presented the theoretical basis and introduced some of the methodological approaches that informed the research design of this thesis (discussed further in the following methods chapter).

Overall, the review supports Devine-Wright et al.'s (2017) recent call for more social scientific analysis on ES in energy research and articulates how the present study aims to address this knowledge gap through a social perceptions assessment concerning ES. The chapter also outlined how the thesis marries several theoretical and methodological frameworks to conduct this analysis across spatial and temporal scales, for a more comprehensive understanding of society's response to alternative energy deployment. Thus, by offering a new cross-national comparative SPEED case study on ES, this work aims to: (1) help advance the SPEED and ES social-scientific research agenda (i.e., beyond the current sub-national, single-case focus); (2) enhance the understanding of socio-political processes surrounding energy technology deployment, more broadly; and (3) provide further insight for appropriate policy and practice for low-carbon energy development. In laying this foundation, the thesis now proceeds with an outline of research methodology and then follows with presentation of empirical results.

Chapter 3 – Methodology and Methods

3.1 Overview

The purpose of this thesis is to explore and compare both media and public perceptions of ES in Canada and the UK in order to examine how the emerging technology is currently portrayed in two different public spheres. In doing so, the goal is to better understand the socio-political factors surrounding ES social acceptance and development in the two countries. This chapter describes the research design, methods, and analytical techniques applied in each phase of the project (i.e., PH1, PH2) in order to meet these objectives. Justifications for thesis design and methodological strengths/weaknesses are also discussed in this chapter. A short summary concludes the chapter and helps to introduce the subsequent results section.

3.2 Research design

This thesis builds upon a pilot study that I (under the supervision of Drs. James Gaede and Ian Rowlands) conducted for the NSERC Energy Storage Technology (NEST) Network (Ganowski et al., 2018). The pilot project compared media representations of ES between 2007 and 2017 in two Canadian provinces in order to explore how sub-national socio-political factors potentially influence energy technology deployment in a transition context. The present study was also developed alongside a cross-national public survey led by Dr. Christopher Jones (University of Surrey - UNIS), Dr. James Gaede, and my supervisor Dr. Ian Rowlands (University of Waterloo - UW). The thesis is thus divided into two phases: **(PH1)** a *comparative mixed methods media content analysis (MCA)*; and **(PH2)** a *comparative secondary analysis of public survey data (SSA)* obtained from the UW-UNIS study. By characterising both media and public perceptions of ES in Canada and the UK, this work attempts to explore emerging trends in social acceptance of ES in two national settings. The following chapters are thus organised to reflect the project phases, each designed to respectively address the research questions introduced in [Section 1.2](#):

- **PH1:** Comparative Mixed Methods Media Content Analysis (MCA) – **RQ1, RQ3**
- **PH2:** Comparative Secondary Survey Analysis (SSA) – **RQ2, RQ3**

3.2.1 Exploratory and case study research

This work is descriptive and exploratory, combining both qualitative and quantitative methodologies for analysing primary and secondary data. Exploratory research is commonly adopted in mixed methods inquiries as a means of investigating new, complex problems, which

are difficult to define and/or to solve definitively (such as social acceptance of energy innovation) (Bryman, 2016). Babbie (2007) suggests an exploratory approach for research that aims to analyse a problem in order to gain insight on a social phenomenon, and generate initial solution ideas, while testing the feasibility of more extensive, future studies on the topic. Since the project examines social dynamics around an emerging energy technology, an exploratory approach was deemed appropriate.

The project also takes a national case study approach, which is commonly used in the social sciences for diverse and deeper exploration of complex issues (Zainal, 2007). Yin (1984; p. 23) defines this method “as an empirical inquiry that investigates a contemporary phenomenon within its real-life context.” Case study methods are commonly used for examining socio-economic, cultural, and environment issues, such as energy sustainability. Yin (1984) argues that case studies are most useful when (a) the research problem asks ‘how’ or ‘why’ questions (e.g., how is ES framed in media discourse); (b) the researcher has little or no possibility to control the events involved (e.g., I have no control over media reporting and social acceptance of ES); and (c) a contemporary phenomenon is being examined in a real-life context (e.g., ES development is a salient issue with practical implications for Canada and the UK).

An exploratory, case study approach was also suitable for this work given its connection to a broader research collaboration between UW and UNIS on the social acceptance of ES in Canada and the UK. The exploratory nature of this thesis was thus also designed to support the various projects emerging from this collaboration.

3.2.2 Case studies

Canada and the UK were chosen as case studies for comparative analysis for several reasons. First, both governments have recently invested in extensive RD&D programs and energy policy to prioritise ES in their national decarbonisation strategies (e.g., Canadian Energy Storage Roadmap by Natural Resources Canada, UK Smart Energy Plan) (Tuck et al., 2017; Ofgem, 2017) (see [Section 1.4.1-1.4.2](#) for further detail on national contexts for storage). Second, both countries have competitive markets for grid-scale and BTM ES, but face some unique challenges for deployment, which make for interesting comparative insights and cross-national learning (Rosenbloom et al., 2018; Winfield et al., 2018). Third, recent technical and market developments have led to increased media attention on ES as a ‘transformative’ and ‘disruptive’ technology (Navigant Research, 2017), as well as on each country’s position in the

global storage market. Fourth, despite sharing common market drivers and energy policy goals (e.g., coal phase-out plans), the countries possess unique energy supply mixes and market designs, political legacies, and cultures – all of which will likely have implications for ES deployment. For instance, while the UK has a national electricity market structure, Canada’s electricity generation, transmission, and distribution is governed by provincial jurisdictions. This difference in governance allowed for interesting sub-national SPEED results in our pilot study (Ganowski et al., 2018), but somewhat limited the ability to capture Canada’s ‘national voice’ on ES in the present study. Nonetheless, the case studies provide an opportunity for insightful cross-examination and insight on the social perceptions of ES in two countries currently pursuing clean energy solutions. Finally, 2018 was an opportune time to conduct a comparative study between Canada and the UK, as the year marked new commitments to strengthening bi-lateral cooperation in the fields of science, technology, innovation, and entrepreneurship; with clean energy technologies being one of the six priority areas identified (The Canadian Trade Commissioner Service, 2018). In sum, Canada and the UK make for timely and salient comparative national case studies, which offer value in a compare and contrast context for addressing the research problem.

3.2.3 Scope and scale

The scope of this work is defined using Upham et al.’s (2015) ‘three levels of acceptance analysis’ framework. In other words, the thesis examines (1) the *socio-political acceptance* (general level: public stakeholders, governments, media); (2) of an *energy technology* (object in question: energy storage); (3) at the *national level* (scale: cross-national). Acceptance at a socio-political level considers various institutions, actors, policies, regulations, and socio-economic factors influenced by varying perceptions of emerging technologies (Stephens et al., 2013). This level of acceptance is often considered to be most important for societal uptake of alternative energy technologies as it links community and market factors to institutional and government change and is required to overcome the ‘lock in’ of the existing energy regimes (Wolsink, 2013; Klitkou et al., 2017), as outlined by the MLP framework (Taylor et al., 2013; Geels, 2002).

The *technology in question* is energy storage (ES), which is used here as a shorthand term referring to a suite of grid-scale and BTM storage technologies which can be used for storing and recovering electricity on power grids (Gallo et al., 2016). While data concerning thermal ES were not specifically excluded from the PH1 MCA sample, the focus of the study (as

per PH2 survey data/research design) is on electrical ES. The study also examines ES technologies in aggregate to account for the relatively limited interaction that public stakeholders have had with storage applications to date. Based on our Canadian pilot study, taking this broader approach returns a larger sample of media discourse than would a narrowed focus on specific technologies (e.g., flywheels or batteries) (Ganowski et al., 2018). Finally, as with most technical topics, media tend to avoid scientific jargon by using umbrella terms (such as 'energy storage') to enhance public interest and understanding. This approach was thus also taken in communicating the concept of ES in the two national public surveys.

Nonetheless, as ES technologies become more integrated into people's daily lives, greater understanding of how media and publics portray its applications will be important for developing appropriate policy and deployment strategies (e.g., tax incentives, land-use, siting). I acknowledge that different ES technologies and system components will have unique socio-technical characteristics, as well as acceptance profiles, media salience, and associated narratives. Thus, despite the rather conceptual focus on ES (e.g., storage as one potential clean energy solution), this study unpacks some of these nuances through quantitative media and survey analyses that focus on specific technologies where applicable.

This thesis also examines ES at the national scale, as I am interested in how its diffusion in society will contribute to national climate targets and energy transition efforts. The research thus assesses whether there is a general social perception that ES is acceptable for each country's broader political, economic, and cultural priorities in an energy context (Upham et al., 2015). Accordingly, PH1 of the thesis focuses on national newspaper discourse (where possible), given that: (1) general public opinion is more accessible and formalised in larger publications, than in smaller local outlets (Moezzi et al., 2017); and (2) national newspapers continue to play a critical agenda-setting role for public and political processes (Iggers, 2018). Similarly, PH2 assesses results from two surveys comprising nationally representative samples.

3.3 Methods

3.3.1 PH1 – Comparative Mixed Methods Media Content Analysis (MCA)

The following sections outline research methods used for PH1 of the study, including rationales and procedures used to collect, prepare, and analyse media content from both national samples.

3.3.1.1 Media Content Analysis (MCA): A mixed methods approach

A comparative national media content analysis (MCA) was carried out to examine and compare media representation of ES in Canada and the UK. MCA is a widely accepted research method in the social sciences used to study the contents and implications of various media texts (e.g., newspapers, blogs) (Macnamara, 2005). This typically involves collecting and analysing media text elements (e.g., words, phrases, themes) in order to draw inferences on their meaning and broader effects in society (Macnamara, 2005). Such analyses are useful for probing social acceptance around particular issues because news media: (1) can provide a representation of public discourse and activities in relation to emerging issues, such as technology developments (Gamson & Modigliani, 1989); and (2) can further influence public perception and reinforce or alter public discourse on those issues (Shaw, 1979; McCombs, 2005). MCAs are also often prerequisites for studying media consumption and framing ‘effects’ – i.e., the focus of the UW-UNIS survey study. In fact, it makes little sense to investigate the complex process of ‘framing’ with frames that are “infrequent, insufficiently described or not a consistent component of the news environment” (Cappella & Jamieson, 1996; p. 49). As such, I draw upon and further test the frames that emerged from our Canadian pilot study to support this research design and validate the UW-UNIS framing experiment.

To systematically analyse media content in PH1, a mixed methods MCA was performed. This involved quantitative analysis that measured the frequency of content (i.e., news articles, buzzwords, technology mentions) across the whole sample ($n = 494$), as well as a qualitative analysis of more recent media (2016-2017; $n = 216$) for more in-depth, reflexive analysis (Altheide & Schneider, 2013). From this perspective, quantitative content analysis is concerned with measuring and analysing manifest content (i.e., surface-level content of articles, which can be recorded rather objectively), while qualitative content analysis is concerned with latent content (i.e., the underlying meanings of the text, as interpreted by coders in an inherently subjective process) (Lombard et al., 2002).

Three analytical techniques were used to perform the MCA: (1) *frequency analysis* (to measure issue salience); (2) *frame analysis* (to examine representation and perceived risks/benefits of the technology); and (3) *narrative analysis* (to better understand meaning-construction around ES) (Metag, 2016). A description of these techniques and examples are provided in Table 2.

Technique	Description and purpose	Example research questions	Example study
Frequency analysis	Examines issue salience (i.e. level of attention) in media coverage by counting news items (e.g. articles) over time	Has the level of climate change communication changed in two Canadian newspapers from 1988 to 2007?	Ahchong & Dodds (2012)
Frame analysis	Examines key 'frames' and various aspects of issue in question, issue 'valence' (i.e. positive/negative), and issue perspectives – often measured by identifying and cataloguing perceived benefits and risks (e.g. SPEED framework)	How are smart grids being framed in Canadian news media?	Mallett et al. (2018)
Narrative analysis	Examines actors, arguments, themes and events that together create 'storylines' around issue	What types of climate change narratives exist in UK news media and how have they changed over time?	Hielscher & Sovacool (2018)

Table 2. Overview of MCA techniques: frequency, framing, and narrative analyses

3.3.1.2 Frequency analysis – Analysing issue salience

A 'frequency analysis' can reveal the level of attention (i.e., often referred to as 'attention salience') (Lim, 2010) that key issues such as energy innovations are receiving in the media and how this salience is evolving over time (Macnamara et al., 2005; Schmidt et al., 2013). Accordingly, to begin to understand how salient the issue of ES is in Canada and the UK (**RQ1**), the annual frequency of published ES articles and the frequency of specific technology and buzzword mentions were analysed in each sample (2008-2017). This was done to provide insight on temporal patterns in national media attention on ES, as well as to determine which ES technologies are receiving the most attention (e.g., see Asplund et al., 2013). An additional analysis was conducted to determine the number of and extent to which articles 'focused' on storage exclusively. See [Section 3.7.1.1](#) for details on how issue salience was analysed. In sum, documenting the frequency of such elements, while considering the contexts in which they are discussed (achieved later through frame and narrative analyses), can help reveal how external factors (e.g., policy change) are leading to issue attention patterns, such as media 'hype cycles' (Downs, 1972; Holt & Barkemeyer, 2012; Dedehayir & Steinert, 2016).

3.3.1.3 Frame analysis – Characterising benefit and risk frames

As mentioned, ‘frame analyses’ presume that societal frames can influence public understanding and perception, which in turn can shape important technology and policy development processes (Goffman, 1974; Pan & Kosicki, 1993). In a media context, framing refers to “the methods by which the mass media organise and present issues and events” (Dimitrova & Strömbäck, 2005; p. 404) in order to shape opinions of and responses to emerging issues. The use of specific words, examples, and reference to sources or people when describing salient topics are popular techniques used by journalists to ‘frame’ societal issues (McQuail, 2005; p. 378-379). Benefit and risk framing in the media have been particularly known to inform audiences’ evaluation of energy issues (see [Section 2.2.3](#)). The combined use of media and public survey analyses has also been useful in examining framing effects (e.g., Delshad & Raymond, 2013; Zhou & Moy, 2007). Finally, since framing is common in media coverage on new and controversial issues, Stephens et al. (2013) note that frame analyses are useful for studying discourse on new energy innovations, which are often subject to conflicting stakeholder and public perceptions. Accordingly, to answer **RQ1(b)**, a SPEED frame analysis was conducted to characterise perceived benefits and risks of ES in news media into six dimensions (cultural, economic, environmental, political, regulatory and legal, and technical) (see [Section 3.6.1.2](#) for full explanation on this procedure).

3.3.1.4 Narrative analysis – Analysing imaginaries and storylines

‘Narrative analysis’ examines the imaginaries, storylines, and themes used by media to describe and mobilise action on particular issues (Metag, 2016; Hermwille, 2016). Like frames, narratives serve as organising principles for meaning-making (Metag, 2016). For example, various MCA studies have used this technique to understand how apocalyptic narratives that use the phrase ‘global warming’ influence public understanding and action toward climate change (Krøvel, 2011). In respect to energy system change and the MLP, Hermwille (2016) notes that narratives often weave various frames together to characterise a broader system framing that serve as “action guidelines” for regime actors (Byrne et al., 2011; p. 9). The use of narratives in public communication can thus have implications for public and policy action regarding niche-innovation development. Crucially, media narratives around such issues typically differ between countries, suggesting that national socio-political contexts play a key role in how energy technologies are portrayed in the media (Metag, 2016).

A narrative analysis was thus conducted to better understand and compare how

Canadian and UK news media construct meaning around ES. This was done by deductively coding for narratives appearing in each national media sample. Throughout the coding process, other emerging narratives were also catalogued to capture national differences in ES portrayal, as well as to examine surfacing relationships and tensions between stakeholders. While overlapping with the SPEED frame analysis, the narrative analysis provided richer insights on media representation of ES in each country (**RQ1b**) beyond risk and benefit perceptions.

3.3.1.5 Combining MCA techniques: The rationale

All three MCA techniques were applied in this research to account for their unique limitations, as well as to effectively build upon the methodology used in our pilot study (Ganowski et al., 2018). A combined approach also provided the flexibility needed to compare media framing results with public survey results obtained from the UW-UNIS project. While similar in scope and purpose, the survey project, led by Dr. Christopher Jones, differed from this research in respect to its theoretical and analytical foundations. The UW-UNIS project took a causal approach, applying Huijts et al.'s (2012) framework (see [Section 2.2.2](#)) to determine what influences public attitudes about ES, while the present exploratory study uses Stephen et al.'s SPEED framework to examine media and public perceptions of the technology. These varying frameworks led to slightly different definitions of 'frames' and the parameters used for examining their potential effects on publics. For instance, the discursive themes used in news articles to describe ES were defined, in this study, as narratives (e.g., 'climate change,' 'economic development,' 'energy security,' and 'technology innovation'). In the survey project, these same narratives were referred to and used as 'framing conditions' for the experimental online questionnaire deployed in both countries. Narrative analysis thus allowed for bridging of empirical findings from the MCA performed in this thesis and the UW-UNIS survey project.

Finally, while a complex set of interactions between media discourse and social acceptance should be assumed, frame and narrative analyses can help clarify how these interactions are unfolding in real-time by revealing underlying meanings and implications of media content (e.g., risk/benefit frames, themes, buzzwords) (Stephens et al., 2009). In sum, all three analytical techniques are useful for examining media coverage on niche-innovations like ES. By combining these techniques, researchers can help ensure more systematic MCAs, which can help inform energy policy and market developments that accurately reflect key stakeholder concerns and interests (Corbett & Durfee, 2004).

3.3.1.6 A cross-national comparative approach

This research takes a comparative cross-national approach for various reasons. First, the globalization of energy technology development and media's prominent role in both 'setting' and 'reflecting' this agenda (Scheufele, 2004) presents a case for more international comparative framing research in the energy field (De Vreese, 2005; Djerf-Pierre et al., 2016). Second, cross-national comparisons are well-suited for SPEED analysis, as they can offer diverse insights on technology deployment while demonstrating how national socio-political factors influence news framing across different dimensions. Further, the importance of cross-national differences in journalistic practices and the ways in which national institutional, political, and social contexts inform news coverage (and vice versa) are well known (De Vreese, 2005; Dimitrova, 2018). The case of ES is thus fitting for this approach as the growing global ES market will likely have transnational economic, environmental, and social implications (Connolly et al., 2012; McPherson et al., 2016).

Finally, as Dogan & Pelassy (1990) note and others continue to support, anytime there is potential for premature generalisations or assumed universality of a novel concept (such as a new energy innovation), comparative analysis is strongly warranted (Dimitrova, 2018). Yet, with some exceptions (e.g., Djerf-Pierre et al., 2016; Meadowcroft et al., 2018), cross-national framing studies on low-carbon energy technologies remain scarce. This is contributing to a strong 'ethnocentric bias' in media framing literature, both in terms of the issues examined and the geographical focus of the studies (i.e., on sub-national regions in North America) (Guo et al., 2012). This thesis thus addresses the limitations of single-region/country framing studies in the energy arena by providing one of the first cross-national comparative frame analyses on ES.

3.3.2 PH2 – Comparative Secondary Survey Analysis (SSA)

The following section provides an overview of PH2, including a brief explanation of the UW-UNIS survey study and the methods performed to analyse and compare results from this parallel project to the MCA performed in PH1.

3.3.2.1 Overview of survey project and secondary analysis approach

The UW-UNIS study comprised two national surveys investigating public perceptions of ES in Canada and the UK. The online questionnaire (hosted by Qualtrics) engaged a representative sample of Canadian ($n = 1022$) and UK publics ($n = 1044$) to complete a set of questions designed to identify: (1) the nature and antecedents of their overall perceptions of the

use of ES in their national (or provincial) energy network; (2) their specific perceptions of four forms of ES (i.e., pumped-hydro, lithium ion batteries, compressed-air, and flywheels); and (3) to better understand how certain framing of ES potential (i.e., helping to tackle climate change, enhancing energy security) affects perceptions of ES technologies among the sample. Since ES is still a generally unfamiliar topic to most publics, the survey comprised a series of specially prepared flash cards with the basic information that respondents needed to assess and compare different storage technologies prior to providing their opinions about them.

The surveys were conducted independently in each country in June (UK) and July (Canada) of 2018, allowing for a cross-national comparison of public attitudes toward ES. Separate research design and ethics approval processes were undertaken by the lead researchers. See [Section 3.5.2](#) for further details on sample recruitment and survey demographics. The two studies support one another in various ways. One objective of the UW-UNIS project was to investigate how societal framing of ES (e.g., as a decarbonisation solution) affects public attitudes about storage. Both studies thus hinge on the same body of literature which examines the influence of emphasis framing (inherent in political and media discourse) in shaping public opinion on novel issues affecting society. Accordingly, the media components of this thesis were applied to the 'societal framing' element of the survey study (and vice versa) in order to explore the complex relationship between media discourse and public acceptance of ES. In other words, the frames chosen for the manipulation experiment in the survey (e.g., 'climate change,' 'energy security,' etc.) were derived from the Canadian pilot study, which helped to inform the design of this thesis. Likewise, findings from the public survey were analysed and integrated into this work using a mixed methods secondary analysis approach (Creswell, 2011; Bryman, 2016). Findings from this thesis will also help to inform future work emerging from the UW-UNIS research collaboration.

3.4 Strengths and Weaknesses of Methodology

3.4.1 PH1 – Comparative Mixed Methods Media Content Analysis (MCA)

MCA is a well-established, inexpensive, and unobtrusive approach to appraising public discourse (Macnamara, 2005; Bryman, 2016). Suitable for both qualitative and quantitative analytical measures, MCAs are also favourable for large sample sizes, generalisability, and international comparisons (Macnamara, 2005). Still, the method has invited some validity and reliability concerns in the last few decades. Qualitative MCAs (which try to capture latent or cultural meanings of a text) have been criticised for producing unreliable results, while

quantitative MCAs sometimes fall short in validity (Zhou & Moy 2007). For instance, ‘frames’ are rather abstract variables which can be difficult to identify and tedious to code. MCAs with framing components thus require reliability and validation measures (e.g., inter-coder reliability tests, triangulation) in order to adhere to scientific methodology as closely as possible (Van Gorp, 2007). Similarly, for quantitative MCAs, the sample selection, data collection, and frequency analysis techniques must be sound and reliably applied in order to ensure study results are valid (e.g., that the observed patterns are meaningful) (Riffe et al., 2014).

These limitations were mainly addressed by performing inter-coder reliability tests ([Section 3.7.1.8](#)) and using a mixed methods MCA approach, where both: (1) quantifiable data are collected and examined (i.e., via frequency analyses) in order to draw replicable inferences on the meaning of these elements; and (2) contextual and cultural factors (i.e., beyond specific text content) are considered by examining the relationship between the text and its likely meaning to (and effect on) relevant audiences (Macnamara, 2005). This combined approach (see [Section 3.3.1.5](#) for full rationale) helped to account for limitations such as those associated with interpreting issue salience patterns from longitudinal article frequency data across a range of data sources (Riffe et al., 2014). Still, as in most MCA studies, certain assumptions must be accepted in order to make such inferences. For instance, the ability to nationally compare ES issue salience over time assumes that newspaper samples were representative in their relative share of coverage for each publication and, importantly, also representative over time, reflecting annual changes in ES frequency reporting for each newspaper (e.g., as in Listerman, 2010). Further, despite best efforts to select comparable and representative national media samples, factors such as varying newspaper formats and sizes, as well as possible changes in page numbers and/or frequency of total articles published annually over time create some limitations for inferring changes in issue salience (i.e., by country, political orientation of newspapers, etc.). Again, efforts to address these limitations included combined use of both quantitative and qualitative MCA methods, as well as selecting and analysing data based on similar MCA research concerning issue salience of relevant topics (e.g., Dotman et al., 2012; Listerman, 2010; Boycoff, 2007; Barkemeyer et al., 2017; Stephens et al., 2009). Finally, in order to address broader validity and replicability issues associated with framing techniques, the selection of and coding for media frames were based on existing frameworks (i.e., SPEED) and results obtained from our pilot study (Ganowski et al., 2018).

3.4.2 The SPEED framework

Stephens et al.'s (2013) SPEED framework was selected for the qualitative MCA as it provides an established set of coding criteria for evaluating social acceptance of energy technologies using a benefit-vs-risk perspective (Langheim et al., 2014; Feldpausch-Parker et al., 2015; Mallett et al., 2018). This deductive approach, which involved deriving frames from SPEED literature and coding for them in the MCA, also allows for more quantifiable and generalisable results, than do inductive framing techniques (Matthes & Kohring, 2008). The framework is particularly useful for analysing media content as researchers can use SPEED criteria to easily identify and organise perceived benefits and risks into various categories (e.g., environmental, social, political etc.). SPEED was also specifically designed for systematic comparisons, which makes the framework suitable for cross-national analysis. SPEED has been applied in over a dozen comparative energy studies, including acceptance assessments on wind power (Stephens et al., 2009), CCS (Feldpausch-Parker et al., 2015), and smart grid (Langheim et al., 2014; Mallett et al., 2018). By assessing different patterns of SPEED framing in Canada and the UK, the PH1 MCA examines how ES discourse varies nationally across six previously mentioned dimensions associated with technology deployment (e.g., cultural, environmental, etc.) (Stephens et al., 2013).

While the SPEED framework enables a quantifiable and replicable coding scheme, its deductive design is generally inflexible for examining emerging themes in a media data set. This limitation was addressed through the narrative analysis, which catalogued emergent narratives alongside the qualitative frame and narrative analyses performed using NVivo. Despite also using pre-determined narratives (in order to align with the UW-UNIS survey and allow for comparative analysis in PH2), the narrative analysis identified emerging themes for consideration in the discussion chapter. A new narrative was coded in the data set if key themes or ideas around ES that were not already captured by the SPEED framework or pre-determined narratives, were noticed while coding each article (Matthes & Kohring, 2008). These emerging narratives were not tested using the same statistical analyses performed for the four key narratives but were qualitatively analysed in the results and discussion sections. Overall, narrative analysis allowed for a deeper understanding of the socio-political factors that the SPEED framework captured as benefit and risk frames.

3.4.3 Other considerations

3.4.3.1 Test coding – Canada vs. UK

To ensure that the UK sample received sufficient consideration of ‘nationally-specific’ narratives, a random test sample of UK articles ($n = 20$) was coded prior to the MCA using the same inductive narrative analysis method applied in the Canadian pilot study (Ganowski et al., 2018). After reading each article in the test sample, I identified key themes related to ES and then coded them as narratives. To gauge what other possible narratives could be discovered in the UK sample, the set of four pre-determined narratives were cross-referenced with those found in similar UK energy framing studies. For instance, Goldthau & Sovacool (2016) (on shale gas) and Pidgeon et al. (2008) (on nuclear power) also identify ‘climate change mitigation’ and ‘economic development’ as key themes in energy media discourse. The narrative test determined that all narratives found in the UK sub-sample ($n = 20$) could be consolidated into the four existing categories. The original set of narratives was thereby retained for deductive analysis of both national samples. However, upon coding the full national samples, an additional narrative (‘political contention’) was in fact observed and described (see [Section 4.2.2.3](#)). In short, the various measures discussed above were taken to maximise validity, reliability, and replicability of the MCA, while obtaining both useful quantitative and qualitative data for supporting future research emerging from this work.

3.4.3.2 Characterising political leanings – Newspapers and survey respondents

Given that the right-left distinction in political ideology is substantively ambiguous and inconclusive (White, 2010) – especially in cross-national/cultural comparative contexts where diverse texts and audiences are examined – this thesis does not attempt to explicitly define the political positions assigned to sampled newspapers or respondents’ self-reported orientations. Indeed, defining liberal (left-wing), centrist/centre, and conservative (right-wing) positions is inherently subjective, and rather futile insofar as: (1) what constitutes left- or right-wing changes over time; (2) a neutral ‘centre’ position on any given issue is usually unknown and unachievable; and (3) there will always be disagreement in society on the definitions of political positions (White, 2010). However, in light of the political nature of energy discourse and development (Scoones et al., 2015), this work broadly considers how varying positions on what might be described, at best, as a ‘political spectrum’ (generally accepted as ranging from ‘very left-wing’ to ‘very right-wing’) might be associated with social representations and perceptions of new energy innovations and transition processes (Carvalho, 2007; Dotson, 2012).

Newspaper political leanings were thus based broadly on classifications made in recent literature, which were then cross-referenced with editorial stances provided by the same 'Media Bias/Fact Check' tool (see p. 48) applied in our Canadian pilot study on ES media coverage (Ganowski et al., 2018). Assessments were made on the account of both overall political stances of newspapers (e.g., centre-right editorial slant) and partisan endorsement (e.g., Vote Conservative). For instance, Post Media newspapers have a right-leaning reputation in Canada, particularly since being ordered to endorse the Conservatives party in the 2015 Federal election (Vessey, 2016; Dusyk et al., 2018). However, the editorial stances of Post Media newspapers vary and continue to evolve (e.g., in response to industry and societal change) (Vessey, 2016; Iggers, 2018) – which creates further limitations for categorising newspaper political biases. For example, *The Montreal Gazette*, which endorsed the Conservative Party in 2015, has since slid left-of-centre (in respect to its editorial slant) in a national media context (CBC News, 2015; Vessey, 2016). Overall, it is noted that the extent and direction of political and other biases (e.g., corporate, advertising) for individual media outlets remains highly disputed (Luhmann, 2000; Iggers, 2018). Despite these considerations, classifying political positions of newspapers was substantiated by existing literature and available resources, and did not interfere with addressing the research questions. Nonetheless, findings concerning political leanings are acknowledged as indicative rather than affirmative. These limitations were less applicable in PH2, as survey respondents were asked to self-identify their orientation using a 10-point scale (1 = very left-wing; 10 = very right-wing).

3.4.4 PH2 – Comparative Secondary Survey Analysis (SSA)

The rationale for linking this thesis to the UW-UNIS public survey was to gain a diverse perspective on the social acceptance of ES in the two countries, and thus maximise the outcomes of two similar cross-national investigations. Many researchers apply this approach in communication studies, as it combines the strengths of various data sets in order to better understand the research problem at hand (Creswell, 2011). For instance, Morgan et al. (2010) pair qualitative social media content with public surveys to examine public attitudes on the depiction of drug use by youth on social media websites. Similarly, Delshad & Raymond (2013) investigate changes in media framing of biofuels and their effect on public attitudes by pairing a national MCA (on biofuel coverage over a decade), with a national public survey completed in 2010. These examples illustrate the potential of using various approaches to uncover new insights via complimentary and combined methods (Snelson, 2016).

However, there are some limitations to comparing longitudinal media data with cross-sectional public survey data. The UW-UNIS surveys only provide public opinion data from 2018, while the MCA reflects societal framing of ES from 2008-2017 (with 2016-2017 representing then-current media). This discrepancy is addressed by performing a separate qualitative analysis of a sub-sample of the entire media data set (i.e., 2016-2017; $n = 216$), which is considered to more recent (2018) discourse. Secondly, the national surveys were designed using Hujits et al.'s (2012) conceptual framework and have been constructed to meet UW-UNIS survey project objectives (e.g., understanding effects of framing manipulation). Although several media-related questions were inserted into the Canada-UK questionnaire, teasing out SPEED and narrative insights for comparative analysis was challenging given differences in definitions and research objectives. The survey also already contained over 50 questions designed to answer the parallel study research questions. Adding additional questions (to directly address this study's objectives) would have likely made the questionnaire less manageable and more frustrating for respondents. This led to some other limitations. For example, not all of perception/attitude questions in the survey captured the full scope of SPEED frame function systems – e.g., most risk/benefit questions focused on economic, technical, and environmental framing (with less focus on political/cultural dimensions). To address these limitations, a broader comparative analysis was performed, using descriptive statistics to draw upon only the most relevant and comparable questions in the survey. See [Section 3.2.2](#) for how survey data were analysed.

3.5 Data collection

3.5.1 PH1 – Comparative Mixed Methods Media Content Analysis (MCA)

To analyse ES media coverage in Canada and the UK, news articles (see [Section 3.6.1](#) for article details) were drawn from each country's top national newspapers reporting on storage between 2008 and 2017 (see Table 3 for overview of national samples). Similar to other media studies (Djerf-Pierre et al., 2016; Barkemeyer et al., 2017), the aim was to capture discourse from 'quality' national newspapers with large readerships and a recognised influence on socio-political life in the two countries. Quality newspapers are traditionally printed in broadsheet format, have predominantly middle- to upper-class audiences (i.e., 'elite publics'), are politically diverse, and are serious in tone (Patterson et al., 2016). Priority was given to national newspapers (where possible), as they typically reflect national public agendas over local contexts (thus fitting within the scope of this research). Selection criteria also included daily average circulation, geographic location, political leanings, and ownership – following

Barkemeyer et al.'s (2017) approach. The selected newspapers also provide considerable coverage on energy issues and are known to have a high agenda-setting impact (Carvalho, 2007; Vessey, 2016). Previous research has identified these sources as major influences on policy discourse and decision-making at national levels (Boycoff, 2007; Doyle 2002), with policy actors regularly monitoring the publications for salient aspects of contemporary public discourse, including energy-related issues. Newspapers were chosen over other forms of media because they continue to be a primary information and news source for public stakeholders, despite increasing digitalisation of media sectors and reliance on television news (Luedecke & Boycoff, 2017; Iggers, 2018). As such, both print and online newspapers were included in the sample.

In an effort to obtain a large, representative sample, five newspapers were chosen from each country. Since Canada only has two national newspapers (*The Globe and Mail* and *The National Post*), three regional newspapers were selected on the account of circulation and geographic diversity (News Media Canada, 2015). Due to language and resource limitations, Canadian francophone newspapers were excluded. To account for this and to increase the geographic and cultural representativeness of the Canadian sample, *The Montreal Gazette* (a regional newspaper based in the country's French-speaking province, Quebec) was selected. The inclusion of this publication skewed the Canadian sample toward a slightly left-leaning and ownership bias – a difficult challenge to overcome, given the country's increasingly liberal media culture and dominating ownership by the Post Media Network (Phillips, 2018; Vessey, 2016). In the UK, editorial stances and newspaper ownership are more diverse. Thus, highly-circulated 'elite' national newspapers were given priority for the UK sample (Scottish Law News Centre, 2018), as they are known for 'setting the agenda' for non-elite papers and typically use more credible sources. To further justify sample selection, newspapers were chosen based on criteria and samples used in comparable MCA studies (e.g., Boykoff, 2007; Deignan et al., 2013; Rachul & Caulfield, 2015; Dusyk et al., 2018; Djerf-Pierre et al., 2016).

Publication	Average daily newspaper circulation (digital and print combined)	Notes	Ownership	Political leaning of newspaper
Canada				
<i>The Globe and Mail</i>	336,487	Daily national broadsheet newspaper; Canada's most widely read newspaper on	Globe and Mail Inc.	Right-centre

weekdays and Saturdays				
<i>The National Post</i>	186,108	Daily national broadsheet newspaper	Post Media Network/Sun Media	Right-centre
<i>The Toronto Star</i>	318,763	Daily regional broadsheet newspaper; Canada's highest-circulated newspaper in overall weekly circulation; based in Toronto, Ontario	Torstar Corp	Left-centre
<i>The Vancouver Sun</i>	136,787	Daily regional broadsheet newspaper based in Vancouver, British Columbia	Post Media Network/Sun Media	Left-centre
<i>The Montreal Gazette</i>	116,446	Daily regional broadsheet newspaper based in Montreal, Quebec	Post Media Network/Sun Media	Left-centre
United Kingdom				
<i>The Daily Telegraph</i>	477,900	Daily national broadsheet newspaper	The Barclay brothers' Press Holdings	Right-centre
<i>The Times</i>	430,000	Daily national broadsheet newspaper based in London, UK	News UK (News Corp)	Right-centre
<i>The Independent</i>	267,900	Daily national broadsheet newspaper	Johnston Press	Left-centre
<i>The Financial Times</i>	186,300	Daily international broadsheet newspaper based in London, UK; (known for reporting on national UK issues)	Nikkei Inc.	Right-centre
<i>The Guardian</i>	149,400	Daily national broadsheet newspaper	Scott Trust Limited's Guardian Media Group.	Left-centre

Table 3. Newspaper sample: Circulation, ownership, political leanings, and other notes.¹

¹Based on available data: circulation numbers reflect 2015 News Media Canada data (Canada) and 2017 Statista data (UK). Editorial stances were retrieved from *Media Bias/Fact Check* <https://mediabiasfactcheck.com> as of June 2018. Ownership information reflects 2017 News Media Canada data (Canada) and 2015 Media Reform Coalition data (UK); UK circulation numbers were rounded based on available data.

Using the Dow Jones Factiva Global News Database, a search was conducted for articles reporting on ES between January 1, 2008 and December 31, 2017 within the selected newspapers from each country. A ten-year time period was chosen in order to examine changes in ES reporting and discourse on related technological and policy developments over time. Factiva was selected as the search engine because it provides: (1) a comprehensive archive of international news sources suitable for comparative analysis (Saraisky, 2016); (2) access to all selected newspapers (in both print and online formats); and (3) intuitive search features that successfully returned ES content in the Canadian pilot study.

While our pilot study (Ganowski et al., 2018) used a more comprehensive search algorithm (i.e., with key terms including various technologies), scoping searches for this project determined that a broader algorithm (with key terms appearing anywhere in the full article) returned a more focused and relevant sample. The search algorithm used for this analysis was therefore:

*(energy storage or power storage or electricity storage or battery storage or thermal storage)
AND (project or research or facility or system or policy or technology)*

In addition to limiting confirmation bias (Nickerson, 1998), the exclusion of all ES technologies (e.g. flywheels, pumped-hydro) in the search criteria yielded more articles that discuss ES in broader SPEED contexts (aligning with the scope of this research). ‘Battery’ and ‘thermal’ storage were retained in the algorithm as they were still considered broader descriptive terms for ES (comprising various technologies – e.g., lead acid, lithium ion batteries). To ensure that only relevant articles were returned, the second portion of the algorithm included (i.e. ‘project’, ‘system,’ etc.), as news articles often use these terms to describe ES developments.

The search was conducted once for each set of newspapers. To capture ‘national level’ media discourse, the ‘Region’ filter on the Factiva search engine was set to each respective country with the ‘Source’ filter including each sample ($n =$ per country) of national newspapers. Retrieved articles were manually reviewed; non-relevant articles (e.g., articles describing employee accolades or energy storage in biological contexts) and duplicates (e.g., wire stories) were removed prior to importing each sample into NVivo for analysis. Since this research focuses primarily on grid-scale and BTM ES, most articles discussing electric vehicles (EV)

were also excluded. The only EV articles that were retained in the sample were those that examined EVs as part of integrated storage systems wherein electricity is stored and returned to power grids (e.g., 'power-to-grid'). For example, articles that focused on EV models or battery parts exclusively were excluded. To reduce the number of such articles returned by the search, the industry and subject tags 'motor vehicles,' 'automotive,' and 'car parts' were excluded from the search.

3.5.2 PH2 – Comparative Secondary Survey Analysis (SSA)

Research design, ethics approval, and data collection for the UW-UNIS study were led by researchers Dr. James Gaede (UW, Canada) and Dr. Chris Jones (UNIS, England), independent of this thesis. The national surveys were constructed and deployed in their respective jurisdictions using Qualtrics, an online-sample sourcing and survey platform often used for public perception studies (e.g., see Demski et al., 2014). Sample sourcing was administered entirely by Qualtrics to a randomised and representative (demographically and geographically-diverse) sample of approximately 1000 adults (aged 18+) across Canada and the UK (see [Section 3.6.2](#) for sample size and demographics). Survey participants were recruited from the company's representative online panel pool, which is selected using a stratified quota sampling method. For example, the Canadian survey sourced participants from all 10 provinces and 3 territories and was also translated for delivery to francophone respondents. Participants received a small financial payment as part of their participation on the Qualtrics sample panel.

3.6 Population and sample size

3.6.1 PH1 – Comparative Mixed Methods Media Content Analysis (MCA)

The newspaper sample is considered to be representative of each country's national 'elite' newspaper discourse, as each country's quality press national newspapers were chosen for analysis. Canada's both (and only) national newspapers were selected (see justification above). For the UK, the top five quality national (also known as 'elite') broadsheet newspapers were selected for analysis, with *The Times*, *The Daily Telegraph*, and *The Guardian* particularly known as the country's most read and influential newspapers (Scottish Lab News Centre, 2018; Press Reference, 2018). A sample of ten newspapers was chosen to obtain a sufficient number of ES articles in both countries.

The Factiva search originally returned a sample of 669 unique articles (Canada: $n = 366$; UK: $n = 303$). Upon removing non-relevant stories, a final total of 494 articles (Canada: $n = 240$; UK: $n = 254$) was retained for data analysis. This filtered total was suitably analysed using primarily quantitative approaches (i.e., NVivo text search queries, descriptive statistics). In order to obtain a contemporary sample for comparative qualitative analysis, a sub-sample (total: $n = 216$; Canada: $n = 78$; UK: $n = 138$) of articles published between 2016 and 2017 was then derived from the total 494. Only the most recently published articles were chosen for qualitative analysis as to answer **RQ1(b)**. Since data collection commenced in the summer of 2018, the last two full years of media reporting (2016-2017) were considered as 'then-current' media. Articles published prior to 2016 were excluded from the qualitative sub-sample given that energy technology developments (and coverage on them) are rapidly evolving issues and content prior to this year would have been less relevant for comparative analysis with 2018 survey data. The final sub-sample for qualitative analysis contained 216 articles (2016-2017).

All types of news articles were included in the total newspaper sample (e.g., business columns, editorials, opinion, reviews) with 'republished news,' 'pricing and market data' and 'obituaries, sports, and calendars' excluded from the Factiva search. This all-inclusive approach helped to account for the blurring boundaries between 'hard news' stories (factual/relevant reporting on economy, international affairs, etc.) and 'soft' or 'advocacy news' (commentaries, op-eds) – both of which are now often understood and consumed by public audiences as 'news' (Iggers, 2018). The inclusion of all types of articles in the MCA also aligned with the survey design, since respondents were more likely to assess their readership trends on the account of the full or general contents of newspapers, rather than just hard news sections. The unit of analysis was the complete newspaper article, excluding multimedia, as the focus was on written media discourse around ES. Excluding visual elements from the analysis also helped to make the qualitative coding task more manageable (i.e., reducing coder fatigue).

