The Role of Health Co-Benefits in the Development of Climate Change Mitigation Policies in Australia, the European Union, China and the United States

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Abstract

Governments are yet to commit to action on climate change commensurate with the likelihood and severity of predicted impacts. The human health consequences of a changing climate are substantial, already being felt and will be exacerbated without ambitious and urgent action. Acting to mitigate climate change can result in ancillary benefits to health outcomes, also known as health co-benefits. Numerous studies over the past two decades have estimated the monetised value of a range of health co-benefits that may result from the implementation of mitigation measures. These studies conclude that accounting for health co-benefits can partially, if not fully, offset abatement costs. Despite this economic rationale for climate action, numerous climate change and health scholars have questioned the influence of health co-benefits on final policies. To date, there has been limited research investigating the political traction of health co-benefits.

To begin to address this knowledge gap, this thesis examines the role of health co-benefits in climate change mitigation policy-making in four Parties to the United Nations Framework Convention on Climate Change. To do so, I first review literature on i) the political economy of health and climate change; ii) the science-policy interface; and iii) power in policy-making in order to identify areas where barriers for the consideration of health co-benefits in climate change mitigation policies may exist. Next, I outline the methods and analytical approach used.

I then examine the role of health co-benefits in climate change mitigation policies through the development of case studies for Australia and the European Union. Next, I present results of my analysis of select Chinese and American climate change policy documents published between 2007 and 2017. The key finding of this research is that while health co-benefits are often a driver of air pollution mitigation policies, their consideration in the development of climate change mitigation policies is context- and policy-dependent. In considering the implications of this finding, I discuss key factors influencing the political traction of health co-benefits in the context of existing literature and possible policy implications. This thesis concludes by outlining contributions of this research to the literature and suggesting future research opportunities.

The significance of this research is its extension of the burgeoning literature on health co-benefits and climate change mitigation policy-making from a social science perspective. Further, this thesis articulates implications for policy and identifies potential opportunities to enhance the political traction of health co-benefits in climate change mitigation policies at a time when strong climate action is so desperately needed.

Declaration

I confirm that the research presented in this thesis is an original contribution primarily undertaken by me and which has not been submitted to any other academic institution. The contributions of co-authors on peer-reviewed publications are explicitly outlined on the following page.

Annabelle Emily Alice Workman

Contribution Declaration for Published Material

This thesis includes in the appendices three publications that were prepared and published during my candidature, as indicated below. I was primarily responsible for each publication and its submission as the corresponding author.

Paper 1 (available at Appendix H and reproduced as Chapter 4 in this thesis):

Workman, A., Blashki, G., Karoly, D., Wiseman, J. (2016), The Role of Health Co-Benefits in the Development of Australian Climate Change Mitigation Policies, *Int J Environ Res Public Health*, 13(9): 927. Available from: http://www.mdpi.com/1660-4601/13/9/927

Author's contributions: I carried out all data collection and analysis and prepared the first draft of the paper. GB, DJK and JW provided input and feedback on the first draft of the paper. I was responsible for finalising revisions, responding to reviewer comments and administrative tasks associated with submission to the journal.

Paper 2 (available at Appendix H and reproduced as Chapter 2 in this thesis):

Workman, A., Blashki, G., Bowen, K.J., Karoly, D.J., Wiseman, J. (2018), The political economy of health co-benefits: Embedding health in the climate change agenda. *Int J Environ Res Public Health*, 15(4): 674. Available from: https://www.mdpi.com/1660-4601/15/4/674

Author's contributions: I performed the literature review and prepared the first draft of the paper. GB, KJB, DJK and JW provided input and feedback on the first draft of the paper. I was responsible for finalising revisions, responding to reviewer comments and administrative tasks associated with submission to the journal.

Paper 3 (available at Appendix H and reproduced as Chapter 5 in this thesis):

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Author's contributions: I carried out all data collection and analysis and prepared the first draft of the paper. GB, KJB, DJK and JW provided input and feedback on the first draft of the paper. I was responsible for finalising revisions, responding to reviewer comments and administrative tasks associated with submission to the journal.

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It takes a village to raise a child. This African proverb is easily extended to the journey of 'raising' a PhD (and I'm sure I'm not the first to make this analogy!) Accordingly, I am compelled to thank a village for the last four years.

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Accessing policy-makers is a challenging endeavour and this research would have been impossible without the generosity of many friends, colleagues and their connections who willingly gave both their time and social capital in order to assist me in establishing connections.

As is not uncommon, I found myself full of self-doubt and riddled with anxiety on many occasions throughout my PhD. There have been individuals in my life who patiently reassured me and shared an exceptional gift with me: their faith in me and my ability to succeed when I didn't think it was possible. To these people – you know who you are – I cannot express the

extent of my appreciation. Thank you for assisting me to achieve great personal and professional growth.

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Dedication

In memory of my extraordinary mother, Heather-Lea Evlyn MacDonald.

I know you would have been proud.

I love you to the moon and back.

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Abbreviations

ANPR	Advanced notice of proposed rulemaking
bcm	Billion cubic metres
CAA	Clean Air Act
CDM	Clean Development Mechanism
CLRTAP	Convention on Long-Range Transboundary Air Pollution
COAG	Council of Australian Governments
COP	Conference of the Parties to the UNFCCC
CO_2	Carbon dioxide
DoE	Department of the Environment, Australian Government
DFAT	Department of Foreign Affairs and Trade, Australian Government
DG CLIMA	Directorate-General for Climate Action, European Commission
DG ENV	Directorate-General Environment, European Commission
DG SANTE	Directorate-General for Health and Food Safety, European Commission
enHealth	Environmental Health Standing Committee, Australian Government
EU	European Union
ETS	Emissions trading scheme
FYP	Five-Year Plan
GDP	Gross domestic product
GHG	Greenhouse gas
HFC	Hydrofluorocarbon
HiAP	Health in All Policies
IDC	Interdepartmental Committee
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPCC SR1.5	IPCC Special Report on Global Warming of 1.5°C
(I)NDC	(Intended) Nationally Determined Contribution
ISG	Inter Service Group
MEE	Ministry of Ecology and Environment, the People's Republic of China
MEP	Ministry of Environmental Protection, the People's Republic of China
Mt	Million tonnes
$MtCO_2$	Million tonnes of territorial carbon dioxide emissions
NDRC	National Development and Reform Commission, People's Republic of China
NGO	Non-governmental organisation
OBPR	Office of Best Practice Regulation, Australian Government
OECD	Organisation for Economic Cooperation and Development
PM&C	Department of Prime Minister and Cabinet, Australian Government
$PM_{2.5}$	Particulate matter 2.5 micrometres or less in diameter
RIS	Regulatory impact statement
SCC	Social cost of carbon
SLCF	Short-lived climate forcer
TWh	Terrawatt hour
UNFCCC	United Nations Framework Convention on Climate Change
U.S.	United States of America
U.S. EPA	United States Environmental Protection Agency
USGCRP	U.S. Global Change Research Program
WHO	World Health Organization
°C	Degrees Celsius

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Chapter One: Introduction

1.1 Contextualising the Problem

The increasing likelihood and severity of potential climate change impacts, as outlined by the Intergovernmental Panel on Climate Change (IPCC), compels governments to urgently implement robust domestic climate change policies. The 2018 IPCC Special Report on Global Warming of 1.5°C (degrees Celsius; IPCC SR1.5) asserted that "climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C" (Allen et al., 2018, p.11). IPCC SR1.5 was unequivocal in its key message: carbon dioxide (CO_2) emissions are required to reach net zero by 2050 in order to provide the possibility of stabilising global temperature rise to 1.5°C above pre-industrial levels.

Despite this, a majority of governments have failed to commit to measures commensurate with the threat that current and projected climate change poses. The adoption of the Paris Agreement at the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) is unprecedented given the (comparatively) ambitious commitment to pursue efforts to limit global warming to 1.5°C above pre-industrial levels. However, recent estimates indicate that temperatures are on a pathway well beyond 1.5°C above pre-industrial levels by 2100 under current policy trajectories (NewClimate Institute, Ecofys, & Climate Analytics, 2018a). Importantly, technological and economic barriers are no longer considered insurmountable; delayed action is now primarily a matter of political will (Watts et al., 2015).

In this way, climate change epitomises a 'malign' environmental problem (Andresen, 2014, refer to Table 1 below) with myriad obstructions contributing to the discrepancy between the actual and required commitment on climate action by governments at the international level. Some obstructions include:

- **Strong values involved**: At the heart of the climate change dilemma lie issues of equity, justice and ethics. An important conclusion from the IPCC is that "economic and population growth continued to be the most important drivers of increases in CO_2 emissions from fossil fuel combustion" (Intergovernmental Panel on Climate Change, 2014, p.5). The 'right' to economic and population growth are value-laden issues that inherently complicate

attempts to address climate change. This ultimately creates an indelible tension between meaningful climate change action and equitable circumstances in both developed and developing states.

- **High political conflict**: Under Article 2 of the UNFCCC, governments have committed to avoid 'dangerous' anthropogenic interference with the climate system. Complexities abound the interpretation of Article 2, particularly given defining 'dangerous' "requires examining scientific climate impact assessments as well as normative judgements" (Victor & Kennel, 2014, p.124). Disagreement between developing and developed nations over the global temperature at which climate change is considered 'dangerous' exemplifies this issue. The latest scientific evidence reaffirms that developing countries – whose populations are simultaneously the most disadvantaged and vulnerable – will disproportionately experience negative impacts at a 1.5°C global temperature increase (Allen et al., 2018). Thus, the long-standing debate over whether a 1.5°C or a 2°C global temperature increase should be considered 'dangerous' reveals an uneven political landscape that "epitomizes geographies of privilege, power and inequality" (Tschakert, 2015, p.10). Sea level rise associated with 1.5°C of warming – let alone a 2°C global temperature increase – is likely to result in significant land loss, and consequent displacement, for a number of developing states in particular (Intergovernmental Panel on Climate Change, 2014).

- **Controversial and uncertain conclusions**: The IPCC acknowledges that "the precise levels of climate change sufficient to trigger abrupt and irreversible change remain uncertain" (Intergovernmental Panel on Climate Change, 2014, p.13). While uncertainty is often an inevitable component of scientific inquiry, it has been a central impediment for climate action (Lewandowsky, Risbey, Smithson, Newell, & Hunter, 2014). In some countries, it has been utilised specifically to undermine bipartisan support for climate change policies (Head, 2014). Further, research suggests that policies are particularly contradictory of existing evidence in the face of scientific uncertainty (Juntti, Russel, & Turnpenny, 2009).

Table 1. A comparison of environmental problems by general characteristics

'Benign' problems	**'Malign' problems**
Consensual knowledge	Controversial and uncertain conclusions
More 'neutral' issues	Strong values involved
Strong 'pushers'	Strong 'laggards'
Problems developing rapidly and surprisingly	Problems developing slowly and as expected
Low political conflict	High political conflict

Source: (Adapted from Andresen, 2014)

As an economy-wide, cross sectoral issue, multi-level action is required in order to meaningfully address tackle climate change. The challenges of international climate action described above are exacerbated by barriers at the sub-national level. In her analysis of climate action at the city level, Burch (2010) developed a typology of barriers that may impede action on climate change. These include:

1. *cultural/behavioural* barriers as a result of "the relationships between individuals in various critical positions within the municipality, their personalities, and the collective ethos and customs at play within the organization" (Burch, 2010, p.7580);
2. *structural/operational* barriers resulting from the "features of the organization's structures and procedures that influence day-to-day activities and long-term policy direction" (Burch, 2010, p.7579);
3. *regulatory/legislative* barriers given "the nature of the policy tools that the municipality has at its disposal and the interactions between multiple levels of government" (Burch, 2010, p.7580); and
4. *contextual* barriers due to "the environment within which the municipality functions and the values and priorities of the public" (Burch, 2010, p.7581).

In essence, committing to ambitious climate action appears a formidable challenge. Accordingly, searching for opportunities to overcome the inertia of climate action is imperative. While it is highly unlikely to be a panacea, the consideration of positive health outcomes that result from the implementation of climate change mitigation policies – termed health co-benefits – may strengthen the justification that some governments require to enhance the ambition of their climate change mitigation policies. Discussed in more detail in the next chapter, health co-benefits can act as a "political bridge across the development gap" (Gao, Hou, et al., 2018, p. 685), and can assist governments to reframe climate change from a longer-term, global issue to a shorter-term, local issue (Spencer et al., 2016), providing "a powerful incentive to accelerate policy change" (Watts et al., 2017, p.1156).

Yet there is limited research examining their role in mitigation policy development or investigating policy-makers' knowledge of and attitudes toward them. Outlined in further detail in the next chapter, the literature that does exist contends that health co-benefits have not greatly influenced policies and concludes that a number of factors inhibit the political traction of health co-benefits in the mitigation policy development process. This is affirmed by analysis undertaken by the World Health Organization (WHO), which established that only six of 46

countries have conducted a valuation of co-benefits of health implications of climate mitigation policies at the national level (World Health Organization, 2015c). These findings highlight the need for additional research on the consideration of health in mitigation policy development and the factors that influence its consideration. It is this research gap that motivates this thesis.

1.2 Aim and Scope

The aim of this thesis is to understand the role that health co-benefits have played in the development of climate change mitigation policies at the national[1] level in four Parties to the UNFCCC: Australia, the European Union (EU), the People's Republic of China (China) and the United States of America (U.S.). To achieve this aim, I have examined the role of health co-benefits in these four Parties to the UNFCCC by seeking to answer two primary research questions:

1. Are health co-benefits considered and accounted for in the development of climate change mitigation policies and if so, how?
2. What factors influence the extent to which health co-benefits are considered and accounted for?

To answer these questions, I have developed case studies and analysed policy documents using Walt and Gilson's (1994) health policy analysis model as an analytical framework (discussed further in Chapter 3). The political economy of health is used as the overarching theoretical framework that guides the examination of the role of health in the development of climate change mitigation policy across different actors. Discussed further in the next chapter, the political economy of health framework recognises that complex and dynamic interactions between various domains – political, economic, social, environmental – have the potential to influence individual and population health outcomes (Birn, Pillay, & Holtz, 2009).

As discussed above, a number of barriers can inhibit the realisation of ambitious climate change policy across scales and Parties to the UNFCCC. The working hypothesis for this thesis was that, in a similar fashion, health co-benefits are yet to gain the political traction

[1] As is discussed further in Chapters 3 and 5, the European Union (EU) is a politico-economic body that for the purposes of this thesis will be examined similarly to a national government given its central role in developing climate change mitigation goals for its 28 Member States, namely the Nationally Determined Contribution that was submitted in the lead-up to COP21 in 2015. While climate change mitigation policies made by the EU technically occur at the supranational level, the term 'national' will be used throughout this thesis to refer to policies developed by all four Parties to the UNFCCC that are the focus of analysis.

they warrant as a result of several barriers that are likely to be politico-economic, institutional and/or social in nature.

In order to produce high-quality research, it is important to achieve a balance between research scope, time and resources (Guest, Namey, & Mitchell, 2013). Accordingly, the following parameters were established for the project (the rationale for each domain, and definitions where required, are provided at Appendix B):

1. **Geographical**: A multi-site case study, including interviews with policy-makers, has been developed for Australia and the EU. I have used a complementary methodological approach – directed qualitative content analysis – to examine China and the U.S. Further details on site selection are available in Chapter 3.
2. **Temporal**: Case study development for Australia and the EU was carried out in 2016 and 2017 respectively. The documentary analysis time period for China and the U.S. was from 2007 to 2017.
3. **Spatial**: Analysis focused on policy development at the national level.
4. **Policy area**: Analysis focused on climate change mitigation policies. Reference to the development of adaptation policies is only made where necessary.
5. **Sectoral**: Policy-makers involved in the development of national climate change mitigation policies within the Ministries of Energy, Transport, Health and the Environment were initially approached to participate in interviews. Other Ministries were approached where warranted based on domestic circumstances or where recommended by interview participants.
6. **Participants**: Semi-structured focused interviews were primarily carried out with policy-makers involved in the development of mitigation policies. Where identified by interview participants, relevant experts were also approached for interview.

Beyond these parameters, it is important to explicitly define several terms relevant to the topic of this thesis. Table 2 lists and defines several key terms central to this thesis and used throughout the dissertation.

Table 2. Definitions of key terms relevant to this thesis

Term	Definition
Role	***The function of health co-benefits in the policy-making process***. Given this research is exploratory in nature, it examined the function of health co-benefits in mitigation policy development in a broad sense. For example, it examined whether the consideration of health is qualitative or quantitative in nature; whether health implications have been a driver of policy development and/or a selling point for final policies or about maximising health outcomes. It would be difficult, if not impossible, to evaluate the relative importance of health co-benefits compared with other considerations; this thesis has made no effort to quantitatively identify the hierarchy of the multiple considerations that inform climate change mitigation policy development but discussed the ranking and prioritisation of multiple considerations during interviews as part of data collection.
Explicit consideration	***The use of quantified and monetised health co-benefits as an input during the mitigation policy-making process.*** This term is used interchangeably with the term 'integration' throughout the thesis to refer to efforts where health co-benefits are accounted for in the policy-making process quantitatively, as opposed to qualitatively.
Ambitious	***The development of climate change mitigation policies that commit to stronger emissions reductions compared to immediate past policies.*** This thesis refers to 'ambition' in policy development relative to preceding policies developed by the national government in question, not relative to a temperature goal, domestic capability or based on justice and equity considerations.
Health	***A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.*** Defining 'health' is not without controversy. WHO maintains its 1946 definition of 'health' as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 1946, p.1). This definition, however, has been critiqued as unfeasible to attain in practice (Bircher, 2005; Saracci, 1997). Recognising these limitations, and in the absence of an explicit working definition of 'health' in the IPCC glossary, the WHO's definition of 'health' lends itself to the idea that experiences of illness can be culturally relative, a position that I accept. However, in order to legitimately compare health status across cultures it is necessary to "distinguish as clearly as possible between the objective manifestations of 'disease' and the subjective experience of 'illness'" (Doyal, 1995, p.9). While acknowledging that disease statistics provide an incomplete perspective, this thesis refers to disease data at the expense of experiential illness in order to facilitate cross-case analysis.
Health co-benefits	***The positive effects that a policy or measure aimed at emissions reduction (mitigation) may have on health outcomes.*** To be clear, the focus of climate change mitigation policies is the reduction of greenhouse gas (GHG) emissions while the focus of air pollution mitigation policies is often non-GHG emissions, although

	the separate policy areas have implications for one another (discussed in further detail in the next chapter). For the purpose of this thesis, I focused on health co-benefits that result from the implementation of mitigation policies targeting the energy and transport sectors – which are often a result of reduced air pollution – as these health co-benefits are disproportionately represented in the existing health co-benefits literature given the ability to quantify and monetise these health co-benefits with relative certainty compared with health co-benefits in other GHG-emitting sectors, such as agriculture.
Health co-harms	***The negative effects that a policy or measure aimed at mitigation may have on health outcomes.*** While the implementation of mitigation policies mostly leads to beneficial outcomes for health, there can also be trade-offs associated with the implementation of mitigation policies. For example, while the use of diesel fuel is comparatively beneficial for climate change vis-à-vis petroleum, it is comparatively detrimental to air pollution and consequently health outcomes.
Climate change mitigation	***Interventions, measures and/or policies developed with the intent of reducing GHG emissions and other climate altering pollutants so as to avoid climate change.*** These policies are generally associated with reducing the use of fossil fuels across all sectors of the economy. For the purposes of this thesis, I focused on policies associated with the energy and transport sectors as these are key sectors for Australia, the EU, China and the U.S. It is important to note that mitigation can also involve the implementation of interventions, measures and/or policies to enhance sinks of GHGs although these policies were considered out of scope for this thesis. As discussed in the next chapter, a suite of mitigation policies exist and are pursued by national governments based on domestic circumstances. While six GHGs are covered by international climate change agreements, national governments have tended to focus on reducing CO_2 emissions; methane and other GHG emissions have historically not received as much attention.
Policy development	***The process undertaken to formulate policies.*** In this thesis, the terms 'policy development' and 'policy-making process' are used interchangeably to describe the formal and informal processes policy-makers employ to prepare policy options for consideration by senior decision-makers. Importantly, policy development is distinct from policy implementation and the legislative process required to operationalise policies.
Policy-makers	***Government employees directly responsible for the formulation of policy options.*** Policy-makers are distinct from senior decision-makers; broadly speaking, policy-makers are likely to have a greater depth of knowledge and understanding of relevant information and policy options than their senior decision-making counterparts, who often have large portfolios and are required to sacrifice knowledge depth for breadth.

1.3 Significance of the Study

As discussed further in the next chapter, the quantification and monetisation of health co-benefits has been performed by economists, modellers and climate change and health researchers for over two decades. Yet, there is a relatively small volume of research within the social science domain that engages with health co-benefits and their policy impact. As such, undertaking this research contributes knowledge in this burgeoning field. Further, as an interdisciplinary research project that sits at the nexus of climate change, health and policy development, this thesis contributes to the existing literature. Specifically, this research makes two contributions:

1. **Extends knowledge on health co-benefits and climate change mitigation policies**. Specifically, this research heightens our understanding of how and when health co-benefits have been used to inform climate change mitigation policies. Further, this research offers a contribution to the limited existing literature that employs the political economy of health framework in the context of climate change. The framework has primarily been used to explore politico-economic implications of issues such as employment, health care and health service provision (Bambra, 2011; Doyal & Pennell, 1979; Navarro, 1981).

2. **Articulates policy implications for the express purpose of supporting tangible policy and practice solutions**. While the findings from this thesis may not be generalisable across all national governments, analysis of the three largest carbon emitters globally along with a large per capita emitter provides a strong starting point for elucidating the current role of health co-benefits in mitigation policy development as well as the identification of potential opportunities to enhance their political uptake in the policy development process in future. I consider dissemination of findings to the research community, the policy community and the advocacy community a fundamental requirement of the research process (discussed further in Chapter 3).

1.4 Thesis Overview

This thesis is organised as follows:

1. This introductory chapter has articulated the motivation for this thesis, introducing the research questions, outlining the significance of the study, and overviewing the structure.
2. The next chapter summarises the health impacts of climate change and potential health co-benefits of climate change mitigation policies before reviewing the literature on i) the political economy of health and climate change; ii) the science-policy interface; and iii) power in policy-making. This chapter is based on a paper published in April 2018 (Workman, Blashki, Bowen, Karoly, & Wiseman, 2018b).
3. The third chapter outlines the analytic framework as well as the methods that were used to answer the two primary research questions. It also provides a rationale for the selected case studies.
4. The fourth and fifth chapters are devoted to reporting on the role of health co-benefits in the development of Australian and EU climate change mitigation policies. These chapters are based on papers published in September 2016 (Workman, Blashki, Karoly, & Wiseman, 2016) and November 2018 (Workman, Blashki, Bowen, Karoly, & Wiseman, 2018a) respectively.
5. The sixth chapter presents findings from directed qualitative content analysis of select Chinese and American climate change mitigation policy documents, to complement the multi-site case study and to provide further insights into the role of health co-benefits in mitigation policy development.
6. The seventh chapter discusses results from all four Parties to the UNFCCC, including the implications of these findings, as well as study limitations.
7. The eighth and final chapter draws conclusions, summarises the contributions made by this research and suggests areas of future research.

Chapter Two: Literature Review

2.0 Preamble

In the previous chapter, I introduced my working hypothesis: that health co-benefits are yet to gain the political traction they warrant as a result of numerous barriers that may be politico-economic, institutional and/or social in nature. To begin to locate answers to the two primary research questions and to explore this hypothesis further, I reviewed the literature in three key fields: i) the political economy of health and the political economy of climate change; ii) the science-policy interface; and iii) power in policy-making. This chapter is essentially a reproduction of a paper titled 'The Political Economy of Health Co-Benefits: Embedding Health in the Climate Change Agenda' that was published in April 2018 in the open access *International Journal of Environmental Research and Public Health* (Workman et al., 2018b)[2], with some additional contextual material to improve the readability of the chapter within this thesis.

The identification of these fields of literature was guided by the analytical framework that underpins this thesis (discussed in further detail in the next chapter). The framework – originally developed to support the reform of health policies – takes a holistic approach to policy analysis through examination of not only policy content, but also the policy context, the policy-making process and the actors involved (Walt & Gilson, 1994). Surveying the literature in these three fields provides a strong foundation for development of case studies investigating the consideration of health co-benefits in the development of climate change mitigation policies. Specifically, this review of the literature facilitates the identification of barriers that may impede the integration of health co-benefits into mitigation policies.

[2] Given this chapter is based on a publication, I use the first-person plural to acknowledge the input of the co-authors.

2.1 Introduction

Anthropogenic climate change remains a pivotal issue on global, national and sub-national scales given the pervasive adverse consequences that are projected. For decades, national and sub-national governments, inter-governmental entities, non-governmental organisations (NGOs) and scientists have dedicated substantial time and energy to understand its causes and propose effective mitigation and adaptation solutions. The Paris Agreement, negotiated and adopted in December 2015, represents the latest attempt by national governments to commit to emissions reduction targets at a global level in order to adequately address the projected consequences of climate change. At COP21, 195 Parties to the UNFCCC adopted the Paris Agreement, an unprecedented achievement in the history of international climate change negotiations which saw COP21 heralded as a success (United Nations Framework Convention on Climate Change, 2016).

Despite the elation surrounding COP21, the Intended Nationally Determined Contributions (INDCs) pledged by participating Parties in the lead-up to COP21 are not commensurate to the catastrophic risks posed by climate change, nor are they sufficiently ambitious given the urgent action required. Initial projections established by the UNFCCC suggested that INDC pledges will result in global average surface temperature warming of approximately 2.7°C by 2100 (United Nations Framework Convention on Climate Change, 2015b). More recent studies, however, project global warming above 3°C as a result of the Trump Administration's announcement to withdraw the U.S. from the Paris Agreement (NewClimate Institute et al., 2018a).

Such projected temperatures represent a marked departure from a commitment in Paris to "holding the increase in global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognising that this would significantly reduce the risks and impacts of climate change" (United Nations Framework Convention on Climate Change, 2015a, p.3). Appropriate renewable energy technologies and adequate sources of finance are available; the primary challenge for ambitious climate action remains political will (Watts et al., 2015).

There is now general political consensus that climate change exists, and that a significant proportion of the action needed to drive rapid economic decarbonisation is likely to be undertaken at a sub-national level (Steffen, 2011). However, durable solutions remain evasive and agreement on ambitious action at national and global levels continues at a slow pace given the diversity of considerations and perspectives informing the debate. The

predicted health and other impacts of climate change denote an economic and an ethical imperative for urgent action. From an economic perspective, many systematic economic assessments of climate change have indicated that the benefits of early action outweigh the costs of delayed action on climate change (Garnaut, 2011; Stern, 2007). Ethically, there are substantial implications for intra- and inter-generational equity; climate change disproportionately affects the most vulnerable populations who are also least responsible (M. Bell & Greenberg, 2018; Patz & Levy, 2015; Watts et al., 2018), not to mention it will greatly impact future generations (World Health Organization, 2017a).

With this in mind, climate change and human health researchers contend that consideration of the human health implications of climate change has the potential to enhance climate change action by overcoming the political polarisation that can often stifle progress. While mixed results have been documented (e.g., see Bain et al., 2015), much climate change communication research concludes that applying a human health frame to climate change can positively influence responses to climate action, irrespective of political persuasion (Maibach, Nisbet, Baldwin, Akerlof, & Diao, 2010; Myers, Nisbet, Maibach, & Leiserowitz, 2012; Walker, Kurz, & Russel, 2018). Specifically, health co-benefits present an opportunity to positively inform the development and communication of ambitious climate change policies.

The health co-benefits of climate change action comprise health benefits that occur as a result of reductions in the emission of GHGs and other climate altering pollutants (Organisation for Economic Cooperation and Development, Resources for the Future, World Resources Institute, & Intergovernmental Panel on Climate Change, 2000). Firstly, some health co-benefits have been shown to provide strong and tangible domestic impacts, especially for developing countries, in relatively short time frames (Nemet et al., 2010; Remais et al., 2014). Given climate change benefits are often longer-term and diffuse, health co-benefits can reduce “the temporal and geographic mismatch between costs and benefits” (Jenkins, 2014, p.475). Secondly, and on a related note, while uncertainty still exists, some health co-benefit studies can provide a comparatively high level of certainty in the estimated benefits, an unusual advantage of health co-benefits given the uncertainty associated with longer-term estimates relating to climate change (Adlong & Dietsch, 2015). Thirdly, over the past two decades, numerous studies have quantified and monetised local, regional and global health co-benefits of mitigation policies (Deng, Liang, Liu, & Anadon, 2017).

Notwithstanding the challenges associated with monetising reductions in health burden (e.g., see K. R. Smith & Haigler, 2008), these quantifications can be used – and have been by some Parties to the UNFCCC, including the EU and the U.S. – to inform the

development of mitigation policies, supporting the consideration of health in climate change cost–benefit models (C. Williams, Hasanbeigi, Wu, & Price, 2012). Numerous efforts have been undertaken to strengthen the role of health in the climate change agenda, including enhancing the role of health co-benefits in policy development (see Section 2.2 below). Despite these efforts, a gap appears to still exist between the potential and actual role of health co-benefits in the development of national climate change mitigation policies. Several explanations have been put forward to explain the lack of political traction of health co-benefits, including a focus on cost minimisation and research translation challenges (Mayrhofer & Gupta, 2016; Nemet et al., 2010; Remais et al., 2014).

To examine this gap, perspectives from the (i) political economy; (ii) science–policy interface; and (iii) power in policy-making literature are used to support the proposition that certain barriers inhibit the integration of health co-benefits into climate change mitigation policies. Through an examination of the fields of literature indicated above, four key interrelated areas are identified where barriers may exist in relation to health co-benefits: 1) discourse; 2) efficiency; 3) vested interests; and 4) structural challenges.

Accordingly, this literature review first summarises the health impacts of climate change and outlines the health co-benefits of climate change mitigation. The chapter then provides an overview of some of the main efforts to enhance the role of health, including health co-benefits, in the climate agenda. Third, the chapter details the methods used to identify the relevant literature. Fourth, findings from a survey of the literature are stratified into the four key interrelated areas. Finally, with the theoretical basis established, insights from the literature are extrapolated to health co-benefits.

2.2 Background

2.2.1 The Health Impacts of Climate Change

In 2009, Costello and colleagues asserted that “climate change is the biggest global health threat of the 21st century” (Costello et al., 2009, p.1693). Climate change is already negatively impacting health, and, if permitted to continue unabated, will exacerbate direct and indirect health impacts to varying degrees across populations (McMichael, 2013; McMichael, Friel, Nyong, & Corvalan, 2008; McMichael & Lindgren, 2011; K. R. Smith et al., 2014; P. Wilkinson, Campbell-Lendrum, & Bartlett, 2003). Vulnerability to the health impacts of climate change is influenced by various factors including geography, current health status, age, gender, socioeconomic status, and infrastructure that “combine in a complex and place-specific manner” (K. R. Smith et al., 2014, p.717).

While the attribution of climate change impacts on human health is challenging (Patz & Levy, 2015), climate change and health researchers utilise sophisticated scientific methods and long-term datasets, which are increasingly able to quantify and attribute specific health burdens to climate change (K. L. Ebi, Ogden, Semenza, & Woodward, 2017; Hales, Kovats, Lloyd, & Campbell-Lendrum, 2014). The IPCC stratifies the health impacts of climate change into one of three classifications: direct impacts, ecosystem-mediated impacts, and human institution-mediated impacts (K. R. Smith et al., 2014, refer to Table 3 below).

Table 3. An overview of the health impacts of climate change

Classification	Potential impacts
Direct	Increased mortality (death) resulting from increased exposure to: hot and cold weather extremes; floods and storms; ultraviolet radiation.
Ecosystem-mediated	Increased morbidity (illness) and mortality from increased exposure to: vector-borne and other infectious diseases; food- and water-borne infections; air pollution and aeroallergens.
Human institution-mediated	Increased morbidity and mortality from poor nutrition; occupational health; mental health; violence and conflict.

Source: (K. R. Smith et al., 2014)

2.2.2 The Relationship between Emissions and Human Health

Understanding the interplay between emission sources, climate change and health is critical to understanding the health impacts of climate change. Access to energy has been fundamental for human development and poverty reduction (Barbier, 2014). To ensure energy access has remained affordable at the household level, fossil fuel subsidies have been in place for decades; in 2014, direct fossil fuel subsidies equated to approximately USD$490 billion (Watts et al., 2017). As the dominant mode of energy production, however, the combustion of fossil fuels has serious ramifications for human health across local, national and global scales (K. R. Smith et al., 2013).

The use of coal, oil and gas for the provision of energy results in the emission of both short- and long-lived climate altering pollutants, including CO_2, methane, nitrous oxide, ozone and black carbon. These pollutants are often classified based on their effect on temperature; some have a warming potential (e.g. GHGs) and some have a cooling potential. While much focus has been placed on mitigation of CO_2 emissions historically, researchers have strongly encouraged the pursuit of complementary measures to mitigate other climate-altering

pollutants – in particular, short-lived climate forcers[3] – given their negative impacts on health and development (Anenberg et al., 2012; Kuylenstierna et al., 2011; D. Shindell et al., 2017; Zusman et al., 2013).

Emissions result in health impacts across the temporal spectrum. Longer-term, GHG emissions from the combustion of fossil fuels contribute to climate change, resulting in direct and indirect health impacts (as detailed in Table 3). The WHO estimates that climate change will account for 250,000 deaths annually in 2030 given predictions for increasing incidences of malaria, diarrhoea, malnutrition and heat stress (World Health Organization, 2015b). Shorter-term, some emissions resulting from the combustion of fossil fuels affect air quality, which in turn can impact the respiratory and cardiovascular health of populations (Balmes, 2017; M. L. Bell & Samet, 2010; A. H. Lockwood, 2017). The WHO estimates that in 2012, seven million deaths were attributable to household and ambient air pollution globally (World Health Organization, 2014a).

The interrelationship between air quality and climate change is inextricable, with many air pollutants produced concurrently with GHGs through the combustion of fossil fuels (Fiore, Naik, & Leibensperger, 2015; Landrigan et al., 2017; Yuqiang Zhang et al., 2016). Further, climate change exacerbates air quality issues, with projections of increasing morbidity and mortality due to ground level ozone and particulate matter 2.5 micrometres or less in diameter ($PM_{2.5}$) in some regions in coming years as a result of climate change (Garcia-Menendez, Saari, Monier, & Selin, 2015; Orru, Ebi, & Forsberg, 2017; Silva et al., 2017; Stowell et al., 2017; Whitmee et al., 2015). Air pollution represents one of many externalities[4] that naturally result from energy production.

[3] Short-lived climate forcers (SLCFs; also referred to as short-lived climate pollutants) are atmospheric substances with a comparatively short lifetime (from a few days up to a decade) compared with CO_2 (up to a century). Some contribute to air pollution and all contribute to near-term climate change. Key SLCFs include black carbon, ground level ozone, methane and fluorinated gases.

[4] Externalities are the social and environmental costs associated with the production of a commodity that are not accounted for (internalised) in the final market price of the product. The European Commission and the U.S. Department of Energy have been researching the environmental and economic externalities of energy since the 1990s (European Commission, 1995), developing methodologies to establish estimates of the social and environmental costs associated with energy sources.

To address emissions, a diverse range of air pollution and climate change mitigation measures can be utilised by national governments. The mitigation policy mix is often dependent on domestic circumstances (Somanathan et al., 2014). Climate change mitigation policies often involve some level of structural change to the energy sector. There are three broad groups under which emissions reduction policies can fall:

- Economic mechanisms, such as emissions trading schemes, cap-and-trade systems or feed-in tariffs, that aim to internalise the externalities of energy production and incentivise a shift toward low-carbon technologies;
- Regulatory mechanisms, such as emission standards that establish pollution limits for a sector or source; and
- Land use change mechanisms, such as policies that promote afforestation in order to create greenhouse gas sinks.

Air pollution policies can also be broadly categorised into two groups (International Energy Agency, 2016):

- End-of-pipe measures, such as retrofitting sources in the transport or energy sectors with filters or scrubbers that capture pollutants prior to their atmospheric release; and
- Regulatory mechanisms, such as emission standards that establish pollution limits for a sector or source.

Often, but not always, air pollution is mitigated through the use of end-of-pipe measures as a comparatively cheaper approach to air pollution mitigation for sectors than the implementation of regulatory mechanisms. Importantly, end-of-pipe measures can reduce the release of up to two-thirds of air pollutants, however structural measures, such as fuel switching, will be required to address the remaining third of air pollutants (Bollen & Brink, 2014). Moreover, while climate change mitigation policies can reduce the release of air pollutants, air pollution mitigation policies do not have the same impact on GHG emissions reduction (Braspenning Radu et al., 2016).

While there can be significant economic costs associated with reducing emissions, there are also substantial economic costs attributable to climate change and air pollution. Estimates of the economic costs associated with climate change suggest that global annual gross domestic product (GDP) could be impacted by up to 3.3 percent by 2060; labour productivity constitutes one area that will be most significantly impacted (Organisation for

Economic Cooperation and Development, 2015). Further modelling by the Organisation for Economic Cooperation and Development (OECD) estimates that the economic consequences of outdoor air pollution will result in health care costs of approximately USD$176 billion and 3.7 billion lost working days annually by 2060 (Organisation for Economic Cooperation and Development, 2016). Given the magnitude of current and projected health impacts, the health community has moved to highlight the potential health co-benefits that can result from ambitious mitigation efforts.

2.2.3 The Health Co-Benefits of Climate Change Mitigation Policies

Where there are health impacts from climate change, it stands to reason that there are health benefits achievable through the implementation of strong mitigation policies. Given the economy-wide, cross-sectoral nature of climate change, health co-benefits have also been identified across sectors (see Table 4). Quantifying and monetising the benefits to health outcomes that arise from the implementation of mitigation measures is by no means a novel concept. In 2000, for example, a collaboration of researchers and organisations released workshop proceedings on the ancillary benefits and costs of GHG mitigation. At the time, there was recognition that "these "bonus" benefits ought rightly to be included in any accounting of the good that will be done by greenhouse gas mitigation" (Organisation for Economic Cooperation and Development et al., 2000, p.3).

Table 4. Health co-benefits by sector

Sector	**Mitigation measures with potential health co-benefits**
Energy	Reduce fossil fuel combustion
	Increase (some) biofuel production
	Adopt carbon capture and storage
Transportation	Improve fuel economy
	Adopt electric and non-combustion vehicles
	Enforce stringent vehicle emission standards
	Increase access and convenience of active transport, e.g. walking and cycling
Agriculture	Reduce livestock production
	Capture methane emissions
Urban planning/ built environment	Increase green space, parks, shading and vegetation in parks and along roads

Source: (Adapted from Remais et al., 2014)

To determine the potential health co-benefits that arise from domestic and global action, complex modelling techniques are utilised by researchers, government and non-

government organisations (C. Williams et al., 2012). The broad methodological processes underpinning health co-benefits studies have been documented (Remais et al., 2014; Ürge-Vorsatz, Herrero, Dubash, & Lecocq, 2014) and several literature reviews on the co-benefits of climate change mitigation policies have been performed (M. L. Bell et al., 2008; Bollen, Guay, Jamet, & Corfee-Morlot, 2009; Chang et al., 2017; Cheng & Berry, 2013; Gao, Hou, et al., 2018; Gao, Kovats, et al., 2018; Kwan & Hashim, 2016; Nemet et al., 2010).

The findings are consistent; despite the heterogeneity of study methods, prospective health co-benefits studies consistently conclude that the implementation of ambitious mitigation measures can reap significant health benefits for local populations in both developed and developing countries, and can partially, if not completely, offset resulting mitigation implementation costs (e.g., see Aunan, Fang, Vennemo, Oye, & Seip, 2004; Balbus, Greenblatt, Chari, Millstein, & Ebi, 2015; Buonocore, Lambert, Burtraw, Sekar, & Driscoll, 2016; Confalonieri et al., 2007; Dudek, Golub, & Strukova, 2003; Jensen et al., 2013; Markandya et al., 2018; Peng, Yang, Wagner, & Mauzerall, 2017; Rafaj, Schöpp, Russ, Heyes, & Amann, 2013; D. Shindell et al., 2012; D. T. Shindell, Lee, & Faluvegi, 2016; A. C. Smith et al., 2016; Thompson, Rausch, Saari, & Selin, 2016; West et al., 2013; Wolkinger et al., 2018; Xie et al., 2018). A strong appeal of health co-benefits is their immediacy. Specifically, health benefits associated with reduced air pollution can materialise promptly after mitigation measures are implemented (Ikefuji, Magnus, & Sakamoto, 2014; Remais et al., 2014, refer to Table 5).

Table 5. Examples of potential health co-benefits from mitigation activities relating to the energy and transport sectors, including the anticipated time lag for the realisation of health co-benefits

Mitigation activity	Potential health co-benefits	Anticipated time lags
Reductions in fossil fuel use and/or improvements in fuel economy; incentivise electric vehicle use; tighten vehicle emission standards	Reduction in sudden cardiac death risk	Days to weeks
	Reduction in acute respiratory infections	Weeks and months
	Reduction in chronic obstructive pulmonary disease exacerbations	
Increases in accessibility to active modes of transport, including walking and cycling	Reduction in type 2 diabetes	Years
	Reduction in depression	
	Reduction in breast and colon cancer incidence	

Source: (Adapted from Remais et al., 2014).

While health co-benefits studies have the potential to constitute an integral policy-relevant input into mitigation policies, researchers within the field acknowledge several limitations:

1. **Methodological heterogeneity:** Within health co-benefits studies, models are designed based on a conceptual framework "linking the mitigation policy to specific public health drivers in the near- and mid-term over which beneficial health impacts accrue" (Remais et al., 2014, p.448). As such, different assumptions, uncertainties and parameters underpin each study, making comparisons between studies difficult. Consequently, across the scientific and political domains, the integration of scientific findings into policy is complicated by the "lack of shared assumptions, methods and data" (Nemet et al., 2010, p.6).
2. **Absence of retrospective analysis:** A significant majority of health co-benefits studies are *ex ante* (prospective) evaluations (C. Williams et al., 2012). Retrospective analysis of health co-benefits would provide a "greater grounding in real data" (Jack & Kinney, 2010, p.175) that would enhance the legitimacy of findings for policy-makers.
3. **Double counting:** Given the overlap in co-benefits categories, particular attention must be paid to analysis of health and welfare endpoints in order to avoid the potential for double counting and overestimating the economic benefits that arise from health savings (Ürge-Vorsatz et al., 2014).
4. **Absence of co-harms:** Equivalent to health co-benefits, adverse health side effects (also known as co-harms or trade-offs) may arise from mitigation policies in the areas of geoengineering, affordability of essential items such as food, increased biofuel use and some carbon pricing mechanisms (Remais et al., 2014; K. R. Smith et al., 2014). The causal pathways to co-harms are inherently complex and so are often ignored in co-benefits studies (C. Williams et al., 2012). Further, very few co-benefits studies genuinely consider inequalities of health impacts from policy, including "socio-economic, ethnic and gender inequalities in health" (Shaw, Hales, Howden-Chapman, & Edwards, 2014, p.428).

Despite these limitations, there are some important examples that suggest health co-benefits can and do influence the development of climate change mitigation policies. In the U.S., for example, climate change mitigation policies have been pursued through clean air legislation in recent years with health co-benefits publicly communicated as a key selling point (Jacob, 2015) in an attempt to pursue climate action despite the politically toxic nature of the climate change debate. However, there is recognition that co-benefits have not gained commensurate political traction in a majority of Parties to the UNFCCC (B. Cohen, Tyler, &

Torres Gunfaus, 2017; Jack & Kinney, 2010; Mayrhofer & Gupta, 2016; Nemet et al., 2010; Remais et al., 2014; Watts et al., 2018).

Varying explanations have been proposed. Some of these explanations align with political economy thinking. For example, Nemet and colleagues (2010) argued that a political "focus on cost minimization—rather than comparison of benefits and costs—diminishes the role of benefits in general" (Nemet et al., 2010, p.1). In their literature review of co-benefits, Mayrhofer and Gupta (2016) concluded that, given the dominant influence of economists, the application of "co-benefits ends up being a 'business-as-usual' incremental approach which does not adequately call for the structural change needed to address climate change…" (Mayrhofer & Gupta, 2016, p.28).

Other research studies posit alternative explanations. For example, Remais and colleagues (2014) advanced the need to enhance the policy relevance of health co-benefits studies by prompting health co-benefits researchers to "iteratively engage policy makers actively in their work" (Remais et al., 2014, p.453). Others suggest that the science–policy interface presents a number of challenges, and a viable solution requires a more integrated approach (A. Smith, 2013; Stordalen, Rocklöv, Nilsson, & Byass, 2013; Watts et al., 2018). While the explanations offered to date provide a solid foundation for exploring solutions to enhancing the role of health in the climate change agenda, additional insights may be gleaned from consideration of the political and economic structures and processes that underpin policy development.

2.2.4 Efforts to Enhance the Role of Health in the Climate Change Agenda

It is well-established in the literature that political, economic, social, and environmental factors influence individual and population health outcomes (Barton & Grant, 2006; Birn et al., 2009; Dahlgren & Whitehead, 1991). Consequently, almost every policy area will have impacts on, and implications for, health (Baum, 2008a; Ottersen et al., 2014). The consideration of health in policies outside of the health sector is not a new concept. The 1978 Alma Ata Declaration on Primary Health Care and the 1986 Ottawa Charter for Health Promotion promoted the development of healthy public policies, recommending that public policies across various levels of government should explicitly account for health impacts (de Leeuw, 2017).

Intersectoral action on health was reinforced in 2006, when a 'Health in All Policies' (HiAP) approach was first conceptualised in the EU; the strategy aims to systematically account for the "health implications of decisions, seeks synergies, and avoids harmful health

impacts in order to improve population health and health equity" (World Health Organization, 2014b, p. 2). The need for a coordinated approach to maximise the health outcomes resulting from public policies was reaffirmed in the landmark report prepared by the Commission on the Social Determinants of Health in 2008, which asserted that "action…must involve the whole of government, civil society and local communities, business, global fora, and international agencies" (Commission on the Social Determinants of Health, 2008, p. 1).

In relation to the climate change agenda specifically, extensive efforts have been undertaken over the past three decades to enhance the role of health in the agenda at national and global levels. Firstly, the IPCC's Working Group II on Impacts, Adaptation and Vulnerability has examined the health impacts of climate change in a standalone chapter since the third assessment report was released in 2001, with a dedicated section on health co-benefits in the latest assessment report released in 2014 (K. R. Smith et al., 2014). Secondly, in the last decade, the prestigious British medical journal, the *Lancet*, has published several extended series that review the health impacts of climate change (Costello et al., 2009) and the health co-benefits of mitigation activities (Friel et al., 2009; Haines et al., 2009; Markandya et al., 2009; K. R. Smith et al., 2009; Paul Wilkinson et al., 2009; Woodcock et al., 2009). This was followed by the InterAcademy Medical Panel's (2010) health co-benefits statement, which advocated for a greater role for health co-benefits in climate change mitigation policy development across levels of government (InterAcademy Medical Panel, 2010).

More recently, the *Lancet* Commission on Climate Change and Health (the Lancet Commission) was launched in 2015. Comprising a multidisciplinary consortium of researchers, the Lancet Commission provides specific recommendations to government to enhance climate action, and monitors, assesses and reports on progress of health in the climate change agenda (Watts et al., 2015, 2017, 2018). Thirdly, the health community has an increasingly strong presence in climate change discourse, with numerous international collaborations and consortia dedicated to enhancing the consideration of health in the climate change agenda (Patz & Thomson, 2018). This includes at side events that occur concurrently to international negotiations at the COPs (Nilsson, Evengård, Sauerborn, & Byass, 2012; Stordalen et al., 2013). Significantly, the 'right to health' was explicitly included in the Paris Agreement text. This inclusion constitutes the first time that health has been included in an international climate change instrument since the adoption of the UNFCCC (Schütte et al., 2017). Finally, the WHO's recently elected Director-General, Dr Tedros Adhanom Ghebreyesus, has indicated that addressing the health impacts of climate change is a priority under his leadership, an issue he reportedly discussed with participants at the Hamburg G20 summit in July 2017 (World Health Organization, 2017b).

These efforts are to be commended and have ensured that health has been a consideration, particularly in the development of climate adaptation planning at the national level. However, it is important to recognise that significant barriers still exist that challenge the consideration of health in the climate change agenda (Rudolph & Gould, 2015). For example, the WHO acknowledges that the health sector's access to climate financing remains minimal (World Health Organization, 2017a). Additionally, a 2010 survey of representatives of UN agencies, Parties to the UNFCCC and NGOs found consensus that health has not been of great importance, but should be, in international climate change negotiations and outcomes (Singh et al., 2011). Moreover, in 2016, then Secretary-General of the UNFCCC, Christiana Figueres, addressed the Sixty-ninth World Health Assembly congratulating the public health community for their mobilisation in Paris, but also noting that 85 percent of national climate change plans still do not refer to health (World Health Organization, 2016).

The limited traction of health in the climate change agenda is perplexing, given the established biophysical limits to adaptation, as well as the extensive projected costs, including health costs, directly and indirectly associated with climate change (Organisation for Economic Cooperation and Development, 2015). Several solutions to address the discrepancy between the potential and actual traction of health in the climate change agenda have been suggested. These include the need for increased communication, integration, advocacy and leadership efforts by the health community (Butler & Harley, 2010; Stordalen et al., 2013; World Health Organization, 2009). However, as Lockwood (2015) rightfully questions, "…if there are so many 'win-wins' between emissions reduction, economic growth and improvements in well-being, why haven't these already been realized?" (M. Lockwood, 2015, p.149). There is limited research that analyses the influence of political, economic and policy-making structures and processes on the uptake of health in the climate change agenda. Further interdisciplinary assessment is necessary to better understand why health is, or more importantly is not, considered in high level debates about climate change mitigation.

2.3 Methods

Until recently, climate change and health research has been relatively sparse. A 2012 inventory of publications indexed in PubMed under 'climate change' and 'health' identified just over 1500 publications (Stordalen et al., 2013). Government and non-government agencies have started to address this gap by contributing to the literature with their own research and assessments. Consequently, grey literature, including several government and non-government publications, was identified and included in this literature review.

Relevant documents and literature were retrieved between March 2015 and January 2018. To identify relevant peer-reviewed literature, literature searches of three research databases (Web of Science, Scopus, and JSTOR) were performed between May and June 2015. Terms searched included ‘climate change’, ‘global warming’, ‘mitigation policy’, ‘political economy’, ‘health’, ‘health co-benefit’, ‘public health’ and ‘human health’. Monthly alerts were created for each database to identify additional relevant papers published after June 2015. Additional relevant publications and reports were identified through the review of bibliographies. In total, 1600 documents spanning books, peer-reviewed literature and grey literature were identified. To identify the most relevant documents, abstracts and executive summaries were initially screened and searched for key words and phrases. This rapid thematic analysis enabled the establishment of four key interrelated areas and identified the final documents that were included in this chapter.

2.4 Results

A review of the literature on the political economy of health and climate change, the science–policy interface and power in the policy-making process facilitated the identification of four key interrelated areas where barriers may exist for health co-benefits: i) discourse; ii) efficiency; iii) vested interests; and, iv) structural challenges. The literature in these fields is expansive and contested, and the overview presented below is by no means exhaustive. We highlight some of the central tenets and examples from these fields to guide a meaningful discussion on the implications for health co-benefits and to aid the consideration of strategies to enhance their uptake in the development of national climate change mitigation policies.

2.4.1 Discourse

The political economy literature portrays the dominant discourses for both climate change and health as unduly influenced by economic forces. In relation to climate change, for example, at both national and global levels, climate change discourse is embedded in an economic frame, where the problems and the primary solutions are economic in nature. Climate change can be viewed as an economic problem given failures of the market to internalise the costs of using certain environmental ‘goods’ (Stilwell, 2012b). In relation to solutions, it has been asserted that policy-makers have relied heavily upon economic approaches to solve climate change by focusing on efforts to internalise externalities via market-based interventions such as pricing mechanisms, including emissions trading schemes, cap-and-trade systems and carbon taxes. In this way, “climate change action has been transformed, largely through the agency of the state, into the generation of tradable, priced and ownable units of molecular ‘mitigation’”

(Lohmann, 2016, p.481). In pursuing an economic solution, there are claims that governments perpetuate neoclassical economic practices (Rosewarne, 2010).

In relation to health, some political economists argue that in societies where profit primarily motivates economic and social decision-making, health is defined in a functional manner. This perspective critiques the capitalist system by presenting it as reducing an asset-less individual's value to their capacity to generate productivity through labour. In other words, health is inextricably linked with an individual's value to society; sickness is symbolic of "…an inability to produce profit…" (Bambra, 2011, p.8). Further, within this profit-driven structure, a political focus on short-term, quantifiable outcomes poses "particular problems for public health, which is, by its very essence, concerned with long-term outcomes" (Baum, 2008b, p.95). Individualistic assumptions that underpin neoliberalism, which "holds individuals totally responsible for their actions and the consequences, including health" (Baum, 2008b, p.74), has serious implications for health outcomes. By focusing on individual experiences of illness, political, economic, social and environmental factors that may contribute to ill health are easily overlooked (Doyal & Pennell, 1979). An individualistic approach to health encourages victim blaming (Baum, 2008b), which oversimplifies the often complex and convoluted nature of illness, ignoring "the social, cultural and economic context in which decisions are taken" (Baum, 2008b, p.80).

2.4.2 Efficiency

As an extension of the economic dominance of climate change and health discourse, and in line with mainstream economic principles regarding resource allocation, the political economy literature tends to argue that economic efficiency is central to climate change policy decisions. Climate change negotiations are preoccupied with questions surrounding the economic optimisation of emissions reduction and the distribution of responsibility in achieving this outcome (DeCanio, 2009). To determine 'optimal' carbon reduction commitments, that is the most efficient policy option, economic instruments laden with neoclassical assumptions are regularly used as the basis for determining policy options. These instruments are used to determine policies that are politically and economically pragmatic as opposed to optimal for environmental and social outcomes (Beder, 2011) by mixing "descriptive analysis and value judgements in ways that deserve close and critical scrutiny" (Ackerman, DeCanio, Howarth, & Sheeran, 2009, p.299).

The assumptions embedded into these instruments critically inform the final policy outcome, and are regularly contested (e.g. Huber, Ibarreta, & Frieler, 2017; Hutton, 2011;

Moore & Diaz, 2015). While it is not feasible here to review all of the contestations around modelling, two notable examples are worth highlighting. The first example relates to the 'optimal' discount rate to apply to future benefits and costs. A discount rate is used to account for the discrepancy between current and future costs and benefits, by reducing the current value of a cost or benefit that will not be realised for a period of time (Aldy, Baron, & Tubiana, 2003). Put differently, a discount rate "implies that the well-being of this generation matters more than that of its children, who in turn matter more than their children" (Ackerman et al., 2009, pp.300-301). The discount rate used significantly influences the economic output that ultimately informs the preferred policy outcome (Admiraal, Hof, den Elzen, & van Vuuren, 2016), with far-reaching consequences for inter-generational equity. For this reason, the 2006 Stern Review—one of the most comprehensive and longer-term economic cost–benefit analyses of climate change—used a comparatively low average discount rate (Stern, 2007), a decision that was criticised by a number of economists (Nordhaus, 2007).

A second example relates to the technically and ethically complex processes used to assign monetary values to 'invaluable assets', such as human life and health. Currently, different models use different methodologies to determine the valuation of a human life (e.g., see Andersen, 2017). This has resulted in some economic assessments valuing the lives of individuals in richer countries more than the lives of individuals in poorer countries (Ackerman et al., 2009). Such approaches reaffirm that intra-generational inequity remains a key issue in the development of climate change policies.

2.4.3 Vested Interests

An overlapping area covered in the political economy and power in policy-making literature is the role of vested interests in influencing policy outcomes. Despite repeated efforts to demonstrate the economic efficiency of implementing climate change policies, "in reality governments inevitably get it wrong, in part because they are in hock to vested interests" (M. Lockwood, 2015, p.149). Some political economists explain this as partially the result of another relevant yet contested principle underlying economic considerations in the development of policies: the Pareto Principle. The principle holds that any economic change or redistribution is permissible only if the situation improves for one or more individuals without negatively impacting the situation of another.

With the reality that almost every change results in winners and losers, the consideration of this principle often reasserts a neoclassical perspective that non-intervention in the market is the optimal response (Stilwell, 2012a). There is a cognisance of the

importance of who wins and who loses in climate change action. For example, in his thesis on the political economy of the environment, Boyce (2002) hypothesises that the power dynamic between the winners – that is, those who experience net benefits from an activity – and the losers, or those who endure net costs, directly influences the level of environmental degradation that ensues; environmental degradation is greater if the winners are relatively powerful compared to the losers (Boyce, 2002). This hypothesis again highlights issues of intra- and inter-generational equity. Boyce's hypothesis is confirmed by Steves and Teytelboym (2013), whose comparative assessment of the climate change mitigation policies of 95 countries concluded that the size of a country's carbon-intensive industry was a major factor influencing climate change policy adoption (Steves & Teytelboym, 2013).

This has led some political economists to support the position that "…the capitalist market economy is the problem, not the solution. In its modern form, shaped by corporate power, consumerist practices, and the prevailing ethos of individualism, it stands as the antithesis of ecological sustainability" (Stilwell, 2012b, p.334). Similarly, with health, there is recognition that powerful vested interests exist that can and have influenced public health interventions. Tobacco control policy represents one example where vested interests have been implicated in delaying meaningful policy development. Consequently, parallels between tobacco control and climate change policies have been drawn by climate change and health researchers (Nilsson, Beaglehole, & Sauerborn, 2009).

The role of power and vested interests in policy-making is further elucidated when examining key theoretical explanations of the policy-making process. Theoretical positions on the policy-making process exist on a continuum. At one end exist idealistic theories, such as the "rational actor model" that presents policy-making as a logical, linear and tidy process involving a comprehensive assessment of all information in order to produce an optimal policy outcome (Birkland, 2014b). The middle ground is populated by theories such as incrementalism and bounded rationality, which suggest the policy-making process is more opportunistic and iterative in nature, occurring within pragmatic parameters, such as time, information and individual abilities (Birkland, 2014b). At the other end, theories such as Cohen and colleagues' (1972) 'garbage can model' and Kingdon's (1984, 1995, 2011) 'multiple streams' approach to policy-making are found.

These understandings of the policy-making process conceptualise a messy combination of problems, solutions and participants that interact in a non-linear and almost serendipitous manner to produce policy outcomes. The latter theories support the notion that

many actors are involved in the development of policy, none of whom can be considered to hold neutral positions (Birkland, 2014a).

While governments are ultimately responsible for making policies, it is well understood that the various actors contributing to the policy-making process use resources at their disposal in an attempt to influence the final policy outcome. In this way, “governments set the field of play and the rules for debate…but energy comes from actors on the field” (Meiburg, 2010, p.1086). As such, the concept of power is central to the policy-making process (Buse, Mays, & Walt, 2012). Accordingly, there are additional theoretical perspectives on who wields power in the policy-making process. Dahl’s (1961) pluralist perspective, considered the dominant theory in liberal democracies, understands power to be distributed among individuals and groups within society. The role of the state is to act as adjudicator in managing competing interests inevitable in the policy development process (Buse et al., 2012).

Public choice theory extends this understanding of power in the policy-making process by recognising the state as an interest group, with elected officials and bureaucrats pursuing their own self-interests, resulting in distorted policies that benefit certain groups at the expense of the public interest (Buse et al., 2012). Critiques of the pluralist perspective, most notably put forward by Bachrach and Baratz (1962), assert that power is not always overt; “much power is exercised more covertly and through subtle cultural processes…” (Hill & Varone, 2014, p.31). Bachrach and Baratz coined the term non-decision making to capture this concept, arguing that power “often is exercised by confining the scope of decision-making to relatively ‘safe’ issues” (Bachrach & Baratz, 1962, p.948). These analyses of the policy-making process illuminate the ways in which many actors, including experts and those with vested interests, can inform the final policy outcome.

2.4.4 Structural Challenges

The literature identifies several structural and procedural challenges that exist in relation to health and climate change. Firstly, in relation to health, there is an acknowledgement that complex and dynamic interactions between various domains – political, economic, social, and environmental – inform an individual’s or a population’s health status (Birn et al., 2009). These determinants of health often fall outside of what is generally considered the realms of the health sector (Mooney, 2012). As a result, the health sector is limited in its capacity to address in totality many health issues experienced.

In relation to climate change, a “web of stakeholders” are relevant to climate change policy decisions (Bowen, Ebi, & Friel, 2014, p.1034). Included in the list of actors often recognised as influencing the policy-making process are scientists or experts, who legitimise the process by providing objective, evidence-based inputs (Schrefler, 2014). Researchers have considered the ways in which scientific knowledge can be used in the policy-making process. Schrefler (2014) proposed that the use of expert knowledge in regulatory policies falls into one of three categories: instrumental, strategic or symbolic. The instrumental use of experts sees them engaged in the policy process to determine the best solution to a problem. The strategic use of experts sees them involved in the policy process to support a pre-defined policy position. The symbolic use of experts sees them contribute in order to strengthen the legitimacy of the policy makers (Schrefler, 2014). Schrefler outlines a number of potential explanations for the exclusion of expert knowledge in the policy-making process, including that “pre-existing approaches to tackle and decide on a given policy issue are so entrenched…that expertise does not really make a difference when decisions are taken, particularly when these decisions trigger only small incremental changes in existing policies” (Schrefler, 2014, p.71).

While scientific evidence does not always gain the political traction it warrants, there are opportunities to enhance the role of scientific knowledge in the policy-making process. Cáceres and colleagues (2016) provided insight gained from their research in Argentina. The ‘science deficit model’ maintains that low uptake of scientific research in policy development can be explained by poor communication of scientific findings by scientists to policy-makers, or the inability of policy-makers to interpret scientific findings appropriately; “it is basically a technical-communicational problem” (Cáceres, Silvetti, & Díaz, 2016, p.57). Cáceres et al. determined that this theory is problematic in its oversimplicity of the policy-making process. They identified the “power dynamics model” as more representative; this conceptualisation of the policy-making process recognises that while pivotal, science knowledge represents just one element in a “highly contested, non-linear and multi-sectoral field where institutions, subjectivities, values, interests, power relationships as well as knowledge, play a role” (Cáceres et al., 2016, p.62).

Based on their experiences, the authors offered four considerations for enhancing the role of science in the policy-making process. Scientific knowledge is most likely to be incorporated when: (i) “it aligns with the interests of sectors that concentrate the larger shares of political power in society”; (ii) it is “encapsulated in compelling, widely-communicated storylines…well understood and appropriated by society”; (iii) “it has been appropriated by, and is well integrated into the agenda of a wide range of social actors with active

representation in the negotiation process"; and (iv) it can "contribute to create or take advantage of social-political windows of opportunity" (Cáceres et al., 2016, p.63).

These considerations are pertinent when searching for additional explanations to understand the undervalued role of health in the climate change agenda. We now consider how the four key interrelated areas explored above can be extrapolated to provide a better understanding of the potential barriers for health co-benefits in the development of climate change mitigation policies.

2.5 Discussion

Applying insights from the literature on the political economy of health and climate change, the science–policy interface, and power in the policy-making process supports the proposition that current political and economic structures and processes create several barriers for the inclusion of health co-benefits in the development of climate change mitigation policies. It is imperative that researchers are aware of the implications of these challenges; if researchers wish to enhance the political traction of health co-benefits, understanding the complex politico-economic paradigm is vital. Using the four interrelated key areas identified above, insights from the literature are transposed to illuminate additional barriers for health co-benefits in the development of climate change mitigation policies.

2.5.1 Discourse

In a globalised, market-oriented environment, the dominant climate change discourse has focused on the shorter-term costs of action and on 'fair' calculations of burden sharing at the expense of meaningfully incorporating the costs of inaction into the policy-making process. This global framing permeates national levels of policy-making, where "economic growth remains so central to political legitimacy" (M. Lockwood, 2015, p.149). Consequently, many national governments are beholden to the supremacy of economic guidance that focuses on least-cost pathways and the identification of the most 'efficient' policy options.

Further, in a policy-making environment where the benefits can be difficult (but not impossible) to quantify, it is simpler for policy-makers to disregard the qualitative evidence than to try and justify its inclusion in the policy development process. These barriers are exacerbated by the realities of perceptions around health; with individuals considered ultimately responsible for their health, attributing and communicating the health impacts of shorter- and longer-term climate change becomes increasingly challenging. The dominant discourse is further compounded by the reality that the policy agendas of health ministers are

often “crowded with many demands, and influenced by competing and conflicting interest groups” (Baum, Laris, Fisher, Newman, & MacDougall, 2013, p.142). Such political realities support the de-prioritisation of health co-benefits in the development of climate change mitigation policies.

2.5.2 Efficiency

For many governments, a focus on optimising cost-effectiveness results in policy-makers pursuing health gains through direct policies. A notable example is in relation to air quality, where it is cheaper to implement measures to reduce local air pollution than to address air quality through climate policies (Nemet et al., 2010). An exception to this view, as mentioned above, relates to the Obama Administration’s pursuit of climate change mitigation policies through air quality legislation in 2015 to avoid a politically hostile Congress in the lead-up to COP21. The influence of health outcomes as a clearly defined justification for air quality policies is noteworthy, yet this can undermine the consideration of health co-benefits in the development of climate change mitigation policies. This is especially problematic given there can be substantial trade-offs between isolated policy goals of reducing air pollution and abating climate change (Maione et al., 2016; Schmale, van Aardenne, & von Schneidemesser, 2014; M. Williams, 2012).

2.5.3 Vested Interests

The structure of the Paris Agreement, which requires each Party to the UNFCCC to make regular emissions reduction pledges of increasing ambition, will create economic conflicts of interest between stakeholders and sectors domestically (Aaheim, Wei, & Romstad, 2016). The implementation of mitigation policies, often regulatory in nature, naturally creates winners and losers (Schrefler, 2014). Longer-term, winners of ambitious climate change mitigation policies comprise nearly all sectors, including the renewable energy sector, as well as current and future populations, with benefits diffuse across space and time, and difficult to measure. Losers are likely to be big corporations as well as extractive industries, often able to exert undue power and influence over the policy-making process (Aaheim et al., 2016). Conversely, those who suffer most from a delay in effective climate change policies are the most vulnerable populations with minimal to no power in the policy-making process: children, economically disadvantaged populations and future generations.

Vested interests are not limited to corporate interests eager to maintain the status quo. Outside of the more obvious economic motivations that exist for the extractive industry, strong ideological motivations have been linked to the climate change denial movement that has

particularly strong roots in the U.S. Specifically, “a staunch commitment to free markets and disdain of governmental regulations” remains a defining feature of climate change denialists, who appear determined to uphold the “modern Western social order” that is often characterised by political and economic conservatism (Dunlap & McCright, 2011, p.144). This perspective is supported by analysis performed by Jacques and colleagues (2008), which confirmed a strong link between environmentally sceptic publications and conservative think tanks (Jacques, Dunlap, & Freeman, 2008).

2.5.4 Structural Challenges

While an integrated approach is optimal for the development of a cross-sectoral issue such as climate change, the politico-economic realities limit this approach in practice. Different approaches to problems, the use of diverse technical language, and the political reality of bounded rationality complicates cross-sectoral integration efforts. In federated systems, integration challenges are exacerbated given “the potential for differences of ideology and political interests between levels of government…have provided fertile ground for blame-shifting and regulatory complexity” (Baum et al., 2013, p.139). Further, environmental health concerns have tended to be addressed by proposals from environmental agencies, departments and NGOs, as opposed to health departments. In the U.S., for example, the U.S. Environmental Protection Agency (U.S. EPA) was responsible for developing the ‘Clean Power Plan’ and disseminating the health co-benefits (Jacob, 2015). While national health ministries may logically be considered best placed to provide in-house expertise and to advocate for health in the climate change agenda, often acute health care concerns are dominant for health ministries (Baum et al., 2013; de Leeuw, 2017).

Political short-termism and a pragmatic governance style can also undermine optimal policy outcomes, particularly for a cross-sectoral, longstanding policy area such as climate change. For example, analysis of the United Kingdom’s climate policy development by Gillard (2016, 2017) determined that, in the aftermath of the global financial crisis in 2008, climate change policy was considered too expensive to pursue and austerity measures inevitably de-prioritised the implementation of ambitious climate action (Gillard, 2016; Gillard, Gouldson, Paavola, & Van Alstine, 2017).

2.6 Summary

Current efforts to address climate change are inadequate given the projected health and other impacts. Consideration of health, specifically health co-benefits, has been recognised by climate change and health researchers as a potentially strong strategy to encourage more

ambitious climate change action. However, evidence suggests that health co-benefits have not gained the political traction they warrant as a result of numerous challenges. Applying insights from literature on the political economy of health and climate change, the science–policy interface and power in policy-making facilitated the identification of additional barriers that may impact the political traction of health co-benefits. This approach provides a unique perspective on the challenges of meaningfully incorporating health into the climate change agenda. Identifying potential barriers for health co-benefits in the development of climate change policies provided the foundation from which to investigate the role of health co-benefits in climate change mitigation policy-making. The next chapter details the methods used to examine the role of health co-benefits in four Parties to the UNFCCC.

Chapter Three: Methods

3.1 Introduction

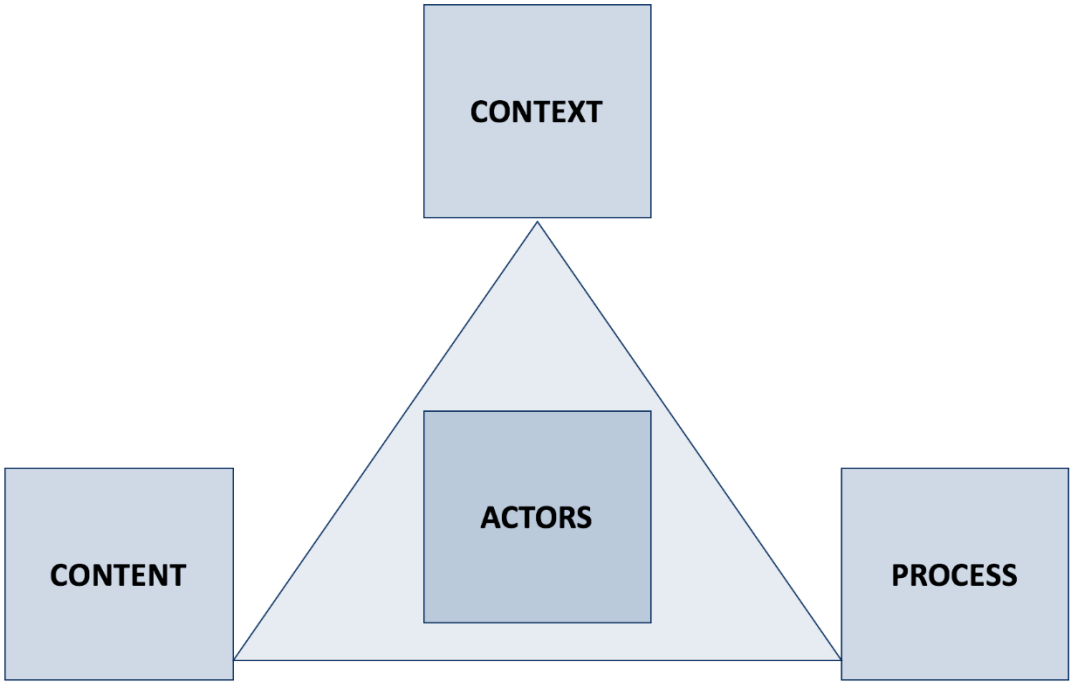
A review of existing literature in the previous chapter suggests that health co-benefits have not received the political traction they warrant and that politico-economic, institutional and/or social factors potentially limit the influence of health co-benefits in mitigation policy development. While a number of explanations have been presented by climate change and health researchers, limited research has been undertaken that specifically examines the role, if any, that health co-benefits currently play in the development of climate change mitigation policies for Parties to the UNFCCC.