Sample sizes and time frames were compared to similar studies (including our Canadian pilot study) and were selected based on their suitability for the chosen analytical methods. A key aim of this research was to build upon the scope and methodology used in Ganowski et al.'s (2018) media analysis ($n = 143$). This was achieved by both scaling the comparative analysis up to a national level and more-than doubling the dataset ($n = 494$). The sample sizes and temporal scope of this project were comparable to similar studies. For instance, Langheim et al.'s (2014) smart grid analysis yielded 231 newspaper articles over a 15-year period using primarily qualitative methods (e.g., manual deductive coding using the SPEED framework).

Taking a mixed methods approach, Delshad & Raymond's (2013) biofuel frame analysis yielded 610 articles over ten-years (1998-2008), which was then compared to the authors' public opinion survey fielded in 2010 (Delshad et al., 2010). A similar observation period (for the 'current' qualitative MCA) was also chosen by Wright & Reid (2011) to analyse 432 articles published between 2006 and 2008 on media framing of biofuels. Given these comparable samples and time scales, and the relative infancy of ES applications, data selection for the MCA portion of the study was justifiable.

3.6.2 PH2 – Comparative Secondary Survey Analysis (SSA)

Sample size and key demographic details for the national survey samples are provided in Table 4. Based on similar perception studies and assessments of Qualtrics as a demographically representative survey sourcing tool, the sample parameters were deemed suitable for the project.

Variable	Category / Label	Percentage of respondents (%)	
		Canada (<i>n</i> = 1022)	UK (<i>n</i> = 1044)
Age (years)	18-24	10.4	10.0
	25-34	15.9	17.8
	35-49	35.7	26.9
	50-64	17.3	26.0
	65+	20.7	19.3
Gender	Female	48.3	45.6
	Male	50.8	53.9
	Other	0.5	0.4
	Prefer not to say	0.4	0.1
Province of residence	Alberta	9.7	N/A
	British Columbia	14.4	
	Manitoba	4.4	
	New Brunswick	4.1	
	Newfoundland and Labrador	2.9	
	Nova Scotia	0.3	
	Ontario	39.0	
	Prince Edward Island	0.9	
	Quebec	21.6	
	Saskatchewan	2.3	
	Northwest Territories	0.1	
	Nunavut	0.1	
	Yukon	0.1	
Education status	≤ Secondary school	22.3	34.2
	College degree	24.3	25.6
	Undergraduate degree	30.8	25.7
		19.2	11.8

	Postgraduate degree	3.0	2.8
	Other		
Occupation status	Employed	59.1	55.7
	Retired	22.6	16.3
	Military	0.2	2.3
	Homemaker	4.3	8.7
	Student	5.2	5.5
	Out of/seeking work	4.2	4.3
	Unable to work	3.1	6.0
	Other	0.5	1.2
	Prefer not to say	0.8	N/A
Political preference	Mean (SD)	5.5 (1.9)	5.3 (2.0)
Respondents asked to self-identify using a 1-10 point sliding scale; 1 = very left; 5 = centre; 10 = very right			

Table 4. Key demographic details of national samples: Canada ($n = 1022$) vs. UK ($n = 1044$); 2018

3.7 Data analysis

3.7.1 PH1 – Comparative Mixed Methods Media Content Analysis (MCA)

Upon retrieving the media sample, NVivo 11.4™ content analysis software was used to code and analyse, by country: (1) the frequency (salience) of ES articles published in each newspaper, over time (2008-2017); (2) the types and frequency of SPEED frames used to describe ES benefits and risks (2016-2017); (3) the types and frequency of narratives in which ES was discussed (2016-2017); and (4) the overall ‘valence’ (i.e., tone/orientation) of ES in more recent coverage (2016-2017). In addition to these qualitative measures, quantitative methods were also taken (e.g., NVivo text-search queries, descriptive statistics) in order to determine (5) other common themes, specific technology and buzzword mentions within the total sample (2008-2017). Qualitative coding was facilitated using a detailed codebook containing various criteria and definitions for analysing components (1) through (4). The following sections provide a breakdown of how these elements were coded.

3.7.1.1 (1) Frequency analysis – ES issue salience in news media

The salience of ES in news media over time was assessed in two ways. First, the total sample ($n = 494$) was analysed, by country, using NVivo queries and frequency tables in SPSS to determine the number of ES articles published annually between 2008 and 2017. Since both print and online newspapers were included in the sample, the focus was on ‘attention salience’

(i.e., issue attention/frequency of reporting), rather than ‘prominence salience’ (i.e., story placement/importance attributed to issue), which is more suitable for analysis of print media only (Lim, 2010). The caution required when measuring attention salience through annual frequency reporting was strongly acknowledged (Riffe et al., 2014). Indeed, despite efforts to select comparable and representative national publications, it is noted that the ability to compare ES issue salience in Canadian and UK news media is somewhat limited due to: (1) inevitably variable publication sizes, formats, page numbers, etc. and potential changes in these newspaper elements over time across the entire sample; and (2) the challenge of obtaining valid data on the total number of *non*-ES articles (for sake of comparison) published annually per newspaper (both digital and print format) across the ten year period.

In view of this, a second approach was used to measure attention salience. Using our pilot study approach (adapted from Langheim et al.'s (2014) smart grid MCA) all articles published between 2016 and 2017 were thoroughly read and coded into one of three ‘focus’ categories (i.e., cases) in NVivo: (1) ‘ES-Focused (ES-F)’, ‘ES-Subsection (ES-S)’, and ‘ES-Irrelevant (ES-IR)’ based on the extent to which the article focused on ES. ‘ES-F’ articles focused entirely on ES systems, technologies, legal processes, and/or markets (e.g., articles discussing new community ES battery projects), while ‘ES-S’ articles did not focus on ES exclusively but mentioned ES or some aspect of it within a subsection of the article (in an energy system context). Non-relevant articles (i.e., those that did not discuss ES in energy system contexts) were initially discarded prior to importing the returned sample ($n = 494$) into NVivo. However, upon closer review of 2016-2017 articles during step two of this analysis, some stories mentioned ES in relevant contexts but failed to provide enough information for frame and narrative coding. For example, articles that mentioned ES only among a list of other technologies at the end of a news story were unsuitable for qualitative analysis and were thus coded as ‘ES-Irrelevant’ (ES-IR). While these articles were still relevant for quantitative analysis (i.e., buzzword text-search queries) and thereby retained in the total sample ($n = 494$), ES-IR articles were excluded from the qualitative analysis sample ($n = 216$), which included only ES-F and ES-S articles published between 2016-2017. Although only ‘current’ articles were used for this analysis, determining the level of attention that articles attributed to storage helped to support quantitative findings on issue salience patterns over time.

3.7.1.2 (2) Frame analysis – SPEED framing

A SPEED frame analysis was carried out in order to identify the frequency and type of frames used to describe ES benefits and risks in each country’s current newspaper coverage

(2016-2017; $n = 216$). Using Stephens et al.'s (2013) SPEED framework and the codebook (see [Appendix B.1.2.2](#) for SPEED coding scheme) the framing of ES benefits and risks in all ES-F and ES-S articles was identified and coded at specific NVivo nodes representing the six SPEED frames: 'cultural,' 'economic,' 'environmental,' 'political,' 'regulatory and legal,' and 'technical.' While characterising benefit and risk frames, other information such as key quotes and salient points were recorded in a coding notes document. Organised by national sample, these notes included SPEED-related content (e.g., quotes, examples of benefits and risks), as well as other overlapping and distinct themes (e.g., political debates, mentions of ES projects) that were not captured by the deductive SPEED coding procedure. Cataloguing both SPEED frames and other relevant content was done this way to support later discussion comparing media coverage on ES in Canada and the UK. This task was fully executed by me, the primary coder, upon satisfying an inter-coder reliability test (see [Section 3.6.1.8](#)).

3.7.1.3 (3) Narrative analysis – Themes and storylines

Following the SPEED frame analysis, the qualitative sub-sample ($n = 216$) was analysed for the four narratives mentioned earlier – 'climate change,' 'economic development,' 'energy security,' and 'technology innovation'. Articles were coded at specific 'narrative cases' in NVivo by identifying the frequent use of words, phrases, and ideas corresponding with each of these themes, as per the narrative coding scheme (see [Appendix B.1.2.3](#)). For example, articles discussing ES in the context of job creation were coded to the 'economic development' narrative case. While the purpose of this analysis was to identify the main angle of each article reporting on ES, many articles contained more than one narrative. Each article was therefore coded for containing up to two narratives (variables were later organised in SPSS as 'First Narrative' and 'Second Narrative'). Narratives also often overlapped with certain SPEED frames. For instance, articles possessing the 'climate change' narrative typically contained SPEED environmental framing (i.e., mentioning specific environmental benefits of ES). Reflecting upon the types and frequency of SPEED frames contained in articles helped ensure accurate narrative coding.

3.7.1.4 (4) Framing analysis – Valence

The 'valence' of each article in the sub-sample ($n = 216$) was also analysed. This was done by determining whether an article portrayed ES as generally 'negative,' 'neutral,' or 'positive' using the respective coding scheme (see [Appendix B.1.2.4](#)) and then coding them at one of the three 'valence cases' in NVivo. For example, those that discussed ES in an optimistic manner, listing more SPEED benefits than risks, were coded as having a 'positive' valence.

Those that discussed ES negatively and contained more SPEED risks than benefits were coded as 'negative.' 'Neutral' articles contained balanced perspectives on ES, containing equal distributions of SPEED benefits and risks.

3.7.1.5 (5) Frequency analysis – Technologies, buzzwords, and other themes

Following the qualitative analyses, another frequency analysis was performed in order to quantify other key themes, technology mentions, and common 'buzzwords' in the entire sample ($n = 494$). To do this, text search queries in NVivo were conducted for articles within each country sub-sample, each containing 4-5 specific search terms derived from the codebook. Search words for these queries were selected based on emerging themes documented during the qualitative analyses, common buzzwords found in the Canadian pilot study, as well as other media studies taking similar text-search approach for quantitatively identifying themes in large news article samples (Stephen et al., 2009). All articles returned by the queries were manually reviewed to confirm whether search term references were explicitly related to discussions about ES – those that did not were removed from query sub-samples. For example, in order to confirm how many articles from each country discussed ES in the context of 'climate change,' a query was conducted using the search terms "climate change," "climate," "global warming," "emissions" and "carbon." See [Section 4.2.1.2](#) for full list of terms and results.

3.7.1.6 Analysing MCA results – SPSS

Both the entire sample ($n = 494$) and the qualitative sub-sample ($n = 216$) were entered into SPSS as separate data sheets. While analyses were primarily correlational, each article was coded for independent and dependent variables (for data organisation). Independent variables included country (i.e., Canada, UK), publication year (i.e., 2008 to 2017), newspaper (e.g., *The Globe and Mail*), and political leaning of newspaper (i.e., left-centre, right-centre). Dependent variables included article focus (i.e., ES-F, ES-S, and ES-IR), valence (i.e., positive, negative, neutral), SPEED frame (i.e., all 12 risk/benefit categories), and narratives frame (i.e., climate change, economic development, energy security, technological innovation). Descriptive statistics (frequency tables, cross-tabulations) and non-parametric tests (chi-square tests for independence, χ^2) were then used to compare different aspects of ES media representation in both countries. These procedures helped to determine whether national differences in article focus, SPEED framing, narrative, and valence variables between Canada and the UK were statistically significant (and thus to help answer **RQ1**). Given the categorical nature of the dataset, chi-square tests with Phi and Cramer's V measures were used to determine

associations between country and various variables, using a statistical threshold of $p = .05$, as per McHugh's (2013) suggestion for rejecting null hypotheses using χ^2 tests. Differences in media reporting on ES between the countries were further analysed by comparing ratios (i.e., risk to benefit framing among SPEED categories), percentage histograms, and cluster bar graphs.

3.7.1.7 The Coding Process: Codebook and NVivo

A critical component of any content analysis is the use of a codebook or coding scheme. These tools provide a systematic guide and rationale for coding content accurately and consistently, thereby ensuring more valid and reliable results (Kathleen & Mclellan-Lemal, 2008). Using a deductive approach, a detailed codebook was developed to ensure consistent coding throughout the PH1 MCA, as well as to help facilitate inter-coder reliability tests. The codebook (see [Appendix B.1](#)) served as a step-by-step manual for conducting the qualitative MCA in NVivo. The document contained four coding schemes (organised into various criteria charts, examples, and key words), which were developed by adapting the pilot study (Ganowski et al., 2018) codebook and drawing upon codebooks used in similar MCA studies (Stephens et al., 2008; 2013; Langheim et al., 2014).

The coding schemes were designed to facilitate analysis for four key components addressing **RQ1**: (1) issue salience; (2) framing; (3) narratives; and (4) valence. Each scheme provided operational definitions and guidelines for assigning media content to particular 'nodes' (e.g., SPEED Economic Benefit Frame) and 'cases' (e.g., Climate Change Narrative) in NVivo. As in Feldpausch-Parker et al.'s (2015) and Mallett et al.'s (2018) approach, "other" categories were developed to capture statements that were either too vague to categorise (but still described ES) and/or reflected emerging themes and narratives (e.g., energy planning, political contention). These "other" categories were used to support discussion of results but were not tested for inter-coder agreement.

3.7.1.8 Inter-coder reliability

Inter-coder reliability tests are fundamental for rigorous design and evaluation of MCA results (Macnamara, 2005; Chaturvedi, 2015). Inter-coder reliability is assessed by having two or more coders categorise at least a sample of content (i.e., the reliability sub-sample) and then using these categorisations to calculate a numerical index of the extent of agreement among coders (Lombard et al., 2002). To satisfy an inter-coder reliability test for the MCA in PH1, two coders (myself and Dr. James Gaede) independently coded the same reliability sub-sample ($n =$

50). Using the codebook to categorise content pertaining to the four variables discussed above (i.e., salience, frames, narratives, and valence), each coder organised content into appropriate nodes and cases in NVivo. The sub-sample ($n = 50$) represented 10% of the total media sample ($n = 494$). Of the sub-sample of 50 articles, 20 fell into the 2016-2017 timeframe (representing 'current' media coverage), thus belonging to the 244 articles that were coded specifically for salience and the 216 that were coded for frames, narratives, and valence. These reliability sub-sample sizes of approximately 10% agree with Lacy & Riffe's (1996) recommendations for large populations of content units.

The 'percent agreement' between coders was tested using Holsti's (1969) method – a commonly-used calculation of the percentage of all coding decisions made by pairs of coders on which the coders agree (ranging from 0.00 [no agreement] to 1.00 [complete agreement]). Holsti's (1969) method is applicable to situations in which two coders independently code units of the sample and is defined by the following formula:

$$PAo = 2A / (N1 + N2)$$

where PAo represents percentage of agreement between two coders, A is the number of two coders' consensus decisions, and N1 and N2 are numbers of decisions coders have made respectively. Recognising the limitations of Holsti's (1969) method (known as a more liberal reliability statistic), agreement was further tested using Cohen's *kappa* (κ) coefficient. Kappa is a preferred measure of reliability as it takes into account the amount of agreement that could be expected to occur through chance (McHugh, 2012). The formula for kappa is:

$$(\kappa) = (PAo - PAE) / (1 - PAE)$$

where PAo represents the observed percentage of agreement, and PAE is the proportion agreement, expected by chance. Once both raters coded the reliability sub-sample in NVivo, results were imported into SPSS and calculated for percent agreement and κ coefficients for salience, narratives, and valence variables (see results in Table 6.)

Percent agreement and κ for SPEED framing variables were tested using the 'Coding Comparison Query' feature in NVivo (as in Mallett et al., 2018). This feature compares coding conducted by two users by calculating κ individually for each combination of node and source. The percentage agreement calculated by the query represents the percentage of the media article's content where two raters agree on whether the content may be coded at a specific node (e.g., technical benefit, environmental risk). Since SPEED frames were highlighted at the

sentence and paragraph levels, comparison query calculations were based at the ‘paragraph’ level, rather than at the ‘character’ or ‘sentence’ levels (QSR International, 2018).

The κ calculations were also set to the paragraph level because the selected unit of analysis for the analysis was the full article; and most of the articles contained eight or more short paragraphs (QSR International, 2018). All inter-coder agreement results for SPEED framing were further analysed for accuracy using SPSS. Strength of agreement was determined using Landis & Koch’s (1977; 55) κ benchmark scale (see Table 5).

Kappa coefficient	Strength of Agreement
<0.00	Poor
0.00-0.20	Slight
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Substantial
0.81-1.00	Almost perfect

Table 5. The Landis & Koch (1977) kappa (κ) benchmark scale for inter-coder reliability

Inter-coder reliability results for all four variables discussed above are displayed in Table 6 below, with final percent agreement results ranging from 72%–98% and κ values ranging from 0.38–0.83. These ranges are comparable to those achieved in other SPEED MCAs that comprehensively report on inter-coder reliability (Stephens et al., 2009). Most, however, fail to provide these details – i.e., simply stating Holsti’s percent agreement (e.g., Mallett et al., 2018).

Variable	Reliability sample size	Number of coding categories	Percent agreement	Cohen’s kappa (κ)	Strength of agreement
Focus	$n = 50$	3	0.90	0.83	Almost perfect
Narratives	$n = 50$	4	0.72*	0.57	Moderate
Valence	$n = 50$	3	0.82	0.38*	Fair
Frames	$n = 20^*$	12	0.98	0.59	Moderate

Table 6. Inter-coder reliability results: Four key media variables analysed in PH1.

SPEED frame	Percent agreement (Holsti)	Cohen’s kappa (κ)
Cultural Benefit	0.99	0.80
Economic Benefit	0.95	0.62
Environmental Benefit	0.98	0.52

*To perform a sensitivity test, the same inter-coder reliability measures were taken for both sample sizes of $n = 50$ (articles published between 2008-2017) and $n = 20$ (articles published between 2016-2017). Results were comparable: percent agreement for the $n = 50$ sample was 97.6% with a κ of 0.58.

Political Benefit	0.99	0.31*
Regulatory and Legal Benefit	1.00	1.00
Technical Benefit	0.94	0.58
Cultural Risk	1.00	1.00
Economic Risk	0.99	0.58
Environmental Risk	1.00	1.00
Political Risk	0.99	0.00*
Regulatory and Legal Risk	0.99	0.58
Technical Risk	0.98	0.38*

Table 7. Inter-coder reliability results: SPEED frames analysed in PH1. Results for sub-sample ($n = 20$); * = categories falling below acceptability thresholds.

Minimum percent agreement and κ thresholds for reliable data vary among disciplines – e.g., acceptable κ values in mass communication studies are typically low. Thus, prior to initial coding, various SPEED studies and inter-coder reliability protocols were reviewed to determine a suitable minimum percent agreement threshold (80%) and acceptable κ value (0.45) for the reliability test. It is noted that κ acceptability values in similar studies are much lower given that kappa is a more conservative statistic measure (Lacy & Riffe, 1996). Values falling below the acceptability thresholds are identified with an (*) in the Tables 6 and 7.

The second coder confirmed that the codebook was clear, but the coding task itself was challenging. As with most SPEED analyses, inconsistencies in coding frames likely resulted from variation between the two coders' interpretations of frames in the article text (Stephens et al., 2009). Indeed, some SPEED frames are more difficult to characterise than others, often due to similarities in coding criteria and/or vague media content. For example, political and regulatory and legal frames often result in higher coding inconsistencies and are sometimes excluded from SPEED results altogether (Stephens et al., 2009).

However, these categories were not removed from the dataset, as they provided important insights about ES discourse – particularly related to politics and perceived technical characteristics – despite revealing relatively lower inter-coder agreement. Rather, to account for coding inconsistencies, the discussions and disputes that arose during reliability procedures were used to refine coding schemes for SPEED frames and valence and were strictly applied to the remainder of the qualitative sample ($n = 216$). The decision to retain less reliable categories was also justified on the account that supplementary MCA techniques were used alongside the SPEED analysis. In other words, most SPEED MCAs use frame analysis as a main analytical method, while this thesis combines SPEED with other approaches – i.e., salience, narrative,

and valence analyses – to support data inferences. Relevant results from these other analyses help to support conclusions drawn from the SPEED frame assessments.

Overall, the reliability of the coding process can be considered satisfactory, with highest reliability found for salience and SPEED frame results, and lower reliability determined for narrative and valence variables.

3.7.2 PH2 – Comparative Secondary Survey Analysis (SSA)

As a student co-investigator of the UW-UNIS survey, I included five specific questions in the online questionnaire, which were used to measure respondents' newspaper readership (e.g. favoured newspapers) and beliefs about the salience and representation of ES in the media (e.g., valence). These questions were designed to help answer **RQ2** and to support discussion on potential implications of media framing. See [Appendix C.2.2](#) for the full set of relevant survey questions. Public survey data from both national questionnaires (deployed in June and July of 2018) were reviewed and recoded as necessary to align with media analysis data (e.g., scales and names of certain variables). Where possible, survey questions were assigned to different MCA components to enable comparative analysis – i.e., questions assessing respondent's perceived benefits and risks of ES were compared to SPEED framing. Simple comparative statistical analyses were conducted, including frequency tables, cross tabulations, independent sample *t*-tests, and chi-square tests for independence.

3.8 Summary

This chapter has outlined the research scope and design, methods, and other methodological considerations of this thesis. It has described the purpose and rationale for combining various qualitative and quantitative techniques for analysing media representations of ES in both countries, as well the approaches taken to facilitate a survey analysis of public opinion data obtained from the parallel UW-UNIS project. The strengths and weaknesses of the study have been described here, as well as measures for addressing study limitations. The following chapter presents results from both phases of the thesis and summarises comparative insights on social perceptions of ES in each country.

Chapter 4 – Results

4.1 Overview

The following chapter presents results from **PH1**: the mixed methods comparative media analysis (MCA) of ES coverage in Canadian and UK newspapers; and **PH2**: the secondary survey analysis (SSA) of UW-UNIS public opinion data. Sections are organised by study phase and type of analysis, each including brief finding summaries. The chapter ends with a summary of comparative insights from both phases, which sets the stage for the discussion chapter.

4.2 PH1 – Comparative Mixed-Methods Media Content Analysis (MCA)

4.2.1 Quantitative findings – ES in Canadian and UK newspapers (2008-2017)

4.2.1.1 Frequency analysis: ES issue salience over time

The Factiva search returned a total of 669 articles (Canada: $n = 366$, 54%; UK: $n = 303$, 46%) reporting on ES between January 1, 2008 and December 31, 2017 (52 duplicates were automatically removed from the search). Upon removing 175 non-relevant articles, 494 articles were retained for quantitative analysis (Canada: $n = 240$, 48%; UK: $n = 254$, 51%). Figure 3 depicts annual frequencies of published ES articles in each country across all sampled newspapers. Overall (both countries combined), ES reporting increased over the ten-year period, particularly between 2012 and 2017. Across all newspapers, article frequency was highest in 2016 ($n = 122$) and 2017 ($n = 122$) and lowest in 2010 ($n = 12$).

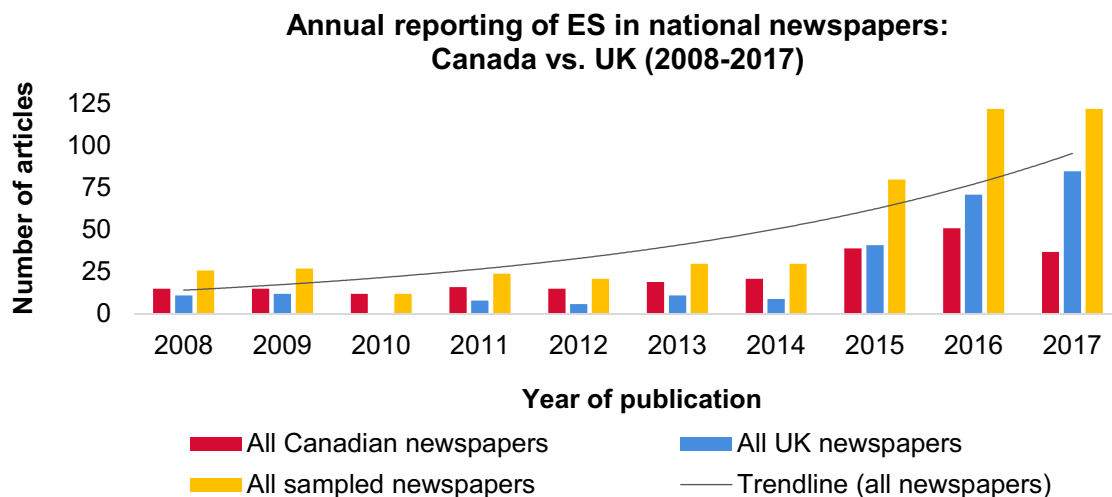


Figure 3. Annual frequencies of ES articles published in Canadian and UK newspapers (2008-2017; $n = 494$); **Note:** rule for trendline = quantitative, exponential

Annual distribution of ES articles varied between the countries. ES coverage in Canadian newspapers increased steadily from 2012 ($n = 15$), peaked in 2016 ($n = 56$), and decreased again in 2017 ($n = 37$). UK newspapers had relatively less ES coverage until 2015 ($n = 41$), at which point the UK began to surpass Canada in annual article frequency, doubling the Canadian total in 2017 ($n = 85$). No ES UK articles were returned by the search for 2010. Chi-square² results confirmed differences between the countries in respect to frequency of ES reporting over time, $\chi^2(9, n = 494) = 48.26, p < .001$. See [Appendix C.1.2.1](#) for full results. Despite the overall increase in ES reporting over time, article frequency data suggested that ES was more salient in UK newspapers than in Canadian newspapers between 2016 and 2017; 64% of this sub-sample ($n = 216$) were UK articles, while only 36% were Canadian articles. In the total Canadian sample ($n = 240$), the highest number of articles published between 2008 and 2017 was in *The Globe and Mail* (98) and *The Toronto Star* (71), with the fewest articles published in *The Montreal Gazette* (12). In the UK sample, *The Guardian* (98) and *The Times* (55) contained the most articles, while *The Independent* (14) contained the fewest. Table 8 below provides a summary. See [Appendix C.1.1.1](#) for full article frequency data.

Newspaper	Distribution Frequency / percentage of total sample	Political Leanings Frequency / percentage of national sample
Canada ($n = 240$)		
<i>The Globe and Mail</i>	98 (20%)	Right-centre = 131 (55%) Left-centre = 109 (45%)
<i>The Toronto Star</i>	71 (14%)	
<i>National Post</i>	33 (7%)	
<i>Vancouver Sun</i>	26 (5%)	
<i>The Montreal Gazette</i>	12 (2%)	
UK ($n = 254$)		
<i>The Guardian</i>	98 (20%)	Right-centre = 142 (56%) Left-centre = 112 (44%)
<i>The Times</i>	55 (11%)	
<i>Financial Times</i>	48 (10%)	
<i>The Daily Telegraph</i>	39 (8%)	
<i>The Independent</i>	14 (3%)	
Total	494 (100%)	Right-centre = 273 (55%) Left-centre = 221 (45%)

Table 8. Distribution of ES articles in Canadian and UK newspapers: Publications and political leanings (2008-2017; $n = 494$)

² Chi-square tests of independence were performed to determine whether national differences between dependent media variables (e.g., number of ES articles published per year) and independent variables (e.g., country of publication) were statistically significant.

Within the ten-year sample ($n = 494$), the total number of published ES articles was higher in right-leaning newspapers (55%) than in left-leaning newspapers (45%). This trend was particularly evident in the 2016-2017 sample ($n = 216$): right-leaning (64%) vs. left-leaning (36%). During this time, ES reporting was particularly elevated in *The Globe and Mail* ($n = 49$) (Canada), *The Guardian* ($n = 48$) (UK), and *The Times* ($n = 43$) (UK). See [Appendix C.1.1.2](#) for full data. However, given the uneven distribution of right-leaning vs. left-leaning newspapers within and between the two national samples (a trade-off of adhering to other sample selection criteria), the ability to infer meaningful differences in this context was limited.

Comparative analyses of article distribution were still conducted despite this limitation: chi-square tests found no significant differences between 'country' and 'political leaning' variables, $\chi^2(1, n = 494) = .09, p = .77$. Another chi-square test was conducted to examine the relation between the political leaning of newspapers and the frequency of ES articles published per year. Results revealed a significant moderate association between these two variables, $\chi^2(9, n = 494) = 52.9, p < .001, \phi = .32$. See [Appendix C.1.2.3](#) for full test results. Overall, between 2008 and 2017, the Factiva search returned a higher frequency of ES articles from right-leaning than from left-leaning newspapers in both countries. The above results also suggested some difference in the extent to which ES was covered in right-leaning vs. left-leaning newspapers. However, as noted above, we cannot confirm that ES is reported on more frequently in right-leaning or left-leaning newspapers without further evidence.

Nonetheless, these findings provide some initial insights for **RQ1**: *How does the salience and representation of ES in news media discourse compare between Canada and the UK (2008-2017)?* Assuming annual ES article frequencies to be a measure of issue salience, the above results suggests that: (1) the salience of ES has increased in national newspaper discourse within both countries since 2008; (2) ES was more salient in recent years (2016-2017) in UK newspapers than in Canadian newspapers; (3) there may be some differences in the extent to which right-leaning vs. left-leaning newspapers report on ES in both countries. Given the limitations noted above and in [Section 3.7.1.1](#), these findings were further supported with qualitative results which also measured issue salience by determining the extent to which articles 'focused' exclusively on the topic of ES (see [Section 4.2.2.1](#)).

4.2.1.2 Frequency analysis: Key themes, buzzwords, and technology mentions

RQ1 also asked how ES is *represented* in national Canadian and UK newspapers between 2008 and 2017. A series of text-search queries were conducted in NVivo to determine the frequency of articles within the ten-year period that mentioned key themes/narratives, specific technologies, and buzzwords when describing ES. Results from the queries are depicted in Table 9 below (see [Section 3.7.1.5](#) for methodological procedure).

Theme/narrative	Text-search terms	Frequency / percentage of articles		
		Canada (n = 240)	UK (n = 254)	Combined (n = 494)
Climate change	<i>climate change, climate, global warming, emissions, carbon</i>	131 (55%)	130 (51%)	261 (53%)
Economic development	<i>economic development, economic growth/opportunity, economy, investment, jobs</i>	127 (53%)	125 (49%)	252 (51%)
Political contention	<i>politics, policy, political, government, public</i>	97 (40%)	132 (52%)	229 (46%)
Technological innovation	<i>Innovation/innovative, R&D/research and development, breakthrough</i>	88 (37%)	77 (30%)	165 (33%)
Energy transition	<i>energiewende, transition, transformation, revolution, phase-out</i>	74 (31%)	79 (31%)	153 (31%)
Energy security	<i>energy security, energy access, secure supply/energy supply, reliability, energy needs/demand</i>	32 (13%)	70 (28%)	102 (21%)
Industry buzzwords	<i>holy grail, game-changer/changing, missing link, disruptive technology/innovation, cutting-edge, ground-breaking</i>	40 (17%)	29 (11%)	69 (14%)

Table 9. ES representations in Canadian and UK newspapers (2008-2017): Text-search query results

The most common themes in the combined sample ($n = 494$) were ‘climate change,’ ‘economic development,’ and ‘political contention.’ Of the entire sample, 261 (53%) articles related ES to the ‘climate change’ narrative by including at least one of the associated words or phrases listed in Table 8. For example, such articles typically linked ES deployment to meeting national climate targets and reducing emissions:

If we are to meet national carbon targets and deliver cheaper power for consumers, then government must provide a level playing field for both solar power and for new storage technologies. – *The Times*, September 25, 2017

National samples were similar in respect to the proportion of articles linking ES to the narratives examined in the qualitative analysis – ‘climate change’ (Canada: 55%; UK: 51%), ‘economic development’ (Canada: 53%; UK: 49%), ‘technological innovation’ (Canada: 37%; UK: 30%). Search queries were also conducted for two additional themes (‘energy transition’ and ‘political contention’), which were identified (often together) during qualitative coding. Results revealed that 31% of articles in both samples linked ES to energy system change such as reduced reliance on fossil fuel generation and grid decentralisation. Articles in this group generally presented such system changes as critical for “the shift to a low-carbon economy” [e.g., *The Guardian*, September 4, 2017] and thus reflected an ‘energy transition’ theme.

Comparative text-search queries also revealed some differences in common themes. For instance, ES was more frequently linked to coverage on ‘energy security’ issues in UK newspapers (28%) than in Canadian newspapers (13%). Expressing concerns over Britain’s increasing energy dependence on other countries, many of these UK articles debated government priorities for delivering secure energy supply. Unclear policy and market signals were often seen as barriers to potential energy security solutions such as ES:

There is an incredible opportunity for the UK to become a world leader in these disruptive technologies, yet our current energy security subsidies favour dirty diesel generation over smart new clean tech solutions. – *The Guardian*, October 15, 2016.

A similar pattern was observed for the proportion of articles discussing ES in political contexts; 52% of UK articles (compared to 40% of Canadian articles) mentioned at least one of the ‘political contention’ search terms. These articles often mentioned ES within broader energy debates, arguing for instance, that “Britain’s energy policy needs a reboot” for technologies such as ES to commercialise [*The Daily Telegraph*, October 24, 2017]. The following quote summarises the political issues that underpinned energy debates in current UK newspapers (with “battery storage” mentioned later in the story as part of the country’s renewables sector):

Uncertainty caused by Brexit [the UK’s then-impending withdrawal from the European Union], the closure of the Department of Energy Climate Change and the approval of [nuclear power plant] Hinkley Point C all dealt a sizeable blow to the UK renewables sector. – *The Independent*, October 28, 2016

Various techno-optimistic ‘buzzwords’ (typically mentioned by industry and government actors) were also identified in both samples. Of the 494 articles, 14% included at least one of the buzzwords listed in Table 9 (totaling 121 references across 69 articles). Phrases such as “game-changer” and the “holy grail” often appeared within ‘climate change’ and ‘energy transition’ narratives, wherein ES was positioned as the “missing link” to solving energy security and sustainability challenges [e.g., *The Guardian*, February 4, 2016]. Overall, ES buzzwords appeared more often in Canadian articles (17%) than in UK articles (11%):

As the world looks for alternatives to the internal combustion engine, light, safe, powerful batteries to drive electric cars, buses, forklifts and other machinery, as well as store wind and solar power are the holy grails of a low-carbon world. – *The Vancouver Sun*, July 11, 2016.

Another set of queries was conducted to determine the salience of specific ES technologies in newspapers (see Table 10 and [Appendix C.1.2.4](#)). While a variety of ES technologies were mentioned between 2008 and 2017, ‘batteries’ (e.g., lithium ion, flow, redox) were most frequently mentioned (i.e., in 61% of the entire sample). Percentages of articles mentioning batteries were similar between Canada (59%) and the UK (63%). ‘Fuel cells’ were the second most frequently mentioned, but only appeared in 9% of the total sample (Canada: 12%; UK: 6%). Ultracapacitors and supercapacitors were least mentioned overall (2%).

Technology	Frequency / percentage of articles		
	Canada (n = 240)	UK (n = 254)	All (n = 494)
Batteries	142 (59%)	161 (63%)	303 (61%)
Fuel cells	28 (12%)	15 (6%)	43 (9%)
Pumped-hydro	20 (8%)	16 (6%)	36 (7%)
Hydrogen storage	30 (13%)	3 (1%)	33 (7%)
Compressed-air	23 (10%)	6 (2%)	29 (6%)
Flywheels	23 (10%)	5 (2%)	28 (6%)
Thermal storage	14 (6%)	7 (3%)	21 (4%)
Ultra/Supercapacitors	7 (3%)	2 (1%)	9 (2%)

Table 10. Frequencies and percentages of ES technology mentions in Canadian and UK newspapers (2008-2017; n = 494)

Overall, more Canadian articles (73%) mentioned specific technologies than UK articles (69%). ‘Fuel cells,’ ‘hydrogen storage,’ ‘compressed-air,’ and ‘flywheels’ were mentioned twice as often in Canadian coverage. These technologies were often mentioned in relation to specific ES projects, such as “the world’s first-ever underwater compressed-air energy storage system” located in Lake Ontario [e.g., *The Toronto Star*, March 17, 2015]. UK articles focused less on novel technologies, and more on affordable and improved battery ES. “Home batteries” (e.g.,

residential battery packs), for example, were often discussed as gaining customer interest and adoption in the UK [e.g., *Financial Times*, December 27, 2017]. Grid-scale battery ES was also frequently debated as an alternative to planned energy projects, including controversial hydro-electricity dam expansions (e.g., Site-C in British Columbia, Canada), new nuclear plants (e.g., Hinkley Point C in Somerset, England), and natural gas-fired facilities (e.g., Metrolinx Eglinton Crosstown LRT station in Toronto, Canada) [e.g., *Vancouver Sun*, November 5, 2017; *The Daily Telegraph*, September 16, 2016; *The Toronto Star*, January 19, 2016].

Several articles examined ES technologies in detail, discussing their varying suitability for system contexts and describing their specific advantages and limitations. Others simply listed (some went on to describe) different technologies that were gaining interest and traction in the industry. The following excerpts provide examples:

Batteries: too costly and they don't last long enough. Ultracapacitors: also too costly, and too quick to discharge. What inspired Veltri [developer] was the idea of building a better flywheel system. The concept of flywheels is simple: An electric motor spins a rotor, which is typically a heavy cylindrical mass made out of a high-strength material, such as carbon composite or steel. – *The Toronto Star*, April 22, 2011

Flywheels, megawatt-sized flow batteries, banks of lithium-ion batteries, ultracapacitors, and a few strangely designed gravity-based systems are among some of the other technologies expected to play a role on the grid in the coming years. – *The Toronto Star*, January 14, 2011

In sum, these results provide further insight on ES salience and representation in Canadian and UK newspapers between 2008 and 2017 (**RQ1**). First, while ‘climate change’ and ‘economic development’ narratives were most common overall ($n = 494$) (as revealed by text-search queries), ES was linked to ‘energy security’ and ‘political contention’ discourse more often in the UK than in the Canadian sample. Second, Canadian articles typically contained more mentions of buzzwords and specific ES technologies than did UK articles (with battery ES being the most commonly mentioned overall).

4.2.2 Qualitative findings – ES in Canadian and UK newspapers (2016-2017)

4.2.2.1 Frequency analysis: Issue salience (article focus) and valence

Of the entire sample ($n = 494$), 244 articles were published between 2016 and 2017 (‘current’ media), including 59 (24%) ES-F, 157 (64%) ES-S, and 28 (11%) ES-IR articles. Upon removing ES-IR articles (i.e., those mentioning ES with insufficient context for in-depth frame/narrative analyses), a total of 216 articles (Canada: $n = 78$, UK: $n = 138$) was retained for

qualitative coding (see [Appendix C.1.1.2](#) for full sub-sample details). The distribution of articles coded at specific 'focus' cases in NVivo was similar between the countries; no significant associations were found between the two variables, $\chi^2(2, n = 244^3) = .05, p = .98$. See [Appendix C.1.2.4](#) for full results. Thus, while quantitative findings (i.e., the annual frequency of published ES articles) ([Section 4.2.1.1](#)) suggested greater (and growing) issue salience in UK newspapers (2008-2017), qualitative findings (i.e., the distribution of articles with varying ES 'focus' codes) showed similar levels of attention attributed to ES in both samples (2016-2017).

However, when ES 'focus' findings were broken down by publication 'year' and 'political orientation' of newspapers (see [Sections AC. 1.1.5](#) for full data tables), results again suggested, to some extent, a growing ES issue salience in the UK (from 2016 to 2017), and declining salience in Canadian newspapers (from 2016 to 2017). The percentage of ES-F articles (i.e., those focusing exclusively on ES) in the UK sample increased from 21% (2016) to 26% (2017), while the respective Canadian percentage declined from 25% (2016) to 24% (2017). Notably, a greater percentage increase in ES-IR articles (i.e., those with insufficient focus on ES) was also found in Canadian coverage between these years: 8% (2016) to 16% (2017). UK ES-IR percentages were 11% (2016) and 12% (2017), respectively. In respect to issue salience patterns in right-leaning vs. left-leaning newspapers (both countries), the percentage of ES-F articles increased from 11% (2016) to 14% (2017) in right-leaning newspapers and decreased from 13% (2016) to 9% (2017) in left-leaning newspapers (see [Appendix C.1.1.6](#) for full data).

ES reporting in Canadian and UK newspapers (2016-2017; $n = 216$) was similar in respect to 'valence' – i.e., the tone/orientation toward ES; 152 (70%) were found to be 'positive' toward ES; 52 (24%) were neutral, and 12 (6%) were negative (see Figure 4). Differences between 'country' and 'valence' variables were not significant, $\chi^2(2, n = 216) = 1.11, p = .57$, nor were differences between newspaper 'political leaning' and 'valence,' $\chi^2(2, n = 216) = 1.55, p = .46$. See [Appendix C.1.2.7-8](#) for full results. The following excerpt demonstrates how ES was often discussed in ES-F articles coded as having positive valence:

Improving Britain's energy storage and managing electricity demand could save consumers up to £8bn a year by 2030, according to a report by Lord Adonis commissioned by the Treasury. It could also enable the UK to meet its 2050 carbon emissions targets and secure the country's energy supply for generations, the report says. – *Financial Times*, March 4, 2016

³ Reflects total number of articles in 2016-2017 coverage, including ES-F, ES-S, and ES-IR articles; once ES-IR articles were removed, the current qualitative sample contained 216 articles.

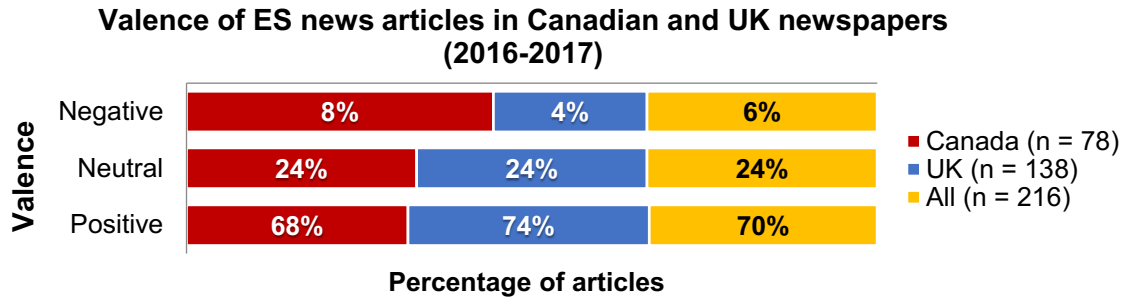


Figure 4. Percentages of ES news articles with varying valence: Canada vs. UK (2016-2017; $n = 216$)

In sum, these results suggest that ES articles published in Canada and the UK (2016-2017) focused on the topic rather exclusively (i.e., mentioning search terms in the first/first few paragraphs) and were generally positive in tone. They also support quantitative issue salience findings by suggesting that the level of attention attributed to ES in newspapers between 2016 and 2017 has increased in the UK and decreased in Canada, as well as increased in right-leaning newspapers and decreased in left-leaning newspapers over the two years.

4.2.2.2 Frame analysis – SPEED framing of ES

RQ1(b) asked *'what are the most prominent 'frames' and 'narratives' around ES in top-circulating national newspapers within each country in more recent years (2016-2017)?* The SPEED framework was thus applied to examine benefit and risk framing of ES in all news articles published between 2016 and 2017. Overall, newspapers contained more positive framing (benefit statements) of ES than negative framing (risk statements) across all SPEED categories, with the exception of the legal and regulatory frame (7% risks; 4% benefits). Figure 6 provides a comparative breakdown of SPEED benefit-vs-risk framing of ES. See [Appendix C.1.2.5](#) for full data table and chi-square results.

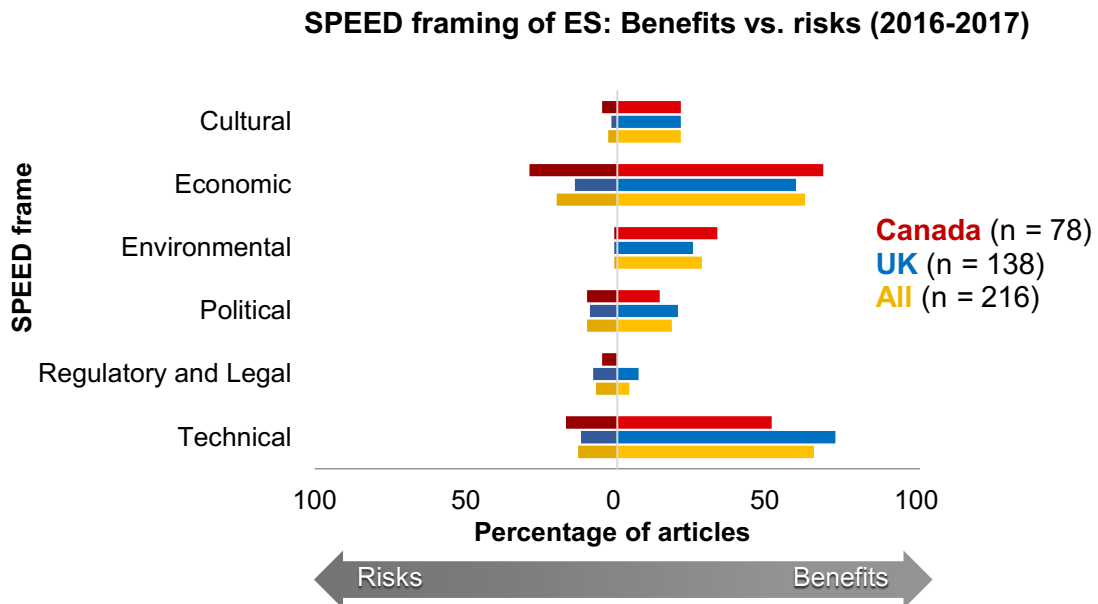


Figure 5. Comparative breakdown of SPEED framing in Canadian and UK newspapers reporting on ES: benefits vs. risks (2016-2017; $n = 216$)

Of the six SPEED categories, economic frames (82% of all articles) and technical frames (78%) dominated ES discourse across all newspapers, while regulatory and legal framing was least common (11%). Environmental framing of ES (contained in 29% of all articles) was also prevalent, particularly in Canadian newspapers (35%). The technical benefit framing of ES dominated overall, with 65% of articles mentioning benefits such as improved power quality and system flexibility [e.g., *The Guardian*, October 9, 2017]. The economic benefit frame was the second most common (contained in 62% of all articles), often linking ES to cost-savings for end-users, new business opportunities, and job creation in the cleantech sector [e.g., *The Globe and Mail*, March 24, 2017]. The environment benefit frame was found in 28% of all 2016-2017 articles, typically arguing that ES can help enable a “clean energy future” by supporting renewable energy development and reducing reliance on fossil fuel energy generation [e.g., *The Globe and Mail*, March 24, 2017]. Overall, the benefit-to-risk SPEED frame ratios (all categories considered) were 3:1 for Canada and 4:1 for the UK, indicating a more favourable benefit-to-risk SPEED framing of ES in the UK than in Canada. As previously mentioned, the regulatory and legal frame was the only category that contained more risk than benefit statements (4:7). Regulatory framing generally focused on inhibiting regulatory conditions, which have been slow and unresponsive to rapid energy technology change in both countries (Kyriakopoulos & Arabatzis, 2016). A comparative breakdown of each national sample’s benefit-to-risk results is provided in Table 11.

National SPEED frame ratio (benefit:risk)

SPEED frame	Canada (n = 78)	UK (n = 138)	All (n = 216)
Cultural	5:1	20:1	7:1
Economic	2.3:1*	4:1	3:1
Environmental	3:1	25:1	8:1
Political	1.4:1*	2:1	1.8:1*
Regulatory and Legal	0:1	0.9:1*	0.6:1*
Technical	3:1	6:1	5:1
Overall Ratio	3:1	4:1	3.7:1

Table 11. National SPEED frame benefit-to-risk ratios: Canadian vs. UK newspapers; **Note:** Ratios presented in lowest terms with all risk values standardised to 1; * = lowest ratios left as decimals for easier comparison

While SPEED framing of ES was generally positive overall, both national samples discussed various risks and concerns regarding the technology’s deployment. The economic risk frame (appearing in 20% of all articles) contained concerns about unclear market rules, lack of funding and investment capital, and the potential threat that ES development could pose to the fossil fuel industries, upon which both countries still rely on heavily to meet various energy needs (including electricity generation) [e.g., *The Globe and Mail*, December 6, 2017]. The technical risk frame (13% of all current articles) contained concerns about the maturity and scalability of ES technologies, as well as their specific technical limitations (e.g., charge capacity, space requirements) [e.g., *Vancouver Sun*, July 11, 2017]. Table 12 below provides a summary of perceived benefits and risks of ES deployment in both countries (includes the full collection of frames found during close qualitative reading of all 2016-2017 articles).

SPEED frame	Benefit	Risk
Cultural	Encourages public support and adoption of renewable power / lower-carbon energy systems (e.g., less NIMBYism than other energy technologies); strengthens community sustainability, engagement, and pride (e.g., participation in ES projects, services remote communities); allows for positive energy consumer behaviour change (e.g., consumer empowerment, agency, energy management)	Invites public skepticism and community opposition (e.g., concerns over loss of control, impact on way of life, siting); cultural reluctance to electricity system changes; may prove difficult to influence consumer adoption and behavior change; potentially leading to social divides, vulnerabilities and frustrations

Economic	Strengthens economy and fosters growth (e.g., job creation, training); opportunities for legacy and new system actors (e.g., increases competitiveness); cost savings at system level (e.g., infrastructure upgrade deferral); cost savings at end-user level (e.g., electricity consumers); commercial optimisation of existing assets (e.g., renewable and others); attracts new business partnerships and investment opportunities (e.g., between local, national and international stakeholders)	High costs outweigh benefits (e.g., technology still cost ineffective); creates new costs or risks to actors within and outside energy system (e.g., transmission, disruption to other industry supply chains, fossil fuel industries); increases economic and financial risks (e.g., inadequate funding, investment difficulties, unclear or lacking market rules, cost analysis difficulties)
Environmental	Supports climate change mitigation and adaptation (e.g., reduces emissions, facilitates conservation and efficiency, supports fossil fuel phase-out); creates no or little harmful waste (e.g. manufacturing processes, sustainable life cycle); improved environmental or public health	Potential threats to ecological health (e.g. land use, resource extraction, habitat destruction, waste disposal); shifting risk to new environmental areas; contributes to carbon emissions and embedded carbon
Political	Positive political ramifications (e.g., fosters stakeholder collaboration and public satisfaction, improves national/regional identity); supports existing energy plans and strategies; aligns with other national policy frameworks and goals	Negative political ramifications (e.g., opposition to new policies, political contention); challenges associated with lacking government support; undermines existing energy plans or strategies; does not align with other national policy frameworks or goals;
Regulatory and Legal	Complements existing regulatory frameworks; encourages new clean energy regulations and policies; supports necessary regulatory changes to energy system	Unsuited for existing regulatory framework; lacking or unfavourable policies and laws (e.g., building code restrictions, permitting issues); lacking, underdeveloped, difficult or deadlocked regulatory processes stalling or derailing system change
Technical	Improves grid flexibility; supports renewable energy integration; increases energy capacity and reliability (e.g., addresses intermittency issues); integrable into existing infrastructure and other sectors (e.g., transportation); technology easily scalable; relatively short project development timelines; part of energy system modernisation	Could cause negative technical consequences; interaction of technologies creates new system risks, needs, or vulnerabilities; requires unavailable resources and/or specialised skills and expertise; unsuitable for existing grid or other energy infrastructure; other technical or logistical constraints; concerns or uncertainties regarding current technological performance (e.g., further testing required)

Table 12. SPEED framework applied to ES coverage in Canadian and UK newspapers (2016-2017; *n* = 216)

To further answer **RQ1**, differences in SPEED framing between the two national samples were compared using chi-square tests of independence. Significant results were found for the economic risk frame, $\chi^2(1, n = 216) = 7.03, p < .01$; the regulatory and legal benefit frame, $\chi^2(1, n = 216) = 5.31, p < .05$; and the technical benefit frame, $\chi^2(1, n = 216) = 9.80, p < .01$. See [Appendix C.1.2.5](#) for full data and test results. Thus, the countries differed significantly in respect to SPEED framing of ES across economic risk, regulatory and legal benefit, and technical benefit categories. Overall, Canadian articles contained more economic framing of ES than did UK articles, often describing the economic value of storage deployment to system actors (e.g., grid operators, utilities, end users) and to Canada's transitioning energy economy overall. One *Globe and Mail* article, titled "In a low-price environment, storage becomes a money maker" illustrated this broader economic focus on ES:

...there is now little doubt that we are on the cusp of big changes in the energy market. The business of digging stuff out of the ground will be with us for a long time but not as a growth industry. Instead, it will be the business of storing and managing power distribution that attracts investment and creates jobs. – *The Globe and Mail*, March 31, 2016.

Canadian articles also noted the rapid pace and declining costs at which ES technologies are being developed, and thus the economic rewards that investors stood to gain. Cascading economic benefits, such as associated growth in the solar and wind energy industries, and increasing demand for mining resources (e.g., graphite, lithium ion, cobalt) were also framed as indirect positive economic impacts of a growing ES sector [e.g., *The Globe and Mail*, December 22, 2016; *Vancouver Sun*, December 21, 2017]. Few environmental and cultural SPEED considerations (e.g., resource exploitation, land use risks) were described in this context.

At the same time, as shown in χ^2 results above, Canadian articles contained significantly more economic risk-framing of ES than did UK articles. These articles discussed financial risks (e.g., to taxpayers, developers, government), investment uncertainties, and other cost and market barriers (e.g., poor access to project capital). Some articles expressed concerns over potential boom and bust cycles, market monopolisation (i.e., by dominating lithium market players) and "over supply concerns" [e.g., *National Post*, March 18, 2017]. More broadly, growth in the ES sector was also linked to economic losses in Canada's nuclear, oil, and gas industries (thus fueling political contentions), particularly in the province of Alberta (Canada's oil capital). Within these discussions, the 'disruptive' nature of ES was viewed as a risk associated with utility revenue instability (e.g., 'death spirals'), job insecurity, and other hits to fossil fuel sectors:

More capital flowing to energy storage and renewables means less investment in new thermal-power plants, a trend that's already starting to hit big equipment suppliers such as Siemens and General Electric. Siemens, for example, recently announced plans to cut nearly 7,000 jobs in its power and gas division, which sells turbines and other equipment for thermal-power plants. One board member went so far as to describe the market as 'burning to the ground' – *The Globe and Mail*, December 5, 2017.

Similarly, UK articles also argued that ES “could help to cut the costs of the green transition” (by up to £8 billion a year) and provide new economic opportunities [e.g., *The Times*, April 17, 2017], while others linked ES to economic risks associated with a more distributed and decentralised energy system (e.g., stranded oil and gas assets) [e.g., *The Daily Telegraph*, April 18, 2017]. Nonetheless, the 'high-risk, high-reward' perspective outweighed economic concerns around ES development in both newspaper samples. And, while economic benefit and risk statements were similar between countries, Canadian articles contained greater economic emphasis on ES overall.

UK newspapers seemed to focus more on the technical function of ES. Despite containing fewer techno-optimistic buzzwords (e.g., “holy grail”) than Canadian articles between 2008 and 2017; 72% of current UK articles contained technical benefit framing of ES. These articles discussed the technology's potential to enable renewable energy integration on power grids (i.e., by reducing intermittent generation issues), improve energy security by optimizing supply and demand (i.e., reducing the need to import electricity via interconnectors), and provide greater system stability and flexibility overall. Within this frame, UK articles also portrayed ES with a strong national focus, emphasising the potential for ES to address domestic energy network and security challenges within a decarbonising energy era:

As Britain builds more wind farms and solar panels, which produce electricity only when the wind blows or the sun shines, keeping supply and demand in balance is becoming more challenging. To keep the lights on, the system needs flexible power sources that can respond quickly to short-term fluctuations to keep the grid frequency at safe levels, such as the service provided by the UKPN battery [...] Batteries that can help to overcome renewables' intermittency by storing power for when it is needed have long been the holy grail of the energy system. Now, thanks to rapid technological advances and cost reductions led by the electric vehicle market, they appear to be within reach. *The Times*, April 17, 2017.

While technical benefits were common in both national samples, some articles expressed doubts about the commercial readiness of large-scale ES, calling for further planning and technical analysis of more experimental niche-innovations. For instance, one Canadian article described a failed wind and pumped-hydro ES project (a result of poor planning and technical issues) in the Canary Islands as a “a cautionary tale” for radical low-carbon energy

investments [*Globe and Mail*, February 24, 2017]. Other technical risk-framing criticised the unprecedented hype around emerging ES innovation and pointed to emerging consequences of techno-optimism in the clean energy sector:

The [energy storage] field is littered with the remnants of grandiose hype and unfulfilled promises. “There’s a battery innovation announced at least every month, usually every couple of weeks [...] The result is massive pressure on inventors, developers and financial backers to proclaim the Next Big Thing without it having passed critical tests such as commercial viability,” Mr. Chamberlain says. “A number of battery discovery claims ended up being big letdowns,” he adds. “The VCs [venture capital firms] are impatient, but the science itself is slow.” – *The Globe and Mail*, February 5, 2016

Technical risk frames in UK articles also described concerns around the technology’s “early stages of development” [*The Daily Telegraph*, June 25, 2016]. Even pro-transition and anti-nuclear discussions (e.g., coverage on the contested Hinkley-C project in England) suggested that technical constraints of ES mean fossil fuels will continue to play a role in the UK’s energy system:

“Hinkley is a project from a dying era,” said Friends of the Earth, the environmental group. Renewables, smart grids and energy storage are the fleet-footed mammals racing past this stumbling, inflexible nuclear dinosaur [...] Yet, the battery technology needed to deliver the green vision – by filling gaps when wind and solar power is unavailable – remains years from maturity. Gas and nuclear will be needed in the meantime to maintain UK energy security as coal-fired power is phased out. – *Financial Times*, July 22, 2017

Nevertheless, UK newspapers appeared to focus more on ES success stories, rather than failures – particularly at the BTM (residential) level, which has seen a rather positive public response (i.e., to home battery technologies such as Tesla’s Powerwall).

Regulatory and legal framing was also more prevalent in UK newspapers. The regulatory benefit-to-risk ratio of 7:8 suggests a similar distribution of regulatory benefit and risk statements in UK articles (with risk statements still more pervasive). However, this ratio may support qualitative findings on what appeared to be a string of flip-flopping arguments (between 2016 and 2017) on the UK’s regulatory development for ES. For example, many regulatory benefit articles identified ES as a catalyst for overhauling outdated regulatory models currently stalling energy transition processes in the UK. At the same time, regulatory risk articles argued that the rapid pace at which ES is being developed is creating new uncertainties and challenges for UK regulators and policymakers. The following excerpts illustrate how this back-and-forth debate took shape between 2016 and 2017:

The [House of Commons Energy and Climate Change] committee specifically recommends much more electricity storage and demand reduction is deployed at scale as soon as possible and warns these moves are being hampered by out of date regulations. “Innovative solutions like storage and DSR [demand side response] to 21st-century energy problems have been held back

by legislative and regulatory inertia,” said MacNeil [Scottish National Party] – *The Guardian*, June 16, 2016.

Lord Adonis [British Labour Party] admitted this change [increasing renewable energy generation] presents an “enormous challenge” to the government, but said it also represented an opportunity to benefit from three “exciting” innovations: interconnection, storage and demand flexibility. “We do not call for new subsidies or significant public spending, but rather a level playing field through fairer regulation and a better managed network to allow these exciting new technologies to compete,” he said. – *Financial Times*, March 4, 2016

Notably, further analysis on the distribution of benefit vs. risk statements over time would help to confirm patterns of contradicting arguments concerning ES regulatory issues.

Canadian articles also discussed lagging regulatory frameworks and attempts for legislated incentives for ES implementation. One article effectively illustrated regulatory risks and barriers for ES in the province of Ontario (Canada’s most active ES jurisdiction):

...There are generally no structures for the offering of bundles of services as energy suppliers, managing and co-ordinating cumulative output of distributed generation and storage when more electricity is needed, conservation and demand management resources, reducing grid demand by relying on distributed generating and storage capacity and ancillary services such as grid-frequency regulation. – *The Globe and Mail*, May 16, 2017.

While some regulatory benefits were identified in earlier articles (published before 2016) during frequency analyses (see [Section 4.2.1.2](#)), none were identified in the 2016-2017 Canadian media sample (hence a benefit-to-risk ratio of 0:1 for the regulatory SPEED category) (see [Section 5.1.2](#) for potential explanations for this).

The above sections have presented SPEED framing results of ES in both national newspaper samples, focusing on the most prominent frames and meaningful differences in risk/benefit categories between the countries. A summary of SPEED framing in other categories (e.g., cultural, political) is provided in Table 11 above.

4.2.2.3 Narrative analysis – ES narratives in Canadian and UK newspapers (2016-2017)

A narrative analysis of the 2016-2017 sub-sample ($n = 216$) provided richer context for quantitative findings and SPEED framing results. Overall, the ‘economic development’ narrative (described in 56% of all 2016-2017 articles) and ‘energy security’ (55%) narrative dominated. The ‘climate change’ narrative was the least common overall, although still mentioned in 25% of 2016-2017 articles. Figure 6 illustrates the distribution of narratives between the national samples (see [Appendix C.1.1.3](#) for full data table). The proportions of articles describing the ‘economic development’ and ‘technological innovation’ narratives were comparable. However,

chi-square tests again confirmed significant national differences in respect to the ‘climate change’ narrative, $\chi^2(1, n = 216) = 10.87, p < .001$, and the ‘energy security’ narrative, $\chi^2(1, n = 216) = 23.36, p < 0.001$. See [Appendix C.1.2.6](#) for full results. In other words, the ‘climate change’ narrative was more prominent in Canadian newspapers, while the ‘energy security’ narrative was more prominent in UK newspapers.

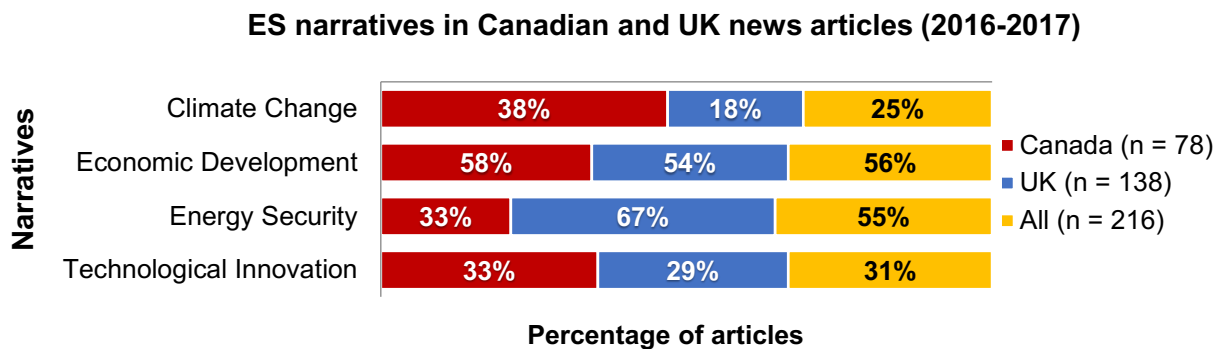


Figure 6. Percentages of articles containing four ES narratives: Canada vs. UK (2016-2017; n = 216); Note: Articles contained multiple narratives

All four narratives were generally positive. The ‘technological innovation’ and ‘economic development’ narratives, for example, painted a picture of economic prosperity behind the anticipated breakthrough in affordable ES technology in both countries. Canadian articles typically used pithy buzzwords to construct the ‘technological innovation’ narrative, while UK articles more commonly assessed technical benefits of emerging ES innovations. Both narratives were slightly elevated in Canadian coverage, which generally portrayed ES as a key innovation that “will support the transition to a cleaner, smarter electricity network in Canada” [*National Post*, March 24, 2017]. The ‘climate change’ narrative was also significantly more common in the Canadian sample. Overall, 28% of Canadian ES articles described climate change as an urgent national issue, with imminent environmental, economic, and cultural implications for Canadian citizens. UK articles also linked ES to climate change mitigation but seemed to focus more on perceived immediate benefits of the technology, such as emissions reductions and meeting clean energy policy objectives [e.g., *The Guardian*, June 9, 2016].

More recent (2016-2017) UK news coverage on ES was dominated by the ‘energy security’ narrative, which was significantly less prominent (as the shown by χ^2 results above) in Canadian newspapers. Indeed, 67% of UK ES articles discussed national challenges in

delivering affordable and secure energy supply amidst rapid technological change and growing political pressures. This narrative often appeared in national energy independence discussions (i.e., around timely Brexit negotiations) (Batel & Devine-Wright, 2018), wherein ES was said to help reduce the UK's reliance on foreign energy supply during a time of increasing price volatility and political uncertainty in the EU [*The Guardian*, August 8, 2016]. The 'energy security' narrative also appeared to be linked to an additional narrative, particularly in the UK, which emerged inductively during qualitative analyses. The 'political contention' narrative examined ES amidst wider energy policy and regulation debates that questioned government decisions within a rapidly evolving energy sector (further discussed in [Section 5.1.3](#)). The following excerpt illustrates how this narrative was constructed:

The UK government has been criticized for recently awarding £175m of subsidy to highly polluting diesel generator farms [...] "Amber Rudd is talking a lot about energy storage, but we need a clear regulatory steer," says [Jill] Caine [UK Electricity Storage Network]. "The planes are circling, but there is no runway to land on." [...] Prof Ian Arbon, at the Institute of Mechanical Engineers, which in 2014 called energy storage the "missing link" in the UK's energy plans, is even more direct: "As a nation we are nowhere near where we should be on energy storage. There is a clear need for massive and urgent attention. Energy storage is one of the obvious solutions to the [decarbonisation] problems we face." [...] The government is keen to build new gas-fired power stations and develop fracking, but Arbon said: "The UK is the only country in the world who thinks it is going to hit its renewable targets by doing more fossil fuels." – *The Guardian*, February 4, 2016.

In sum, SPEED frame and narrative analyses revealed interesting similarities and differences between Canadian and UK news coverage on ES, the implications of which are explored in the following chapter. The following findings from PH1 will be particularly relevant to PH2 results (presented in the next section) and the discussion chapter: (1) a generally positive 'valence' of ES in national newspapers; (2) relatively positive SPEED framing of ES overall (with national differences in economic, regulatory and legal, and technical framing); (3) a prevalence of 'economic development' and 'energy security' narratives (with differences in use of 'climate change' and 'energy security' narratives); and (4) the emergence of additional themes and contention points (i.e., political and regulatory uncertainties around ES).

4.3 PH2 – Comparative Secondary Survey Analysis (SSA)

4.3.1 Overview

The following sections present results from PH2. First, findings from the five media-related survey questions are analysed to provide context for MCA findings in the preceding chapter and the following survey results. Then, in order to answer **RQ2** and **RQ3**, the analysis

focuses on three key aspects, each corresponding to a comparable variable in the MCA, as depicted in Table 13 below. These variables include: (1) public awareness of ES; (2) public risk/benefit perception of ES; and (3) public affect (i.e., emotional orientation/valence) toward ES. Survey questions corresponding to a combined variable (indicated with *) were grouped by lead researchers from the survey project to allow for thematic cross-national comparisons pertaining to public acceptance of ES (e.g., awareness, initial/final attitudes). Variable groupings were validated (independently from this thesis as part of the UW-UNIS survey research process) using Cronbach's alpha reliability measure (Santos, 1999).

MCA variable	Survey variable	Survey questions
(1) Salience of ES in newspapers	Public awareness of ES	(1) Before today, had you heard of ESTs ⁴ ? (Yes/No/Not sure) (2) How much would you say you currently know about ESTs? (1 = nothing; 5 = a great deal)
(2) SPEED risk/benefit framing of ES in news articles	Public risk/benefit perception of ES: (a) General Risk* (b) General Benefit*	(a) Risk* (1 = strongly disagree; 5 = strongly agree): (1) I feel that there are risks to public health and safety from the use of ESTs in my province/the UK; (2) I feel that there are health and safety risks for me and my family from the use of ESTs in my province/the UK; (3) I believe that there could be personal financial risks associated with the use of ESTs in my province/the UK; (4) I believe that the use of ESTs in my province/the UK holds risks for the natural environment; (5) I believe that there are financial risks to the use of ESTs in the in my province/the UK (b) Benefit* (1 = strongly disagree; 5 = strongly agree): (1) For me, the use of ESTs has benefits for ensuring a secure electricity supply for 'end users' in my province/the UK; (2) I believe that ESTs stand to have a positive effect on supporting the electricity network in my province/the UK; (3) For me, the use of ESTs in my province/the UK holds benefits for the national economy; (4) For me, the use of ESTs in my province/the UK holds benefits for advancing technological innovation in my country; (5) I do not believe that ESTs stand to have a positive impact on issues within my provincial/the UK electricity network; (6) For me, the use of ESTs in my province/the UK holds benefits for the national economy (repeated item); (7) For me, there are environmental benefits to the use of ESTs in my province/the UK
(3) Valence of ES in news articles	Public affect toward ES: (a) Positive affect* (b) Negative affect*	(a) Positive Affect* (1 = strongly disagree; 5 = strongly agree): (1) For me, using ESTs in my province/the UK just feels right; (2) I just feel good about the use of ESTs in my province/the UK; (b) Negative Affect* (1 = strongly disagree; 5 = strongly agree): (1) I feel worried about the use of ESTs in my province/the UK; (2) For me, using ESTs in my province/the UK just feels wrong.

Table 13. Comparable variables from MCA and UW-UNIS survey data; * = combined variables

⁴ Acronym used in survey to represent 'energy storage technologies' (i.e., ES)

Other survey findings such as respondents' concerns for relevant issues (e.g., energy security and climate change concerns) were also considered in the comparative analysis. Less comparable variables such as public 'initial attitudes' toward ES (i.e., prior to framing manipulation) and favourability of specific technologies were also examined using descriptive statistics and independent sample *t*-tests in SPSS. An alpha significance level of .05 was used for all statistical tests.

4.3.2 News readership and public exposure to ES in the media

News readership trends in Canada and the UK were similar. Approximately 70% of all survey respondents read about current affairs in newspapers at least several times a month; roughly half (Canada: 52%; UK: 46%) read newspapers often (weekly or daily). Of the Canadian respondents who said they read newspapers, most respondents read at least one of the five publications selected in PH1; *The Globe and Mail* (34%), *The Toronto Star* (26%), *The National Post* (21%) were the top-read newspapers. However, 30% of Canadian respondents also said they read news in 'other' outlets, including online news platforms (e.g., CBC, MSN) and local newspapers. Of the UK respondents who read newspapers, many prefer tabloids such as *The Daily Mail* (33%) and *The Sun* (23%). The top-read UK quality press included *The Guardian* (31%), *The Independent* (18%), and *The Times* (18%). These findings validated the sample selection for PH1, while confirming that publics receive their news from various online and print outlets (particularly in Canada). Media-related survey findings also show that quality broadsheet papers are more commonly read in Canada, while UK publics prefer to read a mix of tabloids and quality press.

Of the respondents who said they read newspapers in both countries ($n = 1915$), approximately 23% said they 'never' encounter articles discussing ES; 63% said they do 'sometimes' (at least a few times a month); and 14% said they do 'often' (daily or weekly). Independent samples *t*-tests revealed that UK respondents ($M = 2.40$, $SD = 1.03$) self-reportedly encounter ES news articles more often than do Canadian respondents ($M = 2.20$, $SD = 1.04$), $t(1894) = 4.10$, $p < .001$. In other words, the majority of respondents were found to be regularly engaging with ES discourse (i.e., on a monthly basis), with UK publics engaging with ES news more often than Canadians.

When asked to evaluate the general 'tone' (i.e., valence) used in news articles to describe ES, 40% of all respondents perceived it to be 'positive,' 52% perceived it to be 'neutral,' and only 8% perceived it to be 'negative.' These findings were similar between the

countries, as shown in Figure 7; however, a slightly higher positive valence perception of ES reporting was noted by Canadian respondents. See [Appendix C.2.1.1](#) for full data table.

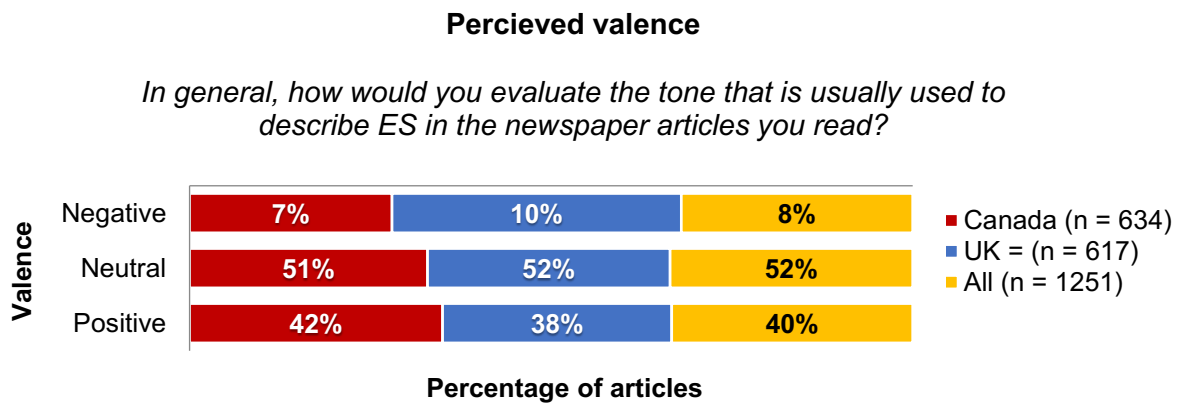


Figure 7. Publics’ perceived valence of ES reporting in national newspapers: Canada vs. UK (2018)

4.3.3 Public awareness of ES

Overall, survey findings revealed that publics in both countries are still rather unfamiliar with storage technologies; 32% of Canadian and 27% of UK respondents reported having heard of ES prior to participating in the survey; approximately 70% of the entire sample said they had not (or were ‘unsure’ if they had heard of ES beforehand). However, after being primed with basic information about ES, 82% of Canadian respondents admitted to knowing at least ‘a little amount’ about it (18% still said they knew ‘nothing at all’). Percentages for UK respondents were 83% and 17%, respectively. The priming information (i.e., general definitions and purpose of ES) was strategically separated from frame manipulations (i.e., descriptions of ES in the context of the four previously described frames/narratives). Basic details about ES served to provide respondents with enough information to determine their initial level of awareness and opinions of the technology. For instance, many respondents stated (as open-ended ‘other’ responses) that they were familiar with storage technologies but were unaware of the overarching term (‘energy storage’) used to describe them.

In terms of demographics, the categories of gender, province of residence, and political orientation suggested the most meaningful differences (the data showed age, employment, and education-differentiated views to be less striking). For instance, of the 842 Canadian respondents who had prior knowledge of ES (i.e., knowing at least ‘a little’ about the technology), 51% were male and 47% were female; however, of those who said they knew ‘nothing at all’ about ES ($n = 180$), 61% were male, while only 38% were female (thus pointing

somewhat in both directions). Greater awareness from females was more apparent in the UK sample. Of the 863 UK respondents with prior ES knowledge, 48% were male and 51% were female, and of those with no prior knowledge of ES ($n = 181$), 66% were male and 33% were female. Comparatively, the least knowledgeable respondents resided in the province of Quebec (20% knew 'at least a little'; 28% knew 'nothing at all'). A regional demographic question was not included in the UK survey. In both countries, respondents who self-identified as having a 'right-leaning' political preference appeared to be more knowledgeable on ES (to some extent), as revealed by the mean political preference scores of 'prior' vs. 'no prior' knowledge groups (1 = left; 10 = right) – e.g., Canada: 5.4 vs. 5.1. It is noted that given the large sample size, such small differences are likely to be meaningful, although, correlation analysis would help to confirm these inferences (Batterham & Hopkins, 2006). See [Appendix C.2.1.1.2](#) for full demographic details of respondents with prior vs. no prior knowledge of ES. Overall, female (UK) and right-leaning respondents (Canada) appeared to have higher awareness of ES technologies.

Interestingly, of the publics who reported having previous knowledge of ES, 21% (Canada) and 29% (UK) had come to learn about it from television; 28% (Canada) and 20% (UK) encountered it on the internet (e.g., social media, blogs), and 20% (Canada) and 23% (UK) read about it in newspapers (print and digital). Approximately 10% of respondents from each sample selected 'other' sources, including courses, business and work, and personal experiences with ES (e.g., living close to facilities). These results suggest that publics are typically engaging with ES discourse in both traditional and contemporary media.

In sum, media-related survey results suggest that while publics in Canada and the UK are engaging with ES news discourse, general awareness of the technology in both countries is limited (with UK respondents having a slightly greater awareness of the concept). Notably, after basic priming, most respondents (approximately 80% in both countries) said they had sufficient understanding of ES, mainly through watching and reading the news. Public exposure to ES in newspapers appears to be slightly higher in the UK than in Canada. Finally, females (particularly in the UK) and right-leaning respondents (Canada) appear to have the highest awareness of ES. In Canada, residents in the province of Quebec appear to be least aware.

4.3.4 Public benefit and risk perception of ES

Survey respondents were also asked to indicate on a series of 5-point Likert scale questions (1 = strongly disagree; 5 = strongly agree) the extent to which they believe ES

deployment in their domestic electricity network holds certain benefits or risks – i.e., to public/personal health and safety, the economy, the environment, the electricity network, and so forth.⁵ Specific questions were assigned for each category (see Table 13). Given the large sample size and combined Likert scale items, independent sample *t*-tests were conducted to compare national mean benefit and risk perceptions (Lubke & Muthén, 2004).

Prior to providing their opinions on specific benefits and risks, respondents stated their ‘initial attitudes’ on whether – ‘all things considered’ – they believed general benefits of the technology to outweigh risks. Results are depicted in Figure 8.⁶ While not significantly so, Canadian respondents had a more favourable initial benefit-vs-risk perception of ES ($M = 3.42$, $SD = 0.99$) than did UK respondents ($M = 3.37$, $SD = 1.1$), $t(1888) = -1.04$, $p = .30$.

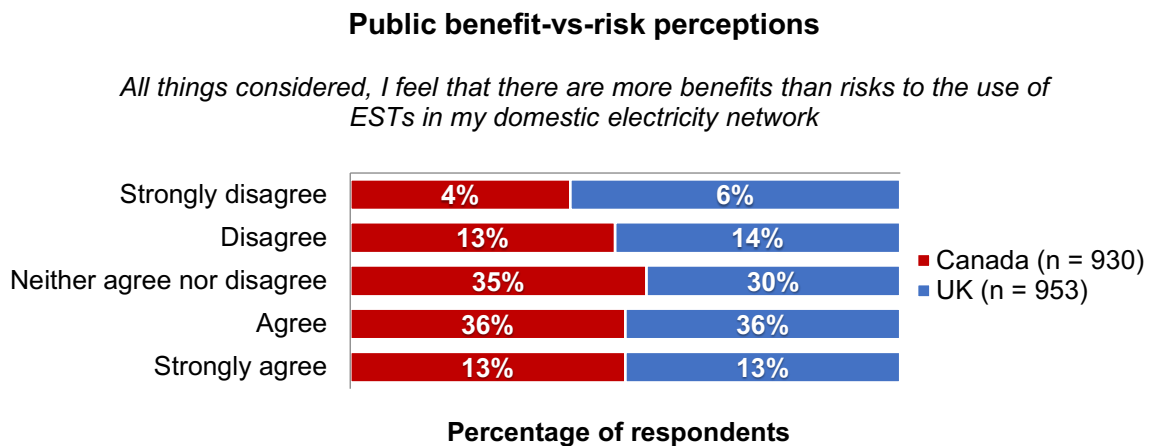


Figure 8. Initial public benefit-vs-risk perceptions of ES: Canada vs. UK (2018; n = 1883)

Benefit-vs-risk demographics were similar to public awareness results (in terms of potentially meaningful categories). However, gender appeared to be less of a factor in this context, particularly within the Canadian sample. For instance, of the UK respondents who agreed that ES benefits outweigh risks ($n = 472$), 53% were male and 47% were female; of those who disagreed ($n = 192$), 51% were male and 49% were female. The Canadian

⁵ To account for differences/inconsistencies in national survey design (i.e., coding of missing data), ‘don’t know’ and ‘prefer not to say’ responses were reported as missing values where appropriate (resulting in lower valid n values in the Canadian sample).

⁶ To account for mostly positively-phrased survey questions, respondents were asked to indicate the extent to which they agree that *risks* associated with ES deployment outweigh *benefits*; this was reverse coded and compared for consistency.

percentages were 53% vs. 46% ($n = 454$) and 54% vs. 46% ($n = 153$), respectively. There was some indication of age-differentiated views in this category (mostly in the UK) with older respondents appearing somewhat more favourable than younger respondents. However, statistical analysis would help to determine meaningful differences in these other demographic categories. See [AC.2.1.1.3](#) for full demographic details of respondents' initial attitudes toward ES benefits vs. risks.

However, while most Canadians had a favourable benefit-vs-risk perception of ES (i.e., 49% vs 16%), a breakdown by province showed that more respondents residing in Alberta 'disagreed' than 'agreed' that the benefits of ES deployment in their province outweigh the risks (i.e., 9% vs. 12%). The same was found, although to a lesser extent, for British Columbia (i.e., 14% vs. 15%) and Quebec (i.e., 39% vs. 41%). Finally, in terms of those who 'agreed' vs. those who 'disagreed' with the statement, less favourable respondents appeared to have a stronger right-leaning political preference (based on the 10-point sliding scale), particularly in Canada (i.e., Canada: 5.1 vs. 6.0; UK: 5.1 vs. 5.8). Finally, compared to Canada, the UK benefit-vs-risk percentage ratio also showed that a slightly higher proportion (+4%) of UK respondents 'disagreed' with the benefits outweighing risks statement (i.e., 50% vs 20%).

Comparative results differed when respondents registered their ES risk/benefit perceptions specifically in respect to the economy, environment, electricity network, and other contexts. Combined mean scores and significance results for these questions are depicted in Table 14. Overall, UK respondents had a significantly higher general benefit perception of ES ($M = 3.72$, $SD = 0.61$) than did Canadians ($M = 3.54$, $SD = 0.48$), $t(1939) = 7.55$, $p < .001$. Accordingly, UK respondents also had a significantly lower general risk perception of ES ($M = 2.92$, $SD = 0.78$) than did Canadians ($M = 3.00$, $SD = 0.74$), $t(2008) = -2.48$, $p < .001$.

Grouped variable	Canada			UK			Independent sample t-test results		
	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD	<i>t</i>	<i>df</i>	Sig. (<i>p</i>)
General Benefit	1000	3.54	0.48	1031	3.72	0.61	7.55	1939	0.000
General Risk	986	3.00	0.74	1025	2.92	0.78	-2.48	2008	0.013

Table 14. Comparative mean and significance scores for general benefit/risk perceptions of ES: Canada vs. UK (2018); depicting combined perception variables; (1 = strongly disagree; 5 = strongly agree, DK + prefer not to say = missing values)

In both countries, the highest perceived risks of ES were economic and environmental – 34% of all respondents ($n = 1871$) perceived⁷ financial risks associated with the use of ES in their electricity networks; 32% ($n = 1867$) perceived risks for the natural environment. Canadian respondents had particularly higher financial risk perceptions; 38% perceived the use of ES to hold general financial risks (i.e., to the public) and 29% perceived personal financial risks associated with ES deployment. By comparison, UK percentages were 30% and 24%, respectively. The countries scored similarly in their personal and public safety risk perceptions of ES. However, Canadian risk perceptions of ES were generally higher across all other risk categories, as depicted in Table 15.

Theme: Risk perception	Canada			UK		
	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD
1 - I feel that there are risks to public health and safety from the use of ESTs in my province/the UK	920	2.92	0.97	953	2.86	0.99
2 - I feel that there are health/safety risks for me/my family from the use of ESTs in my province/the UK	923	2.83	0.98	951	2.84	1.0
3 - I believe that there could be personal financial risks associated with the use of ESTs in my province/the UK	922	2.97	0.96	946	2.83	0.99
4 - I believe that the use of ESTs in my province/the UK holds risks for the natural environment	911	3.09	0.95	956	3.05	1.0
5 - I believe that there are financial risks to the use of ESTs in my province/the UK	934	3.19	0.87	937	3.01	0.95

Table 15. Mean evaluations of public risk perceptions of ES technologies: Canada vs. UK (2018); (1 = strongly disagree; 5= strongly agree, DK + prefer not to say = missing values)

Overall, the highest perceived benefits of ES were related to energy security and grid support; 74% of all respondents ($n = 1973$) perceived ES as having a ‘positive effect’ on supporting their national/provincial electricity network. Similarly, 71% of all respondents ($n = 1964$) agreed that the use of ES would ‘help secure electricity supply for end users.’ By comparison, UK respondents had a particularly more favourable economic perceptions of ES; 68% agreed that the use of ES technologies in the UK holds benefits for the national economy;

⁷ For easier comparison, Likert scales for benefit/risk perception questions were recoded (1-2 = disagreed/did not perceive; 3 = neither agree/perceive or disagree/did not perceive; 4-5 = agree/perceive)

22% 'strongly agreed' with this statement. While 65% of Canadian respondents also agreed with the same economic statement, only 14% 'strongly agreed.' Overall, UK benefit perceptions of ES were generally higher across all benefit categories, as depicted in Table 16.