As part of the literature review, I used insights from literature on i) the political economy of health and climate change; ii) the science-policy interface, and iii) power in policy-making in order to pinpoint potential barriers to the consideration of health co-benefits in policy development. Consequently, I identified four overarching and interrelated areas in which barriers may exist: i) discourse; ii) efficiency; iii) vested interests; and iv) structural challenges.

The purpose of this chapter is to detail the analytical approach and methods that I used to answer the two primary research questions that motivate this thesis. Accordingly, I first introduce the overarching analytical framework that guided analysis for the multi-site case study. Next, I outline the research approach employed. Third, I describe the case study approach used for the research design and articulate the rationale for the chosen sites. Then, I detail the specific research methods used to gather and analyse data for the development of the case study. Finally, I discuss the proposed dissemination strategy for communicating research findings before concluding.

3.2 An Analytical Framework: Walt and Gilson's Policy Analysis Model

In order to undertake climate change policy analysis, I identified an analytical framework that both aligned with the theoretical framework selected for this thesis and the research questions being asked. Walt and Gilson (1994) developed an analytical framework specifically for policy analysis to support the reform of health policies in developing countries. They argued that historically policy analysis narrowly focused on policy content at the expense of three additional domains that can greatly influence policy development: context, the policy-making process and actors. They acknowledged that while their policy analysis model is an oversimplification of inherently complex relationships, it affirms that policy "is the outcome of complex social, political and economic interactions" (Walt & Gilson, 1994, p.359) and supports a more holistic approach to policy analysis. While Walt and Gilson's framework was originally developed for the analysis of health policies, the use of this framework for the assessment of climate change policies is not unprecedented; other researchers have adopted the framework for this purpose and verified its suitability for the task (Bowen, Miller, Dany, McMichael, & Friel, 2013; Morrow & Bowen, 2014, refer to Figure 1 below).



Source: (Walt and Gilson, 1994, p.354; reproduced with permission)

Figure 1. Modified analytical framework used for the analysis of health co-benefits and climate change mitigation policies

3.2.1 Identifying Themes to Facilitate Policy Analysis

While Walt and Gilson's (1994) model provided an overarching analytical framework, I identified six themes to facilitate an in-depth analysis of the role of health co-benefits in the climate change mitigation policy-making process (see Figure 2 below). Identification of the six themes was informed by the four domains of Walt and Gilson's model (refer to Figure 1 above) and a review of the literature (see Chapter 2). I sought feedback from experts to verify the appropriateness of the themes; no additional themes or changes were suggested. The six themes became the foundation of my interview schedule (discussed further in section 3.5.1 below) and created a structure for presenting my case study results in the policy analysis chapters (Chapters 4, 5 and 6). The six themes are conceptualised accordingly:

1. **The policy-making process**: the approaches used to develop climate change mitigation policy given the cross-sectoral and inter-departmental nature of climate change impacts;
2. **Factors influencing the prioritisation of multiple considerations**: the formal and informal processes used to determine which considerations inform the development of climate change mitigation policies;
3. **Barriers and enablers for the consideration of health in mitigation policy**: the possible barriers to the consideration of health and the potential enablers that may facilitate the integration of health into mitigation policy development;
4. **The evidence base for policy development**: the role of experts and the use of and accessibility to scientific evidence in the policy development process;
5. **The role of external actors and stakeholders**: the participation of actors in the policy-making process; and
6. **Communicating policy decisions**: the key arguments used to justify the climate change mitigation policies agreed upon.

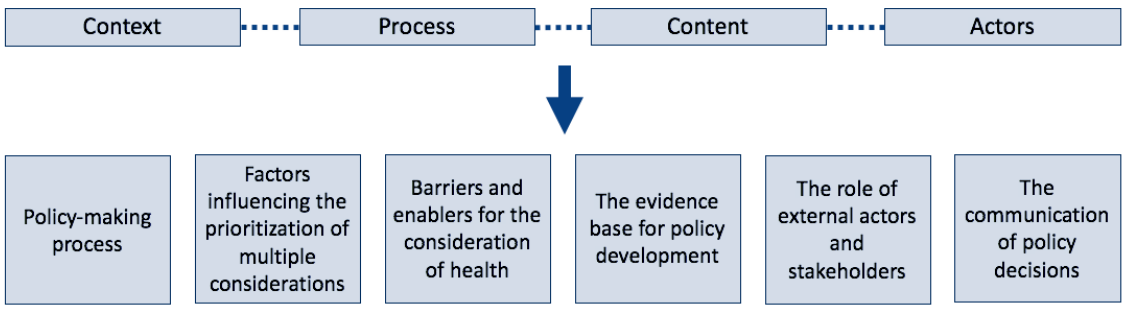


Figure 2. Identification of six themes from the four analytical domains in Walt and Gilson (1994) and a review of the literature

With the analytical framework outlined, I now move to provide an overview of social science research methods that I used for this research and introduce the research strategy employed.

3.3 Research Methods

3.3.1 Research Approach

Historically, research methods founded upon positivist principles and procedures have often – but not always – been utilised to answer questions regarding the natural sciences (Bryman, 2016d). More recently, there has been increasing acknowledgement and acceptance that scientific processes based on alternative epistemological and ontological assumptions, such as interpretivism and constructivism, are also appropriate for answering research questions pertaining to the social sciences (Bryman, 2016d).

Further, research approaches are regularly dichotomised into quantitative or qualitative research, and often polarising characteristics are attributed to each. For example, Bryman (2016) states that quantitative research is deductive, positivist and objectivist in nature, while qualitative research is inductive, interpretivist and constructivist (Bryman, 2016d). In practice, the approaches exist on a spectrum, and there is a level of flexibility in the research methods employed to perform research under the umbrella of either approach. It is not uncommon for researchers to employ a mixed methods approach (Bryman, 2016f; Creswell, 2014b).

I employed methods most strongly associated with qualitative research as well as a deductive approach to undertake this study. Table 6 below provides an overview of the key steps associated with a qualitative approach to research, and a description of each step for this study. As discussed earlier in the chapter, I have established research questions based on research gaps identified following a review of the literature and used theoretical perspectives from the political economy, science-policy interface and policy-making literature to test the proposition that health co-benefits have received limited traction in the development of mitigation policies as a result of numerous political, economic and social barriers.

Table 6. Key steps in qualitative research and a description for this study

Step	Description for this study
General research questions	1. Are health co-benefits considered and accounted for in national mitigation policies and if so, how? 2. What factors influence whether health co-benefits are considered and accounted for?
Selection of relevant sites and subjects	Sites: Australia, the EU, China, and the U.S.[5] Subjects: Policy-makers involved in the development of mitigation policies.
Collection of relevant data	1. Semi-structured interviews with policy-makers and experts; 2. Publicly available government documents relating to the development of mitigation policies (see Appendices C and D for full selection criteria and the full list of government documents analysed).
Interpretation of data	1. Directed qualitative content analysis of interviews and climate change policy documents using NVivo. 2. Triangulation of data sources for case studies.

Source: (Adapted from Bryman, 2016f)

3.3.2 Managing Qualitative Research Criticisms

Evaluating the rigour of qualitative research has been contested. Some researchers have argued that the evaluation criteria used to assess the quality of quantitative research, such as reliability and validity, are applicable to qualitative research in order to maintain standards for the development of high-quality research (Creswell, 2007). Consequently, some critics of qualitative research emphasise the difficulty of designing and conducting a replicable study that produces results that are not open to interpretation or are based on the researcher's perception of what is important (Bryman, 2016f). A related concern regards the generalisability of qualitative research findings, given the subjects of the research may not representative of the larger population of interest (Bryman, 2016f). I have been mindful of conducting a replicable study and have attempted to clearly articulate the processes used to undertake this research through the development of a case study protocol (see section 3.4.2 below).

Other researchers have proposed alternative evaluation criteria that are analogous to quantitative research evaluation criteria but more appropriately relate to the distinctive research designs and methods used. For example, Yardley (2000) offers four essential characteristics upon which qualitative research should be assessed (see Table 7 below). For

[5] I developed full case studies for Australia and the EU and carried out directed qualitative content analysis for China and the U.S.

the purposes of my study, these evaluation criteria are more fitting and I have endeavoured to produce research that embodies the four characteristics detailed.

Table 7. Characteristics upon which qualitative research should be assessed
(Essential characteristics are in bold, examples are in italics)

Sensitivity to context *Theoretical; relevant literature; empirical data; socio-cultural setting; participants' perspectives; ethical issues.*
Commitment and rigour *In-depth engagement with topic; methodological competence/skill; thorough data collection; depth/breadth of analysis.*
Transparency and coherence *Clarity and power of description/argument; transparent methods and data presentation; fit between theory and method; reflexivity.*
Impact and importance *Theoretical (enriching understanding); socio-cultural; practical (for community, policy makers, health workers).*

Source: (Yardley, 2000)

Having introduced the research approach for this study, I now discuss details of the research design. I employed a case study research design for this study and used multiple research methods in order to develop robust cases for two sites: Australia and the EU. I also carried out directed qualitative content analysis of Chinese and American climate change policy documents. Conducting case study research requires considerable planning and preparation prior to commencing data collection in order to develop high-quality research (Yin, 2009b). With this in mind, I detail the approach I used to develop an exploratory multiple-case study, including strategies to actively address limitations of the case study research design.

3.4 Research Design: The Case Study

A case study research design is a useful research approach when posing questions with "the desire to understand complex social phenomena" (Yin, 2009c, p.4). Robert Yin has written extensively on the principles and practices of case study research. Yin's (2009) key components of a case study demonstrate this complexity. He defines a case study as:

1. an in-depth empirical investigation of a contemporary phenomenon within its real-life context, particularly when there are blurred boundaries between the phenomenon and the context in which it exists;
2. depending on "multiple sources of evidence, with data needing to converge in a triangulating fashion" (Yin, 2009c, p.18); and
3. best conducted when underpinned by theoretical assumptions that direct data collection and analysis.

In essence, building a case study involves utilising various methods in an attempt to "reconstruct and analyse a case from a sociological perspective" (Hamel, Dufour, & Fortin, 1993, p.1). Table 8 below provides an overview of the key components of the case study research design and the specific details for this study.

Table 8. Components of the case study research design and details for this study

Component	Details for this study
The study's question(s)	1. Are health co-benefits considered and accounted for in the development of national climate change mitigation policies and if so, how? 2. What factors influence whether health co-benefits are considered and accounted for?
The study's hypothesis	Health co-benefits have gained limited traction in climate change mitigation policies as a result of several barriers, which may be politico-economic, institutional and/or social in nature.
The study's proposition(s)	• Current action on climate change is insufficient given the urgency and risks associated, despite a stated desire among Parties to the UNFCCC to address the issue; • The development of climate change mitigation policies does not occur in a vacuum; it is informed by political, economic and social factors; • The development of climate change mitigation policies is largely underpinned by neoclassical, neoliberal approaches; • A variety of actors with varying levels of power and influence play a role in the development of climate change mitigation policies; • As with many other policies, climate change mitigation policies need to be communicated and "sold" to the public; • Health is one of many sectors that is greatly impacted by climate change, and as such, the health sector could inform and/or motivate climate change mitigation policy development; • The determinants of health often lie outside of the health sector, and as such, achieving positive health outcomes requires a multi-sectoral strategy; • Accounting for health co-benefits in the development of climate change mitigation policies is likely to enhance the ambitiousness of mitigation efforts for Parties to the UNFCCC.
The study's unit of analysis	The policy development processes for climate change mitigation policies in Australia and the EU for NDCs pledged in the Paris Agreement, including the actors and factors that inform the development of those policies[6].
The logic linking the data to the proposition(s)	• Explanation building; • Cross-case synthesis.
The criteria for interpreting the findings	• Cross-case synthesis and policy implications for findings (detailed in Chapters 7 and 8).

Source: (Adapted from Yin, 2009b)

[6] Given time and resource constraints, I will perform directed qualitative content analysis on Chinese and American climate change mitigation policy documents under an extended time period of 2007-2017. This timeframe coincides with a fundamental shift in the development of climate change mitigation policy in both Parties to the UNFCCC, as is detailed further in Chapter 6.

There are three main variations of case studies: i) *descriptive*, which aims "to portray what happened in a particular case" (Yin, 2012, p. xxii); ii) *exploratory*, which "investigates distinct phenomena characterised by a lack of detailed preliminary research…" (Streb, 2010, p.372); and iii) *explanatory*, which are "used to explain causal relationships and to develop theory" (Harder, 2010, p.371). My study adopted an exploratory multiple-case study approach (also known as a comparative case study) in order to investigate the role of health co-benefits in the development of national climate change mitigation policies. Specifically, I developed case studies for two sites, Australia and the EU, in 2016 and 2017 respectively (see Figure 3 below). While the development of full case studies was constrained by logistical considerations, I also carried out a complementary analysis approach, analysing select Chinese and American climate change mitigation policy documents in order to compare findings across the four sites.

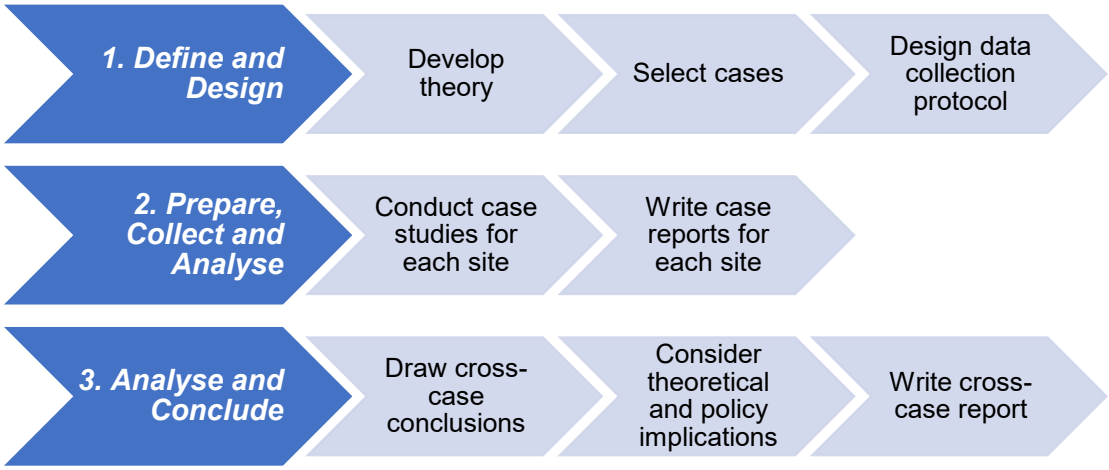


Figure 3. Procedure for developing a multiple-case study

Source: (Yin, 2009b, p.57)

Adopting a multiple-case approach is considered more rigorous than developing a single-case study, as "analytic conclusions independently arising from two cases…will be more powerful than those coming from a single case alone" (Yin, 2009b, p.61). Further, selecting case studies in different geographical regions or with distinctive institutional cultures can help determine points of differentiation, as opposed to representativeness. Simons and colleagues (2009) found that the selection of cases (in their instance, schools) in different regions "enabled us to understand not only *how* the innovation was being implemented in each unique case and what *problems* were encountered, but also whether these were shared characteristics or could be attributed to *differences in demography or the institutional culture* [of the schools]" (Simons, 2009, pp.30-31, emphasis in original).

Defining the 'case', or the unit of analysis, is the most crucial and challenging task associated with case study research (Harder, 2010). For the purposes of this project, my unit of analysis is defined as the current process used to develop climate change mitigation policies for Australia and the EU, including the actors and factors that inform the development of those policies. When developing a case study, a logic model or flowchart can assist in the identification of key topics or questions (Harder, 2010). Figure 4 below comprises key steps in the general policy-making process, based on theoretical conceptualisations of the process (see Chapter 2 for a review of the literature on policy-making). A chief component of this process is that information that influences the final policy outcome can be provided by many actors. Further, the flowchart acknowledges that policies are not developed in a vacuum; the political, economic and social context in which policy decisions are made informs the final policy outcome.

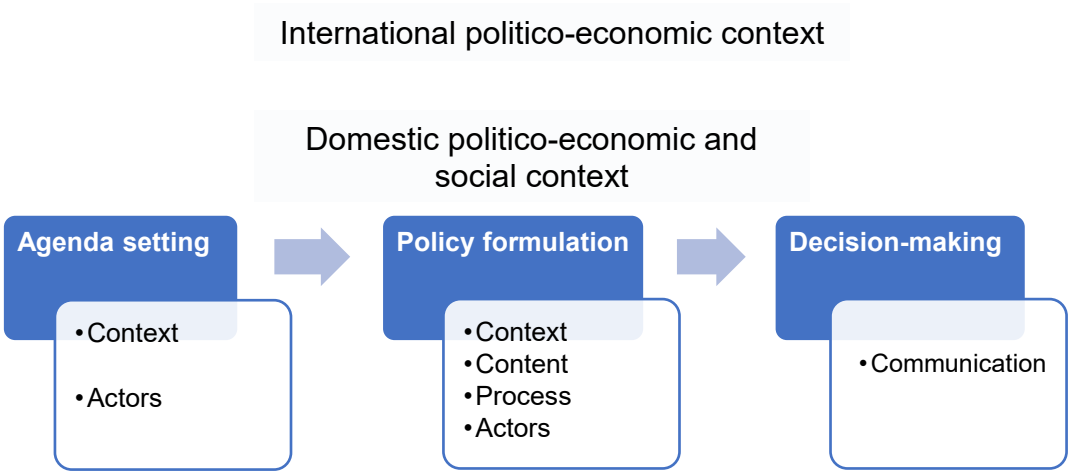


Figure 4. Key steps (blue boxes) and influencing factors (white boxes) in the policy-making process

3.4.1 Case Study Criticisms

As with qualitative research more broadly, Yin (2009) highlights several criticisms made of the case study research design process more specifically in relation to validity and reliability. To address these criticisms, Yin outlines the specific details of logic tests to assess the quality of an empirical case study. Table 9 below details the four assessment criteria and accompanying logic tests, as well as strategies I used to proactively address these criteria. These strategies complement Yardley's characteristics of qualitative research outlined in Table 7 above.

Table 9. Four logic tests to assess the quality of case studies

Assessment criteria	Logic test	Strategies utilised for this study
Construct validity Researcher's subjective judgements guide data collection, as opposed to suitable measures for the concepts being investigated.	Does the study: i) adequately define the topic of the case study through the explicit identification of concepts? ii) identify appropriate measures by which to study identified concepts?	• Use of multiple sources of evidence.
Internal validity Researchers have reached the wrong conclusions by making incorrect inferences or not accounting for confounding factors.	Does the study use evidence to demonstrate that inferences made are correct?	• Undertake explanation building.
External validity Case studies, in particular single cases, are not generalisable.	Does the study provide findings that allow for analytic generalisation, i.e. that support the generalisation of results to a broader theory?	• Use of replication logic.
Reliability There is insufficient documentation to replicate the study, or to determine that the researcher made efforts to mitigate errors and biases.	Does the study sufficiently document the procedures and processes used to design and carry out the research?	• Development of a case study protocol (see Appendix D).

Source: (Yin, 2009b, pp.40-45)

To elaborate on the strategies identified in Table 9 above, I:

- **used multiple sources of evidence**: I triangulated data from semi-structured interviews and government documents to verify the accuracy of findings and to provide a more comprehensive understanding of the mitigation policy development process. This practice fosters more compelling and precise conclusions (Yin, 2009a).
- **employed explanation building**: In Chapter 7, I carried out explanation building through the use of existing evidence in order to demonstrate that the conclusions I made were robust.
- **used replication logic**: Performing replicated studies across multiple sites that yield the same results – or contradictory results that are expected – suggests that the initial propositions identified were accurate (Yin, 2009b). From a review of the literature, I anticipated that the role of health co-benefits in both Australia and the EU are limited as a result of numerous barriers. I followed the same methodological procedures for the development of the Australian and the EU case studies in order to facilitate meaningful comparison between the two sites.
- **developed a case study protocol**: A case study protocol is vital for researchers undertaking a multiple-case study (Yin, 2009d). Information pertaining to the protocol for this study was discussed prior to data collection, and initially documented in the ethics application presented to the University of Melbourne's Science Human Ethics Advisory Group in October 2015 (see Section 3.5.1 below for further detail). The ethics application informed the case study protocol, which includes an overview of the study, field procedures, case study questions, and a guide for the case study report (see Appendix D for the full protocol).

3.4.2 Site Selection in Case Study Research

Care must be taken to select appropriate sites when undertaking a multiple-case study (Yin, 2009b). Important to the multiple-case study is replication of process, and selection of sites that are expected to produce findings that are either congruent or distinctive "for anticipatable reasons" (Yin, 2009b, p.54). A number of factors assisted me in selecting Australia, the EU, China and the U.S. for this study, including fossil fuel consumption and projected climate-related health impacts (see Appendix A for a summary of relevant information for each Party and Appendix B for a summary of key motivations).

Firstly, all four Parties to the UNFCCC comprise some of the largest fossil fuel emitters. Cumulatively, in 2016 they accounted for over 19,000 million tonnes of territorial CO_2

emissions ($MtCO_2$), equivalent to approximately 53 percent of total global CO_2 emissions (Janssens-Maenhout et al., 2017). China is by far the largest emitter globally, emitting over 10,400 $MtCO_2$ in 2016 (Janssens-Maenhout et al., 2017). In the same year, the U.S. emitted just over 5,000 $MtCO_2$ (Janssens-Maenhout et al., 2017) followed by the EU, which emitted just under 3,500 $MtCO_2$ (Janssens-Maenhout et al., 2017). Australia makes a relatively small contribution to the global total of carbon emissions with just under 400 $MtCO_2$, however has comparably high per capita emissions at over 17 tCO_2 per person annually (Janssens-Maenhout et al., 2017). Although changing, fossil fuels still comprise the largest proportion of the energy mix for all four Parties to the UNFCCC. As such, there are likely to be substantial health gains from the implementation of increasingly ambitious climate change mitigation measures.

Secondly, the effects of climate change are already being felt in these four Parties to the UNFCCC and are projected to worsen with corresponding impacts on health outcomes. Australia has experienced unprecedented summer temperatures in the last decade; more frequent hot extremes are anticipated, along with substantial consequences for health (Reisinger et al., 2014). In Europe, extreme weather events are also predicted to increase morbidity and mortality; Southern Europe is projected to experience greater economic disruption from numerous regional variances, including decreased cereal yields (Kovats et al., 2014). China is also projected to experience an increase in the frequency and severity of extreme climate events that will exacerbate health impacts, particularly in vulnerable populations (Hijioka et al., 2014). Finally, projections in the U.S. suggest increases in mean annual temperature and precipitation to varying extents across geographical locations, in conjunction with an ageing population that will become increasingly vulnerable to climate-related health impacts (Romero-Lankao et al., 2014).

Strategically, Australia and the EU represent diverse case studies; their politico-economic and governance differences may elucidate factors that influence the political traction of health co-benefits in the development of climate change mitigation policies:

a. Australia is a liberal market economy with a strong extractive industry sector. Australia is also the first country to rescind a carbon pricing scheme and is generally considered a laggard in climate politics.
b. The EU is a multinational political and economic partnership comprising 28 Member States. It has been recognised for its commitment and leadership on climate policy. The EU is not a nation state, which raises legitimate questions about its inclusion as a case

study for this project. Considerable time was spent deliberating on the inclusion of the EU over a Member State, such as the United Kingdom. While the decision was far from straightforward, two arguments ultimately informed the decision to use the EU as a case study:

i. Although a multinational political and economic partnership, federalist writers assert that the composition of the EU shares similarities with federal and confederal systems such as those established in Germany, Switzerland and the U.S. (Pollack, 2010). Further, systems theorists have argued that the EU "could be theorized as a political system, with a dense web of legislative, executive, and judicial institutions that adopted binding public policies…" (Pollack, 2010, p.27). This architectural arrangement bears similarities to the Australian federal architecture, making the EU a reasonable comparison site.
ii. While Member States are responsible for the implementation of legislated policies, "most environmental policies are formulated within EU bodies, rather than by national and sub-national governments, legislative venues, and regulatory agencies" (Selin & VanDeveer, 2015, p.2) The EU is a member of the UNFCCC COP in its own right and submitted an INDC on behalf of its Member States in the lead-up to COP21 negotiations in Paris. Given this thesis focuses on the *development* of policy, as opposed to the *implementation* of policy, I consider statehood as a unit of analysis redundant.

Given time and logistical constraints – in particular, the difficulties associated with accessing policy-makers in China – it was not possible to develop full case studies for both China and the U.S. However, given their relevance in terms of their emissions profiles, not to mention their influence as two major players in international climate change negotiations, I considered it pertinent to analyse these two Parties to some extent. Accordingly, I selected a complementary methodological approach that aligned as closely as possible with the approach used to develop case studies for Australia and the EU. I performed directed qualitative content analysis (detailed further in section 3.5.2 below) on selected climate policy documents published between 2007 and 2017 and coded the documents using the same six themes identified for in-depth analysis of Australia and the EU (see section 3.2.1 above).

3.5 Research Methods for Data Collection

The development of case studies requires the use of multiple research methods in order to collect adequate data to build a sufficiently comprehensive account of the case. For the

purposes of this study, two research methods are used to gain an in-depth understanding of the mitigation policy development process: semi-structured focused interviews and directed qualitative content analysis.

3.5.1 Semi-Structured Focused Interviews

I carried out semi-structured focused interviews with policy-makers directly involved in the development of mitigation policies in order to examine whether health co-benefits are accounted for in mitigation policy development and what factors influence their consideration. Focused interviews generally involve a shorter interview period – approximately an hour – and are inclined to follow predefined questions (Yin, 2009a). This approach assisted me in replicating the methodological process as closely as possible across the case study sites.

As individuals at the coal face of policy development, policy-makers are well placed to provide insight into the policy development process. The interview schedule (available in Appendix D) comprises eight primary questions that fall into one of six themes identified earlier in the chapter at section 3.2.1. The interview schedule was informed by feedback from experts with environmental health and policy backgrounds, and the questions have been carefully worded to remain as open and neutral as possible; the term 'predicted health outcomes' has been used to refer to co-impacts, in order to minimise the potential for bias and to allow for discussion of potential adverse health outcomes that result from the implementation of mitigation policy (often termed co-harms).

While the interview is an integral data source in case study development, it has several shortcomings as a research method (Yin, 2009a). Many of these are related to response bias on the part of participants. For example, interviewees may provide what they deem to be an appropriate response, as opposed to an accurate one, and they will vary in their ability to articulate and recall particular information (Creswell, 2014a; Yin, 2009a). To mitigate the risk of collecting biased data, I employed the process of triangulation (see section 3.5.3 below).

Participant Recruitment. I carried out interviews with 27 individuals across Australia and the EU who met the participant selection criteria (see Appendix D). Thematic saturation, time and resource constraints ultimately informed the number of interviews undertaken across each location. Interviews were primarily carried out in two locations: Canberra, Australia, and Brussels, Belgium. Given the international nature of climate change policy-making and that English is an official language of both Australia and the EU, I anticipated that all interviewees would have a strong grasp of English; all interviews were consequently conducted in English.

Given the perceived sensitivity of the topic, participants were guaranteed anonymity and demographic details such as gender and age were not collected.

Given competing work commitments, time pressures and the sensitivity of the policy area, I expected accessibility issues to impact the recruitment of participants. Consequently, I used a purposive sampling strategy to ensure "that those sampled are relevant to the research questions that are posed" (Bryman, 2016c, p.408). Personal networks were utilised in the first instance and strategic opportunities were sought at conferences and events. To support the recruitment of participants, I employed snowball sampling; all participants were asked whether they could recommend additional interviewees in their ministry or in another ministry. A participant recruitment strategy is available at Appendix D.

Ethics. An ethics application was submitted for consideration at the Faculty of Science Human Ethics Advisory Group meeting on 11 November 2015. A Plain Language Statement and interview schedule (see Appendix D) accompanied the application. No changes were requested by the HEAG for the ethics application or interview schedule and ethics approval was received on 18 November 2015.

3.5.2 Directed Qualitative Content Analysis

Directed qualitative content analysis constitutes the second research method that I utilised to investigate the development of mitigation policies. Hsieh and Shannon (2005) define qualitative content analysis as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes and patterns" (Hsieh & Shannon, 2005, p.1278). Historically, content analysis has primarily been used as a quantitative research method, with a focus on recording the frequency of patterns within a document. Increasingly, however, content analysis is being utilised by qualitative researchers who are eager to transcend word counts in order to examine "…language intensely for the purpose of classifying large amounts of text into an efficient number of categories that represent similar meanings" (Hsieh & Shannon, 2005, p.1278).

Documents can be conceptualised as "data or evidence of the ways in which individuals, groups, social settings, institutions and organisations represent and account for themselves" (Coffey, 2013, p. 367). For governments, the release of documents that provide details of particular policy options or positions represents an avenue that can be used to justify, legitimise and communicate with key stakeholders. From a research perspective, as a data source "documents provide a mechanism and vehicle for understanding and making sense of

social and organizational practices…" (Coffey, 2013, p.367). In this way, they can be useful in elucidating a government's public position on an issue.

Hsieh and Shannon (2005) outline three distinct approaches to qualitative content analysis: conventional, directed and summative. Using selected publicly available government documents (see Appendices C and D for selection criteria and the full list of documents), I performed directed content analysis in order to collect and analyse data on the development of Australian, EU, Chinese and American climate change mitigation policies. Directed qualitative content analysis is underpinned by a deductive approach, with the intention of validating or conceptually extending existing theories. Key themes emerging from the literature are used to guide the coding scheme that details the process for categorising the documents. Newly established categories offer insight by either providing an opposing perspective or by adding to the current theoretical base (Hsieh & Shannon, 2005). I used the six themes upon which the semi-structured interview schedule is built to develop the coding scheme that guided the analysis of the documents.

There are strengths and limitations to both directed qualitative content analysis and qualitative content analysis more generally. The major strength of directed qualitative content analysis is the capacity to inform theory based on research findings. The method is, however, at particular risk of researcher bias; researchers must be mindful not to unintentionally search for evidence that is supportive of a particular theoretical position (Hsieh & Shannon, 2005). More generally, researchers utilising qualitative content analysis must be cognisant of limitations of the method. Two key criticisms of documents as an evidence source exist. Firstly, documents are produced by organisations with the needs of intended audiences in mind and often present a particular perspective that pursues organisational interests. As such, there is likely to be relevant information that remains protected from public access (Creswell, 2014a). Further, for this reason the authenticity of a document may be questionable; irrespective of the authors or the formality of the document, they should not be treated as reliable sources of evidence or objective accounts (Bryman, 2016b; Coffey, 2013). I used the process of triangulation to address these limitations, which is discussed in further detail below.

Document Identification. Governments regularly publish documents on a broad range of issues with varying purposes in mind. I developed selection criteria (see Appendix D) to support the identification of relevant documents to this study. Selectivity bias is a limitation in using documents as a data source (Yin, 2009a). To address this limitation and to identify as many eligible documents as possible, I used a two-staged approach that involved:

1. performing an extensive search of Australian, EU, Chinese and American government websites and creating a list of government documents that met the selection criteria (see Appendix C); and
2. enlisting the assistance of experts to survey the list of documents in order to verify that the most applicable documents had been identified and included for the purposes of content analysis.

3.5.3 Triangulation

Triangulation is the process of validating research conclusions through the use of multiple measurements, methods or levels of analysis in order to enhance the rigour of the study and to verify the accuracy of the data (Wolfram Cox & Hassard, 2010). Qualitative content analysis provides a complementary research method to interviewing, as it supports the collection and analysis of data which can then be triangulated, that is, comparatively analysed to identify consensus and incongruencies between data sources.

3.5.4 Computer-Assisted Qualitative Data Analysis

I used the qualitative analysis software NVivo 11 (NVivo, 2014) to assist me in undertaking directed qualitative content analysis of both interview and policy document data. The purpose of performing computer-assisted analysis is to minimise the risk of overlooking important themes that emerge from multiple data sources during the development of each case study (Bryman, 2016a). All interview data was transcribed and imported for analysis. All government documents that met the selection criteria (see Appendix C) were also imported for analysis.

3.6 Dissemination Strategy

Bryman (2016) states that “many social scientists feel that research should have a practical purpose and that it should make a difference to the world around us” (Bryman, 2016e, p.5). Indeed, the creation of impactful research is a strong personal motivation and I see the dissemination of study findings as a crucial step in order to maximise the potential impact of research findings. Accordingly, I have prepared a dissemination strategy (see Appendix E) that will be used to guide the distribution and communication of research findings to numerous target audiences.

3.7 Summary

This chapter has provided a detailed outline of the methods that I used to conduct this study. To summarise, I used a deductive analytical approach in order to develop an exploratory multi-site case study that investigates the role of health co-benefits in the development of Australian and EU mitigation policies through triangulated analysis of interview and policy document data. I also employed directed qualitative content analysis to examine the role of health co-benefits in the development of Chinese and American mitigation policies.

Chapter Four: The Role of Health Co-Benefits in the Development of Australian Climate Change Mitigation Policies

4.0 Preamble

In the previous chapter, I outlined the methodological approach I would take to develop a multi-site case study investigating the role of health co-benefits in the development of climate change mitigation policies. This chapter presents results from the first site of the case study – Australia – and is essentially a reproduction of a paper titled 'The Role of Health Co-Benefits in the Development of Australian Climate Change Mitigation Policies' that was published in September 2016 in the open access *International Journal of Environmental Research and Public Health* (Workman et al., 2016)[7], with some additional contextual material to improve the readability of the chapter within this thesis.

This chapter first provides national context by detailing Australia's domestic circumstances vis-à-vis its mitigation policies. Next, it briefly describes the methods used to build the case study. The results are presented in the third section by theme, based on the six analytical themes that informed the interview schedule: i) policy-making process; ii) factors influencing the prioritisation of multiple considerations; iii) barriers and enablers to the consideration of health; iv) the evidence base of policy development; v) the role of external actors and stakeholders; and vi) communicating policy decisions. The fourth section of the chapter discusses the implications of findings including potential avenues to enhance the political traction of health co-benefits in Australia. The fifth and final section concludes the chapter.

[7] Given this chapter is based on a publication, I use the first-person plural to acknowledge the input of the co-authors.

4.1 Introduction

Australia provides an interesting case study for exploring the role of health co-benefits in the development of national mitigation policies. Energy[8] constitutes the largest contributor to GHG emissions, responsible for 76 percent of total GHG emissions in 2013-14 (Australian Government Department of the Environment, 2015). Addressing these emissions is complicated, however, by Australia's federated governance structure. Australian law provides the states and territories with responsibility for policy and legislation development and implementation regarding resources, conservation and environmental protection, including air pollution (Hobday & McDonald, 2014). The provision of health care services is also complex under this federated system, with jurisdictional responsibilities for specific health-related matters at times unclear (Biggs, 2013).

A number of departments are involved in the development of climate change mitigation policies and provided input into the NDC taken to COP21. These include the lead agency for domestic climate change (and air quality) policies, the Department of the Environment[9] (DoE) and the lead agency of international climate negotiations, the Department of Foreign Affairs and Trade (DFAT). While the development of air quality policies and fuel quality standards are also within the remit of the DoE, a Ministerial Forum on Vehicle Emissions was established in October 2015 under the auspices of the Department of Infrastructure and Regional Development[10] and is chaired by the Minister for Urban Infrastructure.