Theme: Benefit perception	Canada			UK		
	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD
1 - For me, the use of ESTs has benefits for ensuring a secure electricity supply for 'end users' in my province/the UK	968	3.77	0.74	996	3.85	0.78
2 - I believe that ESTs stand to have a positive effect on supporting my provincial/national electricity network	968	3.80	0.72	1005	3.87	0.76
3 - For me, the use of ESTs in my province/the UK holds benefits for the national economy	952	3.68	0.76	988	3.78	0.78
4 - For me, the use of ESTs holds benefits for advancing technological innovation in Canada/the UK	965	3.76	0.75	996	3.79	0.77
5 - I believe that ES technologies stand to have a positive impact on issues within Canada/the UK electricity network (reverse coded)	951	2.57	0.95	981	3.42	1.0
6 - For me, there are environmental benefits to the use of ESTs in Canada/the UK	932	3.56	0.83	988	3.64	0.87

Table 16. Mean evaluations of public benefit perceptions of ES technologies: Canada vs. UK (2018); (1 = strongly disagree; 5 = strongly agree, DK + prefer not to say = missing values)

The results depicted in this section suggest that despite reporting less favourable initial benefit-vs-risk perceptions of ES, UK publics have a significantly higher general benefit perception of ES than do Canadians – particularly in respect to technical (e.g., energy security) and economic functions (e.g., financial benefits). Gender demographic differences regarding benefit-vs-risk perceptions were less meaningful in the Canadian sample (pointing somewhat in both directions), while still suggesting more favourable ES perceptions from males in the UK. Right-leaning respondents and those residing in Alberta, British Columbia, and Quebec appear to be less favourable of ES in Canada. The countries shared similarly high benefit perceptions in respect to technological innovation, and similarly low risk perception in respect to public/personal health and safety. Accordingly, Canadian publics showed higher risk perceptions of ES deployment, particularly with respect to economic and financial functions.

4.3.5 Public affect toward ES

Public perceptions of ES in Canada and the UK were also assessed by comparing ‘affect’ – i.e., mood factors that refer to feelings of enthusiasm or happiness (positive) and aversive mood states (negative) (Watson & Tellegen, 1985). Respondents were asked to register the extent to which they agreed with several affect statements regarding ES deployment in their domestic electricity network (1 = strongly disagree; 5 = strongly agree). Overall, UK respondents had a significantly higher ‘positive affect’ toward ES ($M = 3.61$, $SD = 0.77$) than did Canadian respondents ($M = 3.53$, $SD = 0.73$), $t(2002) = 2.24$, $p < .05$. Notably, although not significantly so, Canadian respondents had a lower ‘negative affect’ toward ES ($M = 2.47$, $SD = 0.87$), than did UK respondents ($M = 2.51$, $SD = 0.94$), $t(2004) = 1.04$, $p = .298$. Combined mean and significance scores are depicted in Table 17; mean scores for individual affect questions follow in Table 18.

Grouped variable	Canada			UK			Independent samples t-test results		
	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD	<i>t</i>	<i>df</i>	Sig. (<i>p</i>)
Positive Affect	984	3.53	0.73	1021	3.61	0.77	2.24	2002	0.025
Negative Affect	990	2.47	0.87	1021	2.51	0.94	1.04	2004	0.298

Table 17. Comparative mean and significance scores for general positive/negative public affect toward ES: Canada vs. UK (2018); depicting combined affect variables; (1 = strongly disagree; 5 = strongly agree, DK + prefer not to say = missing values)

Theme: Affect	Canada			UK		
	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD
Positive 1 - For me, using ESTs in my province/the UK just feels right	951	3.62	0.80	997	3.69	0.82
Positive 2 - I just feel good about the use of ESTs in my province/the UK	956	3.48	0.79	999	3.55	0.83
Negative 1 - For me, using ESTs in my province/the UK just feels wrong	961	2.37	0.95	1000	2.38	1.03
Negative 2 - I feel worried about the use of ESTs in my province/the UK	976	2.57	0.97	1000	2.64	1.02

Table 18. Mean evaluations of public affect toward ES: Canada vs. UK (2018); (1 = strongly disagree; 5= strongly agree, DK + prefer not to say = missing values)

Demographics were compared using ‘Positive Affect 2’ and ‘Negative Affect 2’ variables (since personal good/bad orientations toward ES are more comparable to ‘valence’ than right/wrong perceptions). Once again, the most striking differences appeared to be related to gender, province of residence (Canada), and political orientation. For instance, of the Canadian respondents who had a positive affect toward ES ($n = 498$, 52%) – i.e., ‘agreeing’ that the use of ES technologies simply ‘feels good’ – 56% were male and 44% were female. By comparison, UK gender demographics for positive affect ($n = 532$, 53%) were 54% and 46%, respectively. Those identifying as ‘other’ genders (<1% in both samples) tended to ‘neither agree nor disagree’ with affect statements. Accordingly, in both countries, a greater proportion of respondents reporting a negative affect were female (i.e., Canada: 57%; UK: 55%). In most Canadian provinces, respondents had a favourable positive vs. negative affect toward ES, with the exception of those residing in Alberta (i.e., 9.0% vs. 9.1%), Quebec (21.1% vs. 23.0%), and some prairie and eastern provinces. Finally, when comparing positive vs. negative affect groups, less favourable respondents again appeared to have a stronger right-leaning political orientation, particularly in Canada (i.e., Canada: 5.3 vs. 5.9; UK: 5.4 vs. 5.5). See [Appendix C. 2.1.1.4](#) for full demographic details for respondents’ positive vs. negative affect toward ES.

Overall, these results again suggest that UK publics are more favourable of ES than Canadians in respect to their emotional ‘affect’ toward the technology. In both countries, males appear to be more favourable in this context; some Canadian provinces (e.g., Alberta, Quebec, etc.) appear less favourable than others, and right-leaning respondents again appear to be less favourable toward ES (particularly in Canada).

4.3.6 Other findings – Personal narratives and technology favourability

4.3.6.1 Personal narratives

The UW-UNIS survey study considered a range of factors that might potentially affect public acceptance levels of ES (e.g., Green ID, political orientation). In order to answer the posed research questions (i.e., RQ2 and RQ3), survey questions about public concern for ‘energy security’ and ‘climate change’ were also included in this analysis. Mean and significance scores for the combined variables are depicted in Table 19 below. Scores for specific concern variables follow in Table 20.

Combined variable	Canada			UK			Independent samples t-test results		
	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD	<i>t</i>	<i>df</i>	Sig. (<i>p</i>)
Energy Security Concern	984	2.63	0.69	1024	3.03	0.66	13.2	1993	0.000
Climate Change Concern	996	3.17	0.78	1020	3.11	0.78	-1.87	2013	0.062

Table 19. Comparative mean and significance scores for public energy security and climate change concerns: Canada vs. UK (2018); **Note:** scales based on 4-point Likert scale (1 = Not at all concerned; 2 = not very concerned; 3 = fairly concerned; 4 = very concerned); *depicting combined concern variables

Theme: Energy security concern	Canada			UK		
	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD
1 - Electricity in my province/the UK will become unaffordable	970	3.04	0.89	994	3.17	0.85
2 - Electricity in my province/the UK will be rationed	944	2.45	0.90	967	2.88	0.89
3 - Canada/the UK will become too dependent on energy from other countries	955	2.51	0.98	980	3.19	0.89
4 - Terrorist attacks will cause interruptions to Canadian/UK electricity supplies	927	2.39	0.94	956	2.82	0.94
5 - Supplies of fossil fuels (e.g. coal and gas) used to generate electricity in my province/the UK will run out	957	2.76	0.93	998	3.17	0.86
6 - There will be power cuts in my province/the UK	946	2.59	0.88	969	2.93	0.85
Theme: Climate Change Concern	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD
1 - I am concerned about the potential effects of climate change on society (societal impact)	996	3.10	0.84	1013	3.03	0.84
2 - I am concerned about the potential effects of climate change on me and my family (personal impact)	986	3.25	0.83	1020	3.19	0.84

Table 20. Mean evaluations of public affect perceptions toward ES: Canada vs. UK (2018); (1 = strongly disagree; 5= strongly agree, DK + prefer not to say = missing values);

UK respondents had a significantly higher concern for national energy security issues ($M = 3.03$, $SD = 0.66$) than did Canadian respondents ($M = 2.63$, $SD = 0.69$), $t(1993) = 13.2$, $p < .001$. UK publics were especially more concerned with their country becoming 'too dependent' on energy supplies from other countries. Canadian respondents had a slightly higher concern

for climate change impacts ($M = 3.17$, $SD = 0.78$) than did UK respondents ($M = 3.11$, $SD = 0.79$); however, not significantly so, $t(2013) = -1.87$, $p < .062$. In sum, these results indicate national differences in respect to publics' concern for related energy issues. Here, the notion of energy security was once again more prevalent in the UK public sphere, while climate change appeared to be a more prevalent issue in Canada.

While these findings do not provide insights on public opinions of ES specifically, they do provide further context for addressing the research questions by suggesting national differences in public perceptions of issues related to ES deployment. Since 'energy security' and 'climate change' topics represent common 'narratives' in ES discourse (as per PH1 results), people's perceptions of such issues may affect their understanding and acceptance of technologies that are designed to address them (Hermwille, 2016). As such, the two factors are broadly understood here as 'personal narratives' and are considered during PH1 and PH2 comparisons.

4.3.6.2 Technology favourability

The national surveys also measured public opinion of specific ES technologies by presenting respondents with flashcards describing four target ES technologies (i.e., flywheels, lithium ion batteries, pumped-hydro, and compressed-air) in a randomised order. The flashcards contained pictures and information on how each technology works, its commercial status, and technical characteristics. Respondents registered their attitude towards each technology (1 = very unfavourable; 10 = very favourable) and were then asked to select which they would favour for use in their province/country. Both Canadian and UK respondents were generally favourable of all four ES technologies; average mean scores for each item were above the hypothetical midpoint of the 10-point scale. Pumped-hydro ES was most favourable overall (Canada: $M = 6.90$, $SD = 1.98$; UK: $M = 6.60$, $SD = 2.03$); compressed-air ES was least favoured in the UK ($M = 5.93$, $SD = 1.95$); and flywheels were least favoured in Canada ($M = 6.30$, $SD = 1.98$). These opinions were reflected in responses to the forced preference question. Pumped-hydro ES was again the most favoured technology in both countries (registered as the top choice by approximately 38% of all respondents) and followed by lithium ion batteries (24%). However, there was a reversal in the relative preferences for compressed-air vs. flywheels as the least-favoured technologies. When respondents were forced to choose one, flywheels became least favoured in the UK (14%) and compressed-air became least favoured in Canada (13%). Less than 10% of respondents in both countries preferred no deployment of ES at all.

Independent sample *t*-tests revealed significant differences between countries in respect to favourability rankings for specific technologies, as well as average favourability for all options. Canadian respondents had a significantly higher (average) favourability of all ES technologies ($M = 6.44$, $SD = 1.54$) than did UK respondents, ($M = 6.16$, $SD = 1.55$), $t(2028) = -4.10$, $p < .001$. Results for technology favourability comparisons are depicted in Table 21 and Figure 9 below. Overall, these findings suggest that publics (in both countries) do not equally favour all ES technology options. They also suggest significant national differences in respect to public preferences for various technologies, with Canadians showing higher (as shown by independent *t*-test scores below) favourability for ES technologies overall.

Technology	Canada			UK			Independent sample <i>t</i> -test results		
	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD	<i>t</i>	<i>df</i>	Sig. (<i>p</i>)
Pumped-hydro	991	6.90	1.98	1044	6.60	2.03	-3.72	2028	0.001
Lithium ion batteries	988	6.43	2.19	1044	6.08	2.13	-3.70	2016	0.000
Compressed-air	989	6.11	2.06	1044	5.93	1.99	-2.08	2017	0.038
Flywheels	988	6.30	1.98	1044	6.04	1.95	-3.03	2021	0.002
All technologies (avg)	991	6.44	1.54	1044	6.16	1.55	-4.10	2028	0.000

Table 21. Comparative mean and significance scores for public favourability of specific ES technologies (1 = very unfavourable; 10 = very favourable); Canada vs. UK (2018)

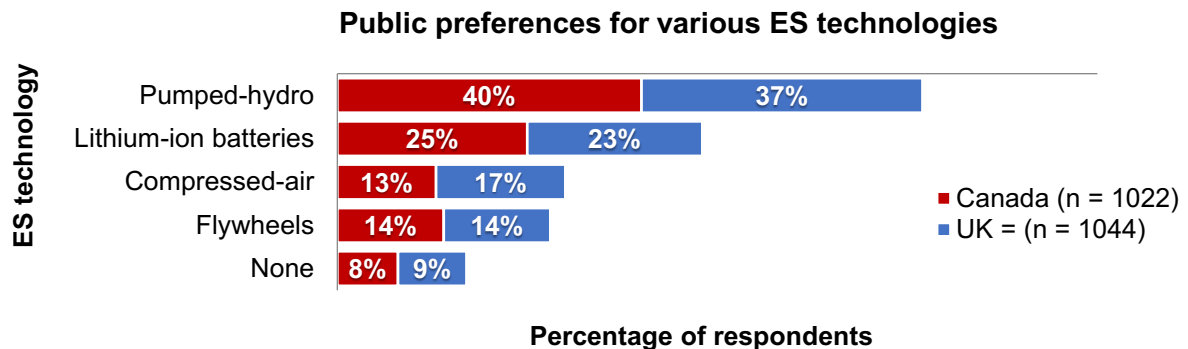


Figure 9. Public preferences for use of various ES technologies in domestic electricity networks; Canada vs. UK (2018); $n = 2066$.

4.4 Summary

This chapter has presented results from PH1 and PH2 of the project, providing a cross-national comparison between Canada and the UK of both media representation and public perceptions of ES. Key findings from this chapter are summarised in Table 22 on the following page and are further unpacked in the following discussion chapter.

Theme	PH1 – Media Content Analysis (MCA)	PH2 – Secondary Survey Analysis (SSA)
(1) Salience	<p>Salience of ES in newspapers</p> <p>(a) ES coverage has increased in national newspapers over the last ten years (both countries); coverage appears to be higher in UK newspapers than in Canadian newspapers (2016-2017)</p> <p>(b) Disproportionally higher representation of battery ES found in newspapers overall (both countries); more frequent mentions of specific technologies found in Canadian newspapers overall</p>	<p>Public awareness of ES technologies</p> <p>(a) Newspaper readership higher in Canada than UK; yet public engagement with ES news coverage higher in the UK</p> <p>(b) Low/moderate awareness; majority of respondents have basic knowledge (both countries)</p> <p>(c) Public awareness slightly higher in UK; right-leaning (Canada) and female (UK) publics most familiar with ES</p>
(2) Framing	<p>SPEED framing of ES in newspapers</p> <p>(a) Positive framing of ES overall; benefit statements outweigh risk statements (both countries)</p> <p>(b) Benefit framing of ES more prevalent in UK newspapers than in Canadian newspapers</p> <p>(c) Economic and technical benefit framing most prevalent overall (both countries)</p> <p>(d) Economic and regulatory/legal risk framing of ES more prevalent in Canada; Technical benefit framing more prevalent in UK</p>	<p>Public risk/benefit perception of ES</p> <p>(a) Positive perceptions of ES overall; benefit perceptions outweigh risk perceptions (both countries)</p> <p>(b) High general benefit (and low risk) perception of ES more apparent in UK than in Canada; right-leaning publics less favourable (both countries, particularly in Canada); Males more favourable (UK)</p> <p>(c) Economic and technical benefit, and environmental risk perceptions of ES most prevalent overall (both countries)</p> <p>(d) Economic risk perceptions more prevalent in Canada; Technical (energy security) benefit perceptions more prevalent in UK</p>
(3) Narratives	<p>Media narratives around ES</p> <p>(a) ‘Economic development’ and ‘energy security’ narratives most prevalent overall (both countries); ‘climate change’ more prevalent in Canada; ‘energy security’ more prevalent in UK;</p> <p>(b) Other emerging narratives: ‘political contention’ (both countries), yet more prevalent in UK</p>	<p>Public concerns for relevant issues</p> <p>(a) ‘Energy security’ concern more prevalent in UK; ‘climate change’ concern slightly more prevalent in Canada</p>
(4) Valence	<p>Positive/negative orientation toward ES</p> <p>(a) ES coverage positive overall (both countries)</p> <p>(b) No relationship found between valence and political leanings of newspapers</p>	<p>Positive/negative affect toward ES</p> <p>(a) Public affect toward ES generally positive overall (both countries); Public affect more positive in the UK</p> <p>(b) Males more favourable (UK); right-leaning publics less favourable (Canada)</p>

Table 22. Summary of key findings from PH1 and PH2: Comparing media and public perceptions of ES in Canada and the UK (2016-2018)

Chapter 5 – Discussion

5.1 Overview

Given the role that media and publics play in society's adoption of new energy technologies, the aim of this research was to better understand the extent and ways in which ES is portrayed and understood in two countries currently undergoing energy system change. To achieve this, a comparative national media and survey analysis of ES perceptions in Canada and the UK was conducted. The goal was to examine and compare the salience and framing of ES between 2008 and 2017, as well as public awareness and perceptions of ES at present (2018) in both countries. The purpose of this chapter is to reflect upon and integrate key findings from chapter 4 within the literatures informing this work, as well as to further support the conclusions drawn in chapter 6. The following sections reflect specifically upon comparative insights that emerged from PH1 and PH2 regarding: (1) issue salience (i.e., media attention and public awareness of ES); (2) framing (i.e., media and public risk/benefit perceptions of ES); (3) narratives (i.e., discursive storylines around ES); and (4) valence (i.e., media orientation and public affect toward ES). Since these aspects relate directly to the research questions posed in [Section 1.2](#), they are used in this chapter as organising principles for examining key findings and their implications for ES development in Canada and the UK. The discussion concludes with a broad summary that is further unpacked in the final chapter.

5.1.1 Issue salience

By bringing certain issues into public focus, news media can both reflect and set national agendas (Shaw, 1979; McCombs, 2005; Weaver, 1991; Stephens et al., 2008; 2013). 'Issue salience' – i.e., the visibility and prominence of an issue in the media – has been known to increase public knowledge, influence opinion, and raise the likelihood for civic and policy action on sustainability issues (Weaver, 1991; Yusuf et al., 2016). Thus, the extent to which media report on new technologies such as ES will likely have public and policy implications for their deployment (e.g., stakeholder advocacy or protestation). This is important from an energy transition standpoint, particularly if the perceived benefits of large-scale ES implementation (e.g., decarbonisation, reliability, efficiency) come to fruition, and publics begin to regularly experience the technology (e.g., via home energy management, proximity to storage facilities).

PH1 results suggest that overall, ES is receiving attention in Canadian and UK national newspapers (**RQ1**). Between the two countries, article frequencies increased between 2008 and

2017, suggesting a growing relevance and public interest in storage during this time. This trend aligns with findings from similar media studies focusing on wind and solar energy (Stephens et al., 2009; Parker et al., 2013), CCS (Feldpausch-Parker et al., 2015), and smart grid (Langheim et al., 2014; Mallett et al., 2016; 2018). In many Western jurisdictions, increasing media attention on 'clean energy technologies' between 1990 and 2015 has been linked to elevated national interests in energy sustainability and climate change mitigation (Stephens et al., 2009; Anderegg & Goldsmith, 2014; Ford & King, 2015; Bolsen & Shapiro, 2018). A growing interest in ES might thus be attributed to the increasing range of services that the technology can provide for our present (aging and problematic) electricity grids (Devine-Wright, et al., 2017), as well as its potential in enabling the shift to more sustainable future grids (and 'desirable' energy futures) (Geels & Kemp, 2007; Negro et al., 2012) – particularly as urgency for decarbonisation increases (Gaede & Rowlands, 2018a).

Similar to Ganowski et al.'s (2018) findings on ES salience in Canadian provincial news media, increases in national ES reporting in Canada and the UK appear to coincide with: (1) related energy policy and regulatory developments (e.g., UK's 2017 Smart Systems and Flexibility Plan); (2) emerging RD&D and market activities (e.g., Ontario's 2012-2015 IESO ES procurements); (3) and 'newsworthy' innovations and projects (e.g., Hydrostor's underwater compressed-air ES project) within the last decade (Tuck et al., 2017; Ofgem, 2017; Cox, 2018; Sidhu et al., 2018). This supports the argument that political and scientific/technological developments, in conjunction with growing climate commitments are contributing to increased media reporting on low-carbon energy technologies (Boycoff, 2007; Stephens et al., 2008; 2013; Ganowski et al., 2018); although, further causal research would help to determine exactly which factors and developments are driving ES salience in national newspapers.

Interestingly, while ES coverage in the UK increased sharply between 2014-2017, Canadian coverage rose steadily from 2014, peaked in 2016, then dropped in 2017 – suggesting evidence of a media hype. Building on Downs' (1972) 'issue-attention' theory, Gartner Group's (1995) 'hype cycle' describes an innovation bias in the media wherein support for a novel concept rises quickly (i.e., due to an 'innovation trigger'), reaches a climax (i.e., 'a peak of inflated expectations'), then drops as costs or risks associated with the innovation are realised and/or more salient issues intervene, causing salience to dwindle into a 'trough of disillusionment' (Gartner Group, 1995) (see Figure 10).

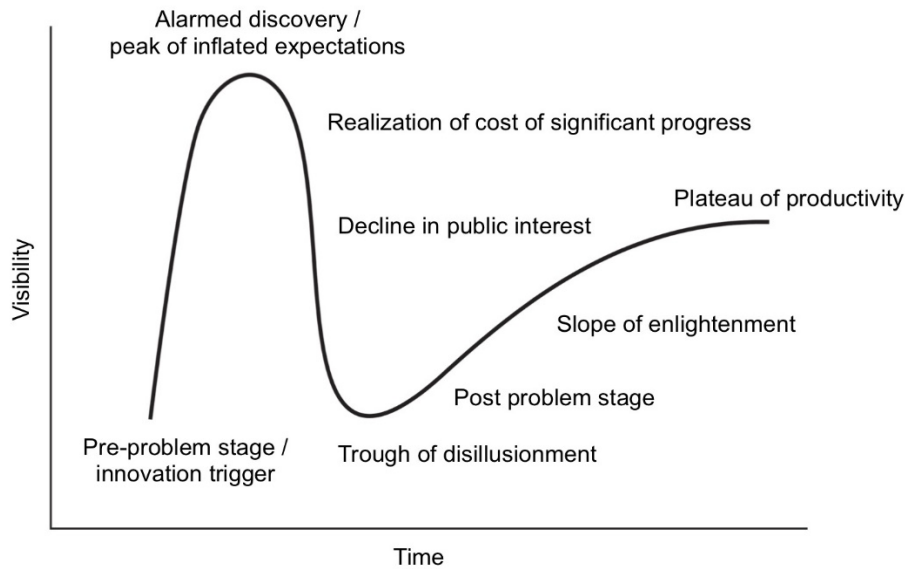


Figure 100. Adapted depiction of Downs' (1972) 'issue attention' and Gartner Group's (1995) 'hype cycle'

Hype cycles are commonly observed in media studies on novel technologies which challenge the 'status-quo' of dominant fossil fuel energy regimes (Verbong et al., 2015; Stephens et al., 2015; Mallett et al., 2018; Holt & Barkemeyer, 2012; Dedehayir & Steinert, 2016). For instance, Ruef & Mackard (2010) observed a similar trend around stationary hydrogen fuel cells in German newspapers (1993-2007), which led to a 'hype-disappointment' dynamic as a result of exaggerated environmental benefits and commercial timelines. Such research suggests that hype cycles can shape public and market responses to emerging technologies. Negative responses, such as public distrust and investment uncertainties, have been particularly observed when technology outcomes fail to meet hyped expectations put forth by media and industry actors. Khodayari & Aslani (2018), for example, find that hype cycles are already affecting commercial investment and innovation processes for certain storage technologies (discussed further in [Section 5.4](#)).

Interestingly, the Canadian hype peak (2016) observed in this study differs from the string of shorter hype cycles (i.e., bursts of enthusiasm and concern) (Geels et al., 2007) observed in our Canadian pilot study on ES salience between 2007 and 2017 (Ganowski et al., 2018). In addition to different research design choices (i.e., newspaper selection, key search terms), this may be due, in part, to the well-documented differences between national and regional news reporting practices (Miller & Pollak, 2013). National papers are known to report on 'the bigger picture' and develop stories as on-going trends (i.e., creating long-term

generalised expectations) (Jerit et al., 2018), while local newspapers tend to prioritise time-bound and event-oriented reports (often resulting in wax-and-wane salience patterns) – particularly if the news is considered to have a high impact on local audiences (Boycoff & Roberts, 2007; Östberg & Kleinschmit, 2016). This may explain the still-rising (unpeaked) interest in ES in UK newspapers (all of which were national, while the Canadian sample contained three regional papers). PH1 results suggest that various domestic energy issues (e.g., energy security) in the UK may continue to elevate ES salience in the coming years (Abdo & Kouhy, 2016). However, a sharp increase in UK coverage since 2014 indicates a sudden interest (perhaps prompted by timely energy market reform and growing energy security concerns) (Newbery, 2016; Grubb & Newbery, 2018) which will eventually level off – and perhaps rise again, representing a ‘slope of enlightenment’ – as ES developments unfold. Nonetheless, the disproportionately higher coverage on ES in more recent UK articles (2016-2017) suggests that the topic may be more ‘front of mind’ in UK energy discourse in recent years, while ES hype in Canada is beginning to level off. Of course, without further longitudinal analysis of a more comprehensive media dataset on ES, it is too early and difficult to confirm that this is case.

While the nature of the PH1 dataset (i.e., unequal numbers of right-leaning vs. left-leaning newspapers in the national samples) limits inferences on political salience, it is worth considering what varying levels of ES coverage in right-leaning vs. left-leaning publications could suggest. Potentially greater attention given to ES in right-leaning newspapers (which, some PH1 results suggest could be the case in Canada) may suggest that the technology – particularly when linked to issues of security, efficiency, and the ‘green economy’ (Corner, 2013; Jackson, 2009) – may carry a more conservative than liberal political salience. Indeed, unlike many renewable energy technologies (which are often more closely associated with climate issues), ES is also tied to industrial development, energy system optimisation, and self-sufficiency (perhaps thus a fitting component of the UK’s ‘Industrial Strategy’) (Ofgem, 2017). Like smart grid technologies (Mallett et al., 2016), this may allow ES to attract more cross-political media attention than technologies with a traditionally left-wing appeal (e.g., solar PV) (Hamilton et al., 2018; Karlstrøm & Ryghaug 2014). If, with further research, ES proves to have a stronger right-leaning salience in news media then we could consider Hamilton et al.’s (2018) argument on increasing bipartisanship of low-carbon energy development in many North American jurisdictions. A positive conservative political salience of ES in the media may help to overcome some political identity-based resistance to clean energy development and climate

action, particularly in more conservative (and 'green' energy resistant) regions in Canada (e.g., Alberta) and the UK (south-east England) (Farstad, 2018). Despite these potential implications, the PH1 newspaper sample, as well as the fundamentally subjective and tentative categorisations of newspaper political leanings limit generalisability in this case. However, we can (based on some evidence here and on supportive literature) still speculate that the extent to which national newspapers report and 'focus' (in their content) on ES in Canada and the UK is linked to the political contexts of domestic media and energy systems. This would support the argument that media construction of scientific knowledge is often intertwined with political ideology (Carvalho, 2007; Dotson, 2012). More directed research on the political salience of ES would help to ascertain these potential findings.

How does media salience compare to public awareness of ES in Canada and the UK (**RQ3**)? Interestingly, while ES salience was comparable to attention given to other low-carbon energy technologies in recent years (Langhem et al., 2014; Mallett et al., 2018), survey results showed that the majority of Canadian and UK publics (approximately 70%) were still unfamiliar with the concept. This was expected, as many ES technologies are still in early development stages, which currently limits publics to engaging with ES through mediated discourse, rather than through first-hand experiences (Devine-Wright et al., 2017; Mallett et al., 2018). Perdan et al. (2016) found a similar case with CCS in the UK; 60% of respondents had also never (or were unsure if they had) heard of the technology prior to partaking in their perception study. The same was observed for public awareness of biofuels in other European countries and the US, even years after the technologies began to commercialise (Chang, 2009; Cacciatore et al., 2012). This may suggest that publics are generally uninformed about emerging low-carbon energy innovations, perhaps until they come to experience them regularly, either through social discourse or in their daily activities (e.g., work, school, home-life). Low response rates for self-reported awareness of ES are even more striking if we consider, as Perdan et al. (2016) suggest, the respondents' likely self-reporting bias against admitting ignorance and the general tendency for polls to overstate recognition (Schwarz, 1999).

Yet, despite reporting low awareness levels, most respondents (over 80% in each country) admitted to engaging with ES in news media (at least 'several times a month') and to knowing ('at least a little') about the concept after being primed with basic information (this was particularly evident in the UK sample). As mentioned earlier, many respondents also reported their awareness of traditional ES technologies (i.e., pumped-hydro), but noted unfamiliarity with

advanced innovations (e.g., underwater compressed-air ES). Some admitted to being simply unaware of the umbrella term ‘energy storage,’ which points to the implications that terminology and ‘top-of-mind associations’ might have for public awareness of ES (Clarke et al., 2015). Interestingly, a greater portion of UK respondents admitted to having personal experiences and education on the topic (e.g., living close to facilities, through business or education) than did Canadians. Thus, while higher public awareness of ES found in the UK aligns with more frequent ES reporting in national newspapers, exposure to ES media discourse in this case, may not necessarily explain varying levels of awareness between the two countries. Stephens et al. (2009) remind researchers of the complex set of variables (e.g., political orientation, education, personal experiences, local contexts, opinions on related issues, etc.) that must be considered when examining the relationship between media and public awareness/perception of energy technologies. For instance, a comparatively higher awareness of ES in the UK may be associated with the political representation and/or salience of ES, the majority public’s political preference, and their engagement with energy development (Karlstrøm & Ryghaug, 2014; Carvalho, 2007).

In agreement with literature on political ideology and public acceptance of clean energy technologies (Robertson, 2017, Jones & Dunlop, 1992), PH2 results also suggest that right-leaning respondents were less supportive of ES (particularly in Canada). These results somewhat challenge – at least in respect to the determinant factor of political orientation – the positive relationship that many have found between levels of public awareness (which PH2 suggests are highest among right-leaning respondents) and support for renewable energy technologies (Pierce et al., 2009). Indeed, while a greater awareness of ES was reported by right-leaning respondents, more conservative publics actually appear to be less favourable of the technology. While an explanation for this goes beyond the exploratory parameters of this study, further causal analysis here may reveal that heightened awareness of ES in this demographic group is negatively associated with people’s level of acceptance of storage.

Overall, PH2 results indicate that public awareness of ES in Canada and the UK is relatively lower than what has been found for more-established energy technologies (e.g., wind turbines, solar PV) (Peterson et al., 2015), yet similar to less salient innovations such as CCS (Perdan et al., 2016) and biofuels (Sengers et al., 2010). Notably, previous research on similarly unfamiliar technologies has indicated that public awareness increases quickly as publics engage with and become exposed to information about such innovations (Shackley et al., 2005; Upham and Roberts, 2011; Mallett et al., 2018). Thus, 2018 low levels of awareness of ES

suggest great potential (i.e., a clean slate) for shaping public perceptions through media and other public communication in the coming years.

5.1.2 Framing

Media framing is known to shape public responses to new energy developments in society (Stephens et al., 2008; 2013; Lakoff, 2010), and is thus important for agenda-setting in energy transition processes (e.g., technology deployment, policy reform) (Lyytimäki et al., 2018). Accordingly, the ways in which potentially transformative innovations such as ES are framed in public discourse can inform their technological trajectories (i.e., within the MLP topography) (Leech et al., 2011; Ockwell & Byrne, 2010). As such, a key objective of this thesis was to characterise and compare framing of ES in Canada and the UK in order to better understand how these dynamics are unfolding in the two nations.

The SPEED frame analysis (PH1) revealed that media representations of ES in the two countries are similar, yet fundamentally different (**RQ1**). The most striking similarity was the overall positive (benefit) framing of ES in both countries, as well as the dominance of economic and technical frames, which contributed to techno-optimistic portrayals of storage. Still, the countries differed in their overall benefit-to-risk frame ratios, revealing a more favourable media perception of ES in the UK than in Canada overall. As in similar cross-national media frame analyses (Mallett et al., 2016), the two countries also differed in frequency distribution of SPEED frames, supporting the possibility that national energy and socio-political contexts (i.e., of the political economy) (Tugwell, 1980) underlie the framing (and domestication) of energy technologies in media discourse (Clausen, 2004). This finding was similarly observed at the sub-national level in our pilot study (Ganowski et al., 2018), wherein framing of ES varied by province (i.e., Ontario vs. Alberta) in reflection of unique regional socio-political contexts related to energy market structure, history, industry politics, and culture.

Similar to MCA results, public survey findings (PH2) also revealed higher benefit than risk perception of ES in both countries overall, with more favourable opinions emerging from UK respondents (**RQ2**). In fact, with the exception of contrasting emphasis on 'environmental risks' associated with ES, media framing of the technology (PH1) was generally congruent with public benefit and risk perceptions (PH2) (**RQ3**). Benefit-oriented perceptions of ES in both countries suggest that unlike shale oil or gas development (Clarke et al., 2015) and even certain renewable technologies (e.g., biofuels) (Delshad and Raymond, 2013), storage has been positively portrayed in the public sphere between 2016 and 2018 (**RQ1**, **RQ2**). However,

research on innovation diffusion (Kennedy, 1964; Rogers, 2010) suggests that this is likely to change, and rather quickly, as technology hype dissipates and publics encounter new information, including frames and counter-frames, serving to (re)shape their original perceptions (Perdan et al., 2016; Lakoff, 2007). For instance, the case with smart meters in Canada (Mallett et al., 2018) suggests that public perceptions will evolve as more ES units are deployed and stakeholders begin to personally experience the technology (e.g., use of home batteries, proximity to ES facilities) (Upham & Roberts, 2011). In many cases – i.e., where technologies are ‘shoved’ onto publics with inadequate communication and engagement efforts from external authorities (Mallett et al., 2016) – risk perceptions may begin to outweigh benefit perceptions. Thus, gaining early insight into public framing of ES may allow industry and policymakers to ‘get ahead’ of social acceptance, which is problematically often viewed as an afterthought than a forethought in energy technology deployment (Wüstenhagen et al., 2007; Stephens et al., 2013). Integrating early social concerns and opinions on ES into policy and communication design may be particularly important for garnering greater public support in the short and long-term.

The prevalence of technical and economic framing of ES in Canadian and UK national newspapers reflects a similar frame profile found in provincial Canadian coverage on ES between 2007 and 2017 (Ganowski et al., 2018). This finding also aligns with other SPEED studies on energy technologies in North America, such as smart grid (Stephens et al., 2015; Langheim et al., 2014; Mallett et al., 2018), and biomass (Feldpausch-Parker et al., 2015). However, the dominance of these frames differs from media representation of more debated innovations (e.g., CCS) (Feldpausch-Parker et al., 2015), as well as established renewable technologies (e.g., wind turbines). The latter tend to see more cultural and environmental risk framing (Stephens et al., 2009), while ES appears to be framed as a more ‘techno-economic’ innovation for energy system change (Cherp et al., 2018). Similar to our Canadian pilot study, a greater technical and economic media emphasis on ES in Canadian and the UK was linked to the technology’s recognised potential for enhancing existing electricity networks and enabling a future, ‘improved’ grid (Gaede & Rowlands, 2018a), while creating new (‘green’) economic opportunities (e.g., job creation). More favourable framing of ES in the UK was linked to widely-observed technical benefits of storage in UK newspapers (i.e., improved grid performance and energy security), which was then echoed by respondents’ benefit/risk perceptions in PH2 (e.g., on the potential for ES to address electricity network issues). This technical focus on ES aligns with increasing national energy security priorities and concerns (also revealed by the narrative

analysis in PH1), which alongside climate change and affordability, have been key drivers for clean energy development in the UK in recent years (Johansson, 2013; Demski et al, 2014; Abdo & Kouhy, 2018) and will likely continue to be post-Brexit (Batel & Devine-Wright, 2018).

Overall, this techno-economic focus in both countries reflects: (1) unique and similar national contexts and priorities for ES in this context (i.e., grid modernisation, energy security); (2) the increasing eminence of economic arguments in energy change debates (Leach et al., 2010; Djerf-Pierre et al., 2016); and (3) modern ecology discourses within the “cultural economy of cleantech” (Capriotti, 2012) (explored further in [Section 5.1.3](#)). As Djerf-Pierre et al.’s (2016) study on biofuel framing also suggests, media are increasingly relying on economic and technical frames to portray new energy technologies as vehicles to the ‘green economy’ (Jackson & Victor, 2013; Jackson, 2009). This framing supports Dryzek’s (1998) ‘ecological modernisation’ and ‘survivalist theory,’ as it suggests that ‘technologies of the future’ will come to our rescue by providing enough clean energy resources to help us transform our high-carbon economies without hindering economic growth. Supported by techno-economic values and ‘green capitalist’ traditions, this trend might offer one explanation for the potential right-leaning salience/awareness of ES observed (particularly in the Canadian sample) (Corner, 2013). However, it does not align with evidence that right-leaning respondents tend to report less favourable perceptions of ES (i.e., in terms of benefit/risk perceptions and affect). Given the political nature of energy issues in industrial society (Dragoilovic & Einsiedel, 2014; Bolsen & Shapiro, 2018), Fraune & Knodt (2018) recently examined some of the causes and consequences of partisanship around clean energy technologies. Interestingly, they found that populism (especially right-wing) and post-truth politics – which appear to have escalated since major political events like the US presidential election of Donald Trump and since initial Brexit propositions captured international interest (Mounk & Eiermann, 2017) – strongly indicate the polarisation of energy transition processes such as alternative technology innovation. Further research on ES in this context might help to better ascertain the role of political ideology in informing public acceptance for low-carbon energy technology deployment.

Nevertheless, the potential consequences of ES techno-optimism (particularly of the unsubstantiated kind) are obvious. From an environmental perspective, exaggerations of the technological potential for addressing sustainability issues allows ecological overshoot to persist and encourages public passiveness to important socio-political and cultural arenas for sustainable energy change (Kirby & O’Mahony, 2017). In other words, ‘radical hope’ (Barry,

2016) in 'techno-fixes' often leads to the dismissal of behavioural-based energy solutions (e.g., conservation and efficiency), which can in turn perpetuate currently growth-oriented energy economies, inching us closer to exceeding socio-ecological boundaries (Barry, 2016; Raworth, 2012). From a social acceptance perspective, propagandised techno-optimism increases the likelihood of failed stakeholder expectations (i.e., 'hype-disappointment'), which can adversely affect the perceived legitimacy of the ES sector, threatening investments and innovation processes (Ruef & Mackard, 2010), and thus the potential for ES innovations to emerge beyond current niche spaces (Winfield et al., 2018). In any case, optimistic techno-economic framing of ES will likely help shape public responses to its deployment, particularly as national energy contexts (e.g., retiring nuclear and gas plants in Canada) and both socio- and geo-political events (e.g., Brexit outcomes in the UK) unfold, in turn prompting governments to make major transition decisions with wide-ranging impacts on energy citizens (Laird, 2013; Jaspal et al, 2014).

Interestingly, while economic framing (both benefit and risk) was dominant in Canadian newspapers overall, a higher distribution of economic risk frames (as compared to the UK) in the country's media sample likely reflects greater economic uncertainty, and perhaps to some extent, regime-resistance to ES (particularly from incumbent actors in provinces with more 'locked-in' fossil fuel energy regimes, such as Canada's oil giant, Alberta) (Geel et al., 2014; Vergragt et al., 2011; Klitkou et al., 2017). Indeed, high economic-risk framing (namely in Alberta's regional newspapers) was also observed in our Canadian pilot study, suggesting persistent market and financial barriers for ES deployment in the highly fossil fuel-dependent jurisdiction (Ganowski et al., 2018). Moreover, higher economic risk framing in Canadian news media (PH1) also aligned with Canadian survey respondents' financial/economic risk perceptions of ES (PH2). However, public opinions of ES in this respect were more closely tied to personal financial risk perceptions, perhaps reflecting common public concerns over electricity pricing in Canada (particularly in Ontario), and the impact that renewable energy development has had on rate increases (rather than the broader economic considerations reflected in news media) (Winfield et al., 2018).

Significantly lower regulatory and legal framing of ES in Canada might be explained by underdeveloped provincial frameworks for ES implementation or little regulatory salience around the issue overall (Langheim et al., 2014). This may reflect lower regulatory concern around ES in Canada, but (as suggested by inter-coder reliability results) may be more likely due to the

nature of regulatory ES discourse in news media. In both countries, the regulatory SPEED function was often too vague to code as a benefit or risk frame, as it generally focused on energy regulation conditions around ES rather than on consequential outcomes. Thus, the discourse was more adequately captured as the ‘political contention’ narrative which was observed during NVivo text-search query searches and narrative analysis (see [Section 5.1.3](#)).

Where comparisons were possible, analysis showed that media and public framing of ES was generally congruent (**RQ3**). However, ‘environmental risk’ framing of ES was more prominent in PH2 than in PH1. While ‘environmental benefit’ framing was apparent in both data sets, the absence of environmental risk frames in both newspaper samples was striking. This may be an indication of a pro-environmental bias for ES in news media between 2016 and 2017, perhaps unintentionally orchestrated by the Climate Publishers Network (to which both *The Guardian* and *Toronto Star* belonged between 2015 and 2017). The Network promoted climate change-related news, leading up to and following the 2015 United Nations Paris Climate Change summit in order to raise public awareness of environmental issues. Notably, this type of environmental coverage on ES was more apparent in the Canadian sample. Alternatively, this finding may suggest that national press is currently taking an ‘industry lapdog’ (rather than a ‘watchdog’) position toward ES development (Whitten-Woodring, 2009) by promoting and disguising commercial interests through environmental benefit framing (Howell et al., 2014). Regardless, MCA results (e.g., inflated optimism around ES, particularly in Canada) clearly suggest that what used to be known as ‘balanced’ journalism is hardly evident in more recent (2016-2017) media coverage on ES. In the same vein, public survey results clearly illustrated public risk perceptions of ES that newspapers failed to report; out of the technical, economic, and cultural risk perceptions measured in the survey, environmental risk concerns for ES deployment were surprisingly among the highest in both countries. This suggests that in both countries, the 2016-2017 portrayal of ES as a beneficial ‘green’ technology is more apparent in media discourse than in the public’s eye.

In short, both PH1 and PH2 results suggest a generally positive, techno-economic framing of ES in both countries, yet varying benefit and risk frame distributions which reflect unique national drivers and contexts for ES deployment. Findings therefore support the ‘domestication’ of ES in national media – i.e., the argument that a combination of domestic structural (e.g., energy resources and production), institutional (e.g., politics and industry), and cultural (e.g., social values and priorities) factors influence the ways in which technologies are

framed. Striking national differences in economic framing perhaps suggest that structural economic differences (e.g., grid system and market design) may be more responsible for how ES is framed than cultural factors – the latter being more apparent in Mallett et al.'s (2016) comparison of smart grid framing in Canada and the US. Indeed, results support the argument that new energy technologies are often framed and domesticated by media in different ways, but nevertheless imply that these social constructs play a key role in systems of energy innovation and technology diffusion (Skjølsvold, 2015). Still, differences in environmental framing of ES between PH1 and PH2 also suggest some misalignment between media and public perceptions of the technology in respect to sustainability aspects and political salience (**RQ3**). Comparing these framing results with ES representations in other countries, perhaps with contrasting media contexts and political economies, would provide further insight on these inferences.

5.1.3 Narratives

In order to better understand social representations of ES in Canada and the UK, this thesis also examined how frames around storage are weaved together to create 'narratives' – i.e., discursive storylines or sociotechnical imaginaries for constructing meaning (Hermwille, 2016). Serving as links between scientific development and social learning, narratives can be fundamental to transition processes – particularly when used to describe desirable and anticipated futures (rather than physical realities) related to complex or unfamiliar issues, such as alternative energy technology deployment (Hermwille, 2016). Accordingly, since most ES solutions are still in early development stages (and thus generally invisible to public stakeholders), social learning of ES currently relies on the narratives circulated in public discourse. There is also some misalignment among current expectations for ES, the technology's maturity for deployment, and existing regime conditions for its uptake in Canada and the UK (Taylor et al., 2013; Gaede & Rowlands, 2018a). As such, emerging and shifting narratives around ES (i.e., due to project outcomes, changing stakeholder perceptions, etc.) will play a performative role in the technology's trajectory within these two countries. By exploring early ES narratives in news media, we can draw upon social discourse for insight on how the innovation is progressing along the MLP topography.

Accordingly, **RQ1(b)** asked what the most prominent narratives around ES are in each country's national newspapers in recent years (2016-2017). PH1 results confirmed four dominant narratives in the two media datasets: (1) 'climate change' – i.e., ES as a climate

change mitigation and sustainability solution; (2) 'economic development' – i.e., ES as a vehicle for economic opportunities and growth in energy-related sectors; (3) 'energy security' – i.e., ES as the key to securing safe, reliable, and abundant energy supply; and (4) 'technological innovation' – i.e., ES as the forefront of technological development. As expected, the prominence of these narratives varied between the two national samples (PH1) and resonated differently with Canadian and UK survey respondents (PH2). However, two other key findings are noted here: (1) individually, all four narratives were generally in favour of ES, carrying a discursive affinity for heightened techno-optimism; and (2) while each storyline contained unique sets of conflicts, solutions, actors, and so forth, the four narratives co-existed harmoniously in both samples, often complementing one another to reinforce greater advocacy for ES. In many cases, decoupling narratives within news articles was challenging, particularly when storylines were woven together to portray ES as a 'triple-threat' solution for the 'energy trilemma' (i.e., sustainability, affordability, security). In other words, both Canadian and UK news media often bundled these narratives together (e.g., see Wright & Reid, 2011) in order to construct 'win-win-win' scenarios for national priorities on climate change, energy generation and use, and technological innovation. The following excerpt provides an example:

Improving Britain's energy storage and managing electricity demand could save consumers up to £8bn a year by 2030, according to a report by Lord Adonis commissioned by the Treasury. It could also enable the UK to meet its 2050 carbon emissions targets and secure the country's energy supply for generations – *The Financial Times*, March 4, 2016

Others have also observed this narrative dynamic – e.g., see Asayama & Ishii (2017) on CCS in Japan, Hielscher & Sovacool (2018) on smart meters in the UK, and Wright & Reid, (2011) on biofuels in the US – suggesting that media often string together narratives concerning complex and unfamiliar phenomena in order to better appeal to the cultural lived experiences and values of public audiences (e.g., energy security, environmental protection). However, in this effort to gain public legitimacy through narrative 'alignment' (Wright & Reid, 2011), media tend to exaggerate opportunities and overlook risks pertaining to new technologies (as evidenced by environmental framing results in PH1) (e.g., see also Jönsson, 2011). This in turn can further perpetuate inflated optimism surrounding alternative energy innovations like ES.

The prevalence of the 'economic development' narrative in both samples points to high expectations for ES to yield profit opportunities for domestic energy sectors. This finding aligns with the top benefit frames found during the SPEED analysis (i.e., economic and technical), which were strategically used to construct desirable economic imaginaries around ES. By

stringing economic benefit frames together (e.g., job creation, infrastructure upgrade deferral, consumer savings), Canadian and UK newspapers constructed a utopic economic future following the anticipated breakthrough in cost-effective storage technology [e.g., *The Financial Times*, July 18, 2016]. Aligning with framing results, the ‘economic development’ narrative positioned ES as both a tremendous wealth opportunity for existing energy economies, but also as the key to unlocking the ‘green economy’ (Jackson, 2009). The narrative thus portrayed rapid ES development as a signal of forthcoming economic change to conventional, fossil fuel-dependent energy regimes:

There is now little doubt that we are on the cusp of big changes in the energy market. The business of digging stuff out of the ground will be with us for a long time but not as a growth industry. Instead, it will be the business of storing and managing power distribution that attracts investment and creates jobs. – *The Globe and Mail*, March 31, 2016

At times, in an effort to garner support from market spectators, the ‘economic development’ narrative portrayed ES strictly as an industrial innovation, focusing on venture capitalist opportunities and other financial rewards for both investors and non-investors [e.g., *Vancouver Sun*, November 5, 2016]. However, in most cases, this narrative echoed the often-criticised ‘green growth’ discourse (Alexander, 2014). In this sense, ES was described as a ‘money-making’ environmental innovation which could provide win-win solutions under the assumption that any innovation that offers eco-efficiency (e.g., optimisation of grid assets) has a positive impact on economic growth, which in turn has a positive impact on the preservation of natural capital (Jacobs, 2013) [e.g., *The Toronto Star*, January 21, 2011].

From a sustainability perspective, this rhetoric – upheld by ‘economic development’ and ‘technological innovation’ narratives – is precarious. It fuels the flawed, yet still widely-held view (even amongst some environmentalists) that ‘green growth’ is the desirable path to sustainability (Alexander, 2014). It reinforces the assumption that negative environmental and social costs of high-carbon, growth-oriented energy economies, can be eradicated through technological innovation (Barry, 2016). This generates high expectations for immediate commercial success of ‘techno-fixes’ such as ES while nurturing social complacency (rather than spurring transformative change) within existing energy regimes (Reid & Wright, 2011; Jacobs, 2013). Indeed, by explicitly linking ES to profitability, Canadian and UK media drew upon underpinning ideologies of the Western world, including free-market capitalism and the notion that ‘business as usual’ – in the face of climate crisis – can continue, so long as it is ‘greened’ through technological innovation (Bornschiefer, 2018). In observing that ES

commercialisation can improve energy system and market efficiencies, the bundling of 'economic development' and 'technological innovation' narratives helped to legitimise the notion that conventional energy systems, operating within growth-based socio-economic regimes, can be made more sustainable without hampering growth (Barry, 2016). Yet, there is substantiated evidence (e.g., dating back to Jevon's Paradox in 1865) (Alcott, 2005), which indicates that techno-efficiency improvements cannot reduce anthropogenic ecological impacts if they are cultivated within growth-oriented economic systems; rather, they can considerably reinforce ecological degradation. For technological innovation to truly address sustainability issues, it must emerge within a new economic paradigm based on 'sufficiency' rather than 'limitless growth' (Meadows, 1972; Jackson, 2009; Alexander, 2014).

As Wright & Reid (2011) would suggest, the current 'framing' of our 21st century sustainability problem also proposes that energy transition processes (e.g., low-carbon technology and policy deployment) are mainly driven by private activities achieved through markets and institutions, rather than democratic processes and public participation. Legitimising this assumption in the public sphere can hinder social acceptance and public participation in technology change, which is now widely observed as essential for accelerating the energy transition (Miller et al., 2013; Burke, 2017; Peterson et al., 2015; Demski et al., 2015; 2019). Moreover, the exaggerated likelihood for immediate economic success, coupled with unreflexive observations of ES agendas, may perpetuate techno-optimism through a 'bandwagon' effect that could very well leapfrog public disappointment and disengagement stages, and invite active resistance (e.g., to projects and policies). As seen with the US biofuel movement, favourable techno-economic emphasis on ES can spark sudden, unsubstantiated support for the technology, which can then manifest into less-favourable discourse as hypes are unmet, and risks and costs are fully realised. The case of hydrogen fuel cell development between 1993 and 2007 in Germany suggests that such hype communication can easily backfire and spur public resistance to change, stall innovation processes, and slow technology and policy implementation (e.g., via RD&D funding cuts, project abandonment, negative press) (Ruef & Markard, 2010).

Similar to SPEED findings, national differences in narrative use also suggest the domestication of ES in both countries – which, as discussed earlier, can inform the ways in which publics identify with and accept technologies in relation to domestic priorities and values (Clausen, 2004; Fouquet & Pearson, 2012). For instance, by linking ES to national energy

trends (e.g., energy decarbonisation in Canada) and priorities (e.g., energy security in the UK), as well as national values (e.g., electricity affordability in Canada) and socio-political conflicts (e.g., Brexit uncertainty in the UK), news articles constructed imaginaries around ES that resonate with domestic audiences. A greater focus on climate change in the Canadian sample likely emerges from the country's historical struggle to meet international climate targets (e.g., Kyoto Protocol, G8 Summit, 2015 Paris Climate Agreement) (Hayden, 2014; Boothe & Boudreault, 2016), as well as growing public advocacy for more robust climate action in light of its lagging performance on decarbonisation (Bukhari et al., 2018; Burck et al., 2018; CBC News, 2018). Overall, this narrative functioned to convince readers that ES deployment will play a key role in the changes required to tackle national climate crises and can thus help preserve the quality of life which Canadians cherish. The following excerpt provides an example of how ES was domesticated in this context:

Climate change is already affecting many things Canadians hold dear - our extraordinary landscapes; our iconic species; our glaciers, rivers and lakes; even our ski hills and maple syrup, not to mention our nation's favourite game (by 2100, there may be no ice for future Wayne Gretzkys to practice on in their winter backyard rinks). These changes are sending a clear message that we must radically change the system within which we live, including how we manage landscapes, run our industries, make consumer choices, and build our cities. Clearly, this is a complex challenge that requires action by innovative leaders at many levels [...] The good news is the transition to a sustainable future provides opportunities worth trillions of dollars for companies and financiers. Meanwhile, renewable technologies such as battery storage and solar panels are developing exponentially, and costs are plummeting, expediting opportunities for systemic transformation. – *Vancouver Sun*, March 3, 2017

PH1 results revealed how Canadian ES articles leverage the 'climate change' narrative by drawing upon national values and cultural markers (e.g., appreciation of natural capital, hockey, maple syrup) in order to appeal to a national public and portray ES as a sustainability solution. Accordingly, this narrative coincided with a greater public concern for climate change (compared to the UK sample) in PH2, suggesting congruence between media and public perceptions of ES in a narrative context (**RQ3**). This domestication effect is important for the uptake of ES and broader energy transition efforts, as the success of system change is said to be largely dependent on the degree to which decision-makers and proponents succeed in connecting policy and technology development with shared national values and cultural experiences (e.g., security, affordability) (Malone et al., 2017). Thus, narratives which draw such connections in the public sphere can help bolster support for policies and investments required for meeting decarbonisation and other energy goals.

Likewise, the UK media's focus on ES as an 'energy security' solution reflects the

country's increasing concerns over secure energy supply in the face of: (1) dwindling natural gas resources and government subsidies; (2) contradicting energy planning strategies put forth by the government between 2016 and 2017 (i.e., unclear capacity market rules, continued investment in fossil fuel generation); and (3) overall concerns around energy trade and pricing amongst Brexit uncertainties (Cox, 2018; Matsumoto et al., 2018). ES was particularly domesticated (i.e., nationally contextualised) in UK newspapers when linked to domestic energy and industrial strategies (e.g., the UK's 2017 Clean Growth strategy), market reform activities (e.g., the UK 2013-present Electricity Market Reform), and the UK public's culturally-lived experiences with security issues [e.g., *The Guardian*, January 23, 2017]. The following excerpt provides an example:

Energy storage is important for renewable energy not because green power is unpredictable – the sun, wind and tides are far more predictable than the surge that follows the end of a Wimbledon tennis final or the emergency shutdown of a gas-fired power plant. – *The Times*, November 16, 2017

The prevalence of the 'energy security' narrative in UK newspapers, also coincided with survey results, as UK respondents showed greater concern over energy security (expressing greater interest in ES as a security solution) than did Canadian respondents. This again supports congruence between media and public perceptions of ES and illustrates how the technology conforms to domestic energy priorities and concerns (**RQ3**).

The bundling of 'energy security' with other narratives (namely 'economic development') portrayed ES as an 'all-in-one' national solution for a more reliable and secure future energy system in the UK [e.g., *The Independent*, May 15, 2017]. At the same time, the portrayal of ES as a "no regrets option" for "boosting energy security" in the UK also exposed poor and contradictory government action for ES implementation [*The Guardian*, February 4, 2016]. The following illustrate how ES fits into contentious energy discourse in the UK during this time:

It's embarrassing that Britain, one of the world's leading economies, has to hand out taxpayer-funded subsidies to clunking old coal plants and highly polluting diesel generators to keep the lights on. The right mix of renewable energy, battery storage and efficiency measures offer a much better alternative. – *The Guardian*, October 16, 2016

Compared with alternative energy sources, such as offshore wind and solar, backed up by interconnectors and battery storage, Theresa May should see better ways to keep the lights on, prices fair and carbon emissions down. – *The Guardian*, September 1, 2016

Indeed, the 'energy security' narrative revealed an additional narrative around ES which was not deductively coded for but emerged, as anticipated, during qualitative and text-search

analyses. Unlike the other four narratives, the ‘political contention’ narrative did not observe ES as a protagonist of any given storyline, but conveyed discussions and debates on policies, regulatory conditions, and government (in)action concerning storage development. From a broader perspective, this narrative highlighted the politicisation of energy transitions in national media (as one *Daily Telegraph* article explicitly noted) and reaffirmed the inextricable relationship between energy and politics in industrial societies (Tugwell, 1980) – a dynamic which will likely inform ES deployment in both countries [e.g., *The Daily Telegraph*, May 2, 2017] (Meadowcroft, 2009; Gaede & Rowlands, 2018a; Healy & Barry, 2017; Fraune & Knodt, 2018).

A greater prominence of the ‘political contention’ narrative in the UK sample is likely due to the current state of energy security, market and regulatory reform, and a general political uncertainty in the EU (Grubb & Newbery, 2018; Li & Pye, 2018). Interestingly, unlike the other narratives, ES fell into two conflicting storylines here. One argument was such that the UK government continues to impose unfavourable market and regulatory conditions for large-scale ES deployment; while the other vouched that government is fully committed to “leveling the playing field” such that ES projects could succeed in the new capacity market scheme [e.g., *The Guardian*, January 30, 2017; *The Financial Times*, March 4, 2017]. Similarly, in some Canadian news articles, government investment in ES amidst a broader clean energy agenda was glorified as one of the greatest “nation-building exercise[s]” of the century [e.g., *National Post*, March 4, 2017]. Other articles contained attacks on government for “dragging its heels” on ES, as well as concerns over poor policy track records in certain Canadian provinces (e.g., “Ontario’s failing electricity policies”), which need addressing before the country can “seize the energy opportunities of the 21st century” [e.g., *The National Post*, March 4, 2014; *The National Post*, September 3, 2016; *The Globe & Mail*, May 16, 2017]. Despite these conflicting storylines, the ‘political contention’ narrative (in both samples) echoed an underlying premise: *government is a critical actor in driving the clean energy transition, yet the extraordinary rate at which transformative technologies, such as ES, are advancing exceeds the capacity of decision-makers to control and regulate niche-innovations in order to seamlessly support large-scale low-carbon energy development.* The following excerpts illustrate how this narrative appeared in both samples:

Renewables have undergone a technological revolution, but it is now time for energy policy and infrastructure to catch up. “Britain’s rising imports are, in the short term, an easy way out for a government that has failed to deliver.” – *The Daily Telegraph*, October 24, 2017

A technological revolution in energy systems is now under way. How governments respond to these developments will have a major impact on the shape of future energy systems, and their

role in enabling [Canada] to meet the goals of the Paris Agreement. – *The Globe and Mail*, May 16, 2017

This narrative, which was also apparent in our pilot study (Ganowski et al., 2018), supports observations on governments' important, yet challenging (and often contested) role in advancing energy transition processes (Sung & Park, 2018) – including ES deployment (Kittner et al., 2017; Gaede & Rowlands, 2018a; Winfield et al., 2018) – within an era of unprecedented technological change. It echoes Mark Winfield's (2017) *Globe and Mail* article on electricity policy "falling behind the energy revolution" in Ontario, as well as similar observations on the UK's policy struggles within transitioning electricity market systems (Bolton & Foxon, 2015; House of Commons, 2016; Li & Pye, 2018). The 'political contention' narrative further supports the position that ES is becoming a politicised energy topic, and that narratives around the technology are shifting as various system actors *re-frame* the innovation in order to maintain control over it within incumbent energy regimes (Gaede & Rowlands, 2018a). In other words, the political contention around rapid ES development in both countries may reflect the attempts of institutional actors to keep sustainable innovations 'on a leash' (Smink et al., 2015), until they align with incumbent interests (or alter them to affect system change). This again provides some evidence of ES undergoing important niche-regime interactions, thus supporting Winfield et al.'s (2018) observation of storage sitting at a "niche-to-regime" cusp (Geels & Schot, 2007).

In both countries, back and forth media debates on governments' handle on ES point to some niche-regime misalignment between 2016 and 2017, particularly at the policy and regulatory levels (Winfield et al., 2018). From a social acceptance lens, this inconclusive discourse sends unclear messages to key stakeholders, which may adversely affect public trust in national/provincial ES implementation strategies, as well as stakeholder opinions and adoption of the technology itself. For example, one news article noted that "continued uncertainty around the [UK] Government's energy policy has created a confusing picture for investors seeking a low-risk return," which allegedly contributed to an "all time low" ranking for investments in the country's clean energy sector in 2016, following early Brexit debates [*The Independent*, October 28, 2016].

In sum, PH1 results identified four different, yet complimenting ES narratives in Canadian and UK newspapers that contributed to a positive media representation of storage overall (**RQ1**). The dominating 'economic development' and underpinning 'technological innovation' narratives in both samples heightened techno-optimism around ES (Ruef & Mackard, 2010). The 'climate change' and 'energy security' narratives contributed to this effect,

while clearly domesticating ES perhaps in an effort to capture national appeal (Clausen, 2004; Skjølsvold, 2012). Relevant PH2 results corresponded with narrative use in national newspapers, again suggesting congruence between media and public perceptions of ES (RQ2; RQ3). The deductive narrative analysis reflected national-level differences in ES progress to date, as well as broader socio-political and energy priorities for the technology. Finally, an underlying ‘political contention’ narrative functioned differently (than dominant narratives) to reveal political tensions, and perhaps niche-regime misalignments concerning ES in the two countries. While this was particularly evident in the UK, it is noted that even the ‘political contention’ narrative still supported ES, despite articulating interrelated conflicts among system actors. Overall, these findings suggest that ES narratives in the Canadian and UK public spheres are operating in reinforcing, complex ways to both reflect and influence domestic contexts for ES deployment; the potential consequences of which (e.g., unsubstantiated techno-optimism, public interest and acceptance, distrust in government leadership) warrant further investigation. Additional inductive narrative analysis would help to determine other conflicting and/or complementing ES discourses – perhaps similar to what Hielscher & Sovacool (2018) found for smart meter imaginaries in the UK (e.g., ‘empower consumers’, ‘the low-carbon grid,’ etc.) – beyond the five narratives described here.

5.1.4 Valence

The final indicator used to determine and compare social perceptions of ES in Canada and the UK was ‘valence’ – i.e., the general orientation or portrayal of storage in the public sphere as desirable or regrettable. Given the more intuitive nature of interpreting valence, this variable was used as a triangulation technique which helped to summarise the overall ‘tone’ of ES representations in the two countries. In the PH1 MCA, valence was assessed by characterising media orientation toward ES as ‘negative,’ ‘neutral,’ or ‘positive’ (see [Appendix B.1.2.4](#)). In the PH2 survey analysis, valence was assessed by measuring public ‘affect’ (i.e., emotional orientation) toward ES, using Likert-scale questions to tap into respondents’ attitudes toward ES deployment in their domestic electricity networks.

Overall, in line with the preceding discussion on techno-optimism, PH1 results revealed strong positive valence toward ES in both 2016-2017 national media samples (i.e., 70% of ES articles = ‘positive’; 24% = ‘neutral’; 6% = ‘negative’). In PH2, publics generally agreed with this interpretation: 40% ($n = 499$) of all respondents (who read newspapers) reported that ES is positively portrayed in the media (52% reported ‘neutral’; 8% reported ‘negative’). Together, these findings suggest that ES is represented/perceived favourably in national newspapers in

both countries between 2016 and 2018 (**RQ1**). The slight discrepancy between MCA results and public perceptions on ES media portrayal here may be due, in part, to the different observation periods for which these conclusions were drawn. For instance, 2018 ES media coverage (observed by survey respondents) may have very well been less positive (more neutral) than 2016-2017 ES coverage (analysed during the MCA). Given that respondents considered the same newspapers that were sampled in PH1 to make this assessment (which was confirmed by answers to the PH2 news readership questions), this finding may suggest that more recent ES coverage (2018) is more 'neutral' (i.e., balanced) (Luedecke & Boycoff, 2018), while earlier coverage (as also shown by frame/narrative results) was more inclined to favour ES. While respondents' assessment of ES media portrayal in PH2 provided further insight on PH1 valence results, the potential of neutral reporting and acquiescence bias is noted here (given that ES is a rather unfamiliar and complex topic to the public) (Ross & Mirowsky, 1984).

Still, many technology diffusion and media hype studies suggest that early media coverage on new innovations is often more optimistic, as it is still free of competing positions that later trickle into public discourse to cause a "trough of disillusionment" (i.e., declined issue visibility and expectations) (Rip, 2006; Rogers, 1983; 2010). As such, survey respondents' reporting of less positive ES valence (2018) may suggest a dissipating hype around ES following what appears to have been a "peak of inflated expectations" in 2016 for Canada, and perhaps (if we continued the MCA) in 2017 for the UK (Gartner Group, 1995; Bakker & Budde, 2012). This potential decline in ES valence may be a result of various factors, including time lags between hyped project announcements and actual deployments (e.g., 2012-2015 IESO ES procurements in Canada) [e.g., *The Globe and Mail*, February 6, 2017] and delays in ES legislation caused by more pressing political issues (e.g., Brexit) [e.g., *The Independent*, October 28, 2016] (Pratt, 2018; Batel & Devine-Wright, 2018). Downs (1972) and the Gartner Group (1995) may have argued that such factors could have led to a decline in media attention (salience) on ES after 2017. However, declining valence appears to be more relevant to Ruef & Mackard (2010) notion of a 'hype-disappointment' dynamic.

To elaborate on this point from earlier sections, the hype-disappointment dynamic is often a product of what Bakker & Budde (2012) call 'expectations and innovation races.' In this sense, strong positive valence around ES between 2016 and 2017 reflects a storage hype in both countries that is evidently attracting and mobilising system actors, funding, investments, policy and other institutional change that would otherwise not have progressed (at least not as quickly) (Bakker & Budde, 2012; Kittner et al., 2017; Winfield et al., 2018). ES hypes appear to

have instigated an ‘innovation race’ in which both new and incumbent regime actors are rushing to solve “the storage conundrum” so as not to miss out on a new opportunity which could otherwise result in being ‘left behind’ as the world shifts to smarter and more sustainable energy systems [e.g., *The Globe and Mail*, March 28, 2016]. However, this is also very much an ‘expectations race’ in which communication (i.e., media discourse) is just as important for driving change (i.e., by holding innovators and governments accountable for delivering their promises to public stakeholders) as innovation itself (Li et al., 2015). This dynamic has been widely observed with EVs, stationary hydrogen fuel cells, and automated vehicles, resulting in a range of outcomes, from institutionalised innovation activities to public distrust in developers (Aggeri et al., 2009; Bakker & Budde, 2012; Ruef & Mackard, 2010; Hopkins & Schwanen, 2018). For instance, in the late 2000s, the automotive industry began an expectations race for ‘who would be the most innovative and responsible car maker’ (Bakker & Budde, 2012). Growing expectations eventually triggered an EV innovation race, particularly as battery technology matured and actors (e.g., policymakers, regulators) began to “break out of the waiting game” to match efforts of niche innovators (e.g., Tesla Inc.) (Bakker & Budde, 2012; p.11). This effect continues to have implications for EVs in a transition context, as hypes shape innovation interactions between niche and regime spaces (Geels, 2007; 2014; Rosenbloom et al., 2016). PH1 findings suggest that the same might hold true for ES. Valence results illustrated an explicit hype-race dynamic, particularly in the UK, and a probable hype-disappointment effect brewing in Canada. The following excerpts provide further context:

Dozens of companies are racing to find affordable ways to store intermittent solar and wind power, but the effort has been hampered by the relatively high cost of batteries. With average lithium-ion cell prices about a third of what they were in 2010, energy investors are looking at opportunities closely. – *Financial Times*, May 3, 2016

Some 75 of these projects are for cheap batteries and storage. Nobody knows which will win the race: organic flow batteries, or those using zinc-air, among others, but Washington believes several could cut energy storage costs by 80pc to 90pc [...] Once electricity can be stored at a viable cost, the “intermittency” problems of wind and solar fade away. This alone could render Hinkley Point [proposed nuclear plant] an anachronism by 2025. – *The Daily Telegraph*, September 16, 2016

At first glance, this discourse spells good news for ES deployment. However, as inflated expectations and unrealistic timelines begin to meet socio-political and institutional inertia – the “nebula of regulations and investment procedures” that stalled Hydrostor’s underwater compressed-air project in Canada’s Lake Ontario serves as an example [*The National Post*, January 31, 2015] – the hyped ES sector may become “littered with the remnants of grandiose hype and unfulfilled promises” [*The Globe and Mail*, February 5, 2016]. This may in turn lead to adverse effects on public acceptance of announced projects, stakeholder trust in developers

and decision-makers, as well as continued investments and innovation processes for ES (Ruef & Mackard, 2010). The notion of public trust (or rather distrust) in actors involved in ES deployment will be especially important in the UK, where there appears to be a growing public ‘trust deficit’ toward energy companies and governments as a result of perceived profit and political motivations driving inadequate and unjust energy system changes (Demski et al., 2015; 2019). In this way, hype-disappointment dynamics (manifested by unfulfilled promises and failed expectations) may threaten public willingness to accept and contribute (e.g., financially, socially) to energy transition processes, such as energy technology deployment. Proactively addressing these dynamics with more diverse, transparent, and realistic portrayals of ES will help to balance uncertainty and optimism for its development, thus protecting against such consequences (e.g., see Asmaya & Ishii, 2017). Further research on how these hype dynamics are evolving over time, as well as correlational assessments among specific socio-political factors (e.g., policy developments, public trust), media frames, and ES deployments would provide richer insight on these findings.

Overall, media valence was generally congruent with public affect toward ES; both study phases suggested a strong positive orientation toward ES (**RQ3**). This correspondence between media and audience perceptions suggests that the positive reports of ES contained in national newspapers also appear in the cognitions of public audiences – as similarly observed by Chang (2009) on biofuel perceptions in the US. This finding agrees with similar national-level studies that have found widespread support for and interest in low-carbon energy development, particularly for climate change mitigation (Hagen & Pijawka, 2016; Wolf & Moser, 2011). However, PH1 also revealed that positive orientation of ES was upheld more by economic and technical representations, which integrated environmental dimensions, but did not rely on them build a strong case for ES.

However, this study also suggests some differences between Canadian and UK public support for storage. Although PH1 did not reveal meaningful national differences in media valence, PH2 suggested that UK respondents exhibit more positive affect toward ES than do Canadians (**RQ2**). This aligns with studies that have found UK citizens to possess a relatively higher (as compared to countries such as the US, Sweden, and Japan) acceptance of “climate-friendly” energy technologies (e.g., solar and wind power, EVs, and biomass) (Reiner et al., 2006). The finding also brings us back to the question of whether ES constitutes an ‘environmental’ or an ‘industrial’ energy innovation (Jacobs, 2013). Is it both? And, what might that mean for public understanding and acceptance of the technology in the two countries? The

well-documented case of public resistance to wind turbines – which in many jurisdictions are perceived as unaesthetic industrial developments that spoil natural landscapes and cause health and ecological impacts (Deignan et al., 2013; Songsore & Buzzelli, 2015) – suggest that the industrial representation of ES may invite some pushback as ES units are deployed in different public and natural spaces.

Indeed, several findings from PH1 (e.g., dominating techno-economic narratives) suggest that ES is not (and perhaps should not be) classified as a ‘green’ technology, but rather as a transformative industrial energy innovation that provides major efficiency and sufficiency advantages, with added sustainability benefits. Gaede & Rowlands (2018a) also allude to this by noting that many energy system actors are less interested in ES for “climate change planning” and more so for addressing structural needs of domestic electricity networks (e.g., reducing system costs, supporting grid functions) (p. 271). Together, these findings present an opportunity for more sophisticated analysis (e.g., longitudinal media/survey studies) to determine whether (and which) storage applications are represented and perceived as ‘green’ and/or other forms of energy innovation. Understanding how such meaning construction around the technology influences social acceptance levels – e.g., public willingness to live close to facilities or pay higher electricity bills to support technology deployment – will likely have implications for ES uptake at various energy system levels (e.g., bulk, end-user, etc.).

Finally, while this thesis does not attempt to determine which factors predict national perceptions of ES, we can return to our earlier discussion on ‘identity,’ ‘place,’ and ‘process’ (see [Section 2.2.2](#)) to consider how some of these dimensions might be shaping ES acceptance in Canada and the UK (Peterson et al., 2015). Given the novelty of ES in both countries, public affect (in 2018) can be understood as a product of social representations of ES (rather than personal experiences or physical realities) resonating with the ‘identities’ and ‘processes’ of two national publics. Based on the literature, we can assume that certain demographics (e.g., gender, political orientation) (Dietz et al., 2002; Hamilton et al., 2018), social values and priorities (e.g., security, sustainability) (Wolsink, 2012; Spence et al., 2015; Demski et al., 2015), and processes (e.g., engagement with media) (Parkin et al., 2017) in both countries all help to influence (to different extents) public affect toward ES. Since PH2 results suggested a similar demographic profile for publics with positive attitudes toward ES in both countries (i.e., males, centre-left orientation), national differences in respect to valence might be more appropriately explained by differences in social value systems. For instance, Demski et al. (2015) suggest that social values (i.e., identifiable cultural resources upon which people draw in order to form

perspectives on energy system change) are an important basis for understanding public acceptance of energy transition processes such as technology deployment. In their UK case study, the researchers found that values related to “efficiency and wastefulness,” “environment and nature,” and “security and stability” considerably shaped public opinions on different aspects of energy system change (p.64). Given the national differences in narratives and public concerns around ES (i.e., climate change in Canada; energy security in the UK), it is possible that domestic values and energy priorities are associated with media valence and public affect toward ES. This could be further validated with correlational analyses, and other cross-national case studies. Nonetheless, findings from PH1 and PH2 resonate with Demski et al.’s (2015) notion that public acceptance of energy transition processes will, in part, be conditional, upon how well the technology aligns with domestic socio-political contexts and social value systems.

5.2 Summary

This chapter has unpacked comparative insights on ES representation in Canada and the UK in respect to issue salience, framing, narratives, and valence. Overall, findings suggest increasing ES salience in national news media, with some evidence of declining issue attention in Canada since 2016 and still rising salience in the sampled UK newspapers. In both countries, ES attracted mainly optimistic techno-economic social representations, which differed in certain cases, suggesting to some extent, that national energy contexts, socio-political factors, and social values influence how ES is portrayed in the two public spheres. National public orientation toward ES was also similar in respect to awareness, risk/benefit perceptions, and emotional affect. Yet, some differences in these aspects suggest greater socio-political acceptance of ES in the UK than in Canada. Nonetheless, ES was portrayed positively in both public spheres, with clear congruence between media and public perceptions in many contexts (e.g., techno-economic emphasis), yet discrepancy in others (e.g. environmental risk portrayal). While media findings suggested strong techno-optimism for ES as an energy transition solution, survey results illustrated some uncertainty around storage as a ‘green’ innovation. Findings also suggested evidence of various hype dynamics and domestication effects around ES, which may shape public acceptance, policy development, and innovation processes related to its uptake in both countries. Political energy debates in news media, particularly in the UK, suggested some niche-regime misalignment concerning ES in existing systems, perhaps supporting that ES is indeed a transformative technology for the low-carbon energy transition. The following chapter synthesises these findings and presents final conclusions, research recommendations, and practical considerations emerging from this work.

Chapter 6 – Conclusions and Recommendations

6.1 Overview

This thesis has examined and compared the social perceptions of ES in Canada and the UK in order to gain a better understanding of the socio-political factors surrounding the acceptance and deployment of this potentially transformative technology. This was achieved by applying various social scientific frameworks for examining clean energy development as a two-phase comparative study consisting: (1) a mixed methods media content analysis (MCA) (of national newspaper coverage); and (2) a secondary analysis of public survey data (SSA) fielded from a research collaboration between the University of Waterloo (Canada) and the University of Surrey (UK). The purpose of this final chapter is thus to provide the main conclusions, knowledge contributions, and research and practical recommendations emerging from this work.

The study is situated within various literatures that recognise media and public actors as essential to the success of low-carbon energy technologies within a transitioning global energy landscape. Given the potential that ES has for addressing ‘energy trilemma’ issues (e.g., security, sustainability, affordability), there is now considerable research investigating the techno-economic feasibility of storage for existing and future electricity networks. However, this thesis has aimed to address a gap in energy social science literature on ES, namely on how social perceptions of the technology both reflect and affect its trajectory in society (Devine-Wright et al., 2017; Batel, 2018). Accordingly, using Canada and the UK as national case studies, the project set out to determine: **(RQ1)** how the salience and representation of ES in national newspapers compared nationally between 2008 and 2017; **(RQ2)** how general public awareness and perception of ES compare nationally (2018); and **(RQ3)** how national newspaper representations and public perceptions of ES compare, overall. Using an exploratory approach to answer these questions, the study focused on four aspects (i.e., issue salience, framing, narratives, and valence), thus offering several empirical benchmarks for future research in this space.

6.1.1 Research conclusions

Despite all potential for generalisability, the findings presented in this thesis are with respect to the research samples used in PH1 and PH2, and not to the entire media or public population in Canada, the UK, and/or any other jurisdiction. Further, all conclusions provided in this chapter were drawn in recognition of the theoretical assumptions and methodological

limitations noted in chapter 3 and 5. As such, the following conclusions can be presented based on the research questions noted above:

RQ1. Overall, PH1 results showed an increase in national newspaper reporting on ES in both Canada and the UK between 2008 and 2017, suggesting that the salience of storage has increased in both public spheres over the last ten years. However, while ES reporting continued to increase in national UK newspapers up until 2017, coverage in Canadian newspapers has dissipated since peaking in 2016. Albeit difficult to determine without complete data from all newspaper (and other media) sources from this period, qualitative analysis on the extent to which articles ‘focused’ on ES (2016-2017) supported the salience growth trend found for the UK, as well as the drop in media attention on ES observed in Canada after 2016. Taken together, these findings suggest a still growing ES media hype in the UK (at least until 2017), while pointing to a potential hype-disappointment trend forming in Canada. In terms of media representation, ES attracts a positive, techno-economic framing that draws on environmental considerations but capitalises mostly on issues related to energy security, affordability, technological innovation, and economic opportunity in order to appeal to the national public. National differences in ES framing and narratives also illustrate the domestication of storage – i.e., unique socio-political contexts, energy priorities, and social values appear to be shaping the ways in which storage is portrayed in the two public spheres. Overall, despite being positively portrayed in both countries, ES appeared to be more salient and favourable in the UK, than in Canadian news discourse in recent years (2016-2017).

RQ2. Despite similarly low public awareness of ES to date in both countries, the technology appears to be generally supported by Canadian and UK publics. Still, national differences were found in respect to public knowledge levels, benefit and risk perception, and emotional affect toward the technology. Overall, UK publics appear to be slightly more knowledgeable and considerably more favourable of ES in respect to these factors, despite showing lower favourability than Canadians for specific ES technologies. In both countries, self-identified right-leaning and female respondents seem to be most familiar with ES, yet also appear to be the least accepting of storage deployment in their domestic electricity networks. Interestingly, political orientation appeared to underpin demographic differences in ES acceptance in Canada, suggesting ES to be a more politically polarised energy topic for Canadians. In the UK, gender differences were more striking here, suggesting that males and females do not share the same level of acceptance for ES.

RQ3. Overall, media and public perceptions of ES in both countries are generally congruent (2018). Alignment was particularly evident in respect to shared positive, techno-economic emphasis on the technology (e.g., technical benefit frames, economic narratives). In agreement with media framing and agenda-setting literature, ES discourse also appears to be both reflective of and influential to domestic contexts, such as energy planning and social values related to sustainability (Canada) and security (UK). However, media and public orientation toward ES was less congruent in respect to environmental risk portrayal. In a sustainability context, media framing of ES was strikingly more positive than public perceptions of the technology. In other words, while newspapers position ES as a climate-friendly energy solution, the general public appears to be less certain of the technology’s ‘greenness.’ Aside from these differences, media and public responses to ES development appear to correspond in both countries.

6.1.2 Broader conclusions and implications

People, as energy consumers and producers, taxpayers and voters, and technology users and protestors, can profoundly inform the direction and pace of energy system change (Miller et al., 2013; Demski et al., 2019; Patterson et al., 2015). A greater understanding of public perspectives of the energy transition and the innovations designed to enable it can thus help to improve national energy dialogue and participation, encourage collaborative decision-making, and illuminate contention points and opportunities that might otherwise be overlooked by transition proponents (Demski et al., 2019). Accordingly, comparing social perceptions of new energy technologies cross-nationally provides rich insight on how complex socio-technical processes (e.g., technological innovation) are interacting with domestic factors (e.g., civic engagement, political economy, social values) to inform regime-level energy transformations (Geels, 2002; 2014; Stephens et al., 2008; 2013). By exploring this concept in the context of ES, this thesis has broadly observed the often-underestimated socio-political drivers of energy transition processes (Stephens et al., 2013; Laird, 2013; Miller & Richter, 2014), while illustrating the rather nuanced trajectory of a particularly salient energy technology in Canada and the UK (Geels, 2007; Taylor et al., 2013; Winfield et al., 2018).

Probing public discourse on ES revealed evidence of an ongoing ‘innovation race’ – a convincing indicator of meaningful niche-regime interactions in Canada and the UK that may profoundly transform national energy generation and use for a more desirable energy future (Bakker & Budde, 2012). At the same time, it also illuminates broader energy planning and policy debates, which suggest that Canada and the UK, irrespective of all energy transition efforts, are by no means on a smooth, linear path to this more desirable future. In fact, many elements of ES discourse (e.g., risk frames, contentious narratives) point to the incumbent resistance, challenges, and uncertainties that underlie disruptive change currently taking place in existing energy regimes (Geels, 2014). In pursuit for more sustainable and secure energy futures (Burke & Stephens, 2018; Jasanoff, 2018), we ought to consider these often-neglected ‘messier’ aspects of energy transformation and resist the temptation to rely on ‘techno-fixes’ for addressing modern energy challenges. Failing to do so may lead decision-makers to dismiss and/or fail to plan for important social implications of energy transitions (Laird, 2013; Miller & Richter, 2014; Miller et al., 2013).

Indeed, much of the discourse on ES in both countries suggests that this niche-innovation is, in many ways, a threat to the incumbent actors, institutions, and ideologies that

have upheld centralised, fossil fuel-based energy regimes for generations. While some see the collapse of these regimes as crucial for realising a renewable energy future, others call for a more cautious approach, pointing to the equity issues that need to be addressed for a ‘socially just’ transition to occur (Jasanoff, 2018). As Healy & Barry (2017) observe, “overcoming ‘carbon lock-in’ cannot be at the price of ‘energy injustice lock-in’” (p. 475). Exploring ES through a socio-political lens can help to illuminate some of the underlying social implications and impacts of rapid technological change in our global energy landscape. As such, this research raises other important questions:

- (1) Are public stakeholders adequately informed of the emerging technologies that will greatly alter their understanding of and interaction with energy? Are they equipped to adapt to the accelerating rate of energy system change? How do we ensure that publics are meaningfully engaged in these transition processes (financially, politically, socially)? How can we enhance existing public communication and social learning around technology and system change?
- (2) How do we encourage social intermediaries, communicators, and decision-makers to circulate more credible, transparent, and balanced energy discourse that resonates with national audiences and encourages public participation in the transition? How do we hold leaders accountable to their promises and commitments to energy transition processes? And to ensuring transition benefits and costs are dispersed fairly amongst energy citizens? How do we ensure vulnerable groups are not ‘left behind’ in ‘the innovation race’ to more desirable energy futures?

While these questions lie beyond the scope of this project, they are certainly raised by the ideas explored in this work. Nonetheless, examining the deeper social considerations of energy system change – and their interplay within the public sphere – will require clean energy enthusiasts in both research and industry to ‘curb their techno-optimism’ (Skjølsvold, 2012) in order to more adequately consider the performative role of people and social discourse energy system change. Indeed, this study only begins to illustrate the many social facets of energy, which increasingly demand specialised analysis as ‘integrated socio-energy systems’ (Laird, 2013), particularly through the lenses of public engagement, energy democracy, and social justice (Sovacool, 2014; Miller & Richter, 2014).