Economically, Australia's strong and influential fossil fuel resource sector significantly contributes to GDP; in 2017, coal overtook iron ore to become the largest economic export commodity, worth AUD$66.2 billion (approximately USD$51.6 billion) (Khadem, 2019). There are claims that indicate the resource-based policy community constitutes the most cohesive, well-connected policy community within the Australian climate change policy environment (Alberici, 2018; Bulkeley, 2000; Cook, 2016). Recent government decisions suggest that the resource-based coalition is still a strong and influential force within climate policy development. For example, at COP21 then-Prime Minister Malcolm Turnbull announced that Australia rejected a communiqué supporting reform for fossil fuel subsidies given the potential implications for diesel fuel rebates for farmers and miners (Conifer, 2015).

[8] Energy comprises electricity emissions (34%), emissions from direct combustion (17%), emissions from the transport sector (17%) and fugitive emissions (8%).
[9] The Department of the Environment was renamed the Department of the Environment and Energy in July 2016 and received legislative responsibility for energy policy, the national energy market, and energy efficiency from the Department of Industry, Innovation and Science.
[10] The Department of Infrastructure and Regional Development was renamed the Department of Infrastructure, Regional Development and Cities in September 2016.

Politically, climate change has proven to be a polarising and controversial policy area, implicated in several political leadership changes and federal election results (Curran, 2011; Talberg, Hui, & Loynes, 2013). Internationally and domestically, it has been described as being a laggard in its climate policy ambition (e.g. Rollins, 2015). For example, Australia gained notoriety as one of only three developed countries permitted to increase emissions under the Kyoto Protocol as a result of "particular trade and economic circumstances" (Hill, 1996 in Papadakis, 2002, p.267). Today, Australia continues to use its "unique national circumstances" (Australian Government Department of the Prime Minister and Cabinet, 2015, p.23) of dependence on emissions-intensive industries to justify its national emissions reduction targets at the international level.

Australia was the first country to repeal a carbon pricing mechanism, following the rise to power of the Coalition government in 2014. Instead of a price on carbon, the Coalition government has pursued a 'direct action' approach since 2015 to meet domestic and international carbon abatement targets. The centrepiece of the approach is the Emissions Reduction Fund, a scheme that involves government purchases of domestic abatement opportunities through a reverse auction mechanism.

Public attitudes toward climate change are increasingly supportive of climate action. For example, in the lead-up to the most recent federal election, held in July 2016, polling suggested public support for action on climate change was the strongest it has been since 2008 (The Climate Institute, 2016). Most recently, the Coalition government's response to IPCC SR1.5 prompted climate change and health professionals and academics to publicly reprimand the government (Arabena et al., 2018).

Australia has not been immune to climate-related health impacts. The largest health burden from climate-related events is from heat exposure, which has been responsible for over 5,000 deaths between 1884 and 2010 (Hanna & McIver, 2018). The productivity implications of heat stress are by no means trivial; 2013/14 estimates suggest the annual economic burden of productivity loss from heat-related morbidity in Australia equates to approximately AUD$5.8 billion (approximately USD$4.7 billion) (Zander, Botzen, Oppermann, Kjellstrom, & Garnett, 2015). Records from other extreme weather events, including bushfires, drought, floods and storms indicate that over 1,600 fatalities have occurred between 1900 and 2017, although the validity of this data is questionable (Ying Zhang et al., 2018).

In relation to air quality, the federal government introduced legally binding air quality standards in 1998 for criteria pollutants including nitrogen dioxide, sulfur dioxide, ozone and

particular matter. The development of policies to meet these standards remains the jurisdictional responsibility of the states and territories. In 2015, state, territory and federal environment ministers established the 'National Clean Air Agreement', which provides a unified framework for reviewing criteria pollution standards as well as establishing product emission and efficiency standards (Australian Government, 2015a). In 2016, strengthened standards for particulate matter entered into force (Australian Government Department of the Environment and Energy, 2018). While Australia's air quality is considered comparatively good, emissions have been responsible for a proportion of deaths annually. In 2016, for example, 3,071 deaths were attributable to $PM_{2.5}$ (Health Effects Institute, 2018).

As is explored in the case study below, these and other factors have influenced the Australian narrative on climate change, as well as the role and influence of multiple considerations, including health, in the development of Australian climate change mitigation policies.

4.2 Methods

The theoretical and analytical frameworks, as well as the research methods used to undertake this study, were detailed in Chapters 2 and 3. To avoid unnecessary repetition, this methods section has been truncated.

This research is situated within the political economy of health, which provides a robust framework in which to explore health within the climate change agenda. Health is inherently political in nature given "power is exercised over it as part of a wider economic, social and political system" (Bambra, Fox, & Scott-Samuel, 2005, p.187). To support the application of this theoretical framework, a complementary analytical framework was identified and used to inform the research project. Walt and Gilson's policy analysis model (Walt & Gilson, 1994) provides a holistic approach to the consideration of the policy-making process, by moving beyond purely content analysis to consider broader contextual and process factors that are likely to influence the policy development process. With this in mind, key factors influencing the development of mitigation policy have been incorporated into our assessment of Australia's mitigation policy development, including Australia's politico-economic context; governance structures and policy processes; cultural factors and public attitudes toward climate change; the role of external actors and stakeholders; as well as the climate change narrative and drivers for mitigation policy communication.

Study Design. A case study approach was chosen to undertake this research. Several data sources were used to develop a comprehensive Australian case study. Semi-structured interviews constitute the primary data source, and were undertaken with individuals who met the eligibility criteria: federal government employees involved in the development of mitigation policies. Interviews are supplemented by secondary sources, primarily recent federal government policy documents (see Table 10 and refer to Appendix C) that were identified prior to and during interviews (see Appendix D for the selection criteria).

The interview schedule comprises eight questions that fall into one of six key themes: i) the policy-making process; ii) factors influencing the prioritisation of multiple considerations; iii) barriers and enablers for the consideration of health in mitigation policy; iv) the evidence base for policy; v) the role of external actors and stakeholders; and vi) the communication of policy decisions.

Table 10. Key policy documents informing case study identified prior and during interviews

Document title (year of publication)	**Department responsible for publication**
Emissions Reduction Fund White Paper (2014)	Department of the Environment
United Nations Framework Convention on Climate Change Taskforce Final Report (2015)	Department of the Prime Minister and Cabinet
National Climate Resilience and Adaptation Strategy (2015)	Department of the Environment
National Energy Productivity Plan 2015–2030 (2015)	Department of Industry, Innovation and Science
Vehicle Emissions Discussion Paper (2016)	Department of Infrastructure and Regional Development

Recruitment of Stakeholders. Given the political sensitivity that has surrounded Australian climate policy in recent years, we anticipated that the recruitment of federal government employees might be challenging. Consequently, we utilised personal networks and networking at conferences in the first instance followed by snowball sampling to recruit participants. We sought to recruit at least one employee who met the eligibility criteria outlined above from across six departments associated with the development of national energy- and transport-related mitigation policies (see Table 11). Permission was sought to record interviews to aid in the transcription process. No participants objected to the recording of their interview. Individuals who agreed to participate were informed that transcripts would be de-identified in order to protect their identity. Consent forms were received from all interviewees prior to

interviews being conducted. We transcribed all interviews verbatim, and then verified all interview transcripts to ensure accuracy of the transcription process.

Table 11. Departments approached during the recruitment of interview participants

Federal Government Department
Department of the Environment (DoE)
Department of the Prime Minister and Cabinet (PM&C)
Department of Foreign Affairs and Trade (DFAT)
Department of Industry, Innovation and Science (DIIS)
Department of Infrastructure and Regional Development (DIRD)
Department of Health

Data Collection. The interview schedule was piloted three times between April and May 2016 by participants with a background in either Australian health or climate change policy. Two of the three participants provided permission for their interview data to be incorporated into the case study. The interview schedule did not change between the pilot and formal phase of interviews. I conducted all formal interviews with federal government employees who met the eligibility criteria between June and July 2016. This period coincided with the Australian government assuming a caretaker role in the lead-up to the July 2016 federal election. In total, eighteen individuals were approached for interview. Four individuals declined, suggesting more appropriately placed colleagues to participate. Two individuals were non-responsive and one individual left their respective Department prior to the interview. Of the eleven interviews that eventuated, six interviews were carried out face-to-face in either workplaces (*n*=5) or at neutral locations (*n*=1), and five interviews were conducted by phone. Interview lengths ranged from 38 to 75 min.

Snowball sampling identified one additional individual who did not meet the eligibility criteria but who nevertheless had relevant expertise in the development of Australian climate change mitigation policies given a previous high-level position in federal climate change policy development. Interviews with this participant followed the same process as the formal interviews, and data from this interview informed the development of the case study. While the number of interviews carried out was effectively determined by time constraints, despite the small sample size, we assessed that data saturation was achieved as evidenced by the repetition of themes and a lack of new themes emerging.

Data Analysis. De-identified transcripts were imported into NVivo 11 (NVivo, 2014) and initially coded based on the themes identified in the interview schedule. Additional sub-themes were

identified during the coding process and have been integrated into the results and discussion sections below.

4.3 Results

The analysis of interviews and secondary sources provides a level of insight into the role of health co-benefits as a consideration in the development of Australian climate change mitigation policy. The results are presented below in line with the themes used during the interview schedule. We elaborate on sub-themes where they have been identified during the coding process.

4.3.1 Policy-Making Process

Most interviews began with broad policy-making discussions, exploring the processes used to account for multiple considerations in cross-sectoral policy areas, and how who is "at the table" is determined. Most interviewees outlined the whole of the government approach that is used at the federal level to develop cross-sectoral policies. Interviewees described the cabinet submission development process. In line with Australian Administrative Orders, the Department of the Environment is the line (or central) agency for domestic climate change mitigation policy, while the Department of Foreign Affairs and Trade was primarily responsible for the development of Australia's INDC that was taken to COP21. To inform the Cabinet submission, the line agency may decide to establish an interdepartmental committee (IDC) for the purpose of seeking input from other relevant agencies. A regulatory impact statement (RIS) – a form of impact assessment – would generally be included as part of the cabinet submission process, and may be accompanied by a cost–benefit analysis.

The Office of Best Practice Regulation (OBPR) was identified as the gatekeeper of RIS development, responsible for determining the robustness of the quantitative data underpinning a RIS, as well as RIS approval. Interviewees noted that, irrespective of an IDC, all departments are provided an opportunity to provide input, comment, or both on each cabinet submission prior to its consideration by cabinet ministers. Many interviewees emphasised that quantifying and monetising multiple considerations, particularly costs, constituted an integral component of the policy development process:

> "…what we're encouraged to do as often as we can is to monetise things, not necessarily because money is how the world goes round, but because money is a… common way of measuring things…we're often encouraged to do an economic analysis because what it does is it allows us to compare otherwise quite disparate things…" (I_01)

A number of interviewees also made the distinction between quantifying costs and benefits, and how this impacts upon their consideration in a RIS:

> "…usually you can quantify the costs relatively well…and then, you can usually quantify some benefits relatively easily but then there tends to be a whole class of benefits that are difficult to quantify, and what you will often do in a regulatory impact statement is reference them qualitatively…Now sometimes that would be because your benefits already exceed your costs, so you can consider them upside, but other times that's purely because you don't have the data…if you depend on that and you don't…have enough actual support, then it could undermine your policy..." (I_03)

A number of interviewees noted that the Department of Health would not have been considered one of the core agencies during the development of mitigation policy. For example, while the Department of Health did provide comment on the proposed INDC that was taken to cabinet in the lead-up to COP21, several interviewees from across departments stated that they were a peripheral agency in the target development process:

> "…so…when we convened IDCs [we] invited health…to those meetings, and the comments that health made at the time…they were very generalised statements…" (I_04)

4.3.2 Factors Influencing the Prioritisation of Multiple Considerations

Interviewees were asked to comment on the different processes used to rank or prioritise different considerations that inform policy development. Economic and employment considerations were primarily discussed as informing the development of mitigation policy in Australia. Several factors will influence the extent to which these considerations are prioritised in the development of mitigation policies, although bureaucrats do not overtly rank or prioritise considerations themselves:

> "…we didn't rank particular…aspects as more important than others…in the decision-making process…we didn't rank economic over…social well-being…or the climate impacts. …so we didn't but you can bet that the people making the decisions were weighing those things up in their minds and assigned different values to them." (I_10)

One factor influencing the prioritisation of multiple considerations is that ministers are individually responsible for agenda setting within their own department or portfolio, which

inevitably informs the direction of policy development, and the consideration and prioritisation of multiple considerations:

> "…there are a number of…criteria the government use. How they actually in the end come up with that is…hard to distinguish, so each…minister and each…portfolio would come to it with their own…set of priorities…we're really focused on making sure that…we know exactly what the rest of the world is doing, and that…we're in the pack and…we compare well to the rest of the world essentially. …Treasury will have a different view. …Environment will…want to know that whatever policies we set we can meet domestically…" (I_02)

The political reality of Australian climate change policy is another factor that influences how considerations are prioritised in the development of mitigation policy. A number of interviewees conceded that the politicised nature of the climate change debate in Australia has in part determined which considerations are included in the development of mitigation policy, and how these considerations influence policy development:

> "…it becomes a political judgment amongst the policy-maker essentially about…how much pain am I going to suffer as a result of choosing a particular outcome and because the current environment of climate policy in Australia is so politically toxic it makes…everyone risk averse" (PI_02)
>
> "…the problem Australia's had…is just how toxic the debate has been and how politicised the debate has been, and therefore…there hasn't been the bandwidth to have that kind of conversation with the public about this." (I_02)

The core climate change narrative in Australia is a third factor that influences which and how multiple considerations are prioritised. Almost all interviewees acknowledged the crucial role that economic considerations play during the development of mitigation policies, asserting that economic factors are always first order. Economic analysis or modelling, or both, is often used to inform the development of policy and can strongly influence the government's priorities and choices. This is in part explained by the relative ease of quantifying the impacts, particularly costs, to the economy of mitigation action. However, it can also be in part explained by the government's current narrative on climate change, which according to some interviewees, frames climate change action as an economic burden with the potential to create issues for the competitiveness of major industries:

> "…it really depends a bit on the government of the day. I mean the government we had last year was about…economic growth…and jobs and preserving industry and making sure we do what the rest of the world's doing…a range of those factors…" (I_02)
> "...if you read for example, the…issues paper produced by PM&C last year before the decision was taken on what Australia's 2030 target should be…you'll see it's still…all about burdens and competitiveness, and if we cut back, if we put in a carbon price…what happens to our aluminium sector…when others don't do it, leakage, all that sort of stuff, that's all the old argument." (I_07)

The UNFCCC Taskforce final report (Australian Government Department of the Prime Minister and Cabinet, 2015, p.21) mentions that, during the submission process, some individual submissions highlighted the "consequences of inaction, such as environmental and health impacts…", but there is no indication of whether or how these impacts were taken into account during the INDC target setting process. A direct query about this during one of the interviews elicited the following response:

> "I think that…extent, things like health were factored in, it was this general…vibe if you like…there's a cost of not doing anything…and…in my view, wasn't a particularly strong factor and it certainly wasn't…a consideration that was unpacked in a very detailed and systematic way, it was just…there are costs of not taking action." (I_04)

In relation to the consideration of health, interviewees determined that it is currently a second- or third-order issue, similar to other sectors of the economy that are inevitably affected by climate change but do not significantly influence policy decisions:

> "I think at the moment health is seen as…relevant to climate change in the same way that infrastructure, and…numerous other things are, and they're all grouped together in this sort of, climate change is going to have broad impacts across the whole scope of our economy and public policy…so there just becomes this sort of homogenous mass of stuff…" (I_04)

The de-prioritisation of health as a potential co-benefit of mitigation measures becomes evident when analysing key policy documents, such as the Emissions Reduction Fund White Paper (Australian Government, 2014, p.7):

> "The Emissions Reduction Fund will help reduce Australia's greenhouse gas emissions while delivering valuable co-benefits to Australian businesses, households and the environment. For example, households and businesses will save money by improving their energy efficiency. Revegetation will improve water quality, and reduce erosion

> and salinity. Replenishing the carbon content of soils will improve the health and productivity of Australian farms."

As one interviewee noted when discussing the Emissions Reduction Fund White Paper:

> "…what's useful to look at is the communications…you'll often see phrases along the lines…this policy is reducing emissions while…improving the productivity of farms, cutting costs, and…increasing the productivity…of businesses…you can see that…what is being done there is very overtly talking up the co-benefits as a way of saying this is a great policy and it's ticking lots of the boxes…Now there's no obvious reason…why health benefits couldn't be included…in that list of dot points…at the moment we talk up the productivity or economic benefits…" (I_01)

The same government rhetoric emphasising reduced emissions while improving productivity and competitiveness is evident in Australia's National Energy Productivity Plan 2015–2030 (Australian Government COAG Energy Council, 2015, p.6):

> "By increasing our energy productivity we strengthen our economy and help safeguard our environment. Businesses reduce their energy costs through innovation and modernising their infrastructure—improving their output and making them more competitive. Household consumers benefit through lower energy bills and increased home comfort. At the same time, Australia reduces its carbon footprint and contributes to the global challenge of mitigating climate change. It's a win, win, win for Australia."

4.3.3 Barriers and Enablers for the Consideration of Health in Mitigation Policy

4.3.3.1 Barriers

Interviewees were asked what they considered to be potential barriers and enablers in accounting for health in the development of mitigation policies. Several barriers that impact the consideration of health co-benefits in the development of climate change mitigation policy were identified (refer to Table 12 below). These fall into two broad areas:

1. A lack of expertise within government, advocates outside of government, and context-specific robust data; and
2. The long-term nature of health impacts, the shorter-term issue of an "invisible" problem, the challenges of distinguishing and articulating the link between the combustion of fossil fuels and health impacts, and the primary consideration of health within climate change adaptation policy.

Table 12. Summary of barriers to the consideration of health in the development of Australian climate change mitigation policies

Challenges with data and expertise	• Lack of expertise and/or advocacy within and outside of government • Lack of robust, context-specific data • Competing priorities within the health department
Challenges with attribution	• Challenges associated with linking health impacts to climate change • Health perceived as relevant to adaptation measures

In the first area, interviewees identified a lack of strong advocacy from within and outside of government for the inclusion of health co-benefits in the development of mitigation policy. A number of interviewees acknowledged that federal government employees tasked with the scoping and development of mitigation policy were unlikely to have a health background and relied on the Department of Health to provide relevant input:

> "…it's not this department's, it's not PM&C's, it's not DFAT's job to understand the health impacts of climate change, it's the Health Department's job to bring those considerations to bear, and so it kind of depends on them prioritising it and having the capability…around that function." (I_04)

Interviewees also raised the issue that the number and prominence of Australian climate change and health experts and advocates from the health sphere presented a challenge. The late Tony McMichael, a leading Australian epidemiologist and environmental health expert, was acknowledged as a well-regarded Australian climate change and health expert with a level of influence. However, some interviewees felt that there were now few resounding academic champions on the issue of climate change and health within Australia, and those who were in the space were yet to genuinely capture the government's attention:

> "…a key actor in the field, like…Anthony McMichael was massive in his day…we worked quite a lot with him, so if someone wanted to get to us, they'd go through him and then he'd raise it with us and then that would be taken notice of…" (I_09)
>
> "…yes you have…a few very visible…public health officials talking about the climate in public…but you don't have them…linking that to the core government narrative on climate change…that's one about the economics, it's around what other countries are doing, and essentially I think you want to flip it from being a defensive and problematic issue to an opportunity issue…" (I_02)

In addition, interviewees conveyed that the lack of local, robust evidence inhibited the inclusion of health co-benefits in policy development in any meaningful way. It was recognised that, while health co-benefits had the potential to be used to bolster the rationale for ambitious action, in the absence of a defensible evidence base situated within the Australian context, the inclusion of health co-benefits as a consideration in mitigation policy may actually undermine any policy proposal put forward to cabinet:

> "…quality data just doesn't seem to be in existence, particularly for Australia…there's stuff out of the US and the EU…and all that data is done in a contextual environment, bigger cities, different weather conditions, all those sorts of things, so it's not directly translatable to Australia necessarily." (I_05)
>
> "…if it's not strongly defendable or robust data, it comes under criticism, undermines a whole lot of the argument, not just the health bit of the argument…" (I_05)

In the second area, interviewees identified the conundrum of longer-term health impacts from climate change and the challenge of drawing clear, defensible links between health co-benefits, climate change, and the combustion of fossil fuels. While some interviewees were able to articulate the distinction between the longer-term health co-benefits associated with climate change and the shorter-term health co-benefits associated with the mitigation of fossil fuel use, some interviewees found it difficult to acknowledge that Australia would see any domestic health gains from the implementation mitigation measures, reiterating that avoided health costs from climate change would only result from concerted global effort to address climate change:

> "…yes it's true that if you…reduced emissions in the…Latrobe Valley it would also clean up the Latrobe Valley, but the materiality of these things is just very different…I mean you just have to go to Beijing to realise that…quite apart from global warming they've got to do something about the smog in Beijing and that's true of lots of big…Chinese cities, so…it absolutely makes sense from their point of view to talk about the co-benefits. …but I don't think it makes anything like the same amount of sense, for the sort of things we're going to do to reduce emissions…changing…the energy mix that goes into electricity generation, making…cars more fuel efficient, you think about the various things we're going to do…there may be co-benefits but they're going to be tiny by comparison with other countries…" (I_06)

Interviewees suggested that the longer-term impacts to health from climate change increase the challenge of considering health during the development of mitigation policies:

> "…so the government line is that because there's no sort of direct links…well there are…actually inalienable…links between climate change and health, but…you can't put it down on paper and say…this degree of change in heat will definitely arrange in this sort of…illness…I do think it generally acts as a barrier but I don't think that's anyone's fault, I just think it's the nature of the game because…it's all concomitant and variation so…there's a change in the climate, and then there's a corresponding change in…prevalence of respiratory diseases and only then do you get the corresponding change of…health, health is sort of at the bottom. And…there's so many easy ways to break the links between the two that…you're never going to get anyone to agree that climate change is to…blame." (I_09)
>
> "…when people say you die of a heat wave…a lot of people don't associate it with…their gran had a heart attack. They thought she was old, she had a heart attack…" (I_03)

There was also an acknowledgement from some interviewees that competing priorities, particularly in the health domain, exacerbate the de-prioritisation of health co-benefits:

> "...you go to the health department and it's not their biggest issue…it's their fiftieth issue. And you go to the local government, and it may not be their biggest issue, it's their fiftieth issue…" (I_03)
>
> "…who's got the most pressure on which particular areas…that's why in health in many ways, treatment is so much easier than prevention…you can't make money in prevention, I mean you can…lift taxes…but that's…not intrinsically the prevention industry producing that…" (PI_01)

Finally, numerous interviewees spoke about health's inclusion within the realm of climate change adaptation policy:

> "…I think, within public policy…the extent to which health is relevant to climate change is seen through an adaptation lens primarily, not through a mitigation lens." (I_04)
>
> " …I've done a little bit of work in adaptation…and a lot of health issues obviously are in the adaptation rather than the mitigation side…" (I_03)
>
> "…in terms of making decisions about the target, I don't think other than as one of the many things that adds up…health played a big part. Where we see most of its activity is more kind of in that…adaptation side." (I_10)

Health as a key focus of adaptation policy is reiterated in the Australian government's National Climate Resilience and Adaptation Strategy (Australian Government, 2015b, pp.58-59):

> "…climate change poses challenges to the health of Australians through stresses such as heatwaves, droughts and an increase risk of food and water borne diseases. …Australia is responding to the health effects of climate change within the overall context of existing health services and the preventive health mechanisms that help provide a healthy and safe environment – for example, clean water and air, safe food and housing, and protection from pollutants and the spread of disease. State and territory governments play a crucial role in delivering health services across Australia…"

Of note, cross-jurisdictional governance structures within Australia see health and adaptation policy primarily the responsibility of state and local governments. While the inclusion of health in adaptation policy was not explicitly discussed with interviewees as a potential barrier to its consideration in mitigation policy development, the statement above from the National Climate Resilience and Adaptation Strategy reinforces that positioning health as an adaptation issue facilitates the transfer of responsibility for health in the climate change agenda from the federal government to state and local governments. This inevitably acts as a barrier to any meaningful consideration of health in national climate change mitigation policy development.

4.3.3.2 Enablers

Interviewees found it difficult to identify current enablers for the consideration of health co-benefits in the development of climate change mitigation policies. A number of potential or prospective enablers were identified, but these were primarily based around a visible increase in impacts over the coming decades and decreasing technological costs in the energy and transport sectors. While not necessarily pertinent to national policy, one interviewee raised the recent Hazelwood coalmine fire in the state of Victoria as a potential enabler for increasing the role of health co-benefits in the development of mitigation policy:

> "…It will be fascinating to see what happens with the Latrobe Valley post the Hazelwood mine fire…if you're a politician who needs to make a decision about closing a coal-fired generator on the back of something like that happening…and there's people dying from coal pollution, it makes your job a hell of a lot easier…" (PI_02)

Opportunities to increase the role of health co-benefits in the development of mitigation policy were discussed during interviews, and are outlined in further detail in the Discussion section below.

4.3.4 The Evidence Base for Policy Development

Interviewees were asked about the extent to which peer-reviewed scientific literature is used in the development of policy, in order to determine whether the health co-benefits literature may have the potential to inform mitigation policy development. Opinions varied on the importance and inclusion of peer-reviewed literature in the policy development process. Most interviewees felt that peer-reviewed literature was considered to some extent in policy development; however, accessibility issues at times presented a challenge to its consideration and inclusion. In the absence of good quality domestic research, interviewees indicated that international research from reputable organisations and agencies, such as the International Energy Agency (IEA) or the OECD, was also considered and utilised during policy development.

Beyond the peer-reviewed literature, interviewees indicated that synthesised information products from domestic think tanks and institutes were often useful and included in ministerial briefings or policy documents. There was also recognition that time constraints were imperative for the consideration of research and peer-reviewed literature:

> "…it takes sometimes a while for peer-reviewed literature to get out, and sometimes you want a quick answer, and I sometimes say that…there's either a three-minute answer, a three-month answer or a three-year answer, and you've got to be really clear about…what you're looking for…" (I_02)

Many interviewees highlighted that relevant experts and peer-reviewed authors at times provided direct input into policy development. There was an acknowledgement that experts represented one group of key stakeholders in the policy process (discussed further below); however, their level of influence on the policy decisions was relatively limited due to structural and communication issues:

> "…the kind of incentives and milestones that are placed on academics are very, unique...and the sort of timeframes that I have on things are also very unique, and… what we've tended to is…find academics who are particularly relevant to us, and become really good mates with them. …so I have had academics who've had a lot of

> influence over what we're doing, but regularly, they're a subset of the academics that could be influencing us…" (I_03)
>
> "I think academics…at least some of them that I've spoken to especially recently seem to expect that public servants will have the same sort of depth of…understanding and analytical rigor…as them…which we don't…we're not academics…and so what we actually need is for academics to understand that we're different…it's almost a language barrier between…academic speak and public policy speak…" (I_04)

4.3.5 The Role of External Actors and Stakeholders

Interviewees were asked in what ways external actors and stakeholders inform the policy-making process, and whether there are avenues beyond the formal consultation processes that facilitate stakeholder input. Three key groups of stakeholders relevant to the development of Australian mitigation policy were discussed: business and industry stakeholders; NGOs; and experts. The role of community stakeholders and public attitudes were touched on briefly by some interviewees, but did not provide any real insight into their role in policy development. Broadly, there was recognition of the importance of stakeholders in the political process:

> "…in government you need to have stakeholders and you need to know who's out in the field, and you need to be well-networked…ministers and minister's offices…have meetings with these people…and then they ask us to come along…or say, we've just met with this person…and it filters down to us…to action it. Or it's…us through our network, gathering those ideas, and, part of that is self-preservation for bureaucrats because it's a contestable space and if we're not providing advice…the government will go looking for it elsewhere…" (I_02)

In relation to formal consultation processes, many interviewees indicated that discussion and other government policy papers released for consultation would likely have already had a level of input through targeted consultations and direct engagement with a number of influential and relevant external actors and stakeholders. It was recognised that there are resource limitations which impact the amount of consultation that is undertaken, but also that the process can become less valuable over time as the same issues are raised time and time again. Many interviewees also noted that informal processes tended to provide a greater level of influence than formal processes:

> "…direct engagement with policy-makers, be they at the political level or the bureaucratic level is probably…as influential if not more influential than the formal…public submission processes…" (I_04)

A number of interviewees accepted that business and industry stakeholders are the most influential in the policy development process, given their role in economic growth and stability and alignment in values and ideology. There was also recognition that business stakeholders are well-equipped to provide a strong rationale for their preferred policy proposals:

> "…business has a paved road rather than one they have to hoe themselves. They can get access to the Prime Minister and ministers…pretty much anytime they want to. So, if they've got a beef, they can be very influential….governments here just see business quite rightly as…basically carrying the economy, and so if they've got a particular point of view, then they're going to be able to make it…" (I_07)
>
> "…for better or worse, they run really good campaigns, and they put together…a war chest, put together champions, they put together…the narrative and…a policy menu for government…" (I_02)

NGOs can also play a role in the development of mitigation policy; however, it depends on the strategies they employ as to how influential they can be:

> "...environment stakeholders if you like, to cast it a bit broader, are in my view most influential when they're providing information-rich input. …if they're just sort of stating positions and lobbying, then…it helps in terms of the atmospherics around public policy and the realm of what's possible, but in terms of informing…a policy process, it's…the more rigorous analytical stuff that's helpful…" (I_04)
>
> "…the ones that are traditionally heard best are the ones that…have the strongest, most intellectually robust arguments…and cases, and that are…seeking out to persuade rather than embarrass." (I_07)

The role of experts in mitigation policy development has already been discussed in the section above. In addition to involvement through technical working groups or advisory panels, the importance of being perceived as objective and a good communicator can influence the level of input an expert has in the policy development process:

> "…you'd be looking for somebody who's…a scientist who's policy neutral if you like, or as close to it as possible…if you're an expert and you can craft an argument that's of interest to, policy-makers and advisers…in a highly…contested…area such as climate change…the policy-makers and advisers who think your point is relevant and the ministers ought to know, then you can be called in…experts can be heard if they can…put their message in terms that are relevant to…the policy process…" (I_07)

4.3.6 The Communication of Policy Decisions

Interviewees were asked about the drivers associated with the communication of climate policy, and whether health benefits and healthcare savings might be a useful communications frame in communicating policy decisions. Aside from the policy areas of vehicle emissions standards and energy efficiency, most interviewees argued that the use of health co-benefits to justify the implementation of mitigation policies would be limited. Most reasons provided focused on the same issues identified as barriers for the consideration of health co-benefits in the development of mitigation policies – issues around a lack of robust domestic data, the indirect nature of health co-benefits, as well as Australia's current climate change narrative and mitigation policy approach:

> "I think in general terms…it absolutely would help but I think…you need to look at it in the context of…what policies you're communicating. …I think with the current government's policies…the reason they're emphasising things like agricultural productivity and energy productivity is because…it's a…very direct action approach…the communications are emphasising that…we can reduce emissions…by taking direct action, and by taking direct action we're actually helping farmers…and we're helping businesses to continue to grow…I don't think…talking about health outcome would work in the context of the government's current policies…any analysis of health benefits of action would probably say the targets aren't high enough to achieve much benefit…" (I_04)

4.4 Discussion

The results presented above indicate that health co-benefits currently play a minimal role in the development of national climate change mitigation policies in Australia. As the results outline, there are several factors that determine the extent to which multiple considerations, including health co-benefits, influence the mitigation policy development process. The case study above identifies that economic factors are one of, if not the most, significant consideration in the development of mitigation policy. This finding is similar to work undertaken by Baum and colleagues (Baum et al., 2013) on the social determinants of health, and aligns with the theoretical underpinnings of the political economy of health framework.

4.4.1 A Preoccupation with Economic Modelling

Several interviewees stated that economic modelling and analysis is seen as a crucial input that informs policy development, and has the potential to encourage the exclusion of certain considerations during mitigation policy development. One reason offered for the focus on

modelling was that often the resulting numbers are considered objective, factual evidence, useful for justifying policy decisions:

> "But the trouble is…and this is…really relevant in the Australian case, whenever you produce numbers, ministers think they're facts. The only thing you can know about those numbers is they're wrong, but ministers see them as…factual. You can stand in front of them and you can make…an elegant and compelling argument…about why things should be done…in the interest of the Australian economy, the Australian people, the global commons…but it will count for nothing against some joker who's pulled out his phone…and uses the calculator and produces a list of numbers." (I_07)

In this way, quantitative inputs are prioritised over qualitative inputs in the policy development process. Some interviewees recognised the limitations of economic models, and the difficulty of addressing those limitations given the current institutional policy-making process, where the OBPR are required to approve a RIS and accompanying cost-benefit analysis prior to its submission to cabinet:

> "The numbers of problems in the RIS process…I mean, mostly because…you're often working in a social or in an energy…some sort of policy area, and then you've got to put it in the right terms for the economists, then you've got to go and argue with the economists that their assumptions are not better than yours, and you've got to get them to approve it." (I_03)

A number of interviewees reinforced the contribution of modelling to the recent INDC target setting policy process. Ultimately, of the four target scenarios modelled – 13%, 26%, 35%, and 45% absolute emission reductions compared with 2005 levels – the government settled on a target of 26%–28%:

> "…the economic modelling that we did was about…estimates of the economic cost to the economy of different…targets, with a kind of understanding that the whole point of this exercise was for Australia to…play its fair share in…achieving global…reductions in emissions…and signing up to various…commitments, like…the two degree commitment…but ultimately…the work was designed to try and give a sense of how much…cost would be imposed on the domestic economy by signing up to different…emissions reductions targets, and also to get a sense of what other countries were doing…that's not completely straightforward because we've got different population growth from other countries, so it depends how you measure it…we presented a lot of those sort of comparisons…" (I_07)

> "…my view is that way too much emphasis gets put on modelling outputs…the 2030 target…it was all done last year, so you're projecting fifteen years out…you can't predict GDP fifteen years in advance with enough precision…in the target process, there was a lot of discussion about whether there should or shouldn't be economic modelling…and a lot of the reason why there was discussion…was…because of the exact point of once you're doing modelling and once there's numbers, people just get fixated on those numbers and lose sight of…the limitations of those numbers and the assumptions that are sitting behind them…and…lose sight of all the…other considerations that sit around it…" (I_04)

Bearing in mind the significant role of economic modelling and analysis to the policy development process, several interviewees suggested that numerous opportunities exist to increase the role of health co-benefits as a consideration in Australian climate change mitigation policy development.

4.4.2 Increasing the Role of Health Co-Benefits as a Consideration in the Development of Mitigation Policy

Firstly, there is an opportunity to integrate health more meaningfully into climate change mitigation policy in a comprehensive review of Australian climate change policy. A comprehensive review of climate change impacts on Australia has not been undertaken since the Garnaut Climate Change Review was commissioned by the Australian Labor Party and Australian state and territory governments in 2007, and as one interviewee lamented, the INDC target setting process had provided a platform but was not utilised:

> "…so the INDC process was a missed opportunity essentially because…in theory those processes should provide an opportunity for national governments to assess what's in their broader national interest…one of the biggest failings in domestic policy, and it's broader than health, is that we haven't for a while…attempted a systemic assessment of what climate change means for the systems which we…need, whether they be health system or financial system…what the impact of global action is on our long-term prospects for…our exports, for example…" (PI_02)

The Coalition government, recently returned to power following a federal election in July 2016, has pledged to undertake a comprehensive review of Australian climate change policies in 2017. A number of interviewees identified this audit as a strategic time to raise the profile of health co-benefits and advocate for their inclusion in the mitigation policy development process.