In respect to social representation theory, this thesis also reinforces the notion that: (1) energy technologies are domesticated (i.e., contextualised) differently across national settings in order to appeal to domestic audiences and key actors (Skjølsvold, 2012; Clausen, 2004); (2) socio-political issues and geo-political contexts are important in the construction of media frames (Stephens et al., 2013; Jaspal et al., 2014); and (3) energy innovation media hypes may be just as (if not more) important for system change than innovation itself (Songsore & Buzzelli, 2014; Bakker & Budde, 2012). For instance, there are certain implications for publics interacting

with new energy innovations through discourse circulated by society's intermediaries, rather than through physical realities. This research supports evidence that media can help to drive social learning on complex scientific issues through disseminating nationally-resonating imaginaries (e.g., storylines, promises) with which publics engage and base their perceptions upon until they experience new innovations first-hand. In this way, media framing can both foster and inhibit coherence between technical and public assessments of scientific phenomena, which we know is critical to the success of socio-technical movements like the energy transition (Gitlin, 2003; Gamson & Modigliani 1989).

Further, the fact that newspapers domesticate ES to provide interpretations of what the technology means for national energy futures reaffirms that the press play a key role in processes of innovation and technology diffusion (Ruef & Mackard, 2010; Rip & Kemp, 1998). The potential consequences of hype dynamics raise particular concerns here. Techno-optimistic domestication of ES in Canada and the UK may help to drive innovation in national cleantech sectors and/or stimulate supportive policy for low-carbon technologies. Alternatively, techno-optimism may lead to hype-disappointments which can ultimately reinforce resistance to low-carbon energy deployment (Ruef & Mackard, 2010; Geels, 2014). To this point, as active citizens and public audiences, we ought to explicitly acknowledge and respond when media abuse their power as social intermediaries (through their manipulative and misconstrued framing of key issues). More importantly, we ought to encourage energy decision-makers and experts to work collaboratively with public communicators in order to produce more robust, transparent, and substantiated energy discourse in an era of system evolution and uncertainty. This may help to increase public trust and engagement in energy transition processes, which in turn, could accelerate appropriate deployment of ES technologies and other low-carbon solutions (Tewksbury et al., 2000; Entman, 2007; Rosenbloom, 2018; Demski et al., 2019). Nevertheless, these implications call for further attention on social perceptions of such energy transition developments and on the role that media play in this process (Lyytimäki et al., 2018; Barry, 2016; Healy & Barry, 2017).

6.1.3 Research outcomes and significance

The overarching aim of this work was to examine national portrayals of ES in order to help inspire more strategic and informed public communication, policy design, and deployment strategies that align with national decarbonisation and energy democracy goals (Miller &

Richter, 2014; Dryzek & Stevenson, 2011). In addressing some key items on Devine-Wright et al.'s (2017) social science research agenda for ES, this study has articulated the value of probing the public sphere for insight on complex social dimensions of energy transitions, while providing some practical entry points for supporting ES trajectories in two countries.

A particular strength of the study was its use of cross-disciplinary conceptual and methodological tools (e.g., SPEED, MLP) across different spatial and temporal scales for understanding public responses to ES development (Batel, 2018; Köhler et al., 2017). Additionally, this work has helped to: (1) advance the SPEED research agenda beyond single-method, single-case, and sub-national applications; (2) broaden the understanding of socio-political factors underpinning energy technology deployment (e.g., public opinion, social discourse, political salience); and (3) provide new insights for decision-makers to draw upon in order to advance ES development that reflects national public concerns and values.

Research findings are particularly relevant to energy scholars, policymakers, market analysts, practitioners, and journalists concerned with a budding ES industry and the role that people will play in it. For technology developers and scientists advancing storage RD&D, findings are useful in ascertaining the extent and ways in which their efforts are being communicated and accepted by key public stakeholders such as investors and consumers. For reporters and communication practitioners, research outcomes also provide insight on how to improve the comprehensibility and accuracy of communicating ES developments to the public (e.g. via balanced, nationally-salient discourse). Finally, decision-makers can draw upon these findings to guide their efforts in policy and regulation for ES, improving the prospects for meeting public concerns and expectations while furthering energy sustainability goals.

Lastly, this work helps to advance ongoing Canadian RD&D on ES by contributing to the research agenda of the NSERC Energy Storage Technology (NEST) Network. The project serves to support the international collaboration between NEST and the EPSRC Centre for Doctoral Training in Energy Storage in the UK, while strengthening research links between the University of Waterloo and the University of Surrey. In contributing to these cross-national programs, this thesis supports cross-cultural and interdisciplinary research on ES.

6.1.4 Research and practical recommendations

While local and individualist approaches have an important place in energy acceptance studies (Bögel & Upham, 2018), this work supports recent calls for more comparative, cross-national and collective research on ES implementation (Livingstone, 2018; Devine-Wright et al., 2017). Inter-jurisdictional SPEED and MLP assessments using public discourse (e.g., traditional and social media, policy documents) can contribute to a greater social scientific understanding of ES and its relationship with energy citizens (Stephens et al., 2008; 2013; Geels, 2007). In using the public sphere as a site for empirical research, this thesis points to new research and practical opportunities for ES deployment in Canada, the UK, and beyond.

For example, while questions of “what is being said about storage?” and “what images are being used to make sense of it?” (Devine-Wright et al., 2017; p.29) have been addressed here, further research is needed on the ‘political nature of meaning-making’ around this innovation (Batel et al., 2016). For instance, by focusing on the nature of ES discourse, this study focused less on the role of actors (e.g., politicians, developers, energy companies) *in* ES discourse. Answering questions such as “Who is saying what regarding ES? How? With what functions and consequences?” would help to discern and leverage political discourse for advancing ES and energy transition goals (Devine-Wright et al., 2017; p.30). Despite exploring media as “middle actors” who circulate and “legitimate particular agendas” (Devine-Wright et al., 2017; p. 30), this analysis could be enriched with more systematic consideration of which actors are promoting and/or challenging social representations of ES in order to advance specific interests – political or otherwise (e.g. protecting fossil fuel sectors, influencing energy policy, cleantech investment, etc.). Pairing MCA methodologies with the SPEED framework would also support this assessment by helping to ascertain actors’ perceived risks and benefits of ES (e.g., see Langheim et al., 2014).

The qualitative findings in this study could also be strengthened with longitudinal MCA approaches which examine discursive ES trends over time to recognise changes in perceptions and technology trajectories. Albeit a more extensive task (requiring several content coders), qualitative analysis of larger and diverse media samples (e.g., a combination of social and traditional media) over five- or ten-year observation periods (rather than two) would provide richer context for findings presented in this study. For example, examining how narratives (across different jurisdictions) are evolving as ES moves along the MLP topography would be interesting from the ‘social imaginaries’ perspective offered by Hielscher & Sovacool (2018) and

would certainly compliment Demski et al.'s (2015) focus on the role of 'social values' in energy technology change. These approaches would also help to build upon the work of Grünewald et al. (2012) and Gaede & Rowlands (2018b) on ES in Canada and the UK.

MCA research on ES could also be supplemented with more sophisticated survey analysis – e.g., pairing media content and rolling cross-sectional survey data. Vreese et al. (2017) suggest that such 'linkage studies' can help researchers more confidently ascertain media framing *effects* on public audiences and social processes. Certainly, this study has focused more on exploratory dimensions, which have specific limitations for interpretation and generalisability of findings. Triangulation of research methods would help enrich this work and contribute to Devine-Wright et al.'s (2017) research agenda for ES. For example, combining public discourse analyses (e.g., Hielscher & Sovacool, 2018; Stoddart et al., 2018) with stakeholder interviews (e.g., Grünewald et al., 2012; Gaede & Rowlands, 2018a) and public surveys (e.g., Hamilton et al., 2018) in cross-national comparative contexts, would allow researchers to gain a fuller picture of the socio-political dynamics informing ES implementation, perhaps at different scales (local, regional, national). Finally, as the technology matures, it will be crucial to apply these approaches to specific storage technologies. Researchers should distinguish among the many applications that make up 'energy storage' as they will all possess unique socio-technical characteristics, public acceptance profiles, and social representations (Geels, 2007). For example, the framing findings in this study can serve as a foundation for more focused social acceptance research on say, residential storage batteries and/or grid-scale compressed-air facilities. Such analyses may help to reveal the importance of 'size' and 'scale' (e.g., individual home batteries vs. grid-scale battery facilities) in shaping public perceptions and adoption of new 'transformative' energy technologies.

In addition to these recommendations and the questions proposed in [Section 6.1.2](#), other potential research directions include: (1) identifying and comparing lessons from ES (issues and perceptions at the abstract level) with lessons from other alternative energy technologies (e.g., wind turbines) that have attracted controversy (perceived risks/costs vs. benefits, threat to locked-in existing activities); (2) exploring (as technology and economics improve) how other important socio-technical elements – i.e., economic factors such as financial incentives, payback periods, electricity prices, and technology costs – are shaping public perceptions and adoption of technologies (at individual, household, community, national levels); and (3) considering, more closely, not only the cross-national differences in transition discourse

and technology trends, but also the similarities found in these contexts and what they may mean for macro-level energy system change (e.g., international patterns, global ‘shifts’).

Accordingly, as ES continues to mature and contribute to evolving energy systems, media coverage (i.e., framing, hype cycles) will also evolve and require closer attention from technologists, investors, policymakers, developers, and energy practitioners. Greater efforts will be needed to bridge the widening gap between rapid energy technology development and the capacity of publics to process and respond to it (e.g., see Mallett et al., 2016). Thus, in the same way that system actors can help circulate new information about ES (e.g., via media interviews, news releases) they can also proactively regulate it to ensure accurate portrayals of technical progress, policy developments, cost and other social implications. In addition to the obvious onus on journalists and editors, private and public firms can help curb inflated techno-optimism and engage publics in knowledge mobilisation and decision-making regarding ES deployment. National energy literacy campaigns and local demonstration projects would help to improve currently low public awareness and uninformed opinions on unfamiliar ES technologies – and perhaps prepare them more adequately for forthcoming technology rollouts. For example, publicly accessible technology case studies, as well as consumer engagement efforts are two practical pathways for bridging these gaps. Many energy companies – e.g., Anesco (UK) and Alectra Utilities (Canada) – are already experimenting with these public-focused approaches (see <https://anESCO.co.uk/case-studies/> and <https://powerstream.ca/innovation/micro-grid.html>). However, to contain the self-promoting interests of these stakeholders, independent actors (operating outside of industry and government) such as environmental non-profits, consumer rights groups, and industry watchdogs will have an important role to play here. Environmental Defence (Canada) and Citizens Advice (UK) are two further examples of actors who can help provide other informed perspectives and help to build transparency, recognise uncertainty, and strengthen legitimate foundations for optimism or pessimism around ES.

Finally, from a policy angle, governments may wish to carefully leverage national narratives to garner public participation in and support for ES development. For instance, countries such as the US, Sweden, and Brazil have been known to use domestic narratives and social values to facilitate successful implementation of major energy technologies (e.g., nuclear power, biomass) (Malone et al., 2017). Similar to how the Swedish government advanced biomass by catering to national appeal for ‘local energy control’ and ‘natural energy products,’ the Canadian government can more visibly build ES into its climate policy (a rather salient topic

in the country's political and public sphere) perhaps in ways that integrate the prosperity of clean energy sectors with both community and national-scale Sustainable Development Goals (SDGs) (Kyriakopoulos & Arabatzis, 2016). Similarly, the UK may wish to deploy national energy campaigns that frame ES as an energy security mandate. This could take form as a national 'clean energy challenge' or 'innovation jam' paired with citizen dialogues (Pidgeon et al., 2014) that engage diverse actors (e.g., developers, students, consumers) – from all positions on the political spectrum – in exploring new solutions for securing long-term low-carbon energy supplies. The theme for say, 2020, might be 'storage for security.' Such initiatives could assist in building favourable and appropriate strategies for ES deployment, as well as broader public participation and bipartisan collaboration in tackling broader energy and climate issues.

Indeed, both countries are advancing ES solutions for addressing the energy trilemma, but each possesses unique national narratives and social values, which may prove to be key factors in building policy and public support for ES. Proponents can leverage this to their advantage but should be cognizant of the growing public trust deficit toward energy transition actors (e.g., energy companies, politicians) in some jurisdictions (Parkhill et al., 2013; Demski et al., 2015; Hanus et al., 2018) – and thus the potential repercussions of making unsubstantiated promises and setting unrealistic goals. Rather than exploiting frames and narratives to further self-interests (which publics are increasingly conscious of) (Demski et al., 2019), such actors should make more genuine efforts to restore civic trust and encourage engagement in energy system change. Decision-makers ought to carefully integrate compelling and transparent energy dialogue with robust commitments to socially-just and responsible transition activities. Of course, this will be challenging amidst conflicting stakeholder interests in energy change and the competing roles of governments in ensuring impartial assessments and building public support for key initiatives (Geels, 2014). In view of the political motives and partisan divides in energy development (e.g., incentives to deploy initiatives preferred by majority of voters) (Dragojlovic & Einsiedel, 2014; Bolsen & Shapiro, 2018), perhaps the call-to-action here is best suited for science communication scholars and practitioners serving as intermediaries for social change. This final recommendation thus calls for new strategies and greater efforts to:

- (1) construct and circulate productive social representations (e.g., frames, narratives) of energy innovations and transition processes that resonate with and encourage active participation from domestic audiences;

- (2) acknowledge and clearly present the scientific evidence (e.g., links to raw data and reports, interpretable data visualisations) upon which such representations were constructed and upon which consensus and advocacy amongst technical and relevant experts have been established;
- (3) ensure that both the descriptions of emerging energy innovations (e.g., experimental ES innovations and projects) as well as the motivations and goals for pursuing them are clear, realistic, and comprehensible to laypersons; and
- (4) recruit credible and experienced spokespersons (e.g., technologists and industry experts for commentaries) and leverage trusted media platforms, particularly for high-impact news with wide-ranging implications for diverse audiences

6.2 Final statement

In sum, the large-scale deployment of ES may be instrumental in advancing more secure, lower-carbon energy systems in Canada and the UK. However, given the agenda-setting influence of media, and the role that publics, through their engagement with new technologies, play in energy transition processes, the social representation of ES in these jurisdictions (and beyond) warrants careful consideration. Decision-makers, proponents, and public communicators ought to be cognizant of how they contribute to the social construction and learning of potentially transformative technologies such as ES, as this will have vast implications for their uptake in incumbent energy regimes. As one of the first cross-national comparative analyses on ES in this context, this work has helped to bridge a knowledge gap in energy social science by examining media and public perceptions of storage technologies in two countries that are currently pursuing more desirable energy futures. Overall, while ES appears to be favourable in both Canada and the UK, cross-national variations in social representations and perceptions of the technology suggest that complex structural, institutional, and cultural contexts at the national level are shaping the ways in which ES, as part of an energy transition agenda, is being contextualised and received by the public sphere. Findings propose that national energy priorities, socio-political issues, and social values are important to the representation and public acceptance of ES in the two jurisdictions. Further comparative and triangulated research on ES would help to enrich these findings and support ES development for meeting national energy challenges, such as sustainability and security. Nonetheless, by exploring ES at the nexus of technology, people, and social change, this research articulates the value of exploring the social dimensions of our pursuit for a lower-carbon energy future.

Bibliography

- Abdo, H., & Kouhy, R. (2016). Readings in the UK energy security. *Energy Sources, Part B: Economics, Planning, and Policy*, 11(1), 18-25.
- Aggeri, F., Elmquist, M., & Pohl, H. (2009). Managing learning in the automotive industry—the innovation race for electric vehicles. *International Journal of Automotive Technology and Management*, 9(2), 123-147.
- Alcott, B., (2005.) Jevons' paradox. *Ecological Economics*, 54(1), 9–21.
- Alexander, S., (2014). *A Critique of Techno-Optimism: Efficiency without Sufficiency is Lost*. (Working paper series 2014: no. 1). Melbourne, Australia: Melbourne Sustainable Society Institute. Retrieved March 27, 2019 from <http://samuelalexander.info/wp-content/uploads/2017/02/A-Critique-of-Techno-Optimism-Samuel-Alexander.pdf>
- Altheide, D. L., & Schneider, C. J. (2013). *Qualitative Media Analysis*. Los Angeles, USA: Sage.
- Amrouche, S. O., Rekioua, D., Rekioua, T., & Bacha, S. (2016). Overview of energy storage in renewable energy systems. *International Journal of Hydrogen Energy*, 41(45), 20914-20927.
- Anderegg, W. R., & Goldsmith, G. R. (2014). Public interest in climate change over the past decade and the effects of the 'climategate' media event. *Environmental Research Letters*, 9(5), 054005-054013.
- Aneke, M., & Wang, M. (2016). Energy storage technologies and real-life applications – A state of the art review. *Applied Energy*, 179(C), 350-377.
- Asayama, S., & Ishii, A. (2017). Selling stories of techno-optimism? The role of narratives on discursive construction of carbon capture and storage in the Japanese media. *Energy Research & Social Science*, 31, 50-59.
- Asplund, T., Hjerpe, M., & Wibeck, V. (2013). Framings and coverage of climate change in Swedish specialized farming magazines. *Climatic Change*, 117(1-2), 197-209.
- Babbie, E. (2007). *The Practice of Social Research* (11th ed.) Belmont, USA: Wadsworth.
- Bakker, S., & Budde, B. (2012). Technological hype and disappointment: lessons from the hydrogen and fuel cell case. *Technology Analysis & Strategic Management*, 24(6), 549-563.
- Balducci, P. J., Alam, M. J. E., Hardy, T. D., & Wu, D. (2018). Assigning value to energy storage systems at multiple points in an electrical grid. *Energy & Environmental Science*, 11(8), 1926-1944.
- Barry, J. (2016). Bio-fuelling the Hummer? Transdisciplinary thoughts on techno-optimism and innovation in the transition from unsustainability. In *Transdisciplinary Perspectives on Transitions to Sustainability* (pp. 120-137). Belfast, UK: Routledge.

- Batel, S., & Devine-Wright, P. (2018). Populism, identities and responses to energy infrastructures at different scales in the United Kingdom: A post-Brexit reflection. *Energy Research & Social Science*, 43, 41-47.
- Batel, S., Castro, P., Devine-Wright, P., & Howarth, C. (2016). Developing a critical agenda to understand pro-environmental actions: contributions from Social Representations and Social Practices Theories. *Wiley Interdisciplinary Reviews: Climate Change*, 7(5), 727-745.
- Batel, S., Devine-Wright, P., & Tangeland, T. (2013). Social acceptance of low carbon energy and associated infrastructures: A critical discussion. *Energy Policy*, 58, 1-5.
- Batterham, A. M., & Hopkins, W. G. (2006). Making meaningful inferences about magnitudes. *International Journal of Sports Physiology and Performance*, 1(1), 50-57.
- Baum, M. A., & Zhukov, Y. M. (2018). Media ownership and news coverage of international conflict. *Political Communication*, 36(1), 1-28.
- Becherif, M., Ramadan, H. S., Cabaret, K., Picard, F., Simoncini, N., & Bethoux, O. (2015). Hydrogen energy storage: new techno-economic emergence solution analysis. *Energy Procedia*, 74(1), 371-380.
- BEIS. (2017, March). *UK Energy Statistics, 2016 & Q4 2016*. Retrieved November 28, 2018 from Department for Business, Energy, and Industrial Strategy: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/604695/Press_Notice_March_2017.pdf
- BEIS. (2019, January 30). *Storage at Scale Competition*. Retrieved January 21, 2019 from Department for Business, Energy & Industrial Strategy: <https://www.gov.uk/government/publications/storage-at-scale-competition>
- Bidwell, D. (2013). The role of values in public beliefs and attitudes towards commercial wind energy. *Energy Policy*, 58, 189-199.
- Blidook, K. (2009). Choice and content: Media ownership and democratic ideals in Canada. *Canadian Political Science Review*, 3(2), 52-69.
- Bolsen, T., & Shapiro, M. A. (2018). The US news media, polarization on climate change, and pathways to effective communication. *Environmental Communication*, 12(2), 149-163.
- Bolton, R., & Foxon, T. J. (2015). A socio-technical perspective on low carbon investment challenges—insights for UK energy policy. *Environmental Innovation and Societal Transitions*, 14, 165-181.
- Boothe, P., & Boudreault, F. A. (2016). *By the numbers: Canadian GHG emissions*. London, Canada: Western University/Lawrence National Centre for Policy and Management Ivey Business School.
- Bornschiefer, V. (2018). *Western Society in Transition*. New York, USA: Routledge.

- Boykoff, M. T., & Rajan, S. R. (2007). Signals and noise: Mass-media coverage of climate change in the USA and the UK. *EMBO reports*, 8(3), 207-211.
- Brannstrom, C., Jepson, W., & Persons, N. (2011). Social perspectives on wind-power development in West Texas. *Annals of the Association of American Geographers*, 101(4), 839-851.
- Bryman, A. (2016). *Social Research Methods*. Oxford, UK: Oxford University Press.
- Bukhari, A., Collyer, D., Dunsky, P., Giroux-Schmidt, C., Langer, J., McDonald, J., ... & Verchuren, A., (2018). *Canada's Energy Transition: Getting to our Energy Future, Together. Generation Energy: Council Report*. Retrieved December 1, 2018 from Natural Resources Canada: www.nrcan.gc.ca
- Burck, J., Hagen, B., Marten, F., Höhne, N., & Bals, C. (2018, December). *Climate Change Performance Index Results 2019*. Retrieved March 18, 2019 from Germanwatch/Climate Action Network: www.climate-change-performance-index.org.
- Burke, M. J., & Stephens, J. C. (2018). Political power and renewable energy futures: A critical review. *Energy Research & Social Science*, 35, 78-93
- Byrne, R., Smith, A., Watson, J., & Ockwell, D. (2011). *Energy Pathways in Low-Carbon Development: From Technology Transfer to Socio-Technical Transformation*. Brighton, England: STEPS Centre/The Sussex Energy Group. Retrieved October 15, 2018 from https://steps-centre.org/wp-content/uploads/Energy_PathwaysWP1.pdf
- Cacciatore, M. A., Binder, A. R., Scheufele, D. A., Shaw, B. R., Cacciatore, M. A., Binder, A. R., & Shaw, B. R. (2012). Public attitudes toward biofuels. *Politics and the Life Sciences*, 31(1), 36-51.
- Cappella, J. N., & Jamieson, K. H. (1996). News Frames, Political Cynicism, and Media Cynicism. *The Annals of the American Academy of Political and Social Science*, 546(1), 71-84.
- Caprotti, F. (2012). The cultural economy of cleantech: environmental discourse and the emergence of a new technology sector. *Transactions of the Institute of British Geographers*, 37(3), 370-385.
- Carlman, I. (1982). Wind energy potential in Sweden: The importance of non-technical factors. *International Symposium on Wind Energy Systems*, 2(4), 335-348.
- Carvalho, A. (2007). Ideological cultures and media discourses on scientific knowledge: re-reading news on climate change. *Public Understanding of Science*, 16(2), 223-243.
- CBC News. (2015, October 17). Federal party endorsements: Where do Quebec's newspapers stand?. *CBC News*. Retrieved March 29, 2019 from <https://www.cbc.ca/news/canada/montreal/federal-election-endorsements-quebec-newspaper-1.3276416>

- CBC News. (2018, December 12). We're running out of time: Canada under pressure to step up at global climate conference. *CBC News*. Retrieved January 4, 2019 from <https://www.cbc.ca/news/politics/climate-poland-canada-lead-1.4943722>
- Chang, S. (2009). *The influence of media frames on the public's perception of biofuels*. (Master's thesis, Iowa State University, no. 10593). Retrieved October 5, 2018 from Iowa State University Digital Repository: <https://lib.dr.iastate.edu/etd/10593>
- Chappin, E. J., & Ligtoet, A. (2014). Transition and transformation: A bibliometric analysis of two scientific networks researching socio-technical change. *Renewable and Sustainable Energy Reviews*, 30, 715-723.
- Chaturvedi, H.K. (2015). Evaluation of inter-rater agreement and inter-rater reliability for observational data: An overview of concepts and methods. *Journal of the Indian Academy of Applied Psychology*, 41(3), 20-27.
- Chen, H., Cong, T. N., Yang, W., Tan, C., Li, Y. & Ding, Y. (2009). Progress in electrical energy storage system: A critical review. *Progress in Natural Science*, 19(3), 291-312.
- Cherp, A., Vinichenko, V., Jewell, J., Brutschin, E., & Sovacool, B. (2018). Integrating techno- economic, socio-technical and political perspectives on national energy transitions: A meta-theoretical framework. *Energy Research & Social Science*, 37, 175-190.
- Cherry, T. L., García, J. H., Kallbekken, S., & Torvanger, A. (2014). The development and deployment of low-carbon energy technologies: The role of economic interests and cultural worldviews on public support. *Energy Policy*, 68, 562-566.
- Clausen, L. (2004). Localizing the global: 'Domestication' processes in international news production. *Media, Culture & Society*, 26(1), 25-44.
- Connolly, D., Lund, H., Mathiesen, B. V., Pican, E., & Leahy, M. (2012). The technical and economic implications of integrating fluctuating renewable energy using energy storage. *Renewable Energy*, 43, 47-60.
- Corbett, J. B., & Durfee, J. L. (2004). Testing public (un) certainty of science: Media representations of global warming. *Science Communication*, 26(2), 129-151.
- Corner, A. (2013). *A new conversation with the centre-right about climate change: Values, frames and narratives*. Oxford, UK: Climate Outreach & Information Network/BRASS Research Centre. Retrieved January 5, 2019 from <https://evoice.org.uk/kef/about/view/useful-information/conversing-climate-change.pdf>
- Corner, A., Venables, D., Spence, A., Poortinga, W., Demski, C., & Pidgeon, N. (2011). Nuclear power, climate change and energy security: exploring British public attitudes. *Energy Policy*, 39(9), 4823-4833.
- Country Economy (2018). *Country Comparison Canada vs United Kingdom*. Retrieved December 4, 2018 from <https://countryeconomy.com/countries/compare/canada/uk>

- Cox, E. (2018). Assessing long-term energy security: The case of electricity in the United Kingdom. *Renewable and Sustainable Energy Reviews*, 82(1), 2287-2299.
- Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and Conducting Mixed Methods research* (2nd ed.). Thousand Oaks, USA: Sage.
- Cross, K., Gunster, S., Piotrowski, M., & Daub, S. (2015). *News Media and Climate Politics*. Vancouver, BC: Canadian Centre for Policy Alternatives-BC Office
- Curran, R. (2016, February 8). British people think their media is the most biased and right-wing in Europe - and they're probably right. *The Independent*. Retrieved December 20, 2018 from <https://www.independent.co.uk>
- De Vreese, C. H. (2005). News framing: Theory and typology. *Information Design Journal & Document Design*, 13(1), 51-62.
- Dedehayir, O., & Steinert, M. (2016). The hype cycle model: A review and future directions. *Technological Forecasting and Social Change*, 108, 28-41.
- Deignan, B., Harvey, E., & Hoffman-Goetz, L. (2013). Fright factors about wind turbines and health in Ontario newspapers before and after the Green Energy Act. *Health, Risk & Society*, 15(3), 234-250.
- Deloitte (2018). *Supercharged: Challenges and opportunities in global battery storage markets*. Washington, USA: The Deloitte Center for Energy Solutions. Retrieved November 10, 2018 from <https://www2.deloitte.com>
- Delshad, A. B., Raymond, L., Sawicki, V., & Wegener, D. T. (2010). Public attitudes toward political and technological options for biofuels. *Energy Policy*, 38(7), 3414-3425.
- Delshad, A., & Raymond, L. (2013). Media framing and public attitudes toward biofuels. *Review of Policy Research*, 30(2), 190-210.
- Demski, C., Butler, C., Parkhill, K.A., Spence, A., & Pidgeon, N.F. (2015). Public values for energy system change. *Global Environmental Change*, 34, 59-69.
- Demski, C., Poortinga, W., & Pidgeon, N. (2014). Exploring public perceptions of energy security risks in the UK. *Energy Policy*, 66, 369-378.
- Demski, C., Pidgeon, N., Evenson, D., & Becker, S. (2019). *Paying for energy transitions: public perspectives and acceptability*. (Policy Brief). London, UK: UK Energy Research Centre (UKERC) Retrieved March 24, 2019 from <http://www.ukerc.ac.uk/publications/paying-for-energy-transitions.html>
- Devine-Wright, P. (2008). Reconsidering public acceptance of renewable energy technologies: A critical review. In Jamasb T., Grubb, M., Pollitt, M. (eds), *Delivering a Low Carbon Electricity System: Technologies, Economics and Policy* (pp. 1-15). Cambridge, USA: Cambridge University Press
- Devine-Wright, P. (2005). Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy*, 8(2), 125-139.

- Devine-Wright, P. (2011). Place attachment and public acceptance of renewable energy: A tidal energy case study. *Journal of Environmental Psychology*, 31(4), 336-343.
- Devine-Wright, P., Batel, S., Aas, O., Sovacool, B., LaBelle, M. C. & Ruud, A. (2017). A conceptual framework for understanding the social acceptance of energy infrastructure: Insights from energy storage. *Energy Policy*, 107, 27-31.
- Dimitrova, D. V., & Strömbäck, J. (2005). Mission accomplished? Framing of the Iraq War in the elite newspapers in Sweden and the United States. *Gazette*, 67(5), 399-417.
- Djerf-Pierre, M., Cokley, J., & Kuchel, L. J. (2016). Framing renewable energy: A comparative study of newspapers in Australia and Sweden. *Environmental Communication*, 10(5), 634-655.
- Dogan, M., & Pelassy, D. (1990). *How to Compare Nations: Strategies in Comparative Politics*. Chatham, USA: Chatham House.
- Dosi, G. (1982). Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. *Research Policy*, 11(3), 147-162.
- Dotson, D. M., Jacobson, S. K., Kaid, L. L., & Carlton, J. S. (2012). Media coverage of climate change in Chile: A content analysis of conservative and liberal newspapers. *Environmental Communication: A Journal of Nature and Culture*, 6(1), 64-81.
- Downs, A. (1972). The issue-attention cycle and the political economy of improving our environment. In *The Political Economy of Environmental Control* (pp. 9-34). Berkeley, USA: University of California Press.
- Doyle G. (2002). *Media Ownership: The Economics and Politics of Convergence and Concentration in the UK and European Media*. London, UK: Sage.
- Dragojlovic, N., & Einsiedel, E. (2014). The polarization of public opinion on biofuels in North America: key drivers and future trends. *Biofuels*, 5(3), 233-247.
- Dryzek, J. S., & Stevenson, H. (2011). Global democracy and earth system governance. *Ecological Economics*, 70(11), 1865-1874.
- Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). New trends in measuring environmental attitudes: measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues*, 56(3), 425-442
- Dusyk, N., Axsen, J., & Dullemond, K. (2018). Who cares about climate change? The mass media and socio-political acceptance of Canada's oil sands and Northern Gateway Pipeline. *Energy Research & Social Science*, 37, 12-21.
- Edelman (2018). 2018 Edelman Trust Barometer: Canada. Retrieved February 1, 2019 from https://www.edelman.ca/sites/default/files/2018-02/2018-Edelman-Trust-Barometer-Canada_ENGLISH.PDF

- Einsiedel, E. F. (1992). Framing science and technology in the Canadian press. *Public Understanding of Science*, 1, 89-102.
- Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of Communication*, 43(4), 51-58.
- Entman, R. M. (2007). Framing bias: Media in the distribution of power. *Journal of Communication*, 57(1), 163-173.
- Entman, R. M., & Rojecki, A. (1993). Freezing out the public: Elite and media framing of the US anti-nuclear movement. *Political Communication*, 10, 155-173.
- Färdigh, M. A. (2010). *Comparing Media Systems in Europe: Identifying Comparable Country-level Dimensions of Media Systems*. (QoG working paper series 2010: no. 2). Gothenburg, Sweden: The Quality of Government Institute (QoG).
- Farstad, F. M. (2018). What explains variation in parties' climate change salience?. *Party Politics*, 24(6), 698-707.
- Fast, S. (2013). Social acceptance of renewable energy: Trends, concepts, and geographies. *Geography Compass*, 7(12), 853-866.
- Fazey, I., Schöpke, N., Caniglia, G., Patterson, J., Hultman, J., Van Mierlo, B., ... & Al Waer, H. (2018). Ten essentials for action-oriented and second order energy transitions, transformations and climate change research. *Energy Research & Social Science*, 40, 54-70.
- Feldpausch-Parker, A. M., Burnham, M., Melnik, M., Callaghan, M. L., & Selfa, T. (2015). News media analysis of carbon capture and storage and biomass: perceptions and possibilities. *Energies*, 8(4), 3058-3074.
- Fergen, J., & Jacquet, J. B. (2016). Beauty in motion: Expectations, attitudes, and values of wind energy development in the rural US. *Energy Research & Social Science*, 11, 133-141.
- Fischer, F. (2003). *Reframing public policy: Discursive politics and deliberative practices*. Oxford, UK: Oxford University Press.
- Ford, J. D., & King, D. (2015). Coverage and framing of climate change adaptation in the media: A review of influential North American newspapers during 1993–2013. *Environmental Science & Policy*, 48, 137-146.
- Fouquet, R., & Pearson, P. J. (2012). Past and prospective energy transitions: Insights from history. *Energy Policy*, 50, 1-7
- Foxon, T. J. (2013). Transition pathways for a UK low carbon electricity future. *Energy Policy*, 52, 10-24.
- Foxon, T. J. (2011). A coevolutionary framework for analysing a transition to a sustainable low carbon economy. *Ecological Economics*, 70(12), 2258-2267

- Foxon, T. J., Hammond, G. P., & Pearson, P. J. (2010). Developing transition pathways for a low carbon electricity system in the UK. *Technological Forecasting and Social Change*, 77(8), 1203-1213.
- Fraune, C., & Knodt, M. (2018). Sustainable energy transformations in an age of populism, post-truth politics, and local resistance. *Energy Research & Social Science*, 43, 1-7.
- Furby, L., Slovic, P., Fischhoff, B., & Gregory, R. (1988). Public perceptions of electric power transmission lines. *Journal of Environmental Psychology*, 8(1), 19-43.
- Fytli, D., & Zabaniotou, A. (2017). Social acceptance of bioenergy in the context of climate change and sustainability—A review. *Current Opinion in Green and Sustainable Chemistry*, 8, 5-9.
- Gaede, J., & Rowlands, I. H. (2018a). How 'transformative' is energy storage? Insights from stakeholder perceptions in Ontario. *Energy research & social science*, 44, 268-277.
- Gaede, J., & Rowlands, I. H. (2018b). Visualizing social acceptance research: A bibliometric review of the social acceptance literature for energy technology and fuels. *Energy Research & Social Science*, 40, 142-158.
- Gallo, A. B., Simões-Moreira, J. R., Costa, H. K. M., Santos, M. M., & dos Santos, E. M. (2016). Energy storage in the energy transition context: A technology review. *Renewable and Sustainable Energy Reviews*, 65, 800-822.
- Gamson, W. A., & Modigliani, A. (1989). Media discourse and public opinion on nuclear power: A constructionist approach. *American Journal of Sociology*, 95(1), 1-37.
- Ganowski, S., Gaede, J., & Rowlands, I. H. (2018). Hot off the press! A comparative media analysis of energy storage framing in Canadian newspapers. *Energy Research & Social Science*, 46, 155-168.
- Gartner Group (1995). *Hype Cycle Report*. Stamford, USA: Gartner Inc.
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy*, 31(8-9), 1257-1274.
- Geels, F. W. (2005). The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930). *Technology Analysis & Strategic Management*, 17(4), 445-476.
- Geels, F. W. (2007). Feelings of discontent and the promise of middle range theory for STS: Examples from technology dynamics. *Science, Technology, & Human Values*, 32(6), 627-651.
- Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental innovation and societal transitions*, 1(1), 24-40.
- Geels, F. W. (2014). Regime resistance against low-carbon transitions: introducing politics and power into the multi-level perspective. *Theory, Culture & Society*, 31(5), 21-40.

- Geels, F. W., & Kemp, R. (2007). Dynamics in socio-technical systems: Typology of change processes and contrasting case studies. *Technology in Society*, 29(4), 441-455.
- Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, 36(3), 399-417.
- Geels, F. W., Elzen, B., & Green, K. (2004). General introduction: system innovation and transitions to sustainability. In Elzen, B., Geels, F.W., & Green, K (eds.), *System Innovation and the Transition to Sustainability - Theory, Evidence and Policy* (pp. 1-16). Cheltenham, UK: Edward Elgar Publishing.
- Geels, F. W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., ... & Wassermann, S. (2016). The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014). *Research Policy*, 45(4), 896-913.
- Geels, F. W., McMeekin, A., & Pfluger, B. (2018) (In press). Socio-technical scenarios as a methodological tool to explore social and political feasibility in low-carbon transitions: Bridging computer models and the multi-level perspective in UK electricity generation (2010–2050). *Technological Forecasting and Social Change*. DOI:10.1016/j.techfore.2018.04.001
- Geels, F. W., Pieters, T., & Snelders, S. (2007). Cultural enthusiasm, resistance and the societal embedding of new technologies: psychotropic drugs in the 20th century. *Technology Analysis & Strategic Management*, 19(2), 145-165.
- Giddens, A. (2009). *The Politics of Climate Change*. Cambridge, UK: Polity Press.
- Gitlin, T. (2003). *The whole world is watching: Mass media in the making and unmaking of the new left*. Berkeley, USA: University of California Press.
- Goffman, E. (1974). *Frame analysis: An essay on the organisation of experience*. Cambridge, USA: Harvard University Press.
- Goldthau, A., & Sovacool, B. K. (2016). Energy technology, politics, and interpretative frames: shale gas fracking in Eastern Europe. *Global Environmental Politics*, 16(4), 50-69.
- Good, J. E. (2008). The framing of climate change in Canadian, American and international newspapers: A media propaganda model analysis. *Canadian Journal of Communication*, 33(2), 233-256.
- Govia, L. (2018). *Beneath the Hype: Engaging the Sociality of Artificial Intelligence (Master's thesis, University of Waterloo)*. Retrieved January 2, 2019 from UW Space Institutional Repository: <https://uwspace.uwaterloo.ca/handle/10012/13154>
- Grubb, M., & Newbery, D. (2018, June). *UK Electricity Market Reform and the Energy Transition: Emerging Lessons*. (EPRG Working Paper no. 1817). Cambridge, UK: University of Cambridge/Energy Policy Research Group. Retrieved February 1, 2019 from <https://www.repository.cam.ac.uk/bitstream/handle/1810/277387/cwpe1834.pdf>

- Grünewald, P. H., Cockerill, T. T., Contestabile, M., & Pearson, P. J. (2012). The socio-technical transition of distributed electricity storage into future networks – System value and stakeholder views. *Energy Policy*, 50, 449-457.
- Gullberg, A. T., Ohlhorst, D., & Schreurs, M. (2014). Towards a low carbon energy future – Renewable energy cooperation between Germany and Norway. *Renewable Energy*, 68, 216-222.
- Gunningham, N. (2013). Managing the energy trilemma: The case of Indonesia. *Energy Policy*, 54, 184-193.
- Guo, L., Holton, A., & Jeong, S. H. (2012). Transnational comparative framing: A model for an emerging framing approach. *International Journal of Communication*, 6, 24.
- Habermas, J., Lennox, S., & Lennox, F. (1974). The Public Sphere: An Encyclopedia Article (1964). *New German Critique*, (3), 49-55.
- Hagen, B., Middel, A., & Pijawka, D. (2016). European Climate Change Perceptions: Public support for mitigation and adaptation policies. *Environmental Policy and Governance*, 26(3), 170-183.
- Hanus, N., Wong-Parodi, G., Hoyos, L., & Rauch, M. (2018). Framing clean energy campaigns to promote civic engagement among parents. *Environmental Research Letters*, 13(3), 034021.
- Hajer, M. A. (1995). *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process*. Oxford, UK: Clarendon Press.
- Hall, N. L., & Taplin, R. (2008). Room for climate advocates in a coal-focused economy? NGO influence on Australian climate policy. *Australian Journal of Social Issues*, 43(3), 359-379.
- Hallin, D. C., & Mancini, P. (2017). Ten years after comparing media systems: What have we learned? *Political Communication*, 34(2), 155-171.
- Hallin, D.C. & Mancini, P. (2004). *Comparing Media Systems: Three Models of Media and Politics*. New York, USA: Cambridge University Press.
- Hamilton, L. C., Bell, E., Hartter, J., & Salerno, J. D. (2018). A change in the wind? US public views on renewable energy and climate compared. *Energy, Sustainability and Society*, 8(11), 1-13.
- Hayden, A. (2014). *When green growth is not enough: climate change, ecological modernization, and sufficiency*. Quebec, Canada: McGill-Queen's University Press.
- Healy, N., & Barry, J. (2017). Politicizing energy justice and energy system transitions: Fossil fuel divestment and a "just transition". *Energy Policy*, 108, 451-459.
- Hennicke, P., Johnson, J. P., Kohler, S. & Seifried, D. (1985). *Die Energiewende ist möglich*. Frankfurt, Germany: Fischer.

- Heras-Saizarbitoria, I., Cilleruelo, E., & Zamanillo, I. (2011). Public acceptance of renewables and the media: An analysis of the Spanish PV solar experience. *Renewable and Sustainable Energy Reviews*, 15(9), 4685-4696.
- Hermwille, L. (2016). The role of narratives in socio-technical transitions – Fukushima and the energy regimes of Japan, Germany, and the United Kingdom. *Energy Research & Science*, 11, 237-246.
- Holsti, O.R. (1969). *Content Analysis for the Social Sciences and Humanities*. Reading, USA: Addison-Wesley.
- Holt, D., & Barkemeyer, R. (2012). Media coverage of sustainable development issue—attention cycles or punctuated equilibrium?. *Sustainable Development*, 20(1), 1-17.
- Hopkins, D., & Schwanen, T. (2018). Governing the race to automation. In *Governance of the smart mobility transition* (pp. 65-84). Bingley, UK: Emerald Publishing Limited.
- House of Commons (2016, October 15). *Energy and Climate Change Committee: The energy revolution and future challenges for UK energy and climate change policy: Third Report of Session 2016–17*, Retrieved January 7, 2019 from UK House of Commons: <https://publications.parliament.uk/pa/cm201617/cmselect/cmenergy/705/705.pdf>
- Howell, R., Shackley, S., Mabon, L., Ashworth, P., & Jeanneret, T. (2014). Engaging the public with low-carbon energy technologies: Results from a Scottish large group process. *Energy Policy*, 66, 496-506.
- IEA (2014). *Technology Roadmap: Energy Storage*. Paris, France: OECD/IEA. Retrieved December 5, 2018 from <https://www.iea.org/publications/>
- IESO (2018, December 20). *Removing obstacles for energy storage in Ontario*. Toronto, Canada: Independent Electricity System Operator (IESO). Retrieved February 1, 2019 from <http://www.ieso.ca>
- Iggers, J. (2018). *Good News, Bad News: Journalism Ethics and the Public Interest*. New York City, USA: Routledge.
- Isaac, M. S., & Poor, M. (2016). The sleeper framing effect: The influence of frame valence on immediate and retrospective judgments. *Journal of Consumer Psychology*, 26(1), 53-65.
- Iskin, I., Taha R., & Daim, T. (2013). Exploring the adoption of alternative energy technologies: a literature review. *International Journal of Sustainable Society*, 5 (1), 43-61.
- Jacobs, M. (2013). Green Growth. In R Falkner (ed), *Handbook of Global Climate and Environmental Policy* (pp. 197-213). Oxford, UK: Wiley Blackwell.
- Jacobsson, S., & Johnson, A. (2000). The diffusion of renewable energy technology: An analytical framework and key issues for research. *Energy Policy*, 28(9), 625-640.
- Jasanoff, S. (2018). Just transitions: A humble approach to global energy futures. *Energy Research & Social Science*, 35, 11-14.