In particular, areas of energy efficiency and sustainable transport were identified as key policy areas where health co-benefits are quantifiable and could be well received in Australia:

> "…it's only in relation to energy efficiency where you can claim…in Australia…a carbon reduction measure as having a public health benefit. …A move to electrified transport would have a big impact on public health, because…we've got all sorts of…air pollution problems from…internal combustion engines…in the cities." (I_07)
> "…the benefit is those costs are avoided…usually…on…the basis of…deaths…and other kind of respiratory ill effects…and…the costs are there. …so we've been using it for…a long time in the…pollution space and…it'll pull over into motor vehicle efficiency as well…" (I_10)

The area of vehicle emissions is one where the Australian government appears to be genuinely considering health impacts. Following on from the establishment of a Ministerial Forum on Vehicle Emissions in late 2015, the Australian government released a Vehicle Emissions Discussion Paper in early 2016. The first paragraph of the Discussion Paper demonstrates a clear understanding of the link between the combustion of fossil fuels, health impacts, and climate change (Australian Government Department of Infrastructure and Regional Development, 2016, p.2):

> "Emissions from motor vehicles can affect our health by polluting the air we breathe and can also contribute to climate change. To explore options to reduce the environmental and health impacts of emissions from motor vehicles, the Australian Government has established a Ministerial Forum to coordinate a whole of government approach to this important issue."

Beyond the scheduled 2017 climate change policy review, the Council of Australian Governments (COAG) was suggested as an alternative avenue for promoting health co-benefits given the cross-jurisdictional nature of health in Australia's federal system. While the Department of Health is responsible for the Environmental Health Standing Committee (enHealth), it has not recently provided any advice on health in climate change policy. enHealth's Secretariat reports that a new national environmental health strategy is in the process of being prepared (Cheah, 2016). Interviewees also advised that a more cohesive awareness raising campaign was required to elevate the prioritisation of health co-benefits as a consideration in the development of mitigation policy:

> "You need…to marry…a lobbying group like AMA [Australian Medical Association]…a policy advocate group on climate change…and the academic sector…it does need a level of credibility…and it also needs to be able to judge any policy that's put forward against political pragmatism…" (PI_02).

4.5 Summary

The case study presented here provides a level of insight into the role of health co-benefits in the development of Australian climate change mitigation policies. To do so, we explored the policy-making process; factors influencing the prioritisation of multiple considerations; barriers and enablers to the consideration of health; the evidence base for policy; the role of external actors and stakeholders; and the communication of policy decisions. Results indicate that health co-benefits are not meaningfully considered in the development of mitigation policies in Australia. Explanations include a lack of local, robust data and champions both within and outside of government; the current Australian climate change narrative and a focus on domestic economic costs in mitigation policy development; as well as challenges associated with the long-term nature of health impacts and linking health co-benefits to climate change and fossil fuel use.

Based on responses from interviewees, a number of opportunities were identified for increasing the role of health co-benefits in the development of Australian climate change mitigation policies. Beyond addressing the acknowledged barriers, an upcoming government review of climate change policy in 2017 provides an opportunity for health co-benefits to be more meaningfully integrated into mitigation policy. This would require an environmental health champion to coordinate a cohesive and strategic policy campaign that speaks to the dominant climate change narrative within which policy-makers are currently embedded. Further, COAG was identified as a cross-jurisdictional avenue through which health co-benefits might be able to gain some political traction.

While the federal government is ultimately responsible for the development and implementation of climate change mitigation policies in order to meet international emissions reduction obligations, research indicates that health co-benefits are a consideration in climate policies at the sub-national level (e.g. Capon & Corvalan, 2018). Given Australian state and local governments are largely responsible for the development and implementation of health, adaptation and air pollution policies, interviews with relevant state and local government employees may provide additional insight regarding the role of health co-benefits as a consideration in the development of climate change policies more broadly.

Chapter Five: Health Co-Benefits and the Development of Climate Change Mitigation Policies in the European Union

5.0 Preamble

In the previous chapter, I presented the results from the first site of the case study examining the role of health co-benefits for Australia. This chapter presents results from the second site – the EU – and is essentially a reproduction of a paper titled 'Health Co-Benefits and the Development of Climate Change Mitigation Policies in the European Union' that was published in November 2018 in the journal *Climate Policy* (Workman et al., 2018a)[11], with some additional contextual material to improve the readability of the chapter within this thesis.

As a road map, this chapter first provides context by discussing the EU's governance structure relevant to the development of its emissions reduction policies. Next, it outlines the methods used to develop the case study. Third, results are presented by theme, based on the six themes underpinning the interview schedule: i) policy-making process; ii) factors influencing the prioritisation of multiple considerations; iii) barriers and enablers to the consideration of health; iv) the evidence base of policy development; v) the role of external actors and stakeholders; and vi) communicating policy decisions. Fourth, this chapter considers the implications of findings before concluding with further research recommendations.

[11] Given this chapter is based on a publication, I use the first-person plural to acknowledge the input of the co-authors.

5.1 Introduction

As a supranational, politico-economic organisation with 28 Member States, the EU constitutes the third largest GHG emitter globally. In 2014, just under half (48.8%) of EU emissions were generated from the energy supply and transport sectors (European Environment Agency, 2016c). Consequently, numerous studies have analysed the health co-benefits of improved air quality that result from the implementation of climate change mitigation policies (e.g., see Rive, 2010; Schucht et al., 2015; van Vuuren et al., 2006).

While the EU has often been regarded as a global leader on climate action with a suite of mitigation policies, the effectiveness of some mitigation policies has come into question. For example, the European Union Emissions Trading System (EU ETS) was launched in 2005 and represents the first and largest trading market in CO_2 (European Commission Directorate-General for Climate Action, 2016). Yet, carbon price volatility resulting from internal and external challenges has led to criticism of the EU ETS (Edenhofer et al., 2017; Narassimhan, Gallagher, Koester, & Alejo, 2018). Additionally, the effectiveness of EU air pollution mitigation policies has also been questioned, given considerable non-compliance by some Member States (Yamineva & Romppanen, 2017).

The EU is a Party to the UNFCCC in its own right, and since 2007, climate change has formally been an issue of shared responsibility for Member States and the EU's principal policy-making body, the European Commission (the Commission). In terms of governance characteristics, the EU embodies a federalist architecture, interacting with Member States under the guiding principles of subsidiarity and proportionality: in certain circumstances, when it is deemed preferable, the EU can act on behalf of the Member States. Any action taken should not exceed action considered necessary to achieve the EU's objectives as outlined in the governing treaties (Raffaelli, 2017).

In 2010, the Commission established a Directorate-General for Climate Action (DG CLIMA). Prior to the establishment of DG CLIMA, DG Environment (DG ENV) was responsible for climate-related policies. DG CLIMA now leads the development of climate change mitigation policies and responsibilities for emissions have been split: DG CLIMA is responsible for policies covering the six GHGs covered by the Kyoto Protocol while DG ENV is responsible for policies relating to non-GHGs that impact air quality. The two DGs share responsibility for policies relating to methane emissions.

DG CLIMA develops horizontal (economy-wide) policies (Moussis, 2015), using a cost-effective and incremental approach. In this way, EU climate change mitigation policies have been developed iteratively, initially setting common EU-wide emissions reduction targets, followed by more specific, individualised effort-sharing targets for each Member State based on a least-cost pathway. This stepped target-setting approach – and a commitment to carbon capture and storage - has been pivotal given the diverse energy sources and mixes of each Member State. Economic and energy considerations have been at the fore of the development of effort-sharing targets: GDP per capita was the main criterion for determining individualised national targets, and a number of coal-dependent Member States have demanded full control over decisions regarding their energy mix (Visegrad Group, 2014). EU climate change mitigation policies fall into one of two categories: policies covered by the EU's emissions trading system (ETS) and those not (non-ETS). Over the last decade, climate and energy policies have been inextricably linked and have been developed synergistically (Skjærseth, 2016).

Outside of the DGs, a number of agencies support the development of EU mitigation policies. The European Environment Agency supports the Commission in developing evidence-based policy by undertaking assessments and ad-hoc studies to support environmental policy making and to evaluate the effectiveness of environmental policy measures. It also works directly with Member States, assisting with data collection, performing quality checks and gap analyses to facilitate accurate reporting. Eurostat, the EU's statistical agency, also has a central role in collecting, monitoring and disseminating climate- and air quality-related data. Finally, the Commission's Joint Research Centre is pivotal in supporting the DGs in the development of EU mitigation policies, including supporting the provision of cost-benefit analysis of policy options (European Commission, 2016).

In relation to air quality, experiences of acidification and eutrophication in the 1970s and 1980s in Europe have driven the development of evidence-based, increasingly stringent air quality policies over a period of more than four decades (Reis et al., 2012). These air pollution mitigation policies have been pursued by the EU through a commitment to the United Nations Convention on Long-range Transboundary Air Pollution (CLRTAP), which was ratified by the EU in 1982 (European Environment Agency, 2016b). In more recent decades, air quality policies in the EU have focused heavily on the health impacts of air pollution, and for good reason: 2013 estimates determined that exposure to $PM_{2.5}$, nitrogen dioxide and ozone concentrations have been responsible for approximately 436,000, 17,000 and 16,000 premature deaths respectively across the EU Member States annually (European Environment Agency, 2016a).

To address these impacts and public concerns, the Commission has introduced several initiatives. In 2003, the Commission developed a European Environment and Health Strategy (The European Parliament, 2004), which was implemented through the Environment and Health Action Plan 2004-2010 (European Commission, 2004). Most recently, the Gothenburg Protocol, first adopted in 1999 to address acidification, eutrophication and ground-level ozone, was revised and strengthened in 2012 to support the EU's long-term goal of reducing the health impacts resulting from air pollution (Council of the European Union, 2017).

Finally, the EU's long-term objective to achieve "levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment" (The European Paliament, 2002, p. L 242/10) is being pursued though the Clean Air Policy package, which includes a revised and increasingly ambitious National Emissions Ceiling Directive. The package is estimated to accrue health benefits of €40-140 billion (approximately USD$55-192 billion) and to result in €3 billion (approximately USD$4 billion) in productivity gains by 2030 (European Commission, 2013b). Strong public acceptance of climate change and the serious threat it poses is highlighted in the Special Eurobarometer report on climate change, which concluded that 91 percent of respondents consider climate change a serious problem and 65 percent of respondents believe that reducing fossil fuel imports is beneficial for the EU economy and will increase EU energy security (European Commission Directorate-General for Communication, 2015).

With these contextual factors in mind, the following case study examines the role and influence of considerations such as health co-benefits in the development of EU climate change mitigation policies.

5.2 Methods

The theoretical and analytical frameworks, as well as the research methods used to undertake this study, were detailed in Chapters 2 and 3. To avoid unnecessary repetition, this methods section has been truncated.

This study is theoretically grounded in the political economy of health framework. This framework suggests that 'health' can usefully be conceptualised "as a function and reflection of linked determinants that operate at multiple levels: individual, household, community, workplace, social class, nation, and the global political and economic context" (Birn et al.,

2009). Further, many determinants of health are often situated outside of the health sector and require policy action in other sectors (Whitehead, Diderichsen, & Burstrom, 2000). Climate change represents a whole-of-economy issue; every sector will be impacted. With this in mind, Walt and Gilson's (1994) health policy analysis model provided the analytical guide for the evaluation of EU climate change policies in this paper.

Study Design. Semi-structured interviews comprised the primary data source for the development of the case study and were supported by analysis and consideration of secondary data sources, including relevant policy documents (see Table 13 and refer to Appendix C). Questions in the interview schedule were stratified into one of these six themes: i) power in policy-making; ii) factors influencing the prioritisation of multiple considerations; iii) barriers and enablers for the consideration of health in mitigation policy; iv) the evidence base for policy; v) the role of external actors and stakeholders; and vi) the communication of policy decisions.

Table 13. Key Commission documents informing case study development

Document title (year of publication)	**DG(s) responsible for publication**
Impact Assessment: A roadmap for moving to a competitive low carbon economy in 2050 (2011)	DG CLIMA
Energy Roadmap 2050 (2011)	DG Energy/DG CLIMA
Green Paper: A 2030 framework for climate and energy policies (2013)	DG CLIMA/DG Energy
Impact Assessment: the Clean Air Policy Package (2014)	DG ENV
Impact Assessment: A policy framework for climate and energy in the period from 2020 up to 2030 (2014)	DG CLIMA/DG Energy

Recruitment of Participants. Commission officials directly involved in the development of EU climate change and air pollution mitigation policies were the targets of recruitment, given their intimate knowledge as the primary makers of policy and their capacity to provide insight into the role of health co-benefits (refer to Table 14 and Appendix D for selection criteria). However, it was anticipated that Commission policy-makers would be difficult to recruit given competing time pressures. Consequently, political advisors and expert consultants were also approached given their involvement in and knowledge of climate change and air pollution mitigation policy development.

Participants were initially approached for interview by email from March 2017. DG organisation charts and individual connections were used to identify potential participants.

Political advisors for members of the European Parliament's Environment, Public Health and Food Safety Committee and experts supporting the development of impact assessments for EU climate mitigation policy were also approached. Participants were offered anonymity and no demographic data were collected on individuals that participated.

Table 14. Commission agencies approached during the recruitment of interview participants

European Commission Directorates-General and Agencies
Directorate-General for Climate Action (DG CLIMA)
Directorate-General for Environment (DG ENV)
Directorate-General for Health and Food Safety (DG SANTE)
Directorate-General for Energy (DG Energy)
Directorate-General for Mobility and Transport (DG MOVE)
Directorate-General for International Cooperation and Development (DG DEVCO)
Directorate-General for Regional and Urban Policy (DG REGIO)
Directorate-General for Research and Innovation (DG RTD)
Secretariat-General (Sec-Gen)
Joint Research Centre (JRC)
European Political Strategy Centre (EPSC)
Consumers, Health, Agriculture and Food Executive Agency (CHAFEA)
Eurostat – European Statistics (DG ESTAT)
European Centre for Disease Control (ECDC)
European Environment Agency (EEA)

Data Collection and Analysis. The first author conducted all interviews between April and October 2017. In total, 46 individuals were contacted for interview. Ultimately, 14 individuals were interviewed and two individuals provided information via email. Interviews were conducted both face-to-face (*n*=7) and via online videoconferencing (*n*=7). The average interview length was 43 minutes. Interviews were transcribed and verified for accuracy. Transcriptions were imported into QSR International's NVivo 11 Software (NVivo, 2014), where they were coded based on the six themes identified in the literature review. Key mitigation policy documents selected for analysis (refer to Table 13) were also imported into NVivo, where directed qualitative content analysis was performed.

5.3 Results

Overall, this study determined that health co-benefits are an explicit consideration in the development of EU air pollution and climate change mitigation policies. They are incorporated into integrated impact assessments for mitigation policy proposals through a suite of models

that support their quantification and monetisation. They are recognised as a key driver for air quality policies and regularly underpin the communication of these policies to the public. However, they are less relevant and influential in climate change mitigation policies. The economic costs associated with policy implementation and energy supply security remain more powerful influences on climate change mitigation policy outcomes, as Member States pursue their own national interests and agendas. A more detailed examination of the role of health co-benefits in the development of EU climate change mitigation policies is provided below. Interview and policy document data are presented together, stratified by interview theme.

5.3.1 Policy-Making Process

The first theme regularly discussed in interviews was the policy development process used by the Commission, particularly for cross-sectoral policy issues such as climate change mitigation. Interviewees detailed the Commission's process for policy development, referring to the Commission's 2015 'Better Regulation Agenda', which aims to achieve the EU's objectives in the most effective and efficient manner. Many interviewees elaborated on the details of the Commission's 'Better Regulation' guidelines and accompanying toolbox (European Commission, 2015), identifying three key stages of policy development:

1. Once a new or existing policy receives political validation from senior Commission and EU staff, the lead DG responsible for the policy file will establish an Inter Service Group (ISG). The ISG consists of representatives from DGs considered relevant given the specific policy file. An inception impact assessment (also known as a roadmap) is developed by the ISG as part of the policy proposal. This high-level document would outline details including the context, problem definition, objectives and parameters of the proposed new policy or amendments.

2. The second stage involves the development of a policy proposal, which is underpinned by an integrated impact assessment. For complex policy issues, the integrated impact assessment will be developed using several modelling tools to perform a detailed analysis of policy costs, benefits and impacts considered within scope. Once developed, the integrated impact assessment is evaluated by the Regulatory Scrutiny Board, a committee led by DG Sec-Gen, who are responsible for the comprehensive and rigorous review of the integrated impact assessment, including evaluation of the methodologies, analysis and options presented. Several policy options that exist within an established range will be presented in the policy proposal, for consideration by the

co-legislator, the European Parliament and the Council of the European Union (the Council).

3. Assuming the integrated impact assessment passes the Regulatory Scrutiny Board, the third and final stage in the policy development process requires the policy proposal to be formally approved by the Commissioners of the Commission before being provided to the legislator for consideration. A co-decision process is used to legally adopt a proposal, requiring majorities in both the European Parliament and the Council.

Interviewees emphasised that there are several occasions throughout the policy development process where stakeholders are consulted and feedback is sought (see Figure 5 below). Further, a consultation strategy is required to accompany the inception impact assessment that details all planned consultation efforts during the policy proposal development. Finally, the Better Regulations guidelines stipulate an evaluation or 'fitness check' is undertaken for existing policies by DGs, often on a five-yearly basis (European Commission, 2015).

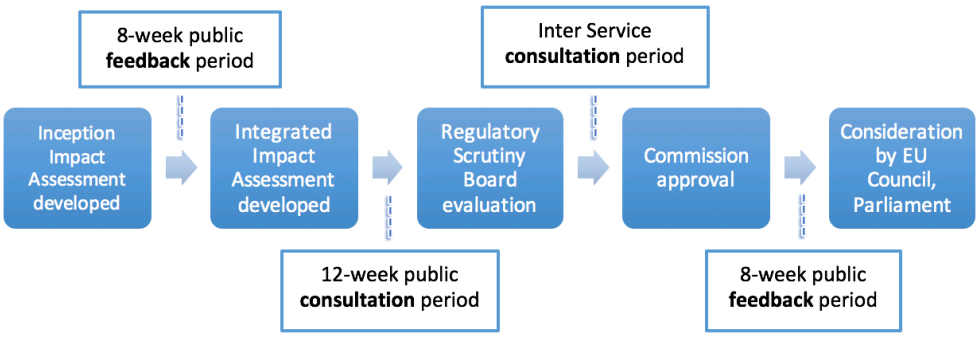


Figure 5. A simplistic representation of the European Commission policy development process

Some interviewees highlighted the integrated nature of policy-making and close working relationships between DGs, with modelling tools and analyses shared and incorporated into integrated impact assessments across policy files to support the harmonisation of policy proposals across DGs:

> "And within the EU, I think…we have full coherence between…climate policy and air pollution policy. We speak with each other on a…daily basis, in order to understand

> where we stand and we use each other's material, the same methodologies, the same models…to drive…the policies." (I_03)

Further and related, many interviewees acknowledged that a key component of robust and transparent policy development involved the use of publicly accessible integrated assessment models that explore cost-effective strategies to reduce both GHG and non-GHG emissions:

> "So the principle of cost-effectiveness is very strong in climate policy and in air pollution policies. And for that reason, we use…very advanced modelling…" (I_03)
> "And very important is that…the GAINS model…is online…so you can actually go and…play around with it yourself…and you can see how this can…influence the policy options for your country…" (I_03)

Some interviewees also demonstrated an understanding of the complex relationship between climate change and air pollution mitigation policies and the need to carefully consider the implications and potential trade-offs:

> "…if you do ambitious air pollution, it's good for…not always actually, it tends to be good…for climate and the same for climate. Most climate policies tend to be good for air pollution, not all, I mean biomass, some of the biomass is actually quite, quite bad for air pollution…" (I_01)

The Commission's impact assessment for the Clean Air Policy Package (European Commission, 2014b, p. 245) outlines the synergistic and antagonistic interactions that can exist between air pollution and climate change policies:

> "…there are substantial interactions between climate change and air pollution policies. A more ambitious climate policy is expected to make reaching the new air quality objectives cheaper by removing highly polluting sources such as coal plants or reducing domestic coal use; however, expanded biomass combustion can result in detrimental health impacts unless sufficiently stringent emissions standards are in place."

Finally, some interviewees explained that mitigation policy development requires an awareness of balancing optimal and politically pragmatic policy options given diverse views within the legislator:

> "…that's what the policy-making process is about…we think we can show that achieving quite ambitious greenhouse gas reduction can be done…some will say this is too expensive and some will say, you haven't looked enough at the health impacts…" (I_01)

5.3.2 Factors Influencing the Prioritisation of Multiple Considerations

Interviewees were asked about the processes and factors that influence the prioritisation of multiple considerations in the climate change mitigation policy development process. Interviewees identified four factors as pertinent to the development of cross-sectoral policies with multiple considerations. These four factors can be stratified into two categories: guiding principles and political priorities. Interviewees identified two guiding principles that underpin the development of climate change policies. Firstly, some interviewees explained that development of impact assessments are guided by sustainable development principles:

> "…an impact assessment should look really at the three pillars of sustainable development, so consider the economic, social and environmental impacts, they're put on an equal footing." (I_02)

Interviewees identified a second guiding principle of limiting global warming to below 2˚C as central to climate change policy development. The determination of the EU's Council of Ministers, as early as 1996, that a rise in average surface temperature of 2˚C compared with pre-industrial levels would constitute 'dangerous' levels of anthropogenic climate change is an integral value that forms the basis of the Commission's climate change policy development for the EU:

> "Two degrees…has been extremely important because…once you don't have that first high-level guiding principle, you can imagine everything you want." (I_05)

Interviewees also identified two key political priorities that inform the final policies agreed upon. First, interviewees reiterated that costs are a powerful influence on the development of policy proposals:

> "Member States that have to implement these measures, they don't look at the positive side. They only look at the cost. They have a very conservative view on this. …even if you show that there were billions saved and so on…if you look at value of statistical life or life years lost and so on, huge benefits. The Member States completely ignored that in the debate. They only looked at the cost figures." (I_03)

In relation to climate change mitigation policies, the Commission's Green Paper on 'A 2030 framework for climate and energy policies' (European Commission, 2013a, p. 10) acknowledges perceived existing tensions between ambitious climate and energy policies and the economic impacts:

> "Energy and climate policies can drive demand and growth in the low carbon economy. The EU is a frontrunner in clean and more energy-efficient technologies, products and services and eco-technologies which together are expected to generate some 5 million jobs in the period up to 2020. Moreover, many of these policies contribute to reduced air pollution and health improvements. At the same time, the policies have been criticised for having a negative impact on energy prices, adversely impacting affordability of energy for vulnerable households and the competitiveness of energy intensive sectors even though they may reduce industry's exposure to energy costs and improve resilience to energy price peaks."

Energy supply security is a second political priority that influences climate change mitigation policy development. Interviewees advised that for the EU, energy supply security is paramount and is a central policy focus for both the EU and Member States:

> "…there are issues relating to energy security, when it's about oil or gas, it is a major import bill. …when the integration of the thinking about climate and energy really happened was in 2006, 2007, when the EU was confronted with…a price spike in oil prices and then suddenly people…and politicians started to see this interaction, OK, if I do more on efficiency or if I do more on renewable energy…it's also an economic hedge against troubles on [the] energy side." (I_05)

The importance of energy supply security is evident in the Commission's press release on the presentation of 'A framework on climate and energy for 2030' (European Commission, 2014c) to the European Parliament and the Council in January 2014:

> "Supported by a detailed analysis on energy prices and costs…the framework aims to drive continued progress towards a low-carbon economy and a competitive and secure energy system that ensures affordable energy for all consumers, increases the security of the EU's energy supplies, reduces our dependence on energy imports and creates new opportunities for growth and jobs…"

5.3.3 Barriers and Enablers to the Consideration of Health in Mitigation Policy

While health co-benefits are an explicit consideration in the development of EU mitigation policies, interviewees acknowledged that while health is the primary driver of air pollution mitigation policies it does not play the same integral role in the development of climate change mitigation policies. Interviewees raised three barriers and three enablers to the consideration of health co-benefits in mitigation policy development (summarised in Table 15 and discussed in further detail below).

Table 15. Summary of barriers and enablers to the consideration of health in the development of EU climate change mitigation policies

Barriers	**Enablers**
Dominant narrative of economic costs and growth in climate change discourse	Well-established and increasingly ambitious air quality policies based on direct health impacts
Challenges with the attribution of (longer-term) health outcomes	Transparency and accountability mechanisms of the Commission's policy-making process
Limited funding dedicated to climate change and health research	Historic weather events with significant health implications

5.3.3.1 Barriers

Firstly, the dominant narrative of costs and growth and the political reality of short-termism was identified as a barrier:

> "…I think it's mostly because the priorities are growth, jobs, economy so the mitigation policy is geared towards that…" (I_09)
>
> "…the barrier there is…decision makers like, OK well, what can I do about that in the next four years I'm in charge. …this long-term uncertainty…is a barrier…" (I_09)

In the Commission's Green Paper on 'A 2030 framework for climate and energy policies' (European Commission, 2013a, p. 10), the Commission acknowledges criticism of the 2020 climate and energy package, given the "negative impact on energy prices, adversely impacting affordability of energy for vulnerable households and the competitiveness of energy intensive sectors even though they may reduce industry's exposure to energy costs and improve resilience to energy price peaks." The Commission's subsequent impact assessment on 'A policy framework for climate and energy in the period from 2020 up to 2030' (European Commission, 2014a, p. 131), concludes that:

> "if 2030 climate and energy targets are met in a cost-efficient manner on the aggregate EU level, costs relative to GDP are typically highest in lower income Member States and in scenarios that require highest investment expenditures due to ambitious EE

> [energy efficiency] and RES [renewable energy sources]. At the same time, environmental and health benefits as well as fuel savings are also highest in these countries."

Second, some interviewees acknowledged that there are still difficulties with attributing and quantifying some of the longer-term health outcomes resulting from climate change:

> "the work on…infectious diseases is a bit more complicated because those impacts are more indirect. We can't really draw direct conclusion of climatic events to infectious disease event because of the…complexity of the disease transmission pathways..." (I_06)

Third, some interviewees suggested that the amount of funding dedicated to climate change and health research acts as a barrier:

> "…because health [funding] is traditionally oriented towards…pharmaceuticals research…end-of-pipe solutions, so they don't really…look at health determinants as much…" (I_09)
> "…I don't think that health has a big weight, I don't think it's…a sector that gets a lot of attention and I think it's definitely underfunded…" (I_06)

Funding of environmental health research has been assessed by the Commission. In 2014, the Commission completed an analysis of environment and health-funded research under the Seventh Framework Programme from 2007-2013 (European Commission Directorate-General for Research and Innovation, 2014). Cumulatively, 147 environmental health projects were provided €550 million (€79 million per annum) during the six-year period. Of these, 22 were air quality-related and 13 were climate change-related. In particular, two research projects investigated health co-benefits – PURGE and URGENCHE – with EU financial contributions of approximately €3.4 million to each project. Funding dedicated to climate change and health research under the Seventh Framework Programme represents 0.08% of the total programme budget (K. L. Ebi, Semenza, & Rocklöv, 2016).

5.3.3.2 Enablers

There were also a number of enablers identified that support the consideration of health in the development of climate change mitigation policy. Firstly, interviewees discussed some of the severe weather experiences in Europe over the past two decades with serious health implications:

> "…we also have these massive climate change impacts in Europe that have a dramatic impact on public health in Europe. If you think back to the 2003 heatwave that claimed something like 70,000 excess deaths…" (I_06)

A second enabler identified was the fundamental importance of transparency and accountability in legitimising the Commission's policy proposals:

> "…it is a fact maybe that it's sometimes more straightforward to…assess your economic impacts of the policy than the health impacts, and that shows sometimes in the impact assessment but…if from the…screening stage…when you discuss whether or not things are likely to have an impact, you identify health as…likely to be significant, efforts will have to be…put into…assessing them seriously…in terms of accountability the impact assessment has to, has to, cannot just ignore them." (I_02)

Third, some interviewees indicated that the long history of increasingly ambitious air quality policies in Europe provided supportive structures for the consideration of health in climate change mitigation policies:

> "…the major finding for air quality and health…there are massive long-term, massive, massive effects to long-term exposure. And…that got accepted pretty quickly…so we…put those numbers into the…Clean Air for Europe programme…and round about the same time also started putting numbers together for the climate policies. …the climate people I think were very ready to take them on board…and, they liked the…whole issue about…the air quality benefits being in the near-term and also within Europe as opposed to…impacts in 2050…" (I_08)

In the Commission's impact assessment for 'A roadmap for moving to a competitive low carbon economy in 2050' (European Commission, 2011, p. 92), the synergies between climate change mitigation and air pollution mitigation policies are highlighted, with the quantification and monetisation of health co-benefits incorporated into the assessment:

> "…Effective decarbonisation will reduce the number of life years lost due to $PM_{2.5}$ by €2.6 million in 2020, €6.3 million in 2030 and €14.3 million in 2050. …effective decarbonisation reduces this type of health damage due to air pollution by €3 to 7 billion in 2020 compared to the reference. …In 2030 the damage reduction increases to around €7-17 billion and in 2050 to €17-38 billion."

5.3.4 The Evidence Base for Policy Development

Interviewees were asked about the role of peer-reviewed literature in the policy development process. Almost all interviewees noted that it is vital that the Commission transparently

develop evidence-based policy. Some interviewees noted that evidence summaries prepared by the IPCC inform the policy development process:

> "When it comes to the collective action the EU thinks should be done on climate change we base ourselves on the IPCC…" (I_01)

Interviewees clarified that both internal – and external where needed – resources are readily available in order to ensure that the best available modelling and analysis tools are used to support the development of policy proposals:

> "The DGs have…a budget…for…contracting studies…a budget to basically have the…models and the contractors…at our disposal when we need them…we are safe in terms of being able to do the work." (I_05)

5.3.5 The Role of External Actors and Stakeholders

Interviewees were asked about the role of external actors and stakeholders in the policy development process. Interviewees discussed the regular opportunities that exist for formal stakeholder consultation throughout the policy proposal development, noting that these can be open or targeted (invite only) consultation opportunities, and can be used as a litmus test of the Commission's policy proposal prior to its consideration by the Council and the European Parliament:

> "…so we have numerous…moments we have [to] consult stakeholders and I have to say it matters, I mean it's not that it's…ignored. …when you do a stakeholder consultation you get a very good view of …the pros and cons regarding your policies out there." (I_01)

In the Commission's impact assessment for the Clean Air Policy Package (European Commission, 2014b, p.88), the Commission included summaries of consultation input, which highlights the diverse stakeholder perspectives on synergies between air quality and climate and energy policies:

> "In terms of how future EU air pollution policy should interact with EU climate and energy policy, over 90% of respondents to the questionnaire for the general public, along with over 80% of government, NGO and individual expert respondents to the questionnaire for experts and stakeholders, support the option that EU air pollution undertakes *additional measures beyond synergies with climate and energy policy*. A majority of business respondents, however, feel that a new air pollution action should not go beyond synergies with climate and energy policy."

The role of multilateral organisations in supporting the policy development process was discussed, particularly work undertaken by the WHO and the OECD:

> "…the human health benefits are based on WHO recommendations and on very…comprehensive work by…OECD on the value of life and value of statistical life and life years lost and combining…these information sources, we can quantify the effects, impacts as well as the monetised…impacts and effects…" (I_03)
> "…the OECD is taken very seriously…the workings of the OECD do have quite a lot of influence over people." (I_09)

The role of the WHO in informing EU air policies is reaffirmed in the impact assessment for the Clean Air Policy Package (European Commission, 2014b, p. 19), which notes that the WHO played a role in the policy review process:

> "For the Ambient Air Quality Directives, the health relevance of the pollutants and standards of the original policy has been reviewed by the WHO, and confirmed, with the caveat that the level at which certain standards are currently set (mainly for PM) provides only incomplete protection for human health."

5.3.6 The Communication of Policy Decisions

The final theme discussed with interviewees explored the communication of policy decisions and whether health co-benefits have the potential to be a useful communications frame. Interviewees advised that health co-benefits are included as one of several justifications for implementing climate change mitigation policies, however they likely resonate more with the broader public than with Member State representatives:

> "I don't think many Member States would think that…whatever they have to do on climate action…that they would be convinced by…health…perhaps a few would, would take it into account…but overall…I think towards the public, yes…it's something that perhaps they can relate more closely to." (I_05)

Interviewees also articulated the challenges of developing policies for populations with different socio-economic characteristics:

> "…in Europe…it matters where you live. In some places air pollution is a bigger problem than others…to some extent, the worst air pollution in Europe is also in the places with the lowest income levels…and that actually makes it more difficult because it's, the lower your income level, the less willingness to pay…" (I_01)

5.4 Discussion

The results detailed above indicate that the EU has a defined policy development process and supporting governance structures in place to develop evidence-based, integrated policies with opportunities for input from diverse stakeholders. Specifically, impact assessments developed for climate change mitigation policies are explicit in their consideration of health and other impacts, and can offer other Parties to the UNFCCC with a good example of processes and tools that can support the incorporation of multiple considerations into the development of a cross-sectoral policy issue.

The results above also demonstrate, however, that despite a robust policy development process, health co-benefits ultimately play a limited role in the development of climate change mitigation policies. In spite of the EU's commitment to the equal consideration of economic, social and environmental impacts, the 'realpolitik' sees economic costs and energy supply security considerations as particularly influential in final climate change mitigation policies. These results reaffirm previous findings on the overarching influence of the material costs of implementing climate change policies (Harrison & Sundstrom, 2007; Skjærseth, 2016) and a preoccupation with cost minimisation in climate policy assessment (M. Williams, 2012). The framing of climate change as a security issue in the EU has also been examined, although perspectives vary; some suggest that security has not been a core component of EU climate discourse (Hayes & Knox-Hayes, 2014) whereas others contend it has been pivotal for DG Energy and the Central and Eastern European states (Skjærseth, 2016).

Theoretically, these findings are consistent with political economy of health conclusions that a robust evidence-base and a morally defensible position are often insufficient to achieve optimal policy outcomes for health (Baum et al., 2013). In reality, the Commission's role in policy development requires balancing the provision of cost-effective and evidence-based policy options with politically palatable policy choices for Member States with their own national interests and diverse stakeholder groups to assuage. These stakeholders include non-state actors, such as business groups with fossil fuel interests, that directly engage with energy and industry departments at the national level (Downie, 2016), as well as representatives of the vehicle manufacturing industry, who have been influential at the Commission level (Čavoški, 2017).

The Commission's focus on evidence base and cost-effectiveness may also help to explain the distinction between the role of health co-benefits in air pollution mitigation policies

and climate change mitigation policies. Scientific expertise has been a cornerstone of air pollution mitigation policies since the establishment of the regional air pollution treaty, the CLRTAP in 1979 (Reis et al., 2012) and studies on the dangers of short- and long-term exposure to air pollutants have been informing air quality policies since the 1990s (A. J. Cohen et al., 2004). Comparatively, cultivation of the scientific evidence base for the health impacts of climate change has been more recent. In Europe, limitations of health impact studies inhibit the utilisation of such research by policy-makers (Hutton & Menne, 2014). While there have been recent novel methodological advances to support the detection and attribution of climate change health impacts (K. L. Ebi, 2014; K. L. Ebi et al., 2017), the diffusion of health between climate change mitigation and adaptation research and policies coupled with challenging research funding environments (K. L. Ebi et al., 2016) exacerbates the limited uptake of health in climate change mitigation policy development. Conversely, health co-benefits that result from improved air quality are primarily achieved through mitigation measures alone.