- Jaspal, R., Nerlich, B., & Lemańczyk, S. (2014). Fracking in the Polish press: Geopolitics and national identity. *Energy Policy*, 74, 253-261.
- Jepperson, R.L. (1991). Institutions, institutional effects, and institutionalism. In Powell W.W., & DiMaggio, P.J. (eds), *The New Institutionalism in Organisational Analysis* (pp. 164-182), Chicago, USA: University of Chicago Press.
- Jerit, J., Zhao, Y., Tan, M., & Wheeler, M. (2018). Differences Between National and Local Media in News Coverage of the Zika Virus. *Health Communication*, 1-8, [online] DOI: 10.1080/10410236.2018.1536949
- Johansson, B. (2013). Security aspects of future renewable energy systems – A short overview. *Energy*, 61(1), 598-605.
- Johnson, D. M., Halvorsen, K. E., & Solomon, B. D. (2011). Upper Midwestern US consumers and ethanol: Knowledge, beliefs and consumption. *Biomass and Bioenergy*, 35(4), 1454-1464.
- Jones, C. R., Gaede, J., Ganowski, S., & Rowlands, I. H. (2018). Understanding lay-public perceptions of energy storage technologies: Results of a questionnaire conducted in the UK. *Energy Procedia*, 151, 135-143.
- Jones, R. E., & Dunlap, R. E. (1992). The social bases of environmental concern: Have they changed over time? *Rural sociology*, 57(1), 28-47.
- Jönsson, A. M. (2011). Framing environmental risks in the Baltic Sea: A news media analysis. *AMBIO: A Journal of the Human Environment*, 40(2), 121-132.
- Karlstrøm, H., & Ryghaug, M. (2014). Public attitudes towards renewable energy technologies in Norway. The role of party preferences. *Energy Policy*, 67, 656-663.
- Kathleen, M., & Mclellan-Lemal, M. E. (2008). Team-based codebook development: Structure, process, and agreement. In *Handbook for Team-based Qualitative Research*, (pp. 119-135). New York, USA: Altamira Press.
- Kemp, R., Parto, S. & Gibson, R. B. (2005). Governance for sustainable development: Moving from theory to practice. *International Journal of Sustainable Development*, 8(2), 12-30.
- Kennedy, C. (1964). Induced bias in innovation and the theory of distribution. *The Economic Journal*, 74(295), 541-547.
- Kern, F. (2011). Ideas, institutions, and interests: Explaining policy divergence in fostering 'system innovations' towards sustainability. *Environment and Planning C: Government and Policy*, 29(6), 1116-1134.
- Kingdon J.W. (1984). *Agendas, Alternatives, and Public Policies*. New York, USA: HarperCollins.
- Kirby, P., & O'Mahony, T. (2017). *The Political Economy of the Low-Carbon Transition: Pathways Beyond Techno-Optimism*. Cham, Switzerland: Springer.

- Kittner, N., Lill, F., & Kammen, D. M. (2017). Energy storage deployment and innovation for the clean energy transition. *Nature Energy*, 2(9), 17125.
- Klitkou, A., Bolwig, S., Hansen, T., & Wessberg, N. (2015). The role of lock-in mechanisms in transition processes: The case of energy for road transport. *Environmental Innovation and Societal Transitions*, 16, 22-37.
- Köhler, J., Geels, F., Kern, F., Onsongo, E., & Wieczorek, A. (2017). A research agenda for the Sustainability Transitions Research Network. Retrieved June 1, 2018. Retrieved from STRN Working Group: https://pure.tue.nl/ws/portalfiles/portal/101288346/STRN_Research_Agenda_2017.pdf
- Krippendorff, K. (2004). Reliability in Content Analysis: Common Misconceptions and Recommendations. *Human Communication Research*, 30(3), 411-433.
- Krøvel, R. (2011). Journalistic narratives of success and failure at the Bali Climate Change Conference in 2007. *Intercultural Communication Studies*, 20(2), 89–104.
- Kyriakopoulos, G. L., & Arabatzis, G. (2016). Electrical energy storage systems in electricity generation: Energy policies, innovative technologies, and regulatory regimes. *Renewable and Sustainable Energy Reviews*, 56, 1044-1067.
- Lacy, S., & Riffe, D. (1996). Sampling error and selecting intercoder reliability samples for nominal content categories. *Journalism & Mass Communication Quarterly*, 73(4), 963-973.
- Laird, F. N. (2013). Against transitions? Uncovering conflicts in changing energy systems. *Science as Culture*, 22(2), 149-156.
- Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, 30(1), 159-174.
- Lazer, D. M., Baum, M. A., Benkler, Y., Berinsky, A. J., Greenhill, K. M., Menczer, F., ... & Schudson, M. (2018). The science of fake news. *Science*, 359(6380), 1094-1096.
- Leach, M., Scoones, I., & Stirling, A. (2010). *Dynamic Sustainabilities: Technology, Environment, Social Justice*. Abingdon, UK: Routledge.
- Lélé, S. M. (1991). Sustainable development: A critical review. *World development*, 19(6), 607-621.
- Levin, I. (1987). Associative effects of information framing. *Bulletin of the Psychonomic Society*, 25(2), 85-86.
- Li, F. G., & Pye, S. (2018). Uncertainty, politics, and technology: Expert perceptions on energy transitions in the United Kingdom. *Energy Research & Social Science*, 37, 122-132.
- Li, F. G., Trutnevyte, E., & Strachan, N. (2015). A review of socio-technical energy transition (STET) models. *Technological Forecasting and Social Change*, 100, 290-305.

- Lim, J. (2010). Convergence of Attention and Prominence Dimensions of Salience among Major Online Newspapers. *Journal of Computer-Mediated Communication*, 5(2), 293–313.
- Listerman, T. (2010). Framing of science issues in opinion-leading news: international comparison of biotechnology issue coverage. *Public Understanding of Science*, 19(1), 5-15.
- Lombard, M., Snyder-Duch, J., & Bracken, C. C. (2002). Content analysis in mass communication: Assessment and reporting of intercoder reliability. *Human Communication Research*, 28(4), 587-604.
- Lovins, A.B. (1977). *Soft Energy Paths: Toward a Durable Peace*. Cambridge, USA: Ballinger Publishing Co.
- Lubke, G. H., & Muthén, B. O. (2004). Applying multigroup confirmatory factor models for continuous outcomes to Likert scale data complicates meaningful group comparisons. *Structural Equation Modeling*, 11(4), 514-534.
- Luhmann, N. (2000). *The Reality of The Mass Media*. Stanford, CA: Stanford University Press.
- Luo, X., Wang, J., Dooner, M., & Clarke, J. (2015). Overview of current development in electrical energy storage technologies and the application potential in power system operation. *Applied Energy*, 137, 511-536.
- Macnamara, J. R. (2005). Media content analysis: Its uses, benefits and best practice methodology. *Asia-Pacific Public Relations Journal*, 6(1), 1-34.
- Mallett, A., Jegen, M., Pillion, X. D., Reiber, R., & Rosenbloom, D. (2018). Smart grid framing through coverage in the Canadian media: Technologies coupled with experiences. *Renewable and Sustainable Energy Reviews*, 82, 1952-1960.
- Mallett, A., Stephens, J. C., Wilson, E. J., Langheim, R., Reiber, R., & Peterson, T. R. (2016). Electric (dis) connections: Comparative review of smart grid news coverage in the United States and Canada. *Renewable and Sustainable Energy Reviews*, 82, 1913-1921.
- Malone, E., Hultman, N. E., Anderson, K. L., & Romeiro, V. (2017). Stories about ourselves: How national narratives influence the diffusion of large-scale energy technologies. *Energy Research & Social Science*, 31, 70-76.
- Markard, J., Suter, M., & Ingold, K. (2016). Socio-technical transitions and policy change – advocacy coalitions in Swiss energy policy. *Environmental Innovation and Societal Transitions*, 18, 215-237.
- Markova, I. (2008). The Epistemological Significance of the Theory of Social Representations. *Theory of Social Behaviour*, 38(4), 461-487.
- Matsumoto, K. I., Doumpos, M., & Andriosopoulos, K. (2018). Historical energy security performance in EU countries. *Renewable and Sustainable Energy Reviews*, 82(1), 1737-1748.

- Matthes, J., & Kohring, M. (2008). The content analysis of media frames: Toward improving reliability and validity. *Journal of Communication*, 58(2), 258-279.
- McCombs, K., & Shanahan, J. (1999). Telling stories about global climate change: Measuring the impact of narratives on issue cycles. *Communication Research*, 26(1), 30-57.
- McCombs, M. (2005). A look at Agenda-setting: past, present and future. *Journalism Studies*, 6(4), 543-557.
- McCright, A. M., Xiao, C., & Dunlap, R. E. (2014). Political polarization on support for government spending on environmental protection in the USA, 1974–2012. *Social Science Research*, 48, 251-260.
- McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia medica*, 22(3), 276-282.
- McHugh, M. L. (2013). The Chi-square test of independence. *Biochemia medica: Biochemia medica*, 23(2), 143-149.
- McKinsey & Company (2016, November 4). *McKinsey on Sustainability and Resource Productivity*. (Report no. 4). USA: McKinsey & Company. Retrieved July 20, 2017 from <https://www.mckinsey.com>
- McPherson, M., Johnson, N., & Strubegger, M. (2018). The role of electricity storage and hydrogen technologies in enabling global low-carbon energy transitions. *Applied Energy*, 216, 649-661.
- McQuail, D. (2005). Book Review: Comparing Media Systems: Three Models of Media and Politics. *European Journal of Communication*, 20(2), 266-268.
- Meadowcroft, J. (2009). What about the politics? Sustainable Development, Transition Management, and Long-Term Energy Transitions. *Policy Sciences*, 42(4), 323.
- Meadowcroft, J., Stephens, J. C., Wilson, E. J., & Rowlands, I. H. (2018). Social dimensions of smart grid: Regional analysis in Canada and the United States. Introduction to special issue of Renewable and Sustainable Energy Reviews. *Renewable and Sustainable Energy Reviews*, 82, 1909-1912.
- Meadows, D.H., Meadows, D.L., Randers, J., Behrens, W.W., (1972). *The Limits to Growth*. New York: USA: Universe Books
- Media Reform Coalition. (2018). *A comprehensive report on media ownership in the UK – October 2015*. Retrieved June 20, 2018 from <http://www.mediareform.org.uk/resources/media-ownership-reports>
- Metag, J. (2016). Content Analysis Methods for Assessing Climate Change Communication and Media Portrayals. *Oxford Encyclopedia of Climate Change Communication*. New York, USA: Oxford University Press. Retrieved July 7, 2018 from <https://www.zora.uzh.ch/id/eprint/134602/>.

- Miller, C. A., Iles, A., & Jones, C. F. (2013). The Social Dimensions of Energy Transitions. *Science as Culture*, 22(2), 135-148.
- Miller, C. A., & Richter, J. (2014). Social Planning for Energy Transitions. *Current Sustainable/Renewable Energy Reports*, 1(3), 77-84.
- Moezzi, M., Janda, K. B., & Rotmann, S. (2017). Using stories, narratives, and storytelling in energy and climate change research. *Energy Research & Social Science*, 31, 1-10.
- Mounk, Y., & Eirmann, M. (2017). *2017 Was the Year of False Promise in the Fight Against Populism*. Retrieved March 1, 2019 from Foreign Policy: <https://foreignpolicy.com/2017/12/29/2017-was-the-year-of-false-promise-for-populism/>
- Morgan, E. M., Snelson, C., & Elison-Bowers, P. (2010). Image and video disclosure of substance use on social media websites. *Computers in Human Behavior*, 26(6), 1405-1411.
- Morris, C., & Pehnt, M. (2012). *Energy Transition: The German Energiewende*. Frieberg, Germany: Heinrich Böll Stiftung.
- Moscovici, S. (1976). *Social Influence and Social Change*. London, UK: Academic Press.
- Moscovici, S. (1984). *The Phenomenon of Social Representations*. Cambridge, UK: Cambridge University Press.
- Muench, S., Thuss, S. & Guenther, E. (2014). What hampers energy system transformations? The case of smart grids. *Energy Policy*, 73, 80-92.
- NationMaster (n.d). *Energy: Canada and United Kingdom compared*. Retrieved December 1, 2018 from <http://www.nationmaster.com/country-info/compare/Canada/United-Kingdom/Energy>
- Navigant Research, (2017). *Country Forecasts for Utility-Scale and Distributed Energy Storage Reports*. Retrieved May 2, 2018 from <https://www.navigantresearch.com/reports/country-forecasts-for-utility-scale-energy-storage>
- Negro, S. O., Alkemade, F. & Hekkert, M. P. (2012). Why does renewable energy diffuse so slowly? A review of innovation system problems. *Renewable and Sustainable Energy Reviews*, 16(6), 3836-3846.
- Newbery, D. M. (2016). Towards a green energy economy? The EU Energy Union's transition to a low-carbon zero subsidy electricity system – Lessons from the UK's Electricity Market Reform. *Applied Energy*, 179, 1321-1330.
- News Media Canada (2015). *News Media Canada data for 2015 daily newspaper circulation in Canada*. [dataset]. Retrieved June 1, 2017 from <https://nmc-mic.ca/about-newspapers/circulation/daily-newspapers/>
- News Media Canada (2018). *News Media Canada data for 2017 daily newspaper ownership in Canada*. [dataset]. Retrieved June 1, 2017 from: <https://nmc-mic.ca/wp->

content/uploads/2015/02/Daily-Newspaper-Ownership-2017.pdf

- Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. *Review of general psychology, 2*(2), 175.
- Ockwell, D., & Byrne, R. (2016). *Sustainable Energy for All: Innovation, technology and pro-poor green transformations*. Abingdon, UK: Routledge.
- Ofgem, (2017). *Upgrading our Energy System: Smart Systems and Flexibility Plan*. London, UK: OGL. Retrieved October 19, 201 from the Office of Gas and Electricity Markets (Ofgem): www.gov.uk/beis www.ofgem.gov.uk
- Olausson, U. (2009). Global warming—global responsibility? Media frames of collective action and scientific certainty. *Public Understanding of Science, 18*(4), 421-436.
- Oltra, C., Delicado, A., Prades, A., Pereira, S., & Schmidt, L. (2014). The Holy Grail of energy? A content and thematic analysis of the presentation of nuclear fusion on the Internet. *Journal of Science Communication, 13*(4), 1-18.
- Östberg, J., & Kleinschmit, D. (2016). Comparative study of local and national media reporting: Conflict around the tv oak in Stockholm, Sweden. *Forests, 7*(10), 1-13.
- Pan, Z., & Kosicki, G. M. (1993). Framing analysis: An approach to news discourse. *Political Communication, 10*(1), 55-75.
- Patterson, C., Emslie, C., Mason, O., Fergie, G., & Hilton, S. (2016). Content analysis of UK newspaper and online news representations of women's and men's 'binge' drinking: a challenge for communicating evidence-based messages about single-episodic drinking? *BMJ Open, 6*(12), e013124.
- Parkhill, K.A., Demski, C., Butler, C., Spence, A., & Pidgeon, N.F. (2013). *Transforming the UK energy system: Public values, attitudes and acceptability – Synthesis Report*. (Working Paper no. 82906). London, UK: UK Energy Research Center (UKERC). Retrieved March 24, 2019 from <http://eprints.whiterose.ac.uk/82906/>
- Pepermans, G., Driesen, J., Haeseldonckx, D., Belmans, R., & D'haeseleer, W. (2005). Distributed generation: definition, benefits and issues. *Energy Policy, 33*(6), 787-798.
- Peters, D., Axsen, J., & Mallett, A. (2018). The role of environmental framing in socio-political acceptance of smart grid: The case of British Columbia, Canada. *Renewable and Sustainable Energy Reviews, 82*(2), 1939-1951.
- Peterson, T. R., Stephens, J. C., & Wilson, E. J. (2015). Public perception of and engagement with emerging low-carbon energy technologies: A literature review. *MRS Energy & Sustainability, 2*, 1-14.
- Phillips, R. (2018). Crash to Paywall: Canadian Newspapers and the Great Disruption. *Canadian Journal of Communication, 43*(1).

- Pidgeon N.F., Lorenzoni I., and Poortinga W. (2008). Climate change or nuclear power: No thanks! A quantitative study of public perceptions and risk framing in Britain. *Global Environmental Change*, 18(1), 69–85 (2008).
- Pidgeon, N., Demski, C., Butler, C., Parkhill, K., & Spence, A. (2014). Creating a national citizen engagement process for energy policy. *Proceedings of the National Academy of Sciences*, 111(Supplement 4), 13606-13613.
- Pierce, J. C., Steel, B. S., & Warner, R. L. (2009). Knowledge, Culture, and Public Support for Renewable-Energy Policy. *Comparative Technology Transfer and Society*, 7(3), 270-286.
- Porter, K. E., & Hulme, M. (2013). The emergence of the geoengineering debate in the UK print media: A frame analysis. *The Geographical Journal*, 179(4), 342-355.
- Pratt, D. (2018). *UK government says 'Brexit' is to blame for stalled progress on energy storage*. Retrieved January 4, 2019 from Energy Storage News: <https://www.energystorage.news>
- Press Reference, (2018). *The United Kingdom*. Retrieved June 20, 2018 from <http://www.pressreference.com/Sw-Ur/The-United-Kingdom.html>
- Protest, D., & McCombs, M. E. (Eds.). (2016). *Agenda setting: Readings on Media, Public Opinion, and Policymaking*. New York, USA: Routledge.
- QSR International (2018). *Run a Coding Comparison query*. Retrieved from http://help-nv11mac.qsrinternational.com/desktop/procedures/run_a_coding_comparison_query.htm
- Rachul, C., & Caulfield, T. (2015). The media and access issues: Content analysis of Canadian newspaper coverage of health policy decisions. *Orphanet Journal of Rare Diseases*, 10(1), 102.
- Ravenhill, J. (2017). *Global Political Economy*. Oxford, UK: Oxford University Press.
- REA. (2016). *Energy Storage in the UK: An Overview*. Retrieved July 3, 2018 from Renewable Energy Association (REA): <https://www.r-ea.net>
- Reilly, J., Prinn, R., Chen, H., Sokolov, A., Gao, X., Schlosser, A., Morris, J., & Paltsev, S. (2018). *Food, Water, Energy, Climate Outlook Perspectives from 2018*. Massachusetts, USA: MIT Joint Program on the Science and Policy of Global Change. Retrieved October 16, 2018 from <https://globalchange.mit.edu>
- Reiner, D., Curry, T., de Figueiredo, M., Herzog, H., Ansolabehere, S., Itaoka, K., ... & Odenberger, M. (2006). An international comparison of public attitudes towards carbon capture and storage technologies. *Proceedings of the 8th International Conference on Greenhouse Gas Control Technologies*. June 19-22, 2006, Trondheim, Norway: Elsevier.
- Rip, A., & Kemp, R. (1998). Technological Change. *Human choice and climate change*, 2(2), 327-399.

- Rip, A. (2006). Folk Theories of Nanotechnologists. *Science as Culture*, 15(4), 349-365.
- Roberts, C., Geels, F. W., Lockwood, M., Newell, P., Schmitz, H., Turnheim, B., & Jordan, A. (2018). The politics of accelerating low-carbon transitions: Towards a new research agenda. *Energy Research & Social Science*, 44, 304-311.
- Robertson, P. (2017). *Renewable Energy: Prospects, Politics, the Public, and Proximity (PhD Dissertation, Utah State University, no. 6690)*. Retrieved March 1, 2019 from Social and Behavioral Sciences Commons Graduate theses and dissertations: <https://digitalcommons.usu.edu/etd/6690>
- Riffe, D., Lacy, S., & Fico, F. (2014). *Analyzing Media Messages: Using Quantitative Content Analysis in Research*. London, UK: Routledge.
- Roe, E. (1994). *Narrative Policy Analysis*. Durham, UK: Duke University Press.
- Rogers, E. (1995). *Diffusion of innovations*. New York, USA: Free Press.
- Rogers, E. (2010). *Diffusion of Innovations*. 4th Ed. New York, USA: Simon and Shuster.
- Romanach, L., Carr-Cornish, S., & Muriuki, G. (2015). Societal acceptance of an emerging energy technology: How is geothermal energy portrayed in Australian media?. *Renewable and Sustainable Energy Reviews*, 42, 1143-1150.
- Rosenbloom, D., Berton, H., & Meadowcroft, J. (2016). Framing the sun: A discursive approach to understanding multi-dimensional interactions within socio-technical transitions through the case of solar electricity in Ontario, Canada. *Research Policy*, 45(6), 1275-1290.
- Rosenbloom, D., Haley, B., & Meadowcroft, J. (2018). Critical choices and the politics of decarbonization pathways: Exploring branching points surrounding low-carbon transitions in Canadian electricity systems. *Energy Research & Social Science*, 37, 22-36.
- Ross, C. E., & Mirowsky, J. (1984). Socially-Desirable Response and Acquiescence in a Cross-Cultural Survey of Mental Health. *Journal of Health and Social Behavior*, 25(2), 189-197.
- Rotmans, J., Kemp, R., & Van Asselt, M. (2001). More evolution than revolution: Transition management in public policy. *Foresight*, 3(1), 15-31.
- Ruef, A., & Markard, J. (2010). What happens after a hype? How changing expectations affected innovation activities in the case of stationary fuel cells. *Technology Analysis & Strategic Management*, 22(3), 317-338.
- Santos, J. R. A. (1999). Cronbach's alpha: A tool for assessing the reliability of scales. *Journal of Extension*, 37(2), 1-5.
- Saraisky, N. G. (2016). Analyzing Public Discourse: Using Media Content Analysis to Understand the Policy Process. *Current Issues in Comparative Education*, 18(1), 26-41.
- Schäfer, M. S., Scheffran, J., & Penniket, L. (2016). Securitization of media reporting on climate change? A cross-national analysis in nine countries. *Security Dialogue*, 47(1), 76-96.

- Scheufele, B. (2004). Framing-effects approach: A theoretical and methodological critique. *Communications*, 29(4), 401-428.
- Schirrmester, M. (2014). Controversial futures – discourse analysis on utilizing the “fracking” technology in Germany. *European Journal of Futures Research*, 2(1), 38.
- Schmidt, A., Ivanova, A., & Schäfer, M. S. (2013). Media attention for climate change around the world: A comparative analysis of newspaper coverage in 27 countries. *Global Environmental Change*, 23(5), 1233-1248.
- Schwarz, N. (1999). Self-reports: How the questions shape the answers. *American Psychologist*, 54(2), 93-105.
- Scoones, I., Leach, M., & Newell, P. (2015). *The Politics of Green Transformations*. New York, USA: Routledge.
- Scottish Law News Centre. (2018). *UK Newspapers*. Retrieved June 1, 2018 from <https://www.scottishlaw.org.uk/scotlaw/newspapers.html>
- Scrase, J. I., & Ockwell, D. G. (2010). The role of discourse and linguistic framing effects in sustaining high carbon energy policy — An accessible introduction. *Energy Policy*, 38(5), 2225-2233.
- Shaw, E. F. (1979). Agenda-Setting and Mass Communication Theory. *Gazette*, 25(2), 96-105.
- Shehata, A., & Hopmann, D. N. (2012). Framing climate change: A study of US and Swedish press coverage of global warming. *Journalism Studies*, 13(2), 175-192.
- Sidhu, A. S., Pollitt, M. G., & Anaya, K. L. (2018). A social cost benefit analysis of grid-scale electrical energy storage projects: A case study. *Applied Energy*, 212, 881-894.
- Skjølsvold, T. M. (2012). Curb your enthusiasm: On media communication of bioenergy and the role of the news media in technology diffusion. *Environmental Communication: A Journal of Nature and Culture*, 6(4), 512-531.
- Smink, M. M., Hekkert, M. P., & Negro, S. O. (2015). Keeping sustainable innovation on a leash? Exploring incumbents’ institutional strategies. *Business Strategy and the Environment*, 24(2), 86-101.
- Smith, A., & Stirling, A. (2010). The Politics of Social-Ecological Resilience and Sustainable Socio-Technical Transitions. *Ecology and Society*, 15(1), 1-11.
- Smith, A., Stirling, A., & Berkhout, F. (2005). The governance of sustainable socio-technical transitions. *Research policy*, 34(10), 1491-1510.
- Snelson, C. L. (2016). Qualitative and Mixed Methods Social Media Research: A Review of the Literature. *International Journal of Qualitative Methods*, 15(1), 1-15.
- Songsore, E., & Buzzelli, M. (2015). Wind energy development in Ontario: A process/product paradox. *Local Environment*, 20(12), 1428-1451.

- Sovacool, B. K., & Ratan, P. L. (2012). Conceptualizing the acceptance of wind and solar electricity. *Renewable and Sustainable Energy Reviews*, 16(7), 5268-5279.
- Spence, A., Demski, C., Butler, C., Parkhill, K., & Pidgeon, N. (2015). Public perceptions of demand-side management and a smarter energy future. *Nature Climate Change*, 5(6), 550-554.
- Statista (2018a). *Global electricity prices in 2018, by select country (in U.S. dollars per kilowatt hour)*. Retrieved April 24, 2019 from <https://www.statista.com/statistics/263492/electricity-prices-in-selected-countries/>
- Statista (2018b). *Circulation of newspapers in the United Kingdom (UK) in 2017*. Retrieved June 1, 2018 from <https://www.statista.com/statistics/529885/uk-daily-newspaper-market-by-circulation/>
- Stephens, J. C., Peterson, T. R. & Wilson, E. J. (2013). Socio-Political Evaluation of Energy Deployment (SPEED): A framework applied to smart grid. *UCLA Law Review*, 61, 1930.
- Stephens, J. C., Wilson, E. J., & Peterson, T. R. (2008). Socio-Political Evaluation of Energy Deployment (SPEED): An integrated research framework analyzing energy technology deployment. *Technological Forecasting and Social Change*, 75(8), 1224-1246.
- Stephens, J. C., Wilson, E. J., & Peterson, T. R. (2015). *Smart Grid (R)evolution*. New York, USA: Cambridge University Press.
- Strbac, G., Aunedi, M., Pudjianto, D., Djapic, P., Teng, F., Sturt, A., ... & Brandon, N. (2012). *Strategic Assessment of the Role and Value of Energy Storage Systems in the UK Low Carbon Energy Future. A Report for Carbon Trust*. London, UK: Imperial College London.
- Sung, B., & Park, S. D. (2018). Who Drives the Transition to a Renewable-Energy Economy? Multi-Actor Perspective on Social Innovation. *Sustainability*, 10(2), 448.
- Taylor, P. G., Bolton, R., Stone, D., & Upham, P. (2013). Developing pathways for energy storage in the UK using a coevolutionary framework. *Energy Policy*, 63, 230-243.
- Taylor, P., Bolton, R., Stone, D., Zhang, X.P., Martin, C., & Upham, P. (2012). *Pathways for energy storage in the UK*. (Report no. 007). [Figure 1]. Leeds, UK: Centre for Low Carbon Futures 2012. Retrieved February 6, 2019 from <https://www.birmingham.ac.uk/Documents/college-eps/energy/research/CLCF-Pathwaysforenergystorage,2012.pdf>
- Tewksbury, D., Jones, J., Peske, M. W., Raymond, A., & Vig, W. (2000). The interaction of news and advocate frames: Manipulating audience perceptions of a local public policy issue. *Journalism & Mass Communication Quarterly*, 77(4), 804-829
- The Canadian Trade Commissioner Service. (2018)0. *Memorandum of Understanding between the Department of Foreign Affairs, Trade and Development of Canada and the Department for Business, Energy, and Industrial Strategy of the United Kingdom of Great Britain and Northern Ireland concerning Science, Technology and Innovation*.

Retrieved November 25, 2018 from the Government of Canada:
<https://www.tradecommissioner.gc.ca/>

- Tuck, A., Q. Wang, K. Malek, Y. Grinburg and F. Bensebaa. (2017). *Canadian Energy Storage Roadmap*. Toronto, Canada: National Research Council Canada. Retrieved June 3, 2017. Retrieved from the Government of Canada: <http://doi.org/10.4224/23001380>
- Tugwell, F. (1980). Review: Energy and Political Economy. *Comparative Politics*, 13(1), 103-118.
- Ulli-Beer, S. (2013). Conceptual Grounds of Socio-Technical Transitions and Governance. In *Dynamic Governance of Energy Technology Change* (pp. 19-47). Berlin, Germany Springer.
- Upham, P., Oltra, C., & Boso, A. (2015). Towards a cross-paradigmatic framework of the social acceptance of energy systems. *Energy Research & Social Science*, 8, 100-112.
- Upreti, B. R., & van der Horst, D. (2004). National renewable energy policy and local opposition in the UK: The failed development of a biomass electricity plant. *Biomass and Bioenergy*, 26(1), 61-69.
- Van Alphen, K., tot Voorst, Q. V. V., Hekkert, M. P., & Smits, R. E. (2007). Societal acceptance of carbon capture and storage technologies. *Energy Policy*, 35(8), 4368-4380.
- Van Gorp, B. (2007). The constructionist approach to framing: Bringing culture back in. *Journal of Communication*, 57(1), 60-78.
- Vessey R. (2016). *The Media in Canada. Language and Canadian Media*. London, UK: Palgrave Macmillan
- Verbong, G., Geels, F. W., & Raven, R. (2008). Multi-niche analysis of dynamics and policies in Dutch renewable energy innovation journeys (1970–2006): Hype-cycles, closed networks and technology-focused learning. *Technology Analysis & Strategic Management*, 20(5), 555-573.
- Vergragt, P. J., Markusson, N., & Karlsson, H. (2011). Carbon capture and storage, bio-energy with carbon capture and storage, and the escape from the fossil fuel lock-in. *Global Environmental Change*, 21(2), 282-292.
- Vezzoli, C., Ceschin, F., Osanjo, L., M'Rithaa, M. K., Moalosi, R., Nakazibwe, V., & Diehl, J. C. (2018). Distributed/Decentralised Renewable Energy Systems. In *Designing Sustainable Energy for All*, (pp. 23-39). Cham, Switzerland: Springer.
- Vliegthart, R., & Walgrave, S. (2012). The Interdependency of Mass Media and Social Movements. In *The Sage Handbook of Political Communication* (pp. 387-398). London, UK: Sage Publications.
- Wade, N. S., Taylor, P. C., Lang, P. D. & Jones, P. R. (2010). Evaluating the benefits of an electrical energy storage system in a future smart grid. *Energy Policy*, 38(11), 7180-7188.

- Walker, B. J., Wiersma, B., & Bailey, E. (2014). Community benefits, framing and the social acceptance of offshore wind farms: An experimental study in England. *Energy Research & Social Science*, 3, 46-54
- Wallis, P., & Nerlich, B. (2005). Disease metaphors in new epidemics: The UK media framing of the 2003 SARS epidemic. *Social Science & Medicine*, 60(11), 2629-2639.
- Ward, B. (2016, January 25). Why are some British newspapers still denying climate change?. *The Guardian*. Retrieved February 1, 2019 from <https://www.theguardian.com/environment/2016/jan/25/why-are-some-british-newspapers-still-denying-climate-change>
- Warren, C. R., Lumsden, C., O'Dowd, S., & Birnie, R. V. (2005). 'Green on green': Public perceptions of wind power in Scotland and Ireland. *Journal of Environmental Planning and Management*, 48(6), 853-875
- Watson, D., & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin*, 98(2), 219.
- Watson, J., Ketsopoulou, I., Dodds, P., Chaudry, M., Tindemans, S., Woolf, M., and Strbac, G. (2018). *The Security of UK Energy Futures*. London, UK: Energy Research Centre.
- Weaver, D. (1991). Issue salience and public opinion: Are there consequences of agenda-setting?. *International Journal of Public Opinion Research*, 3(1), 53-68.
- Weber, R. P. (1984). Computer-aided content analysis: A short primer. *Qualitative Sociology*, 7(1-2), 126-147.
- Whitten-Woodring, J. (2009). Watchdog Or Lapdog? Media Freedom, Regime Type, and Government Respect for Human Rights. *International Studies Quarterly*, 53(3), 595-625.
- Wicki, S., & Hansen, E. G. (2017). Clean energy storage technology in the making: An innovation systems perspective on flywheel energy storage. *Journal of Cleaner Production*, 162(20), 1118-1134.
- Wilson, I. G., McGregor, P. G., Infield, D. G., & Hall, P. J. (2011). Grid-connected renewables, storage and the UK electricity market. *Renewable Energy*, 36(8), 2166-2170.
- Winfield, M. (2017, May 17). Electricity policy is falling behind the energy revolution. *The Globe and Mail*. Retrieved September 18, 2018 from <https://www.theglobeandmail.com/report-on-business/rob-commentary/electricity-policy-is-falling-behind-the-energy-revolution/article34996377/>
- Winfield, M., Shokrzadeh, S., & Jones, A. (2018). Energy policy regime change and advanced energy storage: A comparative analysis. *Energy Policy*, 115, 572-583.
- Wolf, J., & Moser, S. C. (2011). Individual understandings, perceptions, and engagement with climate change: Insights from in-depth studies across the world. *Wiley Interdisciplinary Reviews: Climate Change*, 2(4), 547-569.

- Wolsink, M. (1987). Wind power for the electricity supply of houses. *The Netherlands Journal of Housing and Environmental research*, 2(3), 195-214.
- Wolsink, M. (2012). Wind power: Basic Challenge Concerning Social Acceptance. In *Encyclopedia of sustainability science and technology* (pp. 12218-12254). New York, USA: Springer.
- Wright, W., & Reid, T. (2011). Green dreams or pipe dreams?: Media framing of the US biofuels movement. *Biomass and Bioenergy*, 35(4), 1390-1399.
- Wüstenhagen, R., Wolsink, M. & Bürer, M. J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. *Energy Policy*, 35(5), 2683-2691.
- Yin, R.K., (1984). *Case Study Research: Design and Methods*. Beverly Hills, USA: Sage.
- Young, N., & Dugas, E. (2012). Comparing climate change coverage in Canadian English and French-language print media: Environmental values, media cultures, and the narration of global warming. *Canadian Journal of Sociology*, 37(1), 25-54.
- Yusuf, S. F. G., Krul, K., & Marufu, G. (2016). Representation of Agricultural Issues in South African Newspapers: A Content Analysis. *Journal of Communication*, 7(2), 287-295.
- Zainal, Z. (2007). Case study as a research method. *Jurnal Kemanusiaan*, 9(2), 1-6.
- Zhou, Y., & Moy, P. (2007). Parsing framing processes: The interplay between online public opinion and media coverage. *Journal of Communication*, 57(1), 79-98.

Appendix A – Definitions

AA.1 Definitions of key terms

Domestication/Domesticated: The process by which journalists contextualise global and general issues such as clean energy development to provide local meaning and relevance for their readership, thus domesticating the information (Clausen, 2004). Domestication in the context of energy and public communication poses that a combination of domestic structural (e.g., energy resources and production), institutional (e.g., politics and industry), and cultural (e.g., social values and priorities) factors influence the ways in which energy innovations are framed in news media (e.g., see Skjølsvold, 2012).

Issue-salience: The state or condition of being prominent. The term is observed here through an agenda-setting lens as the level of attention attributed to an issue in the public sphere. In other words, issue salience can be observed as ‘attention salience’ (i.e., the overall frequency or volume of reports on ES in the news) and ‘prominence salience’ (i.e., the relative prominence of the issue gauged by story placement or the level of importance explicitly attributed to the issue) (Shaw, 1979; Protesse & McCombs, 2016; Lim, 2010).

Media: ‘(The) media,’ ‘news media’ and ‘media stakeholders’ are used interchangeably in this thesis, referring to “the publisher, editors, journalists and others who constitute the communications industry and profession, and who disseminate information, largely through newspapers, magazines, television, radio and the Internet” (Boykoff & Roberts, 2007; p. 3).

Multi-Level Perspective: The interplay between niche, regime, and landscape components of a dynamic system; a heuristic model for understanding the process of socio-technical change and transitions (Geels, 2002; 2005; Geels & Schot, 2007):

Niche: The protected spaces or safe havens, such as R&D laboratories, subsidised demonstration projects, or small market niches, where new innovations can emerge and develop free from market and other pressures which occur at the regime level; A niche-innovation refers to the emerging developments within this space (e.g., technologies, patents, programs) that niche-actors (e.g., entrepreneurs, think-tanks) want to advance into the regime space, but often encounter challenges as niche-innovations rarely align with existing regime dimensions (e.g. lack of appropriate infrastructure, regulations, or consumer practices) (Geels, 2011).

Regime: The ‘deep structure’ that accounts for the stability of an existing socio-technical system (Geels, 2004). This constitutes a web of inter-linking actors across different social groups and communities following a set of incumbent rules and processes. Seven dimensions are known to make up socio-technical regimes: technology, user practices and application, the symbolic meaning of technology, infrastructure, policy, and techno-scientific knowledge (Geels, 2014).

Landscape: The exogenous environment and context, which influences niche and regime dynamics (Rip and Kemp, 1998). A broad range of factors is contained here, such as political and economic pressures, social values and cultural norms, public communication and discourse, as well as environmental and other structural issues. Landscape can function as selection environments for niche-innovations (Geels, 2002; 2007).

Public sphere: A virtual or imaginary community which does not necessarily exist in any identifiable space but represents an area in social life where members of society come together to freely discuss societal issues, and through that discussion, can influence political action (Habermas et al., 1974). Here, it is understood as the space in which public discourse, dialogue, and meaning-making around developments in society take place (e.g., media landscape).

Techno-optimism: An exaggerated and unwarranted belief in human technological abilities to solve problems of unsustainability while minimising or denying the need for large-scale social, economic and political transformation (Barry, 2016). In other words, techno-optimism is the belief that the problems caused by economic growth can be solved by more economic growth (as measured by GDP), provided we learn how to produce and consume more efficiently through the application of science and technology (Alexander, 2014).

Appendix B – Codebook

AB.1 PH1 – Comparative Mixed methods Media Content Analysis (MCA): Codebook

AB.1.1 Coding process

The following step-by-step guide was used by both coders (myself, the primary researcher) and Dr. James Gaede (the secondary coder) to code media content in PH1:

- **Step 1:** Read the full article stored in the NVivo library, located under ‘memos’ (in country folder)
- **Step 2:** Code for **Focus** of the article – i.e., read memo content to interpret text, but only code the article source* at the appropriate **Focus Case**
- **Step 3:** Code for **SPEED frames** – i.e., read memo content and code excerpts (sentences, paragraphs) at appropriate **SPEED Nodes**.
- **Step 4:** Code for **Narratives** – i.e., read memo content to interpret text, but only code the article source* at appropriate **Narrative Case(s)**
- **Step 5:** Code for **Valence** – i.e., read memo content to interpret text, but only code the article source* at the appropriate **Valence Case**
- **Step 6:** Repeat steps 1-5 for each article.

AB.1.2 Coding schemes

AB.1.2.1 Focus (salience) coding scheme

The following coding scheme is based on Langheim et al.’s (2014) focused vs. subsection coding approach:

- After reading the full article (**Step 1**), determine the extent to which the article focuses on ES (**Step 2**)
- Once the focus is determined, add the article to the correct **Focus Case**. To do this, right click on the article title (from **Externals** list) and ‘**Code the Source**’ to **one** of the three options (e.g. ES-F). **Note:** An article can only be classified into **one** type of Focus case.

Focus of article	Description	Examples
ES-Focused (ES-F)	ES is the focus of the article; content focuses mainly on ES systems, projects, technologies, policies, markets, regulatory frameworks, and other related processes; key words appear in first (or first few) paragraphs;	Stories about new ES community projects; emerging ES technologies and R&D activities, national/provincial energy plans focusing on ES integration; debates/opinions on ES
ES Subsection (ES-S)	Article mentions ES, but does not focus on storage exclusively; key words often appear later in article (subsections) or are briefly mentioned at the beginning (or end); there is still enough context to code for at least one frame/narrative;	ES mentioned as part of broader energy planning, policy development, and system change; discussed in context of low-carbon technology deployment, R&D, innovation etc.
ES-Irrelevant (ES-IR)	Article mentions ES or key words, but does not provide enough context to effectively code for frames/narratives; ES often mentioned at the end of article	ES mentioned in a list of technologies or R&D developments with little or no context or further information about it;

Table A 1. Article focus coding scheme; describing various levels of ES salience in news articles

AB.1.2.2 SPEED Frames

The following coding scheme is based on Stephens et al.'s (2013) SPEED framework:

- After completing **Step 1** and **2**, return to the memo content of the article.
- Highlight the content that contains the SPEED risk or benefit. Be sure to select the entire **sentence or paragraph in order to provide enough context for later analysis**. Highlighting entire paragraphs (or multiple paragraphs where applicable) is preferred.
- Right click on the highlighted excerpt and '**Code the Selection**' at the appropriate **Node(s)** (e.g. **SPEED Benefit > Environmental**). Or, highlight and drag content to the appropriate node on the left-hand side of the screen. Ensure you have read and analysed the entire article in order to identify all SPEED frames contained within the text.
- **Note:** Try to identify and code **all frames** contained in the text – even if they appear more than once. Remember: a single sentence/paragraph can contain more than one frame (e.g., “**ES will be essential for decarbonising our electricity system, providing new job opportunities** and **improving energy security and reliability**). In this case, code for each frame separately, highlighting enough surrounding content to capture context.