Cost-effectiveness remains a key principle in the Commission's economic analysis of environmental policy-making (Delbeke, Klaassen, van Ierland, & Zapfel, 2010). To date, mitigation of air pollutants has been pursued primarily through end-of-pipe measures, which are cost-effective compared with the structural shifts in the energy sector and the economy that are required to reduce GHG emissions (Bollen & Brink, 2014). Accordingly, the health co-benefits that result from mitigation measures are most cost-effectively achieved through air pollution mitigation policies, enhancing their appeal as a key justification. However, end-of-pipe measures can only reduce air pollutants to an extent. Structural changes, such as those achieved through climate change mitigation, are necessary in order to achieve air quality policy objectives (Bollen & Brink, 2014; Braspenning Radu et al., 2016). Importantly, the more ambitious the GHG emission reductions, the greater the likelihood that air quality co-benefits will be realised (M. Williams, 2012). Integrating climate change and air pollution mitigation policies is not without its challenges (Maione et al., 2016; Reis et al., 2012). Yet, opportunities exist to enhance the current role of health co-benefits in the development of climate change mitigation policies, consequently justifying more ambitious EU climate change mitigation policies (Day, Höhne, & Gonzales, 2015).

5.5 Summary

The development of this case study involved analysis of semi-structured interviews and secondary data sources across six themes, using an analytical framework that considered policy context, content, process and actors. Results indicated that health co-benefits are incorporated into the development of EU climate change mitigation policies and quantified,

along with other relevant economic, social and environmental considerations. However, the extent to which they inform the final policy outcome is limited; material costs and energy considerations are more influential in climate change mitigation policy-making. The separation of responsibility for GHG and non-GHG emissions across DGs decouples climate change and air pollution mitigation policies. As such, health co-benefits remain a primary motivation for the implementation of air pollution mitigation policies but are not considered a major driver of climate change mitigation policies.

Analysis of interview data, policy documents, peer-reviewed articles and news releases that considered the context and process of policy-making as well as actors involved in the process facilitated a comprehensive examination of EU climate change mitigation policy development. Given the dearth of qualitative literature exploring this particular topic, interviewing policy-makers directly involved in the EU policy development process presented a logical starting point for gaining insight into perspectives on health co-benefits in the mitigation policy development process. While the participant sample of 14 is small, the proximity of the interviewees to climate change policy development and their detailed knowledge of EU air pollution and climate change mitigation policies provides a useful basis for this research.

To further enhance the validity of findings, the interview data was augmented by triangulated analysis of secondary sources including relevant policy reports and peer reviewed research. Triangulated analysis of interview data and secondary data sources reveals consensus across most of the themes. For example, Commission programmes, as detailed in Commission publications, demonstrate and reaffirm interviewee perspectives that the three pillars of sustainable development are explicit considerations that inform the development of policy options and recommendations. Additionally, while government documents are not as direct as interviewees in acknowledging the overarching role of upfront costs in determining the final policy outcome, statements on affordability and competitiveness are regularly included and addressed in publications through the inclusion of economic benefits.

Chapter Six: Health Co-Benefits in Chinese and American Climate Change Mitigation Policies

6.1 Introduction

The previous two chapters detailed results from the multi-site case study of the role of health co-benefits in the development of Australian and EU climate change mitigation policies. In the Australian chapter, I concluded that currently health co-benefits play a limited role in the development of climate change mitigation policies at the national level. In the EU chapter, my findings showed that although health co-benefits are an explicit consideration in the development of EU climate change mitigation policies, their influence on the final policies remains limited although they constitute a key driver for air pollution mitigation policies.

Australia and the EU are important players in global climate change negotiations given their emission profiles. However, it is imperative to also investigate the role of health co-benefits in China and the U.S. given their emission profiles. Currently, China and the U.S. represent the two largest global emitters of GHGs, together accounting for 43 percent of CO_2 emissions from fuel combustion in 2015 (Le Quéré et al., 2018). For both countries, fossil fuels comprise the primary fuel mix, with emissions from the energy and transport sectors contributing considerable proportions to the emissions inventory (People's Republic of China, 2016; United States Department of State, 2016).

Further, as will be discussed in detail below, in great part due to their emissions and economic profiles China and the U.S. have been influential in the direction of international climate change negotiations over the past decade. China has committed to restructuring its economy, introducing an ETS and pursuing a strong renewable energy sector with considerable implications for GHG emissions reduction. In the U.S. the Obama Administration worked to deliver on an election promise by introducing a suite of climate change mitigation policies in the face of a hostile Congress and a well-established climate denial coalition[12].

Accordingly, this chapter examines the role of health co-benefits in the development of Chinese and American climate change mitigation policies between 2007 and 2017. This decade represents a formative period in climate change policy development for these two

[12] In September 2016, Republican candidate Donald Trump was elected President of the U.S., on a policy platform that included commitments to withdraw from the international climate change agreement negotiated in 2015, the Paris Agreement, as well as to roll back the suite of climate change mitigation policies developed under the Obama Administration.

Parties. For example, China's first national climate change program was released in 2007 (Schreurs, 2011). A year later, Barack Obama was elected to succeed George W. Bush as U.S. President and pledges to pursue ambitious emissions reduction targets in order to address climate change (Garnaut, Jotzo, & Howes, 2008). Over the following eight years, both countries demonstrate an increasing emphasis on action to address climate change through the development and implementation of a suite of climate change mitigation policies and goals.

This chapter first provides context for policy development in China and the U.S and highlights select climate-related government commitments. It then details the theoretical foundations and methods underpinning the assessment of health in mitigation policy development through directed qualitative content analysis. Next, it discusses results of my analysis, stratified into the same six analytical themes that were used to guide the Australian and EU results: i) the policy-making process; ii) factors influencing the prioritisation of multiple considerations; iii) barriers and enablers for the consideration of health in mitigation policy; iv) the evidence base for policy development; v) the role of external actors and stakeholders; and vi) the communication of policy decisions. Following on from the presentation of results, the chapter discusses the implications of results before concluding.

6.2 Background

Although both countries have large emissions profiles, China and the U.S. are distinctive in their governance arrangements and economic circumstances, which inevitably inform their policies on climate change. In order to contextualise Chinese and American positions and decisions relating to climate change over the past decade, this section details domestic politico-economic circumstances and highlights select climate-related commitments, first for China then followed by the U.S. This section culminates in an outline of the changing Sino-American climate change relationship.

6.2.1 China: A Developing Country with Climate Change Leadership Ambitions?

China is a communist one-party country ruled by the Chinese Communist Party since 1949. China's governance structure has been described as quasi-federal, with the decentralisation of power and responsibility across multiple tiers of jurisdictional authority that includes provinces, autonomous regions and municipalities, prefectures, and counties (Schreurs, 2017).

This governance arrangement has implications for the development and implementation of policies, including those for climate change. The central government sets overarching goals and targets across policy areas, often over five-year or longer timeframes, leaving local governments with increasing responsibility and flexibility to develop and implement their own shorter-term policies in order to achieve the longer-term targets and goals (Hong, Xiao, & Lockie, 2013). With local governments financially incentivised to pursue policies consistent with economic growth, Chinese governance researchers concur that this decentralised approach has regularly resulted in decision-making leading to detrimental environmental consequences (Kostka & Nahm, 2017).

The powerful central agency, the National Commission for Development and Reform (NDRC), has been responsible for the development of climate change policies in China since 2007. China's policy development is guided by, among other things, the Scientific Viewpoint of Development[13], a conceptual framework that encourages sustainability and the holistic consideration of development across economic, political, cultural, social and ecological dimensions (Hong et al., 2013).

China's economy is described as a social market economy and is in transition "from a highly centralised planning economy to a market economy" with greater economic development in eastern coastal regions and less development in western regions (Liu, 2016, p.4). China's economy has grown markedly over the past three decades, with annual growth rates of between eight and ten percent (Schreurs, 2011) that have spurred an associated growth in total energy consumption despite declining energy consumption per GDP unit. China's economy is heavily industrialised; in 2010, industrial products accounted for 94.8 percent of total exports (People's Republic of China, 2012).

[13] This is regularly translated as the Scientific Outlook on Development in many Chinese climate policy documents.

Economic and social development has resulted in an expanding transport sector. In 2005, the average number of vehicles owned per hundred households was 3.37; by 2010, this figure had increased to 13.1 vehicles per hundred households (People's Republic of China, 2012). The substantive scale of China's rapidly transitioning economy in conjunction with its sizeable population at approximately 1.3 billion and ever-increasing demand for energy creates a confronting situation for Chinese climate change policy-makers (Mou, Jiahua, & Ruiying, 2013). Energy security remains a preoccupation for China given rising energy demands. Despite relatively large reserves of coal, an increasing need for oil to power a booming transport sector combined with the consumption rate of coal and gas has required China to import substantial quantities of coal, oil and natural gas in recent years (Jiang, Dong, Kung, & Geng, 2013; Mou et al., 2013).

Such rapid economic growth has significant implications for the state of China's natural environment. Rising energy demands from fossil fuels ultimately result in rising pollution levels and severe domestic air, water and soil pollution has influenced environmental protection efforts in China (Schreurs, 2011). Numerous studies have attempted to quantify the estimated damages from fossil fuel use in China despite substantial data limitations (Nielsen & Ho, 2007). In 2016, the Chinese government reported that direct economic losses associated with climatic disasters in 2014 valued at approximately RMB 213 billion yuan (approximately USD$34.4 billion) (People's Republic of China, 2016). The government's recognition of China's increasingly degraded environment has led to increased expenditure to address environmental concerns. In 2010, RMB 665.5 billion yuan (approximately USD$100 billion) was spent on environmental protection, accounting for 1.67 percent of GDP (Hong et al., 2013).

In 2011, the Chinese government released the 12th Five-Year Plan (FYP) for the Environmental Health Work of National Environmental Protection, which identified major deficiencies in data collection and governance and outlined efforts to address identified limitations (People's Republic of China Ministry of Environmental Protection, 2011). Beyond deterioration of the domestic environment, the Chinese government has become increasingly aware of the impacts and risks of climate change at national and international levels, and the inevitable role it must play to adequately address a changing climate.

In negotiating the Kyoto Protocol in the mid-2000s, as a non-Annex I Party of the UNFCCC China remained a vocal supporter of an international agreement genuinely built upon the principle of common but differentiated responsibilities that took into account the historical emissions of developed countries and the need for such countries to endure the

economic burden of implementing ambitious mitigation measures in addition to offering financial and technological support to developing countries (Schreurs, 2011). Yet, China's involvement in reducing global emissions is undeniable; of the growth in global carbon emissions between 2010 and 2012, China was responsible for 73 percent (Liu, 2016).

Consequently, the Chinese government has pursued policies to promote structural economic change that simultaneously supports the development of strategic emerging industries and the service industry and reduces the proportion of energy intensive industries contributing to economic growth (Garnaut et al., 2008; People's Republic of China, 2016). China has been the largest recipient of climate finance through the Clean Development Mechanism (CDM) of the Kyoto Protocol, which has driven its rapid uptake of renewable energy (Engels, 2018).

Yet, transitioning to a low-carbon economy does not occur quickly nor does it come cheaply. The Chinese government estimates that RMB 30 trillion yuan (approximately USD$4.5 trillion) in additional investment is required out to 2030 in order to transition to a low-carbon economy – RMB 10 trillion yuan for energy conservation and RMB 20 trillion yuan for low-carbon energy development – and is looking toward developed countries and other multilateral processes for support in achieving this endeavour (People's Republic of China, 2016).

Despite its early insistence that developed countries take the lead on climate action, the Chinese government developed and implemented a suite of climate change mitigation policies and increased its own ambition on climate action. In 2007, the Chinese government established the National Leading Group to Address Climate Change, which developed its first national climate change program (People's Republic of China National Development and Reform Commission, 2007). In the same year, the Department of Energy Statistics was established to enhance energy statistics and to tackle climate change (People's Republic of China, 2012). In 2008, the Chinese government restructured its central governance arrangements. The State Environmental Protection Administration was replaced with a new Ministry of Environmental Protection (MEP), which was responsible for the development and implementation of environmental laws and standards (Schreurs, 2011).

Further, in the lead-up to international climate change negotiations in Copenhagen in 2009, a new climate change division was created in the National Development and Reform Commission, one of China's highest ranking government bodies ultimately responsible for economic planning (Jing, 2018). In 2009 in the lead-up to 2010 international climate change

negotiations at COP16 in Cancun, the Chinese government announced its intention to pursue a reduction in GHGs per unit of GDP by 40 to 45 percent by 2020.

In 2011, the 12th FYP for 2011-2015 further cemented the Chinese government's intentions to pursue a low-carbon economy through the pursuit of emissions intensity reductions, energy efficiency measures, a cap on annual coal consumption, and an increase in the share of gas and renewables in the primary fuel mix (Garnaut, 2013). Moreover, in the 12th FYP, the Chinese government announced a national ETS would be introduced in 2017. In what Green and Stern term the 'new normal', in 2014 and 2015 China experienced a slower growth of primary energy consumption, GDP and energy demand (F. Green & Stern, 2017) as a result of the government's concerted efforts in economic structural change.

In 2013, the National Action Plan on Prevention and Control of Air Pollution was released. The Plan introduced 'command and control' regulatory measures, capping coal consumption and mandating the use of end-of-pipe measures. To achieve the Plan's aims, the Chinese government pledged to invest USD$277.5 billion over five years (Chen, Wang, Ma, & Zhang, 2013).

China's NDC, prepared in 2014 for the UNFCCC's international negotiations at COP21 in Paris in 2015, saw a commitment from China to peak CO_2 emissions by around 2030; reduce energy intensity by 60 to 65 percent compared to 2005 levels; and to increase the share of non-fossil energy to around 20 percent of total primary energy supply. In supporting the achievement of this target, a National Plan on Climate Change (2014-2020) was also released in 2014, which emphasised enhancing the overarching climate change framework through capacity building; technological innovation and scientific research; impact assessment; greater public education; and improved climate change management systems (People's Republic of China, 2016).

In 2016, the Chinese government released its 13th Five Year Plan (2016-2020). In its INDC submitted in June 2015, the government alluded to the Plan, acknowledging that out to 2020 "it has identified transforming the economic development pattern, constructing ecological civilisation and holding to a green, low-carbon and recycled development path as its policy orientation" (People's Republic of China National Development and Reform Commission, 2015, p.20). As 2017 drew to a close, the Chinese government released details of the first phase of the national ETS, which initially covers the power sector. This scheme represents the world's largest carbon market and brought global GHG emissions covered by an ETS up to almost 15 percent (International Carbon Action Partnership, 2018).

In April 2018, China announced a new, expanded Ministry of Ecology and Environment (MEE) to replace the MEP. With an increased workforce, the new Ministry will receive responsibility for the development of climate change mitigation policies from the NDRC (Jing, 2018). It will also be responsible for the development of air pollution mitigation responsibilities, facilitating an integrated approach to mitigation policy development.

Beyond the domestic circumstances discussed above, the pace of energy-related technological advancement and increasing accessibility to technology transfer has supported the development of a flourishing renewable energy sector in China. China introduced the Renewable Energy Law in 2005 to support uptake of renewable energy into the electricity grid (Mou et al., 2013). As mentioned above, China has benefitted from climate financing through the CDM of the Kyoto Protocol and since 2009, China has been the world's largest manufacturer of both wind turbines and solar panels, which has supported approximately 1.12 million jobs in the sector (Schreurs, 2011).

6.2.2 The U.S.: Enhanced Climate Action under Democratic Leadership

The U.S. is the oldest federal republic with responsibilities for governance shared across three levels of government: national, state and local (United States Department of State, 2007). As with China, the multilevel governance architecture that supports U.S. policy development has implications for climate action. The diffusion of responsibility across jurisdictions can both challenge and enable climate change policy development. At the national level, a system of checks and balances requires legislation to successfully pass through both chambers of Congress, the House of Representatives and the Senate. The division of voting members of Congress between parties, which often hold distinct ideological positions on issues, can challenge the adoption of new legislation where partisanship exists.

In the face of profoundly polarised positions on climate change across government, industry and society, any meaningful national action on climate change in the U.S. is easily thwarted (Brewer & Pease, 2008). Evidence suggests, however, that sub-national levels of the U.S. government can – and do – forge ahead in the absence of national leadership on climate change, often setting the standard for national governments to follow (Selin & VanDeveer, 2013). For example, 28 U.S. states included GHG emissions reduction targets in state Climate Action Plans developed in the mid-1990s (Byrne, Hughes, Rickerson, & Kurdgelashvili, 2007). Further, in 2009 nine states formed a Regional Greenhouse Gas

Initiative, committing to a cap-and-trade scheme for carbon emissions from their power plants with intentions to reduce emissions longer-term (Selin & VanDeveer, 2013).

Although a developed country, the U.S. is not immune to the impacts of climate change, nor the associated economic costs. In 2016, the U.S. Global Change Research Program (USGCRP) released a scientific assessment of the impacts of climate change on human health in the U.S. The report noted that between 2004 and 2013, approximately 3,300 fatalities were attributable to heat waves, tornadoes and hurricanes, with cumulative economic and health costs of more than USD$500 billion (Crimmins et al., 2016, p.12). Further, climate change in the U.S. exacerbates domestic inequality; under business-as-usual emissions, economy-wide direct damages are projected to cost approximately 1.2 percent of GDP for every additional degree of average surface temperature increase and the poorest counties are expected to experience damages that account for up to 20 percent of county income (Hsiang et al., 2017).

As with China, the U.S. has experienced a shift in the direction of climate change mitigation policy development in the last decade. While political action on climate change in the U.S. dates back to 1987 when the U.S. government first introduced the *Global Climate Protection Act*, climate change mitigation policy development under the Presidential leadership of George H.W. Bush, Bill Clinton and George W. Bush from the late 1980s through to 2008 was relatively homogenous, with GHG emissions reduction pursued through non-interventionist, 'no regrets' policies that focused largely on industry-supported efforts, such as investments in research and development and voluntary reductions (Brewer & Pease, 2008).

Following the election of Barack Obama as U.S. President in 2008, who had voiced comparatively ambitious, long-term emissions reduction targets during his Presidential election campaign, the U.S. EPA took a more proactive regulatory approach to the reduction of GHG emissions. This approach was supported by a legislative lever afforded to the government by the Supreme Court, which is discussed in greater detail below. One of the first climate change policies introduced by Obama was the introduction of legislation that reaffirmed a commitment to develop a low-carbon economy and required all federal agencies to lead by example and reduce GHG emissions through a variety of measures (Executive Office of the President of the United States, 2009). In line with his Presidential election promise, in 2009 Obama also pledged that the U.S. government would pursue a GHG emissions reduction target of 17 percent compared with 2005 levels by 2020 (Executive Office of the President of the United States, 2013).

In 2013, the President's Climate Action Plan was published and set the overarching framework for U.S. climate change policy development under the Obama Administration. The Plan outlined three key pillars for action: 1) a reduction in domestic carbon pollution; 2) domestic preparation for climate change impacts; and 3) leadership at the international level (Executive Office of the President of the United States, 2013). Concurrent to the development of a suite of climate change mitigation policies, the Obama Administration continued to support collaborative efforts between federal agencies to strengthen the scientific base that supports the development of climate change policies. In 2009, the second National Climate Assessment report was released by the USGCRP, followed by the third in 2014 and the fourth in 2017. The Obama Administration indicated that the outputs of the U.S.GCRP were critical for providing the scientific evidence required for informed climate change decision-making and allocated more than USD$2.7 billion to the development of climate science in the fiscal year 2014 budget (Executive Office of the President of the United States, 2013).

In the realm of climate change and health, the Interagency Working Group on Climate Change and Health was created in 2009 with diverse representation from across federal agencies, institutes, and relevant health institutions. The group was responsible for preparing an initial strategic review of the effects of climate change on human health in order to form the basis of the current knowledge base as well as to identify research gaps (Portier et al., 2010).

The role of scientific evidence in U.S. climate change policy development is highlighted in the example of the Clean Air Act. While a detailed examination of climate-related legislation is out of scope, it is crucial to discuss *An Act to Improve, Strengthen, and Accelerate Programs for the Prevention and Abatement of Air Pollution (1963)* (Clean Air Act*;* CAA) and related amendments given its pivotal role in the development of mitigation measures for both GHG and non-GHG emissions under the Obama Administration. The CAA was initially introduced to support the development of programs to monitor and control air pollution. It has been amended several times, including in 1965 when the U.S. government introduced legislation to introduce vehicle emissions standards. Section 202 of the CAA provides that if, based on the U.S. EPA Administrator's judgement, any air pollutant is endangering public health, the U.S. EPA can regulate the emission of the air pollutant from any class of new motor vehicles.

A critical turning point in the development of U.S. climate change policy came with the Supreme Court's ruling in April 2007 on *Massachusetts et al. vs Environmental Protection*

Agency[14]. The Supreme Court overturned a decision made by the D.C. Circuit Court of Appeals based on a 1999 petition brought to the U.S. EPA to regulate GHGs based on Section 202 of the CAA. Following the Supreme Court ruling, the U.S. EPA Administrator released an advanced notice of proposed rulemaking (ANPR) seeking public comment on how to respond to the Supreme Court's decision (United States Environmental Protection Agency, 2008). Two concerns appeared to preoccupy the Administrator. The first was the magnitude of authority that the ruling transferred to the EPA:

> "One point is clear: The potential regulation of greenhouse gases under any portion of the Clean Air Act could result in an unprecedented expansion of EPA authority that would have a profound effect on virtually every sector of the economy and touch every household in the land." (United States Environmental Protection Agency, 2008, p.44355)

The second related to the costs to industry associated with implementing such a rule:

> "Policymakers and the public must consider a broader question: even if greenhouse gas regulation using a law designed for very different environmental challenges is legally permissible, is it desirable? We contend that it is not. We are concerned that attempting to regulate greenhouse gases under the Clean Air Act will harm the U.S. economy while failing to actually reduce global greenhouse gas emissions." (United States Environmental Protection Agency, 2008, p.44362)

Soon after the U.S. EPA released the ANPR, Barack Obama was elected President. A year after President Obama's election, in December 2009, the U.S. EPA Administrator published her finding that compelling scientific evidence existed to define six GHGs[15] as air pollution for the purposes of regulation under Section 202 of the CAA (United States Environmental Protection Agency, 2009). This exceptional finding paved the way for the U.S. EPA to develop regulatory legislation to support the reduction of GHG emissions in the U.S.

Since 2008, the U.S. EPA has been using the social cost of carbon (SCC or SC-CO_2) methodology to account for the health and welfare benefits of GHG emissions reduction. The

[14] Upon receipt the petition in 1999, the U.S. EPA refused to regulate GHGs arguing that the relationship between GHGs and global surface air temperature was not "unequivocally established" and regulation of GHGs was counter to the President's policy position to encourage industry to reduce emissions voluntarily (Payne & Rosenbaum, 2007). The petitioners initially took the U.S. EPA's denial to the D.C. Circuit Court of Appeals for review; both judges on the D.C. Circuit agreed with the U.S. EPA. Following the review decision, the petitioners took an appeal to the U.S. Supreme Court. The Supreme Court determined that not only did the U.S. EPA have the authority to regulate GHGs, but it could also not deny exercising its authority on the grounds of a preferred policy position without due consideration of the scientific evidence (Payne & Rosenbaum, 2007).

[15] The six long-lived and directly-emitted GHGs regulated under the ruling include CO_2, methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons, and sulfur hexafluoride.

SCC method estimates the monetised value of impacts associated with changes to carbon emissions on agriculture, human health and ecosystem services for any given year (United States Department of State, 2014). The development of a standardised method for the purposes of incorporating benefits consistently into benefit-cost analyses further entrenched a commitment to a more holistic consideration of the potential impacts of climate change policy options.

Supporting the overarching aims highlighted in the President's Climate Action Plan, the U.S. EPA and other federal agencies, including the Department of Transport's National Highway Traffic Safety Administration, developed a suite of emission and fuel efficiency standards for both existing and new stationary and mobile sources of fossil fuel emissions (United States Department of State, 2016). Specifically, the U.S. introduced increasingly stringent GHG emissions performance standards for light-, medium- and heavy-duty engines across successive years from 2010 to 2016.

In 2014, the U.S. released its INDC for COP21, committing to an economy-wide GHG emissions reduction target of 26 to 28 percent below 2005 levels by 2025. In 2015, the U.S. EPA finalised carbon pollution standards for fossil fuel-powered plants, the first ever mitigation measure for carbon emissions to be legislated in the U.S. The standards were introduced to reduce carbon emissions from power plants by 32 percent by 2030 compared with 2005 levels. The legislation was heralded for its prioritisation of health, given "the effects on human wellbeing form the basis of the rationale behind the plan, with economic and more general environmental reasons taking a back seat" (The Lancet Respiratory Medicine, 2015).

A concern for many critics of the tranche of climate change policies introduced over the past decade has been the impact of such regulatory measures on the economy. Analysis, however, has demonstrated that this concern is unwarranted. The U.S. EPA demonstrated the net benefits associated with regulatory mitigation measures implemented through the Clean Air Act. In 2011, the U.S. EPA released a report as required by the Clean Air Act that estimates the benefits and costs of the Clean Air Act. The report provided prospective analysis out to 2020 using enhanced models and methodologies. For the first time, the report examined "economy-wide implications of the direct costs *and* the health benefits" of the Clean Air Act on economic productivity (United States Environmental Protection Agency, 2011b, p.2; emphasis in original). The report concluded that:

> "…the annual dollar value of benefits of air quality improvements will be very large, and will grow over time as emissions control programs take their full effect, reaching a level

> of approximately $2.0 trillion in 2020. …Most of these benefits (about 85 percent) are attributable to reductions in premature mortality associated with reductions in ambient particulate matter…Our central benefits estimate exceeds costs by a factor of more than 30 to one…" (United States Environmental Protection Agency, 2011b, Abstract)

Additionally, in its Second Biennial to the UNFCCC in 2016, the Obama Administration highlighted that through a strategic, complementary suite of policies it has successfully decoupled emissions and economic growth. Since 2005, despite real GDP growth of 13 percent, net emissions have declined by an average of 1.3 percent annually, equating to a 10 percent reduction below 2005 levels (United States Department of State, 2016). In the same year, the Obama Administration released a long-term strategy to support the transition to a low-carbon economy, pledging to pursue "economy-wide net GHG emissions reductions of 80 percent or more below 2005 levels by 2050" (The White House, 2016c, p. 6).

The election of Donald Trump in 2016 signalled another drastic shift in the trajectory of U.S. climate change mitigation policy. Under the Trump Administration, the U.S. EPA quickly began to review all climate-related policies following the introduction of two pieces of legislation by President Trump. The first called on federal agencies to repeal at least two existing regulations in order to control regulatory costs (Executive Office of the President of the United States, 2017a). The second required federal agencies to immediately review existing regulations that potentially *burden* the development of any domestically produced energy source (Executive Office of the President of the United States, 2017b; emphasis added).

6.2.3 Concerted Sino-American Efforts to Collaborate on Mitigation Measures

Collaboration between China and the U.S. on GHG emissions reduction began in earnest in 2009, when the two countries signed a Memorandum of Understanding to Enhance Cooperation on Climate Change, Energy and the Environment (Schreurs, 2017). This was reaffirmed in 2013 with a joint agreement to phase out the potent GHG HFCs (People's Republic of China National Development and Reform Commission, 2013). In November 2014, the two countries released a Joint Announcement on Climate Change fortifying their bilateral relationship and reiterating their commitment to climate action (The White House, 2014).

Two additional Joint Presidential Statements on Climate Change were released in September 2015 and March 2016, preceding and proceeding the successful negotiation of the Paris Agreement in December 2015 (The White House, 2015, 2016b). Finally, in September 2016 just prior to the election of Donald Trump as President of the U.S., the White House

released a statement summarising U.S.-China climate change cooperation to date and reasserting that the two largest carbon emitters would continue to work collaboratively with each other as well as other Parties to the UNFCCC to address climate change (The White House, 2016a). While the recent shift in Sino-American relations regarding climate change is out of scope for this chapter, it is of note that following the election of the Trump Administration in September 2016, the consequent initiation of the U.S. withdrawal from the Paris Agreement and the review of many of the Obama Administration's suite of climate policies, China's relationship with the U.S. on climate change has undoubtedly altered, with indications that China is moving to align itself more closely with the EU.

The domestic circumstances and context provided above sets the scene for analysis of the role of health co-benefits in the development of climate change mitigation policies. I now detail the methods used to analyse Chinese and American policy documents.

6.3 Methods

The theoretical and analytical frameworks, as well as the research methods used to undertake this study, were detailed in Chapters 2 and 3. To avoid unnecessary repetition, this methods section has been truncated.

Due to time and resource constraints, a modified approach was used to analyse the role of health co-benefits in China and the U.S. Specifically, I did not undertake interviews with Chinese and American policy-makers nor did I translate any climate change policy documents published in Mandarin. Discussed further in the next chapter, I acknowledge that these parameters are limitations of the study and represent a future research opportunity.

Selection Criteria for Policy Documents. Several criteria informed the selection of Chinese and American climate change policy documents, including criteria regarding authorship, content, language and accessibility requirements (see Appendix D for full details). In summary, I selected policy documents published by Chinese or American government bodies between 2007 and 2017 with a focus on national climate-related mitigation efforts or health-related mitigation activities that were published in the English language and were publicly accessible online. Given the small number of documents initially identified, I expanded the selection criteria for China only to include documents with an environmental health focus.

Selection of Policy Documents. Based on the selection criteria above, I searched Chinese and American government websites as well as the UNFCCC website in order to identify as many applicable policy documents as possible. I identified 23 documents for China and 244

documents for the U.S. Of these, I analysed 13 documents for China and 34 documents for the U.S. (see Appendices C and D for the selection criteria and full list of documents analysed). There is a substantial discrepancy between the number of Chinese and American policy documents identified. One explanation for this discrepancy is the limited number of Chinese policy documents translated into English. A second explanation for this discrepancy relates to U.S. domestic policy-making during the 2007-2017 period; specifically, the Obama Administration developed a suite of climate change mitigation policies to pursue ambitious emissions reduction targets.

Directed Qualitative Content Analysis. In order to align analysis of Chinese and American climate change policy documents as closely as possible to the processes utilised for analysing Australian and EU policies, I employed directed qualitative content analysis to assess the role of health co-benefits in the development of climate change mitigation policies in China and the U.S. I adopted the same six themes that informed the interview schedule used in developing case studies for Australia and the EU: i) the policy-making process; ii) factors influencing the prioritisation of multiple considerations; iii) barriers and enablers for the consideration of health in mitigation policy; iv) the evidence base for policy development; v) the role of external actors and stakeholders; and vi) the communication of policy decisions. In order to perform content analysis, each document was uploaded to NVivo (NVivo, 2014) and coded based on the six themes above. One additional sub-theme, 'government actions', emerged during coding. This sub-theme is distinct from the policy-making process and captured statements on specific existing and proposed climate-related policies and legislation as opposed to the policy-making process more broadly.

A table summarising results for China and the U.S. is available at Appendix G. Detailed results are presented below first for China (section 6.4), followed by the U.S. (section 6.5). Results are further stratified in these sections by the six themes identified above: i) policy-making process; ii) factors influencing the prioritisation of multiple considerations; iii) barriers and enablers to the consideration of health; iv) the evidence base of policy development; v) the role of external actors and stakeholders; and vi) the communication of policy decisions.

6.4 Results for China

Results for China suggest that despite a number of claims to the contrary (e.g., see Engels, 2018; F. Green & Stern, 2017; Holdaway, 2013), health co-benefits do not appear to be an explicit consideration in climate change mitigation policy development. Health is discussed in relation to i) environmental health more broadly; ii) implications for health from air, water and

soil pollution; and iii) climate change adaptation measures, but it is not explicitly mentioned in relation to climate change mitigation measures. Specific results are presented below, stratified by coding theme.

6.4.1 Policy-Making Process

Detailed information on the policy-making process was not included in Chinese climate change policy documents, which is not entirely unexpected given China's one-party governance structure. There are, however, two insights into overarching elements of the policy-making process that can be gleaned. Firstly, it is clear that characteristically Chinese politico-economic ideologies and conceptual frameworks guide policy development:

> "Under the guidance of Deng Xiaoping Theory and important thought of "Three Representatives", we should thoroughly carry out the Scientific Outlook on Development, adhere to people-oriented policy…building a harmonious society and achieving sustainable development." (People's Republic of China Ministry of Environmental Protection, 2011, p.5)

Secondly, as identified earlier in the chapter, the institutional arrangements for climate action embrace an inter-Ministerial approach:

> "To practically strengthen the leadership for addressing climate change and energy-conservation and emission reduction, in June 2007, the Chinese government decided to set up the National Leading Group on Climate Change, Energy Conservation and Emissions Reduction…In 2013…member ministries…increased from the initial 20 to 26…" (People's Republic of China, 2016, p.11)

6.4.2 Factors Influencing the Prioritisation of Multiple Considerations

Analysis indicates that a number of factors influence final climate change policies in the face of multiple considerations in China. First and foremost, the reality of China's transitioning economy and current fuel mix are two factors that influence the prioritisation of multiple considerations during climate change policy development:

> "as a developing country at a low development stage, with a huge population, a coal-dominant energy mix and relatively low capacity to tackle climate change, China will surely face more severe challenges when coping with climate change along with the acceleration of urbanization, industrialization and the increase of residential energy consumption." (People's Republic of China National Development and Reform Commission, 2007, p.14)

Employment is a third factor that influences the Chinese government's prioritisation of multiple considerations in the development of climate change mitigation policies:

> "Huge population results in huge employment pressure, with annually more than 10 million new labor forces in the urban areas and about 10 million new rural labor forces moving to the urban areas as a result of the urbanization process." (People's Republic of China National Development and Reform Commission, 2007, p.15)

Finally, the valuation of economic damages associated with a changing climate is a factor that the Chinese government are aware of as they develop climate change policies:

> "China is subject to impacts of severe climatic disasters, which, featuring high frequency, intensity and wide exposure, cause huge direct losses. In 2014, climatic disasters hit 24.89 million hectares of crops, of which 3.09 million hectares of crops were demolished. At the same time, China reported RMB 103 billion yuan in direct economic losses caused by floods and geological disasters, 83.6 billion yuan by droughts, 12.9 billion yuan by low temperature, cold damage and snow disasters, and 13.6 billion yuan by ocean disasters." (People's Republic of China, 2016, p.2)

6.4.3 Barriers and Enablers to the Consideration of Health in Mitigation Policy

Two barriers and three enablers were identified as informing the consideration of health in the development of Chinese climate-related mitigation policies. Firstly, although not explicitly related to climate change in this instance but environmental health more broadly, a lack of baseline health data and operational management framework acts as a barrier to the consideration of health in policy development:

> "[A] lack of baseline data became a bottleneck in addressing environment and health problems…Since the 1990s, no nationwide or regional large scale environment and health investigation has been carried out. Basic and continuous investigations and monitoring have not been included in the routine work… effective management instruments and methods to deal with environment and health problems are lacking…" (People's Republic of China Ministry of Environmental Protection, 2011, p.3)

Secondly, explicit references to health appear only in relation to adaptation measures in climate change policy documents, suggesting that health is primarily viewed as relevant to adaptation:

> "In human health sector, China implemented the prevention and control of the diseases closely related to climate change, strengthened the studies on the health problems relevant to climate change and its adaptation, and launched the *Project on*

> *the Adaptation to Climate Change to Protect Human Health*." (People's Republic of China, 2016, p.122)

In terms of enablers, recognition that a changing climate will result in negative consequences for human health provides a platform for the consideration of health in the development of mitigation policies:

> "Climate change may increase the frequency and intensity of the heat waves, hence increase deaths and serious diseases induced by extreme high temperature events. Climate change is likely to stimulate the emergence and spread of some diseases and to increase the magnitude and scope of diseases like cardiovascular diseases, malaria, dengue fever, and heatstroke, endangering human health." (People's Republic of China National Development and Reform Commission, 2007, p.19)

A second enabler for the consideration of health in climate change mitigation policy is changing expectations of an increasingly educated and cognisant Chinese public:

> "Protecting the environment and guaranteeing public health [has] become the most urgent demand of the public." (People's Republic of China Ministry of Environmental Protection, 2011, p.2)

A third enabler is recognition that a reduction in coal consumption can positively impact air quality:

> "In the 12th FYP Period, China intensified its control of GHG emissions…and further combated and controlled climate change and air pollution in a synergetic manner." (People's Republic of China, 2016, p.55)

6.4.4 The Evidence Base of Policy Development

While it is difficult to determine the overall influence of scientific evidence on policy development, there are indications that the Chinese government places importance on a role for scientific expertise that supports the development of climate change mitigation policies:

> "In support of the science-based national decision-making on climate change, China has established the National Panel of Experts on Climate Change, which provides scientific advisories and policy-relevant suggestions on strategies, guidelines, policies, legislations & regulations, and measures for coping with climate change." (People's Republic of China, 2012, p.47)

6.4.5 The Role of External Actors and Stakeholders

Despite being an authoritarian regime, there is evidence that the Chinese government recognises that in order to achieve its mitigation goals, a working relationship with business and civil society must exist:

> "…the State Council issued the Comprehensive Working Program of Energy Conservation and Emission Reductions in the 12th FYP Period, which made clear requirements on strict observance of the energy conservation and emission control targets and responsibilities, to further put in place a government-steering market-driven energy conservation and emission control paradigm of full public participation and with enterprise as a principal actor." (People's Republic of China, 2016, p.36)

6.4.6 The Communication of Policy Decisions

In relation to the communication of policy decisions, there was no explicit evidence to suggest that health was used as a communications frame beyond an acknowledgement that economic damages associated with climate change have health implications. There were, however, indications that the Chinese government is conscious of a public mandate that is supportive of action on climate change, in particular the implementation of mitigation measures:

> "The China Center for Climate Communication organized the second national survey of public awareness on climate change, and the results showed a notable improvement in the conscious actions of the public to deal with climate change. 96.8% of the respondents supported the Chinese Government to carry out international cooperation in the field of climate change, 95% adopt mitigation policy measures, and 96.9% control the total carbon dioxide and other GHG emissions…" (People's Republic of China National Development and Reform Commission, 2017, p.40)

There was also evidence of a commitment to enhancing education about environmental health more broadly:

> "In order to enhance public awareness of environmental health and the public's ability to participate, we will establish special columns, issues and channels on the popularization of environmental and health sciences, develop a variety of high-quality columns and other products relating to environmental health education with full use of public media including general newspapers, periodicals, television, radio and the internet." (People's Republic of China Ministry of Environmental Protection, 2011, p.10)

6.5 Results for the U.S.

Results for the U.S. are in stark contrast to China. Under the Obama Administration's leadership from 2009 until 2016, health constituted a core component of the development of climate change mitigation policies, as well as air pollution mitigation policies. Led by the U.S. EPA, in collaboration with other agencies, the U.S. pursued integrated emissions reduction policy development for stationary and mobile sources. Further, recognition of the health impacts of a changing climate and the health co-benefits that result from mitigation is explicit in messaging around the rationale for climate action. Results are presented below by coding theme.

6.5.1 Policy-Making Process

Analysis of U.S. climate change policy documents provided insight into the U.S. climate change policy-making process. It is clear that regulatory impact analyses are a standard component of the policy development process in order to assess the potential costs and benefits associated with any proposed regulation. There is also explicit recognition that policy development is underpinned by economic modelling:

> "The Global Change Assessment Model (GCAM), an economy-wide model that captures important interactions across energy and land sectors and additional sources of non-CO2 emissions, is central to our MCS development." (The White House, 2016c, p.29)
>
> "…EPA analyzed the costs using the IPM [Integrated Planning Model]. The IPM is a dynamic linear programming model that can be used to examine the economic impacts of air pollution control policies for a variety of…pollutants throughout the contiguous U.S. for the entire power system." (United States Environmental Protection Agency, 2012, p.9425)

Secondly, as identified earlier in the chapter, as part of the modelling and impact analysis process, an estimation of the economic and human benefits that result from mitigation measures is explicitly integrated and considered in the policy development process both quantitatively and qualitatively:

> "The U.S. government analyzes the anticipated economic effects of its proposed standards and policies. A key element of these analyses has been the estimation of the potential economic and human welfare benefits of reduced GHGs. Specifically, federal agencies use a metric known as the social cost of carbon (SCC) to estimate the dollar value of the benefits of regulatory actions that affect CO2 emissions." (United States Department of State, 2014, p.99)

> "…we compile and present benefits that cannot be expressed in economic terms. In some cases, we calculate quantitative estimates of scenario differences in the incidence of a nonmonetized effect. In many other cases, available data and techniques are insufficient to support anything more than a qualitative characterization of the change in effects." (United States Environmental Protection Agency, 2011b, p.10)

6.5.2 Factors Influencing the Prioritisation of Multiple Considerations

There appear to be several factors that influence the prioritisation of multiple considerations in the development of U.S. climate change mitigation policies. It is also clear that influential factors changed between the Bush and Obama Administrations. For example, it is evident that economic considerations, among other things, were influential in the Bush Administration's prioritisation of multiple considerations in the development of climate change mitigation policies:

> "The U.S. strategy integrates measures to address climate change into a broader agenda that promotes energy security, pollution reduction, and sustainable economic development. This integrated approach recognizes that actions to address climate change, including actions to mitigate greenhouse gas (GHG) emissions, will be more sustainable and successful if they produce multiple economic and environmental benefits." (United States Department of State, 2007, p.2)

Economic costs remained an influential factor for the Obama Administration, particularly given the propensity for regulations to be challenged through judicial proceedings:

> "in several cases the DC Circuit has elaborated on this cost factor and formulated the cost standard in various ways, stating that the EPA may not adopt a standard the cost of which would be ''exorbitant,'' ''greater than the industry could bear and survive,'' ''excessive,'' or ''unreasonable''." (United States Environmental Protection Agency, 2016, p.35829)

However, other factors were clearly influential in the prioritisation of climate change mitigation policy development. A recurring factor throughout climate change mitigation policies between 2009 and 2016 relates to intra- and inter-generational equity:

> "…the Administrator places weight on the fact that certain groups, including children, the elderly, and the poor, are most vulnerable to these climate-related health effects." (United States Environmental Protection Agency, 2009, p.66498)
>
> "We have an obligation to current and future generations to take action to meet this challenge." (United States Department of State, 2014, p.7)

This was reaffirmed specifically in relation to the Clean Power Plan, where key factors influencing the final policies included energy supply security as well as the economic costs of the proposed regulations for vulnerable communities:

> "In this final rule, we have taken care to ensure that achievement of the required emission reductions will not compromise the reliability of our electric system, or the affordability of electricity for consumers." (United States Environmental Protection Agency, 2015a, p.64663)
>
> "In proposing a federal plan, the EPA considered a variety of potential impacts that its action might have on the environment, on businesses, particularly in the energy sector, and on the reliability of the electrical grid. The agency gave extensive consideration to impacts on vulnerable communities, particularly low-income communities, communities of color, and indigenous communities." (United States Environmental Protection Agency, 2015b, p.64969)

Employment impacts of regulations in the aftermath of the global financial crisis comprised another recurring factor influencing climate change mitigation policies:

> "Although a stand-alone analysis of employment impacts is not included in a standard cost-benefit analysis, the current economic climate has led to heightened concerns about potential job impacts." (United States Environmental Protection Agency, 2011a, p.48318)

While not specifically in relation to climate change mitigation policies, the election of the Trump Administration led to the re-prioritisation of key issues with major implications for climate change mitigation policies developed under the Obama Administration:

> "It is in the national interest to promote clean and safe development of our Nation's vast energy resources, while at the same time avoiding regulatory burdens that unnecessarily encumber energy production, constrain economic growth, and prevent job creation." (Executive Office of the President of the United States, 2017b, p.16093)

6.5.3 Barriers and Enablers to the Consideration of Health in Mitigation Policy

Three barriers and four enablers were identified in affecting the consideration of health in the development of U.S. mitigation policies. In contrast to China, the enablers are presented before the barriers below, in order to follow the chronological order of the examples presented. Under the Obama Administration, three enablers supported the consideration of health in the development of climate change mitigation policies. Firstly, an enabler for the consideration of health in mitigation policies is the Obama Administration's decision to use credible individuals

– in this case, the Surgeon General and the U.S. EPA Administrator Gina McCarthy, an environmental health and air quality expert – to communicate the health implications of a changing climate to the broader public:

> "In April 2015, the Surgeon General spoke publicly about climate change impacts to health following a roundtable discussion on the topic with the President, the EPA Administrator, and others, and also used social media to solicit and respond to questions about health impacts from climate change. The U.S. EPA Administrator has also communicated about these risks to a variety of audiences, citing climate change as among the most significant threats to public health." (United States Government Accountability Office, 2015, p.26)

Secondly, as detailed earlier in the chapter, the U.S. EPA's determination that GHG emissions negatively impacted human health was vital to supporting the consideration of health in future climate change and air pollution mitigation policies proposed by the Obama Administration:

> "In the Endangerment Finding, which focused on public health and public welfare impacts within the United States, the Administrator found that elevated concentrations of GHG emissions in the atmosphere may reasonably be anticipated to endanger public health and welfare of current and future generations." (United States Environmental Protection Agency & United States National Highway Traffic Safety Administration, 2016, p.73486)

Thirdly, by taking a holistic approach in the assessment of the potential benefits and costs associated with U.S. emissions reduction policies, and utilising the most advanced methodologies in order to account for as many benefits as possible despite limitations and uncertainty, the U.S. EPA were able to demonstrate that the benefits of mitigation measures far outweigh the costs. This in and of itself further enables and promotes the consideration of health in mitigation policies:

> "The results of our analysis…make it abundantly clear that the benefits of the CAAA [the Clean Air Act Amendments of 1990] exceed its costs by a wide margin, making the CAAA a very good investment for the nation…" (United States Environmental Protection Agency, 2011b, Abstract)

In relation to barriers, quantifying and monetising the costs is an easier process with fewer certainties around the robustness of the final values. Limitations in models, current knowledge of health-emission exposure pathways as well as access to reliable data often act as barriers in terms of being able to account for all, or even any, of the benefits:

> "The monetized benefits used in the net benefit calculations reflect only a portion of the total benefits due to limitations in analytical resources, available data and models, and the state of the science…" (United States Environmental Protection Agency, 2011b, p.10)
>
> "Every benefit analysis examining the potential effects of a change in environmental protection requirements is limited, to some extent, by data gaps, model capabilities (such as geographic coverage), and uncertainties in the underlying scientific and economic studies used to configure the benefit and cost models." (United States Environmental Protection Agency, 2015b, p.65048)
>
> "…the ability to evaluate, monitor, and project health effects varies across climate impacts. For instance, information on health outcomes differs in terms of whether complete, long-term datasets exist that allow quantification of observed changes, and whether existing models can project impacts at the timescales and geographic scales of interest." (Crimmins et al., 2016, p.5)

A second barrier is the amount of funding dedicated to climate change and health research:

> "…NIH, which awards financial assistance for research, reports that it awarded about $6 million to support research on the health impacts of climate change in fiscal year 2014. This amount comprised a relatively small portion—about 0.025 percent—of the approximately $24 billion that NIH awarded for research that year." (United States Government Accountability Office, 2015, p.19)

An additional two barriers are relevant to the Trump Administration's approach to climate change policy development. Firstly, under the leadership of a new Administrator, the U.S. EPA confirmed its intentions to review the SC-CO_2 methodology, with potential implications for calculating the health co-benefits that result from mitigation measures:

> "as part of a project now underway, the EPA is systematically evaluating the uncertainty associated with its technique for generating and applying this reduced-form technique for quantifying benefits, with the goal of better understanding the suitability of this and comparable approaches to estimating the health impacts of criteria pollutant emissions changes." (United States Environmental Protection Agency, 2017, p.48044)

Secondly, the U.S. EPA raised another important issue that may act as a barrier, not necessarily to the consideration of health co-benefits *per se*, but to their influence on the final policy outcome:

> "Regulating pollutants jointly can promote a more efficient outcome in pollution control management. However, in practice regulations are promulgated sequentially and

> therefore, the benefit-cost analyses supporting those regulations are also performed sequentially. The potential for interaction between regulations suggests that their sequencing may affect the realized efficiency of their design and the estimated net benefits for each regulation." (United States Environmental Protection Agency, 2017, p.48044)

6.5.4 The Evidence Base for Policy Development

While funding for climate change and health research has historically been insufficient, it is evident that scientific evidence more broadly plays a pivotal role in the development of U.S. climate change mitigation policies. Inter-departmental collaboration supporting climate change science has been a feature of U.S. climate-related architecture for three decades. Formerly the Climate Change Science Program, the USGCRP has been responsible for the development of four National Climate Assessments that facilitate the translation of climate change research into policy:

> "The essential capacities for research and observations are widely distributed across U.S. government agencies, and are brought together into a single interagency program through the USGCRP. Growing out of interagency activities and planning that began in 1988, the creation of the USGCRP energized cooperative interagency activities, with each agency bringing its strengths to the collaborative effort. The FY 2010 budget provides over $2 billion for programs under the USGCRP—an increase of $46 million, or about 3 percent, over the 2009 level…" (United States Department of State, 2010, p.8)

There is also evidence to suggest that experts play a role in quality assurance through verifying the rigour of methods used by policy-makers:

> "We base our analysis of the program's impact on human health and the environment on peer-reviewed studies of air quality and human health effects...Our methods also undergo rigorous review by many independent expert panels, including the Science Advisory Board and the National Research Council." (United States Environmental Protection Agency, 2014, p.23610)

The aforementioned endangerment finding that proved a pivotal decision in enabling health to drive the development of mitigation policies was primarily justified on the basis of a robust scientific evidence base:

> "The Administrator has determined that the body of scientific evidence compellingly supports this finding. The major assessments by the U.S. Global Climate Research Program (USGCRP), the Intergovernmental Panel on Climate Change (IPCC), and the

> National Research Council (NRC) serve as the primary scientific basis supporting the Administrator's endangerment finding. The Administrator reached her determination by considering both observed and projected effects of greenhouse gases in the atmosphere, their effect on climate, and the public health and welfare risks and impacts associated with such climate change." (United States Environmental Protection Agency, 2009, p.66497)

Further, the established scientific basis constituted one of the chief motivations in the U.S. EPA's denial of petitions to reconsider the endangerment finding:

> "The science supporting the Administrator's finding that elevated concentrations of greenhouse gases in the atmosphere may reasonably be anticipated to endanger the public health and welfare of current and future U.S. generations is robust, voluminous, and compelling, and has been strongly affirmed by the recent science assessment of the U.S. National Academy of Sciences." (United States Environmental Protection Agency, 2010, p.49556)

6.5.5 The Role of External Actors and Stakeholders

Analysis of climate change policy documents reveals that there are both targeted and general stakeholder consultation processes in place as part of the policy development process in order to ensure that key industries as well as members of the public can provide feedback on and input into proposed regulations:

> "This rule builds on our commitment to robust collaboration with stakeholders and the public. It follows an expansive and thorough outreach effort in which the agencies gathered input, data and views from many interested stakeholders, involving over 400 meetings with heavy-duty vehicle and engine manufacturers, technology suppliers, trucking fleets, truck drivers, dealerships, environmental organizations, and state agencies." (United States Environmental Protection Agency & United States National Highway Traffic Safety Administration, 2016, p.73480)

Unsurprisingly, major stakeholders for climate change mitigation policies include affected industries and states. In relation to vehicle emission and fuel standards, concerted efforts were made to accommodate affected industries, particularly in the face of cross-jurisdictional policy discrepancies:

> "We received more than 200,000 public comments. A broad range of stakeholders provided comments, including state and local governments, auto manufacturers, emissions control suppliers, refiners, fuel distributors and others in the petroleum industry, renewable fuels providers, environmental organizations, consumer groups,

> labor groups, private citizens, and others…Auto manufacturers have stressed the importance of being able to design, produce, and sell a single fleet of vehicles in all 50 states...To that end, we worked closely with the California Air Resources Board and vehicle manufacturers to align the two programs as closely as possible." (United States Environmental Protection Agency, 2014, p.23418)

Finally, there was explicit acknowledgement that consultation takes place at the international level:

> "The agencies also met with regulatory counterparts from several other nations who either have already or are considering establishing fuel consumption or GHG requirements, including outreach with representatives from the governments of Canada, the European Commission, Japan, and China." (United States Environmental Protection Agency & United States National Highway Traffic Safety Administration, 2016, p.73484)

6.5.6 The Communication of Policy Decisions

In relation to the final analytical theme, the use of health as a communications frame is evident in key messaging by the Obama Administration that employs a multiple benefits approach to justify the pursuit of comparatively ambitious climate change mitigation policies in the face of considerable cost:

> "President Obama is putting forward a broad-based plan to cut the carbon pollution that causes climate change and affects public health. Cutting carbon pollution will help spark business innovation to modernize our power plants, resulting in cleaner forms of American-made energy that will create good jobs and cut our dependence on foreign oil. Combined with the Administration's other actions to increase the efficiency of our cars and household appliances, the President's plan will reduce the amount of energy consumed by American families, cutting down on their gas and utility bills." (Executive Office of the President of the United States, 2013, p.5)
>
> "The transition will benefit the U.S. economy in multiple ways…Improved air quality will mean a healthier and more productive workforce. Developing alternative transportation fuels will diversify our energy portfolio, helping to shield the U.S. economy from adverse economic consequences of oil market volatility. Finally, the Paris Agreement signals a sustained shift in the global economy towards low carbon investment, which creates economic opportunity for American businesses." (The White House, 2016c, p.38)

Despite the Obama Administration's efforts to incorporate health into key messaging for climate change mitigation policies, there was recognition from health officials that for the public, the relationship between climate change and health remains tenuous:

> "…health officials told us that stakeholders and the public have limited awareness about climate change as a public health issue, in part because climate change has historically been framed as an environmental issue. State and local health officials discussed climate change impacts on health as an emerging issue that they became aware of within the last decade, in part as a result of educational efforts of the American Public Health Association." (United States Government Accountability Office, 2015, p.37)

Similarly, given concerns the concept and implications of climate change are abstract for the public, the Obama Administration created the concept of carbon pollution – synonymous with GHG emissions – in an attempt to make the impact of GHG emissions more comprehensible to a lay audience:

> "Before President Obama entered office, forecasts projected that U.S. emissions would grow indefinitely. Instead, *carbon pollution* from energy is down 9 percent since 2008. The economy has grown by 10 percent over this period, proving that emissions reductions can co-exist with a strongly growing economy." (The White House, 2016c, p.6; emphasis added)

Finally, the Obama Administration not only discussed the benefits and opportunities of action, it was also explicit about the impacts of delayed action and the role of environmental justice and equity as motivations for climate change action:

> "…a do-nothing approach will disproportionately harm the most vulnerable Americans, including children, the sick, the poor, and the elderly... Existing health disparities and other inequities increase vulnerability to climate health impacts like heat waves, degraded air quality, and extreme weather. Low-income families are the most vulnerable to disruptive events that cause the household breadwinners to miss work." (The White House, 2016c, p.38)

6.6 Discussion

The results documented above expose contrasting attitudes and practices in China and the U.S. toward health co-benefits. For China, health co-benefits do not appear to be a major consideration in the development of Chinese climate change mitigation policies but are influential in the development of air pollution mitigation policies. For the U.S., health co-benefits act as one of the key drivers in the development of both climate change and air pollution mitigation policies given the legislative lever that resulted from the 2009 endangerment finding. The implications of these results are discussed in further detail below.

As a rapidly industrialising country, China's concerted efforts to structurally re-orient its economy toward the service sector and to implement policies that promote a shift away from coal consumption are highly commendable. China was responsible for 40 percent of combined growth in wind and solar photovoltaics generation in 2017, and is now the largest non-hydro renewables-based electricity generator globally (International Energy Agency, 2018). Such achievements have led some researchers to suggest a decoupling of coal consumption and economic growth in China (Qi, Stern, Wu, Lu, & Green, 2016). Further, recent modelling suggests that the implementation of energy intensity, energy efficiency and end-of-pipe measures has resulted in the decoupling of air pollutants from economic growth (Rafaj & Amann, 2018).

Despite this progress, China has been criticised for what are considered "highly insufficient" emissions reduction commitments (NewClimate Institute, Ecofys, & Climate Analytics, 2018b). Further, Chinese CO_2 emissions rose again in 2017, with coal-fired electricity generation increasing due to a higher demand for cooling as a result of unprecedented summer temperatures (International Energy Agency, 2018; NOAA National Centers for Environmental Information, 2018). This reality exposes the precarious position China – and many other countries – face in navigating tensions between transitioning the energy sector while still meeting the needs of the public; a particularly difficult task for an industrialising country.

With this in mind, the motivation for China's decarbonisation efforts appears most likely to be driven by both energy supply security and energy-related economic opportunities (Mathews & Tan, 2014; Schröder, 2012). As a net energy importer with a population that is not expected to peak until 2025 and with a healthy economic growth rate of 6 to 7 percent per annum, China's energy needs will remain high (Schreurs, 2016). Further, as a leading developer and exporter of renewable energy infrastructure, China is capitalising on its investments in the renewable energy sector (Groba & Cao, 2015).

The finding that health co-benefits are not an explicit consideration in the development of climate change mitigation policies is consistent with other analysis. In the lead-up to COP21, WHO analysis determined that there had been no government-led national valuation of the health co-benefits associated with the implementation of climate change mitigation policies in China (World Health Organization, 2015a).

Similarly, there is strong evidence to suggest that health remains a major driver of air pollution mitigation policies. In 2017, Premier Li Keqiang announced the introduction of measures to address poor air quality driven by strong public pressure. Specifically, China introduced policies to facilitate fuel-switching from coal to gas in residential heating. Consequently, China accounted for approximately 30 percent of global growth in natural gas demand in 2017 (International Energy Agency, 2018). In essence, China is reaping climate co-benefits as a result of the implementation of air pollution mitigation policies (Sheehan, Cheng, English, & Sun, 2014).

An opportunity exists to enhance the role of health co-benefits in the development of climate change mitigation policies in China that may help to justify increasingly ambitious mitigation policies more broadly. Cai and colleagues (2018) modelled national and sub-national health benefits resulting from electricity sector mitigation based on China's NDC submitted at COP21. Their results indicate that health co-benefits would offset implementation costs by up to 62 percent by 2030 and would outweigh implementation costs by up to nine times by 2050 (Cai et al., 2018). They conclude that any cost-benefit analysis of climate policy that excludes the consideration of air pollution could substantially underestimate potential benefits. With GHG and non-GHG emissions now regulated under the auspices of one ministry – the MEE – there is the potential to synergistically develop air pollution and climate change mitigation policies and to meaningfully integrate health considerations into policy development.

In contrast, the U.S. introduced comparatively ambitious policies vis-à-vis those of previous administrations once health became the lynchpin around which climate change mitigation policies were pursued following the endangerment finding in 2009. While the evidence strongly indicates that health was a major driver of policy development, there is also robust evidence that other factors, including justice and equity considerations and the opportunities (including economic) afforded from strong climate action, informed U.S. climate change mitigation policy development under the Obama Administration. Further, the evidence presented above demonstrates a clear transition away from the traditional discourse around climate action of costs and burdens toward a reframing around benefits and opportunities.

This result supports the contention that where the political will exists, health co-benefits can be used to justify increasingly ambitious climate change mitigation policies. This positive finding, however, is tempered by the reality of current U.S. climate change mitigation policy development.

In the absence of interviews with policy-makers, it is difficult to ascertain whether health co-benefits motivated and justified increasingly ambitious mitigation policy development or simply represented the most feasible selling point through which the Obama Administration could pursue a commitment to stronger climate action. Further, it is difficult to determine how crucial an integrated approach to climate change and air pollution mitigation policy development was to the ambition of climate change mitigation policies, and the specific influence of health co-benefits in that process.

Reaffirmed by the substantial changes to domestic climate change mitigation policies under the Trump Administration, an integrated approach in and of itself appears insufficient for the development of ambitious mitigation policy development. Returning to a Republican-led Administration has demonstrated the importance of political leadership and ideological values in the development of ambitious climate change policies. Trump has deposed numerous governmental leaders in favour of appointing peers with views more harmoniously aligned with his own; the appointment of climate sceptic and U.S. EPA antagonist, Scott Pruitt, to U.S. EPA Administrator constitutes just one example (Rosner, 2017).

The drastic shift in policies between the Obama and Trump Administrations is also a keen reminder of the malleability of climate change mitigation policy development, especially when processes rely on the use of methods and models based on normative assumptions. The SCC represents a case in point. The Trump Administration has withdrawn all SCC technical guidance developed under the Obama Administration and as mentioned above, the U.S. EPA has recalculated the SCC based on criticism from the Department of Energy that SCC calculations were too high and did not align with the latest science (Frisch, 2017).

While there is cautious optimism that sub-national commitments will in part compensate for the policy vacuum at the national level (Kuramochi, Höhne, Sterl, Lütkehermöller, & Seghers, 2017), there are concerns that the regression in ambition of national climate change mitigation policies and the lack of U.S. political leadership will undermine international climate change politics and architecture, specifically the Paris Agreement (Aldy, 2017).

6.7 Summary

This chapter has presented an analysis of the role of health co-benefits in the development of Chinese and American climate change mitigation policies. Through a process of directed qualitative content analysis, I examined the role of health in select Chinese and American

climate change policy documents. For China, I concluded that contrary to popularly-held views, health co-benefits do not appear to be a significant motivation for the development of climate change mitigation policies. They do, however, appear to be a driver of air pollution mitigation policies. In contrast, health is clearly a primary motivator in the development of both climate change and air pollution mitigation policies in the U.S.

Results for China and the U.S. suggest some similarities and certain distinctions in relation to the role of health co-benefits in the development of Australian and EU climate change mitigation policies. The next chapter brings together results from across the four Parties to the UNFCCC and discusses their implications.

Chapter Seven: Health Co-Benefits and Climate Change Mitigation Policies – A Synthesis and Discussion

7.1 Introduction

The previous three chapters presented results on the role of health co-benefits in the development of climate change mitigation policies in Australia, the EU, China and the U.S. This chapter collates, compares and contrasts these results, answering the research questions that motivate this thesis. While it is difficult to make generalisations that are necessarily applicable to other Parties to the UNFCCC, the results presented below offer insights that extend our understanding of health co-benefits in the development of climate change mitigation policies and facilitate the identification of research and policy implications.

Following the presentation of results, this chapter then considers their implications by returning to compare and contrast results from this study with the pre-existing literature. In elaborating on the factors that influence the consideration of health co-benefits in the policy development process, it becomes evident that several factors influence the role that health co-benefits can and do play in the development of climate change mitigation policies. Following the discussion of research implications, I address the limitations of the study given shortcomings of the research design. The chapter concludes with an outline of policy implications based on the findings presented and discussed.

7.2 Results: A Synthesis

In the introductory chapter of this thesis, I hypothesised that health co-benefits have gained limited traction in climate change mitigation policies as a result of several barriers. To examine this premise, I posed two primary research questions:

1. Are health co-benefits considered and accounted for in the development of national climate change mitigation policies and if so, how?
2. What factors influence whether health co-benefits are considered and accounted for?

In relation to the first question, results from these four Parties to the UNFCCC demonstrate that health co-benefits are a consideration in the development of climate change mitigation policies, with differing approaches employed to support their consideration. Some Parties (Australia and possibly China) consider health co-benefits in a qualitative manner while other Parties (the EU and the U.S.) explicitly consider health co-benefits quantitatively. Further, there appears to be no correlation between the approach taken to consider health co-benefits – that is, a qualitative or quantitative approach – and the level of influence of health co-benefits on the final policies agreed upon.

Table 16 below provides a summary of key results from analysis of the four Parties to the UNFCCC relating to the first research question. The results summarised establish that ***irrespective of whether health co-benefits are considered qualitatively or quantitatively, the political traction of health co-benefits in climate change mitigation policy development is highly contextual***. Specifically, these results highlight that economic and energy considerations are regularly the major drivers of climate change mitigation policies, while health is consistently a key driver of air pollution mitigation policies.

Table 16. Summary of primary results for Australia, the EU, China and the U.S. relating to the first research question

Party to the UNFCCC (year range of analysis)	Key results	Primary mitigation policy driver(s)
Australia (2016)	Climate change mitigation: Health co-benefits considered qualitatively, minimal role on final policies	• Upfront costs of action
	Air pollution mitigation: Health impacts considered, influential role on final policies	• Health
European Union (2017)	Climate change mitigation: Health co-benefits considered qualitatively, minimal role on final policies	• Energy supply security • Upfront costs of action for Member States
	Air pollution mitigation: Health impacts considered quantitatively, influential role on final policies	• Health
China (2007-2017)	Climate change mitigation: No evidence that health co-benefits are explicitly considered in the policy development process	• Energy supply security • Economic and energy opportunity
	Air pollution mitigation: Health impacts considered, influential role on final policies	• Health
United States of America (2007-2017)	Climate change mitigation: Health considered quantitatively, influential role on final policies	• Health • Justice and equity considerations • Economic and energy opportunity
	Air pollution mitigation: Health considered quantitatively, influential role on final policies	• Health

In order to answer the second research question, I adapted Walt and Gilson's (1994) policy analysis framework which facilitated a detailed thematic analysis of the four Parties' policies on climate change mitigation. Doing so assisted me to identify factors that influence the extent to which health co-benefits inform the final climate change mitigation policies agreed upon. Table 17 below presents a summary of results for the four Parties to the UNFCCC across the six analytical themes. The results summarised establish that ***numerous factors and processes inform the development of climate change mitigation policies, and the extent to which health co-benefits play a role in the final policies agreed upon***.

Results from the four Parties to the UNFCCC are examined in further detail following the table.

Table 17. Summary of primary results for Australia, the EU, China and the U.S. in relation to the second research question

Primary results (presented by analytical theme)	Australia	EU	China	U.S.
Policy-Making Process				
Inter-Ministerial approach to policy development, incl. Health representatives	✓	✓	✓	✓
Use of economic modelling to inform policy options	✓	✓	n/a	✓
Quantification of health co-benefits for inclusion in modelling/policy development	×	✓	n/a	✓
Factors Influencing Prioritisation of Multiple Considerations				
Economic costs associated with policy implementation, e.g. industry, jobs, economic growth	✓	✓	✓	✓
Estimates of economic damages associated with climate change	✓	✓	✓	✓
Energy (supply) security: current fuel mix, fuel reserves, import/export of fuels, prices, etc.	✓	✓	✓	✓
Political polarity of climate change debate	✓	×	×	✓
(Perceived) public attitudes toward climate change and climate action	✓	✓	✓	✓
Sustainable development principles: economic, social and environmental factors	×	✓	✓	✓
Overarching goal of limiting global warming to 2°C	×	✓	n/a	✓
Barriers to the Consideration of Health in Mitigation Policy				
Limited number of health champions within and external to government advocating for change	✓	×	n/a	×
A lack of local, robust data to support assessment of health impacts and benefits	✓	×	✓	×
Limitations of models in health-emission exposure pathways	n/a	n/a	n/a	✓
The difficulty of attribution for (longer-term) health impacts	✓	✓	✓	✓
The longer-term nature of climate-related health impacts	✓	×	×	✓
The perception that health is primarily an adaptation issue	✓	×	✓	×
Limited funding for climate change and health research	✓	✓	✓	✓
Concerns relating to upfront economic costs associated with action	✓	✓	✓	✓
Enablers for the Consideration of Health in Mitigation Policy				
Experiences of recent incidents, e.g. weather events, with tangible health-related impacts	✓	✓	✓	✓
Transparency and accountability of policy development process	×	✓	×	n/a
Legislation to facilitate a regulatory approach to GHG emissions	×	✓	✓	✓
Established history of air quality legislation	×	✓	~	✓
Public pressure to commit to action	✓	✓	✓	✓
The Paris Agreement	~	✓	✓	~

Evidence Base of Policy Development				
Use of experts to inform policy development	✓	✓	✓	✓
Use of peer-reviewed literature to inform policy development	~	✓	n/a	✓
Use of information produced by (international) research and multilateral organisations	~	✓	n/a	✓
External Actors and Stakeholders				
General consultation part of the policy development process	✓	✓	n/a	✓
Targeted consultation part of the policy development process	✓	✓	n/a	✓
Business and industry interests influence policy development	✓	✓	n/a	✓
Non-government interests influence policy development	✓	✓	~	✓
Communication of Policy Decisions				
Health is/has been used as a communications frame for climate change mitigation policies	×	×	×	✓
Health is/was one of several justifications used to sell climate change mitigation policies	~	✓	×	✓

Key:
✓ = Yes
~ = to some extent
× = No
n/a = insufficient evidence
Italicised results are common to all four Parties to the UNFCCC.

Having provided the overarching results above, I now provide a more detailed summary, highlighting key similarities and differences between the four Parties across the six analytical themes. Results show both similarities and differences in approaches to considering health co-benefits in policy-making. Importantly, the results ultimately confirm the contentions of other researchers (e.g., see Jack & Kinney, 2010; Mayrhofer & Gupta, 2016; Nemet et al., 2010) that in general, ***health co-benefits are yet to gain the political traction they warrant in the development of climate change mitigation policies at the national level***.

7.2.1 The Policy-Making Process

For all four Parties, an inter-ministerial group that includes health ministry representatives is involved in the development of climate change mitigation policies. These results are suggestive of an acknowledgement that there are implications for health as a result of climate change and that climate-related health impacts can inform the final policies agreed upon. Interviews with Australian and Commission policy-makers indicate, however, that the input of health ministries in the policy development process is somewhat limited; Australian health ministry representatives provided qualitative input, while health co-benefits considerations in the European policy-making process are primarily incorporated through modelling tools that sit with DG CLIMA and DG Energy as opposed to DG SANTE. The limited influence of health ministries appears exacerbated by the diffusion of responsibility for health across jurisdictions.

In the U.S., analysis suggests that while health ministry representatives were involved in certain policy-making activities, such as the development of national assessments of climate change impacts, the leading mitigation policy agencies comprise the U.S. EPA, the Department of Energy and the Department of Transport. In China, limited information is currently available on the policy development process[16]; it is difficult to ascertain the health ministry's level of input into climate change mitigation policy-making.

Aside from China, where there is insufficient information to comment, some form of impact analysis is performed that assesses the costs and benefits associated with proposed policy options in order to ascertain the most cost-effective policy responses, reaffirming that governments identify and often pursue the most cost-effective policies in the policy development process. Further, there appear to be different values placed on certain impacts over others. For example, analysis indicates that in Australia, the economic impacts of climate policies constituted a major consideration in mitigation policy development; the modelling used

[16] The Chinese government has acknowledged this issue and in 2016 introduced guidelines with the intention of increasing the transparency of the policy-making process by 2020.

to underpin emissions reduction policy options strongly focused on competitive advantage implications for business.

There is also variation in the level of transparency of the policy development process, with transparency a critical element in policy development in the EU and the U.S. For the Commission, upholding perceptions of transparency and accountability are vital in order to maintain legitimacy as a supranational entity; reports, modelling tools and stakeholder feedback associated with policy development is publicly accessible. Similarly, in the U.S. where there is considerable scrutiny of policy development, impact assessments and public consultation feedback are made publicly available. In Australia, however, the policy development process is comparatively less transparent; aside from regulatory impact statements which are publicly available, minimal information is provided between the formal stakeholder consultation period – which usually coincides with the development and release of an initial issues paper – and the final policies agreed upon. Transparency of the policy-making process remains a challenge in China.

7.2.2 Factors Influencing the Prioritisation of Multiple Considerations

There are varying factors that influence the prioritisation of multiple considerations in the development of climate change mitigation policies. A common factor for all four Parties is economic considerations. For Australia and the EU in particular, analysis indicates that the upfront costs associated with implementing mitigation measures strongly influence the final policies agreed upon. In contrast, while upfront costs were undoubtedly factors influencing policy development, the economic opportunities that climate action affords appeared to be more important considerations for both China and the U.S.