SPEED Frame	Framing considerations	Benefits	Risks	Example excerpt
Cultural	Consists of benefits and drawbacks of the technology on human health, safety, wellbeing, happiness, and culture; Support or opposition to technology from a social perspective (e.g. aesthetics, local/contextual suitability, likeability, community impact).	Encourages public acceptance/support of renewable power / lower-carbon energy systems (e.g. less NIMBYism than wind energy development); strengthens community sustainability, engagement, and pride (e.g. participation in ES projects, services remote communities); allows for positive energy consumer behaviour change (e.g. consumer empowerment, agency, energy management)	Invites public skepticism and community opposition (e.g. concerns over loss of control, impact on way of life, siting); cultural reluctance to electricity system changes; may prove difficult to influence consumer adoption and behavior change; potentially leading to social divides, vulnerabilities and frustrations	Benefit: “One [demonstration] would be part of a combined wind and energy storage project in an aboriginal community. ‘We have some investors who are very interested in using this for community power,’ he says” – <i>The Toronto Star</i> , 2011/11/19/ Risk: “The petition [against the Goderich ES project] further claims the project won’t benefit the community beyond its construction phase...Many comments accompanying the petition outline concerns about an industrial project taking place so close to a residential area.” – <i>Daily Commercial News</i> , 2017/06/17
Economic	Includes economic advantages, incentives, savings and costs (to stakeholders) and those generally associated with technology deployment at the R&D and commercial scales; discusses economic forecasts, commercial viability	Strengthens economy and fosters growth (e.g., job creation, training, local economic benefits); opportunities for legacy and new system actors (e.g. increases competitiveness); cost savings (utilities, infrastructure upgrade deferral); cost savings	High costs outweigh benefits (e.g. technology still cost ineffective); creates new costs to actors within and outside electricity system (e.g. transmission, disruption to other industry supply chains, fossil fuel industries); increases economic	Benefit: “Energy storage will create well-paid jobs in a thriving new industry.” – <i>Edmonton Journal</i> , 2009/07/11 Risk: “And while the cost of building a fuel-cell stack has decreased tenfold in the past few years, the price is still too high for universal acceptance. So, until the fuel cell enjoys the

	and scalability of the technology.	(end-user, time-shifting consumption); commercial optimisation of existing assets (e.g. renewable and others); Attracts new business partnerships (local, national, international) and investment opportunities;	and financial risks (e.g. inadequate funding, investment difficulties, market concerns, unclear or lacking market rules, cost analysis difficulties)	benefit of mass production, it will remain too costly for everyday use." – <i>Edmonton Journal</i> , 2008/05/14
Environmental	Includes considerations of the technology in respect to sustainability / the environment; Consists of benefits and drawbacks of the technology on the environment (e.g. land, wildlife, atmosphere); can include comparisons against other energy technologies with the same purpose.	Technology supports low-carbon transition/climate change mitigation and adaptation (e.g., reduces emissions, facilitates conservation and efficiency, supports fossil fuel phase-out); creates no or little harmful waste (e.g. manufacturing processes); improved environmental or public health	Potential threats to ecological health (e.g. land use, resource extraction, habitat destruction, waste disposal); shifting risk to new environmental areas; contribution to GHG emissions /embedded carbon	Benefit: "Most of the world is saying we have to get off fossil fuels," he said. "To do that, you need lots of energy storage." In the same way an everyday battery banks energy using chemicals, Hydrostor relies on compressed, bottled air. And because it produces zero emissions, the system can help Toronto adjust to a healthier low-carbon diet" – <i>The Hamilton Spectator</i> , 2015/11/18 Risk: "In the EU, as few as 5% of lithium-ion batteries are recycled. This has an environmental cost." – <i>The Guardian</i> , 2015/08/10
Political	Includes political support and opposition to the technology by political figures, coalitions and the general public; benefits and drawbacks of the technology to a state or nation's national or global standing / identity or goal achievement; and other political issues (e.g. tensions, concerns) related to deployment (e.g., stakeholder conflicts, permitting issues, liability concerns, siting).	Positive political ramifications (e.g. fosters stakeholder collaboration, strengthens regional identity or national reputation; enhanced national independence and energy security); aligns with provincial and national policy goals; Technology supported by government and other political stakeholders	Negative political ramifications (e.g. opposition to new policies, political skepticism and contention); public frustrations; lacking government support/ political will to support technology deployment or necessary policy;	Benefit: The pumped-hydro project [...] fits very well with government's plan to bring on 5,000 megawatts of new renewable generation by 2030," – <i>Calgary Herald</i> , 2016/11/30/ Risk: "Governments have yet to reckon decisively with the framework required to optimise renewable energy and storage and distribution services <i>The Globe and Mail</i> , 2017/05/16
Regulatory and Legal	Includes advantages and risks related to legal and regulatory processes associated with the technology's	Technology well suited for existing regulatory frameworks; encourages new	Technology unsuited for existing regulatory framework; lacking or unfavorable	Benefit: "There just needs to be leadership and direction from the top down," Stevens said. Debbie Boukydis, an

	deployment; legal issues related to permitting, liability and technology siting.	green energy regulations and policies; Progress toward other policy goals; effectiveness of legal framework to enhance system function	policies and laws (e.g. building code restrictions); lacking/underdeveloped, difficult or deadlocked regulatory processes stalling or derailing system change;	official with Enbridge Gas Distribution, said the proposed bylaw is a "very positive step" that will help the company advance a fuel-cell project that has been caught up in "municipal confusion" for the past nine months." – <i>The Toronto Star</i> , 2008/01/23 Risk: "Unfortunately, getting a multi-megawatt storage park built in Ontario won't happen overnight. Regulations, for one, need changing. We need clearer rules that determine how storage operators can buy and sell what is essentially an electricity service." – <i>The Toronto Star</i> , 2012/03/17
Technical	Includes advantages and limitations of the technology and its development; makes comparisons against other energy technologies with the similar purpose (e.g. energy management); discusses technical promise (e.g., advancements, sophistication, reliability), as well as concerns, uncertainties and/or potential (or ongoing) shortcomings of the technology.	Improves grid flexibility; allows greater renewable energy integration; increases energy capacity and reliability (e.g., addresses intermittency issues); integrable into existing infrastructure; applicable to other sectors (e.g., transportation); technology easily scalable; relatively short project development timelines; part of system modernisation;	Potential negative technical aspects of system change; interaction of technologies to create new risks; needs or vulnerabilities; Requires specialized skills and expertise; lacking or unfavorable grid infrastructure; other technical or logistical constraints; concerns or uncertainties regarding current technological performance (e.g., further testing required);	Benefit: "The fledgling firm sees flywheels as a solution to an increasing problem on Ontario's power system: as more and more wind and solar power flows into the grid, systems are needed to counterbalance the natural ebbs and flows of renewable energy." – <i>The Toronto Star</i> , 2013/05/11/ Risk: "The problem is that traditional pumped storage is limited by geography. There are only so many 300-hectare reservoirs at a high enough elevation to be useful." – <i>The Toronto Star</i> , 2011/01/14

Table A 2. SPEED frame coding scheme

AB.1.2.3 Narratives

The following coding scheme is based on Ganowski et al.'s (2018) Canadian pilot study:

- After completing **Step 1-3**, reflect on the content of the article and identify the main themes that connect to the four narratives below.
- Look for '**keywords**' to help you identify narratives (**Note:** the keyword list is not exhaustive - there may be other phrases used to construct narratives).

- Once you have determined the narratives within the article, add the article to the correct **Narrative Case**. To do this, right click on the title (from **Externals** list) and ‘**Code the Source**’ to **ONE OR MORE** of the narrative options (**Note**: one article can possess the ‘energy security’ and ‘climate change’ narrative). However, try to identify the *main angle* of the story and code for the top 1 or 2 narratives.
- **Note**: Narratives will overlap with certain SPEED frames (as shown below) – e.g., an article possessing the ‘climate change’ narrative will likely contain SPEED environmental benefit framing. Consider the types and frequency of SPEED frames in the article to help you determine narratives.

Narrative	Coding criteria (key words, SPEED frame)
Energy security	<p>SPEED frames: Technical/cultural/economic, e.g., ES discussed in the context of providing energy security (access, availability) and resilience to key stakeholders such as grid operators, residential consumers, communities, and other end-users, as well as to the state/nation overall (i.e., discussions on national energy supply and independence)</p> <p>Key words: energy security, reliability, access, resiliency, community resilience, independence, off-grid, power outage, back-up, reserve supply, grid support, balance supply and demand, meeting energy needs, availability</p>
Technological innovation	<p>SPEED frames: Technical/economic, e.g., ES discussed in the context of science, innovation, and technological development</p> <p>Key words: technological innovation/progress/development, cutting-edge, novel/new services/technology, grid modernisation, research, funding, electricity system optimisation, efficiency, innovative, holy grail, missing link, game-changer, future, upgrade, R&D, pilot project, demonstration, testing, revolutionary, solution, revolutionize</p>
Climate change	<p>SPEED frames: environmental/economic, e.g., ES discussed in the context of mitigating climate change, energy sustainability, and meeting other sustainability goals, eliminating fossil fuels for environmental reasons, transitioning to lower-carbon energy systems/society</p> <p>Key words: climate change, decarbonisation, fossil fuel(s), phase out, carbon, carbon emissions, reduce environmental impacts, low-carbon transition, clean/green energy, sustainability, sustainable development, environmentally-friendly, renewable(s), renewable energy, renewable sources, GHG’s, lower-carbon, ecological</p>
Economic development	<p>SPEED: Economic, e.g., ES discussed in the context of economy, finance, and other forms of development, such as the contribution to new/growing economic sectors</p> <p>Key words: economic development, economic growth, business model, jobs, employment, professional development, resources, skills, economy, investment opportunities, revenue potential, cost savings, optimisation, efficiency, business, market(s), partnership, commercial, money, partnership, invest, gains</p>

Table A 3. Narrative coding scheme

AB.1.2.4 Valence

The following coding scheme is based on De Vreese’s (2005) ‘valence framing’ theory and Chang’s (2009) application of valence in a media analysis on biofuel perceptions:

- After completing **Step 1-4**, reflect on the entire content of the article again, and determine what the overall valence of the story is (**in respect to ES***).
- **Note**: Remember, the story may focus on broader issues (e.g., climate policy) which could have a negative tone, but the overall spotlight on ES could be positive. If this is the case, code the article as having a **positive valence**.
- To help you determine valence, turn on NVivo ‘**Coding Strips**’ (under the **View** tab) to see the SPEED risks/benefits previously coded in the article (be sure you only see YOUR coding,

- not the other user's work). (**Note:** More SPEED benefits = positive valence; more SPEED risks = negative valence).
- Pay attention to loaded language and emotionally-charged opinions in the article.
 - Once you have determined the valence, add the article to the correct **Valence Case**. To do this, right click on the title (from **Externals** list) and '**Code the Source**' to **ONE** of the valence options (**Note:** categories are mutually exclusive).

Valence	Coding criteria (key words, SPEED frame)
Positive	Article discusses ES in a positive and optimistic manner; contains more SPEED benefits than risks; contains more techno-optimistic language and buzzwords (e.g. the holy grail, breakthrough, the key to an energy transition, a solution etc.); article title or hook typically includes a positive verdict on ES
Neutral	Article discusses ES in a generally neutral manner; contains a balance between SPEED benefits and risk frames;
Negative	Article discusses ES in a negative, risky, or uncertain manner; contains more SPEED risks than benefits; contains more negatively loaded language (e.g. a costly venture, many barriers to overcome, a clean technology hype, etc.); questions the value of ES (e.g. Is ES <i>really</i> the solution to our changing energy needs?); article title or hook presents a negative/uncertain verdict

Table A 4. Valence coding scheme

Appendix C – Data Appendices

AC.1 PH1 – Comparative Mixed methods Media Content Analysis (MCA)

AC.1.1 Frequency tables

AC.1.1.1 ES article frequency and political orientation: All sampled newspapers (2008-2017)

Canada	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
<i>The Globe and Mail</i>	2	2	6	4	6	7	9	13	31	18	98
<i>The National Post</i>	0	2	2	1	0	5	5	7	5	6	33
<i>The Toronto Star</i>	11	9	3	5	6	4	3	15	10	5	71
<i>The Vancouver Sun</i>	2	0	0	2	2	3	1	4	4	8	26
<i>The Montreal Gazette</i>	0	2	1	4	1	0	3	0	1	0	12
UK											
<i>The Daily Telegraph</i>	0	1	0	2	2	1	4	5	8	16	39
<i>The Times</i>	1	1	0	0	3	3	1	3	17	26	55
<i>The Independent</i>	1	0	0	1	0	1	0	2	6	3	14
<i>The Financial Times</i>	1	0	0	4	1	4	2	4	14	18	48
<i>The Guardian</i>	8	10	0	1	0	2	2	27	26	22	98
Total	26	27	12	24	21	30	30	80	122	122	494

Table A 5. Issue salience (quantitative findings) and newspaper political orientations: ES article frequency distribution across all sampled newspapers (2008-2017); **blue** = right-leaning; **red** = left-leaning

AC.1.1.2 ES article frequency and political orientation: Current newspapers (2016-2017)

Canada	2016	2017	Total
<i>The Globe and Mail</i>	31	18	49
<i>The National Post</i>	5	6	11
<i>The Toronto Star</i>	10	5	15
<i>The Vancouver Sun</i>	4	8	12
<i>The Montreal Gazette</i>	1	0	1
UK			
<i>The Daily Telegraph</i>	8	16	24
<i>The Times</i>	17	26	43
<i>The Independent</i>	6	3	9
<i>The Financial Times</i>	14	18	32
<i>The Guardian</i>	26	22	48
Total	122	122	244

Table A 6. Issue salience (quantitative findings) and newspaper political leanings: ES article frequency distribution across all 'current' sampled newspapers (2016-2017); **blue** = right-leaning; **red** = left-leaning

AC.1.1.3 Narrative distribution in Canadian and UK newspapers (2016-2017)

Narrative	Number / percentage of articles		
	Canada (n= 78)	UK (n = 138)	Combined (n = 216)
Climate change	30 (38%)	25 (18%)	55 (25%)
Economic development	45 (58%)	75 (54%)	120 (56%)
Energy security	26 (33%)	93 (67%)	119 (55%)
Technological innovation	26 (33%)	40 (29%)	66 (31%)

*Articles typically contained more than one narrative; variables not mutually exclusive

Table A 7. ES Narrative frequency distribution and percentages: Canada vs. UK (2016-2017)

AC.1.1.4 ES technology mentions: Canadian vs. UK newspapers (2008-2017)

Technology	Search terms	Number / percentage of articles		
		Canada (n= 240)	UK (n = 254)	Combined (n = 494)
Batteries	battery / (ies)	142 (59%)	161 (63%)	303 (61%)
Fuel cells	(hydrogen) fuel cell(s)	28 (12%)	15 (6%)	43 (9%)
Pumped-hydro	pumped-hydro / pumped storage	20 (8%)	16 (6%)	36 (7%)
Hydrogen storage	hydrogen (energy) storage / cryogenic storage / liquid air	30 (13%)	3 (1%)	33 (7%)
Compressed-air	(underwater) compressed air (storage) / CAES / U-CAES	23 (10%)	6 (2%)	29 (6%)
Flywheels	flywheel(s) / fly-wheel	23 (10%)	5 (2%)	28 (6%)
Thermal storage	thermal (energy) storage / molten salt / borehole / heat storage	14 (6%)	7 (3%)	21 (4%)
Ultra/Supercapacitors	(ultra/super) capacitor(s)	7 (3%)	2 (1%)	9 (2%)

Table A 8. ES technology mentions; frequency distribution and percentages: Canada vs. UK (2008-2017)

AC.1.1.5 ES articles with varying 'focus' levels: Canadian vs. UK newspapers (2016-2017)

Country	Year	n	Frequency / percentage of articles		
			Focused (ES-F)	Subsection (ES-S)	Irrelevant (ES-IR)
Canada (n = 88)	2016	51	13 (25%)	34 (67%)	4 (8%)
	2017	37	9 (24%)	22 (59%)	6 (16%)
UK (n = 156)	2016	71	15 (21%)	48 (68%)	8 (11%)
	2017	85	22 (26%)	53 (62%)	10 (12%)
Total (n = 244)	2016	122	28 (23%)	82 (67%)	12 (10%)
	2017	122	31 (25%)	75 (61%)	16 (13%)

Table A 9. Issue salience (qualitative findings): ES article focus distribution and percentages by year: Canada vs. UK (2016-2017): Note: red = potentially meaningful

AC.1.1.6 ES articles with varying 'focus' levels: Right- vs. left-leaning newspapers (2016-2017)

Political orientation	Year	n	Frequency / percentage of articles		
			Focused (ES-F)	Subsection (ES-S)	Irrelevant (ES-IR)
Right-leaning (n = 159)	2016	75	17 (23%)	50 (67%)	8 (11%)
	2017	84	23 (27%)	49 (58%)	12 (14%)
Left leaning (n = 85)	2016	47	11 (23%)	32 (68%)	4 (9%)
	2017	38	8 (21%)	26 (68%)	4 (11%)
Total (n = 244)	2016	122	28 (23%)	82 (67%)	12 (10%)
	2017	122	31 (25%)	75 (61%)	16 (13%)

Table A 10. ES issue salience (article focus) distribution and percentages by political orientation of newspapers: Canada vs. UK (2016-2017); Note: red = potentially meaningful

AC.1.2 Chi-square test results

AC.1.2.1 National differences in ES issue salience (quantitative; annual ES article frequencies)

Cross tabulation: Number of ES articles published per year * country	Canada (<i>n</i> = 240)	UK (<i>n</i> = 254)	Chi-square (X^2) test results
*See annual ES article frequency distribution data above			$X^2(9) = 48.26$ $p = 0.000$ $\phi = 0.313$ $V = 0.313$ $n = 494$

Table A 11. Chi-square tests for independence used to determine national differences in annual frequency of ES reporting; Phi (ϕ) and Cramer's V (V) used to test strength of association between 'number of ES articles published per year' and 'country' (see below); **Note:** red = significant results

*Interpreting strength of associations

Phi (ϕ)	Values	Strength of association
	+ .70 or higher	Very strong positive
	+ .50 to + .69	Substantial positive
	+ .30 to + .49	Moderate positive
	+ .10 to + .29	Low positive
	+ .01 to + .09	Negligible positive
	0	No relationship
	- .01 to - .09	Negligible negative
	- .10 to - .29	Low negative
	- .30 to - .49	Moderate negative
	- .50 to - .69	Substantial negative
	- .70 or lower	Very strong negative

Table A 12. Phi (ϕ) legend for interpreting strength of association between two variables using chi-square tests for independence (X^2)

AC.1.2.2 National differences in political salience of ES reporting

Crosstabulation: Political leaning of newspapers * Country	Canada (<i>n</i> = 240)	UK (<i>n</i> = 254)	Chi-square (X^2) test results
Left-leaning	109 (45%)	112 (44%)	$X^2(1) = 0.087$ $p = 0.768$ $\phi = -0.013$ $V = 0.013$ $n = 494$
Right-leaning	131 (55%)	142 (56%)	
Total	240 (100%)	254 (100%)	

Table A 13. Chi-square tests for independence used to determine national differences in right-leaning and left-leaning newspaper coverage of ES; Phi (ϕ) and Cramer's V (V) used to test strength of association between 'political leaning of newspaper' and 'country' variables; **Note:** red = significant results

AC.1.2.3 Political leanings of newspapers and frequency of ES reporting

Crosstabulation:				Chi-square (X^2) test results
Political leaning of newspapers		Canada ($n = 240$)	UK ($n = 254$)	
* Number of ES articles published per year				
*See political leaning and ES article frequency distribution data above				$X^2 (9) = 52.940$ $p = 0.000$ $\phi = 0.327$ $V = 0.327$ $n = 494$

Table A 14. Chi-square tests for independence used to determine differences in overall ES newspaper coverage (annual frequency) between right-leaning and left-leaning publications; Phi (ϕ) and Cramer's V (V) used to test strength of association between 'political leaning of newspaper' and 'number of ES articles published per year' variables; **Note:** red = significant results

AC.1.2.4 National differences in issue salience: ES articles with varying 'focus' levels

Crosstabulation:	Frequency / percentage of articles		Chi-square (X^2) test results	
	Article focus * Country	Canada ($n = 88$)		UK ($n = 156$)
Focused (ES-F)		22 (25%)	37 (24%)	$X^2 (2) = 0.050$
Subsection (ES-S)		56 (64%)	101 (65%)	$p = 0.975$
Irrelevant (ES-IR)		10 (11%)	18 (11%)	$\phi = 0.014$
Total		88 (100%)	156 (100%)	$V = 0.014$
				$n = 244^8$

Table A 15. Chi-square tests for independence used to determine national differences in extent to which articles focused on ES; Phi (ϕ) and Cramer's V (V) used to test strength of association between 'article focus' and 'country' variables; **Note:** red = significant results

⁸ **Note:** Article totals differ here as they include the ES-IR articles ($n = 28$) which were later removed make up the final qualitative sample ($n = 216$)

AC.1.2.5 National differences in SPEED framing: Canada vs. UK newspapers (2016-2017)

Cross tabulation: SPEED Frame * Country	Frequency / percentage of articles		Chi-square (χ^2) test results
	Canada (<i>n</i> = 78)	UK (<i>n</i> = 138)	
Cultural Benefit	16 (21%)	29 (21%)	$\chi^2 (1) = 0.008$ $p = 0.931$ $\varphi = 0.006$ $V = 0.006$ $n = 216$
Cultural Risk	4 (5%)	3 (2%)	$\chi^2 (1) = 1.387$ $p = 0.239$ $\varphi = -0.08$ $V = 0.08$ $n = 216$
Economic Benefit	53 (68%)	81 (59%)	$\chi^2 (1) = 1.812$ $p = 0.178$ $\varphi = -0.092$ $V = 0.092$ $n = 216$
Economic Risk	23 (29%)	20 (14%)	$\chi^2 (1) = 7.027$ $p = 0.008$ $\varphi = 0.18$ $V = 0.18$ $n = 216$
Environmental Benefit	26 (33%)	35 (25%)	$\chi^2 (1) = 1.562$ $p = 0.211$ $\varphi = -0.085$ $V = 0.085$ $n = 216$
Environmental Risk	1 (1%)	1 (1%)	$\chi^2 (1) = 0.169$ $p = 0.681$ $\varphi = -0.028$ $V = 0.028$ $n = 216$
Political Benefit	11 (14%)	28 (20%)	$\chi^2 (1) = 1.289$ $p = 0.256$ $\varphi = 0.077$ $V = 0.077$ $n = 216$
Political Risk	8 (10%)	13 (9%)	$\chi^2 (1) = 0.040$ $p = 0.842$ $\varphi = -0.014$ $V = 0.014$ $n = 216$
Regulatory and Legal Benefit	0 (0%)	9 (7%)	$\chi^2 (1) = 5.308$ $p = 0.021$ $\varphi = 0.157$ $V = 0.157$ $n = 216$
Regulatory and Legal Risk	4 (5%)	11 (8%)	$\chi^2 (1) = 0.623$

$p = 0.43$
 $\phi = 0.054$
 $V = 0.054$
 $n = 216$

Technical Benefit	40 (51%)	100 (72%)	$X^2 (1) = 9.804$ $p = 0.002$ $\phi = 0.213$ $V = 0.213$ $n = 216$
Technical Risk	13 (17%)	16 (12%)	$X^2 (1) = 1.103$ $p = 0.294$ $\phi = -0.071$ $V = 0.071$ $n = 216$

Table A 16. Chi-square tests for independence used to determine national differences in SPEED framing; Phi (ϕ) and Cramer's V (V) used to test strength of association between 'country' and each specific 'SPEED frame' variable; **Note:** red = significant results

AC.1.2.6 National differences in narrative use: Canada vs. UK newspapers (2016-2017)

Crosstabulation: Narrative * Country	Frequency / percentage of articles		Chi-square (X^2) test results
	Canada ($n = 78$)	UK ($n = 138$)	
Climate Change	30 (38%)	25 (18%)	$X^2 (1) = 10.869$ $p = 0.001$ $\phi = -0.224$ $V = 0.224$ $n = 216$
Economic Development	45 (58%)	75 (54%)	$X^2 (1) = 0.226$ $p = 0.635$ $\phi = -0.032$ $V = 0.032$ $n = 216$
Energy Security	26 (33%)	93 (67%)	$X^2 (1) = 23.364$ $p = 0.000$ $\phi = 0.329$ $V = 0.329$ $n = 216$
Technological Innovation	26 (33%)	40 (29%)	$X^2 (1) = 4.44$ $p = 0.505$ $\phi = -0.045$ $V = 0.045$ $n = 216$

Table A 17. Chi-square tests for independence used to determine national differences in narrative use; Phi (ϕ) and Cramer's V (V) used to test strength of association between 'narrative' and 'country' variables; **Note:** red = significant results

AC.1.2.7. National differences in valence: Canada vs. UK newspapers (2016-2017)

Crosstabulation: Valence * Country	Frequency / percentage of articles		Chi-square (X^2) test results
	Canada ($n=78$)	UK ($n=138$)	
Negative	6 (8%)	6 (6%)	$X^2(1) = 0.226$ $p = 0.635$ $\phi = -0.032$ $V = 0.032$ $n = 216$
Neutral	19 (24%)	33 (24%)	
Positive	53 (68%)	99 (72%)	
Total	78 (100%)	138 (100%)	

Table A 18. Chi-square tests for independence used to determine national differences in valence of ES reporting; Phi (ϕ) and Cramer's V (V) used to test strength of association between 'valence' and 'country' variables; **Note:** red = significant results

AC.1.2.8 Political leanings of newspapers and valence of ES reporting

Crosstabulation: Valence * Political leaning of newspapers	Frequency / percentage of articles ($n = 216$)		Chi-square (X^2) test results
	Left-centre	Right-centre	
Negative	3 (<1%)	9 (4%)	$X^2(2) = 1.55$ $p = 0.46$ $\phi = 0.085$ $V = 0.085$ $n = 216$
Neutral	16 (7%)	36 (17%)	
Positive	58 (27%)	94 (43%)	
Total	77 (36%)	139 (64%)	

Table A 19. Chi-square tests for independence used to determine difference in valence of ES reporting between left-leaning and right-leaning newspapers; Phi (ϕ) and Cramer's V (V) used to test strength of association between 'valence' and 'political leaning of newspaper' variables; **Note:** red = significant results

AC.2 PH2 – Comparative Secondary Survey Analysis (SSA)

AC.2.1 Frequency tables

AC.2.1.1 Frequency distribution of publics' perceived valence of ES (2018)

Perceived valence	Number / percentage of respondents		
	Canada (n = 634)	UK (n = 617)	Combined (n = 1251)
Negative	45 (7%)	60 (10%)	105 (8%)
Neutral	326 (51%)	321 (52%)	647 (52%)
Positive	263 (42%)	236 (38%)	499 (40%)
Total	634	617	1251

*n's include participants only those who read newspapers; exclude missing values (CA = 382; UK = 418)

Table A 20. Publics' perceived valence of ES media reporting in Canadian and UK newspapers (2018)

AC.2.1.1.2 Demographics of respondents with prior vs. no prior knowledge of ES

Demographic	Category / Label	Percentage of respondents with prior vs. no prior knowledge of ES	
		Canada (n = 842) vs. (n = 180)	UK (n = 863) vs. (n = 181) *
Age (years)	18-24	10.6 vs. 9.4	10.1 vs. 9.4
	25-34	15.3 vs. 18.3	18.3 vs. 15.5
	35-49	37.1 vs. 29.4	27.7 vs. 23.2
	50-64	16.4 vs. 21.7	25.3 vs. 29.3
	65+	20.7 vs. 21.1	18.7 vs. 22.7
Gender	Female	48.6 vs. 38.3	51.3 vs. 32.6
	Male	50.5 vs. 61.1	48.3 vs. 66.3
	Other	0.5 vs. 0	0.2 vs. 1.1
	Prefer not to say	0.4 vs. 0.6	N/A
Province of residence	Alberta	10.1 vs. 7.8	N/A
	British Columbia	14.7 vs. 12.8	
	Manitoba	4.2 vs. 5.6	
	New Brunswick	4.4 vs. 2.8	
	Newfoundland and Labrador	2.9 vs. 3.3	
	Nova Scotia	0.4 vs. 0	
	Ontario	39.7 vs. 36.1	
	Prince Edward Island	1.0 vs. 0.6	
	Quebec	20.2 vs. 28.3	
	Saskatchewan	2.3 vs. 2.8	
	Northwest Territories	0.1 vs. 0	
Education status	≤ Secondary school	20.3 vs. 31.7	32.7 vs. 41.4
	College degree	24.0 vs. 25.6	25.4 vs. 26.5
	Undergraduate degree	31.7 vs. 26.7	26.9 vs. 19.9

	Postgraduate degree	21.0 vs. 10.6	12.5 vs. 8.3
	Other	2.6 vs. 5.0	2.5 vs. 3.9
	Prefer not to say	0.4 vs. 0.6	N/A
Occupation status	Employed	61.2 vs. 49.4	57.9 vs. 44.8
	Retired	22.4 vs. 23.3	15.4 vs. 20.4
	Military	0.2 vs. 0	2.5 vs. 1.1
	Homemaker	3.8 vs. 6.7	7.6 vs. 13.8
	Student	5.1 vs. 5.6	5.1 vs. 7.2
	Out of/seeking work	3.7 vs. 6.7	3.9 vs. 6.1
	Unable to work	2.4 vs. 6.7	6.4 vs. 4.4
	Other	0.5 vs. 0.6	0.9 vs. 2.2
	Prefer not to say	0.7 vs. 1.1	N/A
		Canada (n = 842) vs. (n = 180)	UK (n = 861) * vs. (n = 178)
Political preference asked on a 1-10 point sliding scale; 1 = left; 10 = right	Mean (SD) (1-10 scale)	5.4 (1.9) vs. 5.1 (1.8)	5.3 (2.0) vs. 5.2 (1.8)

Table A 21 Key demographics of respondents with and without prior knowledge of ES (i.e., those knowing at least 'a little' vs 'nothing at all' about ES); * = 2 values (n) missing from UK; red = potentially meaningful

AC.2.1.1.3 Demographics of respondents who agree/disagree that ES benefits outweigh risks

Demographic	Category / Label	Percentage of respondents who agree vs. disagree that ES benefits outweigh risks	
		Canada (n = 454) vs. (n=153)	UK (n = 472) vs. (n=192)
Age (years)	18-24	10.1 vs. 10.5	7.2 vs. 14.6
	25-34	16.3 vs. 19.0	14.2 vs. 24.0
	35-49	33.3 vs. 41.2	27.8 vs. 24.5
	50-64	15.6 vs. 17.6	26.3 vs. 21.9
	65+	24.7 vs. 11.8	24.6 vs. 15.1
Gender	Female	46.3 vs. 46.4	47.0 vs. 49.0
	Male	52.9 vs. 53.6	53.0 vs. 50.5
	Other	0.7 vs. 0	0 vs. 0.5
	Prefer not to say	0 vs. 0	N/A
Province of residence	Alberta	9.3 vs. 12.4	N/A
	British Columbia	14.3 vs. 15.0	
	Manitoba	4.0 vs. 3.3	
	New Brunswick	4.4 vs. 2.6	
	Newfoundland and Labrador	3.3 vs. 2.6	
	Nova Scotia	0.4 vs. 0	
	Ontario	39.2 vs. 41.2	
	Prince Edward Island	1.5 vs. 0	
	Quebec	19.8 vs. 19.6	
	Saskatchewan	3.1 vs. 3.3	
Northwest Territories	0.2 vs. 0		

	Nunavut	0.2 vs. 0	
	Yukon	0.2 vs. 0	
Education status	≤ Secondary school	20.9 vs. 17.6	35.4 vs. 27.6
	College degree	22.5 vs. 25.5	23.5 vs. 31.3
	Undergraduate degree	30.4 vs. 35.3	25.6 vs. 25.0
	Postgraduate degree	22.2 vs. 19.6	13.6 vs. 13.5
	Other	4.0 vs. 0.7	1.9 vs. 2.9
	Prefer not to say	0 vs. 0.7	N/A
Occupation status	Employed	57.9 vs. 69.3	51.5 vs. 66.5
	Retired	26.2 vs. 14.4	23.7 vs. 10.5
	Military	0.4 vs. 0	1.7 vs. 4.2
	Homemaker	3.5 vs. 7.2	7.8 vs. 9.4
	Student	4.8 vs. 3.9	3.8 vs. 3.7
	Out of/seeking work	2.4 vs. 2.6	4.7 vs. 2.6
	Unable to work	4 vs. 1.3	5.7 vs. 2.6
	Other	0.2 vs. 0.7	1.1 vs. 0.5
	Prefer not to say	0 vs. 7	N/A
			Canada
		(n = 454) vs. (n = 153)	(n = 472) vs. (n = 190) *
Political preference	Mean (SD)		
asked on a 1-10 point sliding scale; 1 = left; 10 = right	(1-10 scale)	5.1 (2.0) vs. 6.0 (1.9)	5.1 (2.0) vs. 5.8 (2.2)

Table A 22. Key demographics of respondents agreeing and disagreeing that ES benefits outweigh risks (i.e., agree vs. disagree); * = 2 values (n) missing from UK; red = potentially meaningful

AC.2.1.1.4 Demographics of respondents with positive vs. negative affect toward ES

Demographic	Category / Label	Percentage of respondents with positive vs. negative affect toward ES	
		Canada (n = 498) vs. (n = 165)	UK (n = 532) vs. (n = 208)
Age (years)	18-24	10.8 vs. 10.9	9.0 vs. 15.9
	25-34	17.3 vs. 19.4	17.9 vs. 23.6
	35-49	35.7 vs. 38.2	25.8 vs. 24.0
	50-64	16.3 vs. 20.0	24.2 vs. 22.6
	65+	19.9 vs. 11.5	23.1 vs. 13.9
Gender	Female	44.2 vs. 57.0	45.9 vs. 54.8
	Male	55.6 vs. 43.0	53.8 vs. 44.7
	Other	0 vs. 0	0.4 vs. 0.5
	Prefer not to say	0.2 vs. 0	N/A
Province of residence	Alberta	9.0 vs. 9.1	N/A
	British Columbia	13.3 vs. 12.1	
	Manitoba	4.0 vs. 4.8	
	New Brunswick	4.0 vs. 3.0	
	Newfoundland and Labrador	3.2 vs. 4.2	
	Nova Scotia	0.2 vs. 0	

	Ontario	41.8 vs. 40.0	
	Prince Edward Island	0.6 vs. 0	
	Quebec	21.1 vs. 23.0	
	Saskatchewan	2.4 vs. 3.6	
	Northwest Territories	0.2 vs. 0	
	Nunavut	0.2 vs. 0	
	Yukon	0 vs. 0	
Education status	≤ Secondary school	19.1 vs. 24.2	32.1 vs. 29.3
	College degree	22.5 vs. 26.1	26.1 vs. 33.7
	Undergraduate degree	31.9 vs. 27.9	26.1 vs. 23.6
	Postgraduate degree	22.7 vs. 20.6	13.7 vs. 11.1
	Other	3.8 vs. 1.2	1.9 vs. 2.4
	Prefer not to say	0 vs. 0	N/A
Occupation status	Employed	63.9 vs. 63.6	57.6 vs. 60.1
	Retired	20.9 vs. 13.6	18.5 vs. 10.6
	Military	0 vs. 0	1.9 vs. 4.3
	Homemaker	3.2 vs. 9.1	7.9 vs. 8.2
	Student	5.2 vs. 6.1	4.9 vs. 7.2
	Out of/seeking work	3.2 vs. 3.0	3.8 vs. 3.9
	Unable to work	2.8 vs. 2.4	4.3 vs. 5.3
	Other	0.6 vs. 0.6	1.1 vs. 0
	Prefer not to say	0.2 vs. 1.2	N/A
		Canada	UK
		(n = 498) vs. (n = 165)	(n = 529) vs. (n = 206) *
Political preference	Mean (SD)		
asked on a 1-10 point sliding scale; 1 = left; 10 = right	(1-10 scale)	5.3 (1.9) vs 5.9.	5.4 (2.0) vs. 5.5 (2.2)

Table A 23. Key demographics of respondents with positive vs. negative affect toward ES (i.e., 'I feel good' vs. 'I feel worried'); * = 2 values (n) missing from UK; red = potentially meaningful

AC.2.2 UW-UNIS Survey: Relevant survey questions

The following questions from the UW-UNIS survey study provided relevant findings to answer the **RQ2** and **RQ3** of this thesis (**note:** EST's = energy storage technologies)

[SURVEY QUESTIONNAIRE EXCERPT]

Section 3: Initial Attitudes to ESTs

- **Awareness of ESTs** (Yes, No, Not sure); Knowledge (5 point: A great deal → Nothing at all)
- **Impact of Framing:** The impact of the framing manipulation will be checked in a two-part question, designed to assess relative concern with issues pertaining to the electricity network AND the extent to which respondents feel that ESTs could help address the issue:
 - "For me the UK electricity generating network is: environmentally unsustainable, insecure and unreliable, old and outdated, restricting economic growth in the UK, costly for consumers" (5 point: Strongly agree → Strongly disagree, DK).

- “For me, ESTs can make a meaningful contribution to resolving this issue” (5 point: Strongly agree → Strongly disagree, DK).
- **Where did you first hear about ESTs:** Participants are asked “Before today, how did you first come to learn about energy storage?” and are provided 7 options (e.g. “friend or relative”; “saw it on television”, plus ‘other’).
- **Newspaper readership questions:** Participants are asked a range of questions related to their newspaper readership and media exposure to ES.
 - **Before today, how did you come to learn about energy storage?**
 - From a friend or relative
 - I saw it on television
 - I heard about it in the radio
 - I read about it in print newspapers
 - I read about it in online newspapers
 - I read about it in magazines or other publications
 - I read about it on the internet (e.g. social media, blogs)
 - Other: _____
 - **How often do you read newspaper articles on current affairs (print or online)?**
 - Never
 - Rarely (a few times a month or less)
 - Sometimes (several times a month)
 - Often (weekly)
 - Very often (daily)
 - **When reading newspapers, how often do you read articles that discuss some aspect of energy storage (e.g. technology, project, policy, etc.)?**
 - Never
 - Rarely (a few times a month or less)
 - Sometimes (several times a month)
 - Often (weekly)
 - Very often (daily)
 - **Which newspaper do you read the most? (UK)**
 - Financial Times
 - The Independent
 - The Herald
 - The Observer
 - The Times
 - The Morning Star
 - The Star
 - The Sun
 - Daily Mail
 - Daily Mirror
 - Daily Telegraph
 - The Guardian
 - Other _____
- **Which newspaper do you read the most? (Canada)**
 - The Globe and Mail
 - The National Post
 - The Toronto Star
 - The Toronto Sun
 - The Vancouver Sun
 - The Montreal Gazette

- La Presse
 - The Chronicle Herald
 - The Leader-Post
 - Calgary Herald
 - Ottawa Citizen
 - Winnipeg Free Press
 - Journal Pioneer
 - NB Telegraph Journal
 - The Whitehorse Star
 - Other _____

- **In general, how would you evaluate the tone that is usually used to describe energy storage in the newspaper articles you read?**
 - Negative
 - Neutral
 - Positive

- **Attitudes to ES technologies (Part 1/2):** Participants will be asked to respond to a set of 6 questions designed to assess various attributes of their global attitudes to ESTs. And one question to assess attitude certainty. The same questions are asked towards the end of the survey. This allows us to track how opinions might change following the receipt of information about specific ESTs (5 point: Strongly agree → Strongly disagree, DK).

- **These questions and those listed in Section 5 will be used to tease out SPEED benefit and risk perceptions of ES technologies***
 - All things considered I believe that the use of ESTs in the UK is a good thing
 - Overall, I just feel uneasy about the use of ESTs in the UK electricity network
 - I believe that the use of ESTs in the UK is necessary for the future of the electricity network
 - I am happy that people are willing to invest financially in ESTs for the UK electricity network
 - I would generally accept the installation of an energy storage facility within a mile of my home
 - All things considered, I feel that there are more risks than benefits to the use of ESTs in the UK electricity network
 - I am certain of my opinions about the use of ESTs in the UK electricity network

- **Attitudes to ES technologies (Part 2/2):** Participants will be asked to respond again to a set of 6 questions designed to assess various attributes of their global attitudes to ESTs + one question to assess attitude certainty (5 point: Strongly agree → Strongly disagree, DK)
 - All things considered I believe that the use of ESTs in the UK is a good thing
 - Overall, I just feel uneasy about the use of ESTs in the UK electricity network
 - I believe that the use of ESTs in the UK is necessary for the future of the electricity network
 - I am happy that people are willing to invest financially in ESTs for the UK electricity network
 - I would generally accept the installation of an energy storage facility within a mile of my home
 - All things considered, I feel that there are more risks than benefits to the use of ESTs in the UK electricity network
 - I am certain of my opinions about the use of ESTs in the UK electricity network

- **Attitudes to ES technologies (Part 2/2):** Participants will be asked to respond again to a set of 6 questions designed to assess various attributes of their global attitudes to ESTs + one question to assess attitude certainty (5 point: Strongly agree → Strongly disagree, DK)

Section 5: Comprehensive Assessment of EST Attitudes

- This section of the survey is based upon the factors identified in Huijts et al. (2012) Comprehensive Framework of Technology Acceptance. The target 'behaviour' that is being predicted is 'support of EST use in UK electricity network' (5 point scale: Strongly agree → Strongly disagree, DK)
 - Intention to support (3 items, e.g. "I am willing to support the use of ESTs in the UK")
 - Subjective norm (3 items, e.g. "I think that there is general support among the UK public for the use of ESTs")
 - Perceived Behavioural Control (3 items: "I believe that if I wanted to, I could personally affect decisions being made about the use of ESTs in the UK")
 - Perceived financial cost (2 items: "I believe that the financial investment in ESTs could be better spent on improving the UK electricity network in other ways")
 - Perceived risks (5 items: "I feel that there are risks to public health and safety from the use of ESTs in the UK")
 - Perceived benefits (5 items: "For me, the use of ESTs in the UK, has benefits for ensuring a secure electricity supply for 'end users'")
 - Affect (5 items: "For me, using ESTs in the UK electricity network feels right")
 - Outcome efficacy (2 items: "I believe that ESTs stand to have a positive effect on supporting the electricity network in the UK")
 - Trust (4 items: "I trust that I would be properly consulted should an EST be proposed to be sited near my home")