The energy implications of climate mitigation policies are another factor that appear influential in determining climate change mitigation policies. For the EU and China as net energy importers, energy supply security constitutes a central factor influencing the development of EU mitigation policies, with a focus on policies that promote energy independence and reliability. While energy resources were not discussed explicitly with Australian policy-makers, the energy status quo is undoubtedly financially appealing given Australia remains a net exporter of coal; any policies perceived as threatening to the financial gains of coal exports are likely to be closely scrutinised. In the U.S., opportunities associated with a diversified fuel mix were emphasised by the Obama Administration, especially the positive job impacts that result from the development of a renewable energy sector.

7.2.3 Barriers and Enablers for the Consideration of Health in Mitigation Policy

Both overlapping and distinctive barriers and enablers were found vis-à-vis the role of health co-benefits. Two common barriers identified for all four Parties were the challenge of attribution of (longer-term) climate-related health impacts and comparatively limited funding for climate change and health research. For China, Australia and the U.S., limited access to robust, context-specific data can challenge the explicit consideration of health co-benefits in the policy-making process. Additionally, for China and Australia, the consideration of health primarily in relation to adaptation measures appears to act as a barrier to the consideration of health co-benefits. In Australia, a perceived lack of health champions both within and external to government was identified as a barrier; in contrast in the U.S., the use of health champions in mitigation policy communication and promotion constituted an enabler. For the EU, Member States' preoccupation with the upfront costs associated with climate action remains a barrier, and ultimately influences the level of ambition in climate policies agreed upon. The implications of these barriers are explored further in section 7.3 below.

Recent experiences of extreme weather events, including unprecedented temperatures, and climate-related energy events that have resulted in a substantial number of morbidity and mortality outcomes have acted as enablers for the consideration of health co-benefits across all four Parties. For example, the 2003 heat wave in Europe that was responsible for the death of 70,000 individuals was raised by Commission policy-makers as a particularly influential event in Europe that established the connection between climate change and health. In China, the government has acknowledged strong public pressure to improve environment-related health outcomes, and in the U.S., the U.S. EPA's 2009 endangerment finding represents the cornerstone on which the Obama Administration's climate change mitigation policies were built.

7.2.4 The Evidence Base for Policy Development

In relation to the evidence base of policy, results reveal that the use and importance of scientific evidence and/or expertise in the policy development process varies. Analysis reveals that all four Parties seek expert advice during the policy development process, through expert panels and/or direct input. In the EU and U.S., analysis indicates that substantial funds are made available for the provision of research capacity building expressly for the purposes of informing the policy development process. The limited evidence that exists for China indicates that scientific advice is a key input into climate change policy-making. In Australia, policy-makers noted that experts can provide input into the policy development process although structural and communication issues had the potential to limit their relevance.

Regarding the use of scientific and academic evidence, evidence summaries produced by the IPCC were influential in the EU's climate change policy development process. Similarly, in the U.S. and China, there appears to be a strong emphasis on evidence-based policy-making, with both Parties utilising national scientific programs to facilitate the inclusion of evidence. In contrast, peer-reviewed literature informs Australian climate change policy development to some extent although policy-makers conceded that limited accessibility can hinder its utilisation. Instead, synthesised information prepared by think tanks and intergovernmental organisations were often utilised to inform policy documents.

7.2.5 The Role of External Actors and Stakeholders

Aside from China, where there is limited information on the policy development process, analysis shows that both general and targeted consultations processes are a feature for the EU, the U.S. and Australia. In Australia, policy-makers acknowledged that resource constraints impact the level of consultation undertaken and that informal consultation processes tend to be more influential on policy development than formal processes. In contrast, formal consultation appears a feature in EU and U.S. policy-making, occurring regularly throughout the policy development process.

Further, analysis indicates that business and industry were an influential and targeted stakeholder group during climate change mitigation policy development. In Australia, policy-makers recognised that business and industry stakeholders were most influential on the policy-making process. For the U.S., there is evidence that key industries were frequently consulted throughout the policy development process and that efforts were made to accommodate industries impacted by the policies developed. European Commission policy-makers admitted that interactions with lobbyists occurred although were less explicit about the overall influence of interest groups on climate change mitigation policies.

Evidence for the role of non-government organisations in the policy development process is relatively limited. Commission policy-makers noted the value that publicly accessible information provided by international research and multilateral organisations such as the WHO and OECD can provide in supplementing scientific evidence provided by the IPCC. In Australia, policy-makers noted that non-government organisations can be influential depending on the techniques they employ to communicate with government. In the U.S., evidence suggests that non-governmental groups have the potential to be influential on policy; environmental non-government groups were among a group of petitioners responsible for legal action which ultimately led to the Supreme Court decision that the U.S. EPA was obligated to regulate GHGs.

7.2.6 Communication of Policy Decisions

Aside from the U.S., results from this research support the proposition that health co-benefits have not been used to communicate climate change mitigation policies, nor are they perceived as a useful motivator for selling climate change mitigation policies. Australian policy-makers considered health a second- or third-order issue and argued that given the climate change mitigation policies being pursued, health co-benefits had limited relevance and the actual benefits to health would likely be low. Commission policy-makers recognised health co-benefits as one of many possible justifications for the communication of climate change mitigation policies, although admitted that these were more likely to resonate with the public than with Member State representatives.

Results confirm that health co-benefits are, however, considered a key motivator for the communication of air pollution mitigation policies. In Australia, policy-makers perceived health co-benefits as having relevance only to energy efficiency and vehicle emissions reduction policies. In the EU, policy-makers emphasised that health co-benefits are the primary driver of air pollution mitigation policies. Similarly, in China it is evident that air quality-related health impacts have been a driver of efforts to decarbonise the fuel mix.

The U.S. constitutes an outlier in terms of health as a communications frame for climate change mitigation policies. Results verify that the Obama Administration pursued health as a primary justification for increasingly ambitious climate change mitigation policies, reframing the problem of climate change from an environmental or energy issue to a health issue; one that required action on ‘carbon pollution’.

Of the factors and processes detailed above, some can promote the consideration of health co-benefits in policy development while others can hinder their political traction in the policy-making process. Accordingly, my results provide the basis for establishing a typology of barriers to the consideration of health co-benefits in the development of climate change mitigation policies. Doing so allows me to re-engage with the literature reviewed in Chapter 2, and to investigate the alignment between my results in this study and broader perspectives in the pre-existing literature.

7.3 The Role of Health Co-Benefits in Climate Change Mitigation Policies: A Discussion

In the introductory chapter of this dissertation, I hypothesised that the political traction of health co-benefits is impeded by barriers that may be politico-economic, institutional or social in nature. A review of the literature on the i) political economy of health and the political economy of climate change; ii) science-policy interface; and iii) power in policy-making in Chapter 2 provided insights into factors that may inhibit the integration of health co-benefits into the development of climate change mitigation policies. Results from the analysis of climate change mitigation policy development in Australia, the EU, China and the U.S. now permit me to compare and contrast results from this study with findings from the literature review. In doing so, it is possible to identify key factors that influence the political traction of health co-benefits in climate change mitigation policy.

For most of the Parties, many of the factors identified challenge the political uptake of health co-benefits. Findings from my research on health co-benefits strongly align with conclusions reached by other researchers examining the social determinants of health, principally that the political traction of health in the policy-making process is the result of “a complex set of interrelated and context-dependent factors…and no one single factor predominates” (Baker et al., 2017, p. 108).

In Chapter 2, I identified four interrelated areas in which barriers are likely to exist: i) discourse; ii) efficiency; iii) vested interests; and iv) structural challenges. In conjunction with Walt and Gilson’s (1994) analytical framework, these interrelated areas proved helpful in identifying the six analytic themes that informed the interview schedule and the presentation of results in Chapters 4, 5 and 6.

In order to discuss the implications of my results in relation to the existing literature, the following section is structured around the four domains identified by Walt and Gilson: 1) context; 2) process; 3) content; and 4) actors. While alignment is not perfect, there are strong synergies between the four interrelated areas that I identified in the literature review and Walt and Gilson’s four domains. Given Walt and Gilson’s analytical model constitutes an established analytical framework in the literature, findings discussed below are stratified by Walt and Gilson’s four domains. I will, however, refer to the four interrelated areas I identified in the literature review where appropriate.

Table 18 below presents a summary of the major factors that influence the political traction of health co-benefits in the development of climate change mitigation policies, and is followed by discussion of these factors and their implications.

Table 18. Summary of major factors influencing the political traction of health co-benefits in climate change mitigation policies based on analysis of four Parties to the UNFCCC

Domain	Major factors influencing the political traction of health co-benefits
Context	• Key domestic industries and the energy fuel mix • Government priorities and agendas • Political short-termism
Process	• The problem framing of climate change • The institutional architecture • The decoupling of air pollution and climate change mitigation policies
Content	• The type of mitigation policy measures pursued • The modelling used to support policy development • The evidence base underpinning policies
Actors	• The involvement of non-state actors with varying levels of influence • Political leadership • Public attitudes

7.3.1 Context

A number of contextual factors have implications for the political traction of health co-benefits in climate change mitigation policies. Firstly, results indicate (unsurprisingly) that the impacts of policies on **key domestic industries** and the existing **energy fuel mix** strongly influence the overall ambition of mitigation efforts. For fossil fuel intensive economies, such as the four Parties analysed in this thesis, research confirms that high abatement costs can act as a barrier to transforming mitigative capacity into mitigation action (Winkler, Baumert, Blanchard, Burch, & Robinson, 2007).

With shorter-term economic costs a primary driver of climate change mitigation policies in Australia, and a major consideration for Member States in the EU, the protection of economic growth, as measured by GDP, remains at the fore of policy-making. The existing literature implies that the primacy of economic performance has implications for considerations such as health co-benefits; a focus on the shorter-term economic impacts of policy consequences often deprioritises longer-term issues, such as those associated with population health (Baum, 2008b). This is reaffirmed in studies which have found a de-prioritisation of climate change and healthy public policy implementation during times of economic recession (Baum et al., 2017; Gillard, 2016).

Secondly, the major drivers of climate change mitigation policies provide insight into **government priorities and agendas**, which are informed by a variety of factors (Baker et al., 2017, p. 102):

> "while government priorities can be shaped by evidence, they are also shaped by the values and interests of powerful interest groups, the ideas they use to interpret and portray issues, and the extent to which such portrayals resonate with existing belief systems (ie, ideologies), institutional structures and historical policy trajectories."

Of the factors influencing government priorities and agendas, ideology appears to be particularly important in the context of health co-benefits. Results from this study demonstrate the direct link between political agendas and the ideological underpinnings of policy development, with consequences for the political traction of health co-benefits. For example, as a liberal welfare state and liberal market economy with a politico-social history dominated by business interests and public allegiance to the market (Raphael, 2013a, 2013b), Australia's current conservative government has been preoccupied with "jobs and growth"; accordingly, the national climate change mitigation agenda has primarily focused on issues relating to comparative advantage for industry. This aligns with findings in a recent study investigating how two contextual factors – political culture and economic dependency on fossil fuels – impact attitudes toward carbon taxes. The study determined that although not statistically significant, Australians hold negative attitudes toward carbon taxes given perceptions that this will create a comparative disadvantage for the Australian economy (Harring, Jagers, & Matti, 2018). Additionally, recent research highlights the important role of party politics on mitigation policy attitudes. Results investigating Australia concluded that the strong political polarisation on climate change has had implications for public support of mitigation policies (Linde, 2018).

Conversely, while the U.S. is a liberal market economy with strong neoliberal roots, the Obama Administration's ideological approach to climate change mitigation policy-making more closely aligned with the tenets of egalitarianism and social democracy than with neoliberalism. Evident from the analysis above, the Obama Administration prioritised notions of equity and justice, acknowledging that climate change exacerbates vulnerability and poverty. This particular approach to climate change policy facilitated the use of health co-benefits as a rationale for policy implementation, and reaffirms research indicating that a political process underpinned by social democratic values leads to better population health outcomes (Baum, 2008b).

The reality of **political short-termism** also influences the political traction of health co-benefits. With political parties in democratic countries wedded to the policy cycle, systemic and chronic issues such as climate change are difficult to address in a meaningful way. Results from this study indicate that strong climate change mitigation action requires a social license or the absence of political pressure associated with re-election. Specifically, results from China and the U.S. imply a shift away from the dominant discourse toward a more optimistic view of climate action; one that recognises the domestic benefits and opportunities action affords. For China, climate action and decarbonisation have been motivated by strong public pressure on environmental grounds, the absence of a rival political party and the economic opportunities associated with the renewables sector. For the U.S., strong progress on climate action was made in Obama's second (and final) term in office as President, when the political pressures associated with re-election had dissipated. It was during this period that the Obama Administration adopted a vision for climate action and set a comparatively ambitious, longer-term mitigation policy trajectory out to 2050.

7.3.2 Process

Several factors relating to the policy-making process influence the political traction of health co-benefits in the development of climate change mitigation policies. Firstly, as discussed in relation to structural challenges in Chapter 2, results from across the four Parties are broadly consistent with the political economy of health literature that posits the existence of barriers to the consideration of health in sectors outside of the health sector as a result of the **institutional architecture**. While health ministry representatives are involved in the development of climate change mitigation policies in all four Parties, the (albeit limited) evidence from my analysis suggests that to date, health representatives have played a peripheral role in the development of climate change mitigation policies.

This status quo can be explained – at least partially – by power dynamics within government, where other ministries carry the mandate for climate change mitigation policy development and consequently take accountability for policy failures, as well as credit for policy successes (Carey & Crammond, 2015). This structural barrier is particularly relevant for mitigation, given such measures are primarily pursued by sectors other than health (Gould & Rudolph, 2015). In comparison, adaptation measures "correspond closely to conventional medical and public health practices" (Frumkin, Hess, Luber, Malilay, & McGeehin, 2008, p. 435). The challenges presented by institutional architecture are confirmed in research carried out elsewhere. In California, institutional barriers to public health professionals' involvement in climate change policies were identified, including capacity, authority and leadership limitations (Gould & Rudolph, 2015). Further, an assessment of the WHO – the world's peak

health intergovernmental organisation – determined that a narrow biomedical and technical approach to health combined with an inability to effectively communicate the relevance of health to other sectors has hindered the WHO's capacity to pursue inter-sectoral collaboration (Gopinathan et al., 2015).

Secondly, results from this study reveal that **the problem framing of climate change** determines which considerations are prioritised in the policy-making process. In Australia, the EU and China, climate change has been predominantly framed and managed by policy-makers as an economic, energy and/or environmental problem. In the absence of health as a problem frame for climate change, health co-benefits can be overlooked as an influential factor in the policy-making process. This finding is reaffirmed in other research, where government officials acknowledged that health considerations are not traditionally incorporated into the public policy development process (Baum et al., 2017). Further, this finding aligns with the political economy of health literature, which critiques the dominant biomedical model for health in simplifying, reducing and compartmentalising problems rather than embracing a more holistic approach to understanding a (health) problem (Birn et al., 2009).

The problem framing of climate change as an environmental, economic and energy problem is likely explained by the proximal impact of climate change on these areas, while the (longer-term) health impacts and co-benefits are comparatively distal. Similarly, the problem framing of air pollution as a health problem is likely a result of the proximal relationship between air quality and, in particular, respiratory health. The U.S. represents an outlier in relation to framing, with climate change conceptualised and confronted predominantly as an environmental health problem following on from the U.S. EPA's endangerment finding in 2009.

In order to create a more proximal link between climate change and health, the Obama Administration reconceptualised GHGs as 'carbon pollution'. Strategically, this reframing is important, given research indicates that framing the negative impacts of power plant emissions in the context of air pollution as opposed to climate change increase support of policy action, particularly among conservative voters (Feldman & Hart, 2018; Hart & Feldman, 2018). Further, the case of the U.S. demonstrates how "a certain interpretation of evidence or a framing…becomes powerful only when it is adopted or enacted by a host of relevant decision-makers and stakeholders" (Juntti et al., 2009, p. 211). The importance of political leadership (discussed in further detail in the sub-section below) and political support for mitigation efforts across ministries as a consequence of the health impacts may have facilitated the successful reframing of climate change as a health problem.

An additional distinction between the Parties relates to the coordinated approach taken by the EU and the Obama Administration to develop climate and air pollution mitigation policies. Australia and until recently, China, have decoupled climate change and air pollution mitigation policies, with different ministries and/or different jurisdictions responsible for policy development. While there are undoubtedly major practical challenges involved (Carey & Crammond, 2015), a collaborative and coordinated policy approach that includes both end-of-pipe and structural measures is required in order to maximise reductions of both GHG and non-GHG emissions in order to achieve the greatest health co-benefits (Bollen & Brink, 2014; Braspenning Radu et al., 2016). While the consideration of health co-benefits in air pollution mitigation policies across all four Parties is commendable, on its own it is insufficient to maximise the realisation of health co-benefits. Results from the four Parties imply that **the decoupling of air pollution and climate change mitigation policies** can have consequences for the consideration of health co-benefits in climate change mitigation policy development; most notably, it facilitates the consideration of health in one domain (air pollution mitigation) at the expense of the other domain (climate change mitigation). This is particularly problematic when potential trade-offs between the two policy areas are not recognised and/or thoughtfully addressed during policy development (Klausbruckner, Annegarn, Henneman, & Rafaj, 2016; M. Williams, 2012).

7.3.3 Content

Factors relating to the content of climate change mitigation policies influence the political uptake of health co-benefits. Firstly, a key finding of this thesis is that **the type of mitigation measures pursued** has a direct bearing on the relevance of health co-benefits to climate change mitigation policies. Economic evidence suggests that market-based mechanisms, such as carbon pricing, represent the most efficient and cost-effective avenue for mitigation (Somanathan et al., 2014), and provide the opportunity to internalise at least some of the costs borne to society as a result of fossil fuel combustion (Cuevas & Haines, 2016). As such, carbon pricing mechanisms can create additional revenue that can be used to address potentially regressive outcomes, as well as reduce emissions and associated mortality, leading to health co-benefits (I. Parry, Heine, Lis, & Li, 2014; I. Parry, Veung, & Heine, 2014).

However, the implications for health of such mechanisms depend on the design and context (Cuevas & Haines, 2016). In Australia, for example, the current incentive-based effort relies on the government purchasing abatement opportunities from businesses through a reverse auction mechanism, placing the power of mitigation efforts primarily in the hands of industry. Similarly, over the past decade the EU ETS has experienced challenges with under-priced emissions allowances, resulting in comparatively less mitigation than had been

anticipated. Accordingly, the use of health co-benefits as a key selling point in the communication of mitigation policies is limited. These examples demonstrate how the specific design of climate change mitigation policies can undermine both the role and actual realisation of health co-benefits, and highlight the need for a suite of policy options, including regulatory measures.

Secondly, as discussed in relation to the area of efficiency in Chapter 2, results from Australia and the EU are particularly consistent with the political economy tenet that economic efficiency constitutes the bedrock of climate change mitigation policy development. **The modelling used to support policy development** focuses on establishing least-cost pathways (in the case of the EU) and to ensure that comparative advantage is not compromised (in the case of Australia). In contrast, while the U.S. was also reliant on modelling to inform the development of mitigation policies, the Obama Administration's use of the (global) SCC accounted for, among other things, intra- and inter-generational equity in policy development.

These methods have been drastically modified under the Trump Administration for the express purpose of reversing the Obama Administration's climate change policy trajectory. The capacity for modelling to produce such distinct policy options demonstrates a major shortcoming of utilising such approaches for the purposes of decision-making, namely that models are inherently built upon normative assumptions, leaving them susceptible to subjective outputs (Ackerman et al., 2009; Nature, 2017).

Results indicate that another factor influencing the political traction of health co-benefits relates to **the evidence base underpinning policies**. As discussed in Chapter 2, a "complex relationship between knowledge and policy" exists (Juntti et al., 2009), often presenting challenges to the realisation of evidence based policy development. Results from across the four Parties reported in this study confirm that experts are used to inform policy development. There is, however, no clarity around which experts and to what end; this is consistent with research reviewing the role of experts in the policy-making process, which concludes that to date, the literature remains predominantly theoretical in nature (Spruijt et al., 2014). Further, results presented reaffirm that challenges of attribution given the absence of local data or advanced methodologies impede the consideration of health co-benefits in the climate change policy-making process. These challenges to establishing climate-related health risks are recognised within the literature (e.g. Tong, Confalonieri, Ebi, & Olsen, 2016) and are exacerbated by limited funding for climate change and health research (K. L. Ebi et al., 2016; D. Green et al., 2017; Hosking & Campbell-Lendrum, 2012).

Although limited, the findings across the four Parties studied here broadly align with existing perspectives and reaffirm the role of factors such as ideological position in the final policies agreed upon. For example, the existing literature contends that the production, selection and interpretation of evidence for environmental policy-making is "heavily influenced by decisions about social values and moral and ethical choices" (Juntti et al., 2009, p. 208). More specifically, there are claims that public health evidence has been selectively incorporated into the policy-making process where it aligns with pre-existing political priorities of the government (Baker et al., 2017).

7.3.4 Actors

The numerous actors involved in climate change mitigation policy development are likely to influence the political traction of health co-benefits. Generally speaking, results on the role of external actors and stakeholders in the policy development process are inconclusive, making it difficult to contextualise them within the existing literature. The most robust results were from Australia, where strong evidence exists to assert that the extractive industry continues to exert undue influence on the policy-making process. For the EU and the U.S., results were more circumstantial; both claim to employ formal and targeted consultation processes regularly throughout the policy-making process, acknowledging that a diverse range of external actors and stakeholders contribute input to policy development during this period. With national interests and a large voter base to consider, evidence indicates that the U.S. actively consulted industry with the intention of easing the legislative burden of regulatory measures. Limited comment can be made about external actors and stakeholders in China's policy development given its opaque policy-making process.

It is difficult, if not impossible, to establish the extent to which different actors influenced the final policies agreed upon across the four Parties. Despite this, in line with the area of vested interests discussed in Chapter 2, the evidence available from this study supports the proposition that **the involvement of non-state actors with varying levels of influence** in a crowded policy-making process with many considerations and interests can impact, and in some cases, devalue the consideration of health co-benefits in the policy-making process. Results broadly align with perspectives on health inequities in the literature; experiences of health are greatly determined by "activities that involve actors with different interests and degrees of power" (Ottersen et al., 2014, p. 630).

Results also support the assertion that government officials play a pivotal in the policy development process, particularly those in senior, influential positions. Evidence from this

study suggests that strong **political leadership** from senior decision-makers can greatly influence the political traction of health co-benefits. For example, the leadership exhibited by Barack Obama, the U.S. EPA Administrator Gina McCarthy, and others in the Obama Administration in steadfastly pursuing climate change mitigation policies on health grounds demonstrates the role of political will in the political traction of health co-benefits, and the ambition of climate change policies more broadly.

Evidence from the existing literature strongly supports the contention that political leadership is critical for the integration of health into policy agendas (Baker et al., 2017; Carey, Crammond, & Keast, 2014). For example, in South Australia, a formal political mandate from the central government combined with strong political support from senior decision-makers across sectors proved crucial to establishing legitimacy and sustaining political traction of HiAP within the bureaucracy, particularly in non-health sectors (Baum et al., 2017).

A final category of actors – the public – constitutes a key and influential group in the development of climate change mitigation policies. While studies have identified varied and interrelated factors that have reinforced a gap between levels of public concern and concerted individual action on climate change (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007), **public attitudes** toward climate change also have the potential to be an important enabler for facilitating parliamentary support for climate action. A most recent example is in Australia, where the ex-Prime Minister, Tony Abbott, has been forced to reverse his adversarial position on the Paris Agreement as a result of strong opposition from his constituency and opponents for his electoral seat (Zhou, 2019).

Evidence suggests, however, that public understanding of the link between climate change and health is still limited (Akerlof et al., 2010; Cardwell & Elliott, 2013). As seen in China, public pressure has been instrumental in incentivising governmental action on health grounds. Without strong pressure from constituents, the reality is that ambitious responses to climate change from senior decision-makers are likely to be limited (Rickards, Wiseman, & Kashima, 2014). Unfortunately, the most recent scientific evidence indicates that in the absence of sufficient political action on climate change, experiences of extreme weather and climate-related energy events will increase in both frequency and severity with corresponding health impacts (K. Ebi, Campbell-Lendrum, & Wyns, 2018). As experiences of such events continue to increase with corresponding impacts on human health, it is possible that the political traction of health co-benefits will rise in tandem. Mounting evidence suggests that these types of events provide the impetus governments require to enhance their response to climate change, particularly in the face of public outcry. In Australia, for example, the

Hazelwood coal-fired power station abruptly closed in 2017 following a mine fire in 2014 which had significant health implications for surrounding community members (Wiseman, Campbell, & Green, 2017).

7.4 Research Limitations

There are several limitations to this study that must be raised and which could inform future research (discussed in the next chapter). As I identified in the opening chapters of this thesis, a good proportion of the research effort to date has focused on health co-benefits associated with the energy and transport sectors, given the comparative ease of detecting and attributing health impacts associated with both GHG and non-GHG emissions. This led me to focus on these particular health co-benefits when speaking to policy-makers at the expense of health co-benefits relevant to other sectors, such as the agricultural sector.

Secondly, while the interviewees who participated were best placed to provide insight into the role of health co-benefits in the climate change mitigation policy-making process, the final interview sample size (n=27) was small. Additional perspectives may have provided greater insight and facilitated more robust conclusions. A third limitation of this study is the focus on health co-benefits at the expense of adequate consideration of the potential health co-harms associated with the development of climate change mitigation policies. While my initial intention was to allow for the discussion of both health co-benefits and health co-harms during interviews, conversations with participants regularly led to the discussion of health co-benefits. While the final question of the interview schedule afforded interview participants the opportunity to raise any issues they considered relevant or of interest that we were yet to cover, health co-harms was never raised as a relevant issue.

Fourth, the different methods used to examine Australia and the EU (a multiple-case study based on several data sources including interviews) and China and the U.S. (documentary analysis of select policy publications) constitutes another limitation of the study. While limited resources and time constraints ultimately prevented me from employing the same methodological approach, I concede that based on initial enquiries, access to Chinese policy-makers would have been almost impossible. Ultimately, I pursued a complementary methodological process that provided broadly similar results.

Finally, I acknowledge additional limitations in the methods used to undertake this research. The coding of interviews was solely undertaken by me, although was guided by the structure of the interview schedule in an attempt to minimise the risk of researcher bias.

Moreover, using a semi-structured interview schedule allowed me a level of flexibility in question order based on the natural flow of the conversation. However, for most interviews, the question order primarily aligned with the interview schedule question order. This may have influenced responses and further discussion.

7.5 Policy Implications

According to Patz and Thomson (2018), “practical action requires an informed health workforce, an engaged public, an HiAP approach involving many related sectors, new resources and technologies, and financing equal to the task at hand” (Patz & Thomson, 2018, p. 3). With these elements in mind, I now discuss the policy implications of the findings presented above. Specifically, I focus on identifying opportunities to enhance the role of health co-benefits both from within government and external to government.

7.5.1 Opportunities to Enhance the Role of Health Co-Benefits from Within Government

Assuming there is political appetite to enhance the role of health co-benefits in the development of climate change mitigation policies, several opportunities exist within a government setting. Firstly, there is an urgent need to embed climate change mitigation into the health ministry agenda by devoting the resources necessary to establish in-house expertise. Results suggest that in the absence of pressure and expert input from the health ministries, there is a lack of accountability to the consideration of health outcomes in climate change mitigation policy development.

This would be complemented by additional funding for the express purpose of policy-relevant climate change and health research. Given analysis consistently identified a lack of funding and difficulties in longer-term attribution as key barriers to the consideration of health co-benefits in climate change mitigation policies, enhanced financial support is required for the research community committed to quantifying and monetising health co-benefits beyond those associated with air pollution.

Secondly, the political traction of health co-benefits could be increased through the identification of health champions across ministries and levels of government, as well as outside of government, with the potential to advocate with influence for the integration of health co-benefits. Strengthening the position of health in the climate policy community through the identification of several influential champions for health would greatly assist in embedding health in the climate change agenda. To date, researchers and practitioners have asserted the need for members of the health community to be present in climate policy conversations

across scales of government (e.g. Burke & Fox, 2017; Haines et al., 2009; World Health Organization, 2018). In reality, the promotion of health co-benefits would greatly benefit from champions that sit outside the health sector who are also “at the table” to advocate for health alongside the health community. Non-health champions proved critical for the political traction of HiAP across sectors in South Australia (Baum et al., 2017).

Thirdly, developing and maintaining a compelling narrative with several threads that resonate with diverse groups within the community is necessary. The first, and arguably the most important, narrative must directly challenge the misconception that climate action is primarily a burden by firmly shifting attention to the many benefits, including those relating to health, that result from the implementation of climate policies. This could be achieved through reframing climate change as a health problem and explicitly linking health with each of the three major problem frames: i) environment; ii) economy; and iii) energy. An example previously mentioned occurred in the U.S., where GHGs were reframed as ‘carbon pollution’, which facilitated a link between the environmental frame and the health frame. This also facilitated the reframing of climate action around benefits and opportunities and shifted the policy focus from the global to the local.

Finally, while I acknowledge that this is a contentious suggestion, given the dominance of neoclassical economic thinking in the policy-making process, highlighting the positive implications for the business sector that arise from health gains due to climate action may enhance the political traction of health co-benefits. This strategic approach was utilised by the U.S. EPA in selling the ‘Clean Power Plan’; labour productivity gains were estimated at 300,000 fewer missed work days and were monetized accordingly. The importance of demonstrating the economic benefits resulting from the consideration of health in other sectors was confirmed in research examining HiAP implementation across jurisdictions worldwide (Pinto, Molnar, Shankardass, O’Campo, & Bayoumi, 2015).

7.5.2 Opportunities to Enhance the Role of Health Co-Benefits External to Government

Opportunities also exist outside of government to strategically support greater integration of health co-benefits into climate change mitigation policy development. For example, an opportunity exists to explicitly align the health co-benefits of mitigation with the pursuit of national renewable energy goals.

Signatories to the Paris Agreement have in principle committed to transitioning to low-carbon economies. With energy security of paramount importance to many national governments, emphasising the dual benefits to energy security and health that result from

ambitious climate change action may appeal to policy-makers. As such, there is an opportunity for an increasingly powerful alliance to be built between winners of climate change action – such as the health sector and the renewable energy sector – to destabilise the undue influence of extractive and other emissions intensive industries in the policy-making process. However, existing research suggests that the creation of 'a coalition of the willing' for climate action is insufficient on its own. There is a need for (health) researchers and advocates to appreciate the messy reality of policy-making process. The creation of a campaign that strategically acknowledges government priorities and aligns as practical as possible with politico-economic realities will have a higher likelihood of being politically palatable and influential in the policy development process.

Further, continuing to utilise opportune occasions to communicate the health consequences of climate change, and the health co-benefits that result from strong climate action, to both the politicians and the community is pivotal if the role of health co-benefits in mitigation policy development is to be enhanced. The WHO and others continue to estimate morbidity and mortality rates attributable to environmental risk factors, including climate change. With an increasing frequency in climate-related health impacts from weather events, ensuring that robust, timely evidence on health benefits of climate action is accessible for champions and other knowledge brokers at times when climate change is thrust back to the top of the political agenda will maximise the prospect of firmly embedding health co-benefits into the climate change mitigation policy-making process.

Chapter Eight: Conclusion

8.1 Research Conclusions

This final chapter i) provides conclusions based on results and implications discussed in the previous chapter; ii) recognises the contributions of the findings to the literature; and iii) explores future research opportunities that would strengthen the conclusions presented in this thesis.

In the introductory chapter, I outlined the problem that preoccupies this thesis: that delayed action on climate change is primarily the result of a lack of political will. The existing literature suggests that the consideration of health co-benefits may strengthen the justification of more ambitious climate action but has failed to gain the political attention warranted. Accordingly, the aim of this thesis was to understand the role that health co-benefits have played in the development of national climate change mitigation policies. To achieve this aim, I posed two primary research questions:

1. Are health co-benefits considered and accounted for in the development of national climate change mitigation policies and if so, how?
2. What factors influence whether health co-benefits are considered and accounted for?

Given my working hypothesis that numerous barriers constrain the political traction of health co-benefits in climate change mitigation policy-making, I examined the role of health co-benefits in the development of climate change mitigation policies by building case studies for Australia and the EU and carried out documentary analysis for China and the U.S.

With the first research question in mind, my results show that:

1. health co-benefits were not explicitly considered in the development of Australian climate change mitigation policies relevant to its NDC and consequently do not influence the final policies agreed upon;
2. health co-benefits are explicitly considered in the development of EU climate change mitigation policies relevant to its NDC, but are not a key driver of the final policies agreed upon;

3. health co-benefits have not been explicitly considered in Chinese climate policy documents and do not appear to be a key driver of the final policies agreed upon over the past decade;
4. health co-benefits were explicitly considered in the development of U.S. climate change policies and were a driver of the final policies agreed upon between 2009 and 2016; and
5. health co-benefits are a driver of air pollution policies in all four Parties to the UNFCCC.

The diversity of these results demonstrates that the consideration of health co-benefits in climate change mitigation policy development is conditional. Accordingly, for the second research question posed, my analysis reveals that several factors influence the extent to which health co-benefits are considered, including:

1. political leadership;
2. the choice of problem frame used for climate change;
3. the mitigation policy instruments selected; and
4. the decoupling of climate change and air pollution mitigation policies.

As discussed in more detail in the previous chapter, these findings imply that the role of health co-benefits in the development of climate change mitigation policies is both context- and policy-dependent. With these key results and implications in mind, I conclude that:

1. **health co-benefits are considered to some extent either qualitatively or quantitatively during the climate change mitigation policy development process.** Of the four Parties to the UNFCCC analysed, China was the only Party for which it was difficult to establish any explicit consideration of health co-benefits in the development of climate change mitigation policies.

2. **where the political will exists, health co-benefits can facilitate the development of increasingly ambitious climate change mitigation policies at the national level.** Analysis of the U.S. demonstrates that where the political will exists, health co-benefits can be used successfully to justify the development of increasingly ambitious climate change mitigation policies.

3. **numerous factors influence the consideration of health co-benefits in climate change mitigation policies, some of which act as barriers to their political traction.** Analysis of the four Parties indicates that numerous considerations inform climate change

mitigation policy development, and consequently influence the consideration of health co-benefits in the process. Some of these factors enable the consideration of health co-benefits, such as domestic instances of extreme weather events and/or air pollution, while others act as barriers to their uptake, such as political short-termism, the pursuit of economic growth and the importance of upfront costs.

4. **aside from the U.S., health co-benefits have not gained substantial political traction at the national level.** Australia, the EU and China represent examples where health co-benefits have not gained substantial political traction at the national level; in the case of the EU, Member States appeared to be a major impediment to securing strong climate change mitigation policies.

8.2 Research Contributions

Notwithstanding the limitations of the study mentioned in the previous chapter, the research study presented in this thesis provides an original contribution to knowledge in the field of climate change and human health. Specifically, the research design and results of this study:

1. **contribute to knowledge on health co-benefits and climate change mitigation policies.** Returning to the initial problem of political will and delayed climate action identified in the introductory chapter, this research shows that where the political will exists, health co-benefits can be used to justify increasingly ambitious climate change mitigation policies. Further, my research extends Burch's (2010) research on sub-national barriers to climate action (presented in the introductory chapter) and bolsters our understanding of the numerous barriers that inhibit the development and implementation of optimal climate change policies across jurisdictional levels.

2. **create a new thematic analytical framework, based on modifications to Walt and Gilson's (1994) analytical framework.** This was achieved through the identification of six themes to support the analysis of data sources (refer to Figure 2 in Chapter 3). The thematic framework and the corresponding interview schedule have been documented in published material, allowing other researchers to utilise the framework in any future research that explores the role of health co-benefits.

3. **articulate policy implications with the intention of promoting tangible policy and practice solutions.** The findings, especially the factors that act as barriers to the consideration of health co-benefits, lend themselves to assist researchers and

practitioners in identifying opportunities to strategically enhance the role of health co-benefits in the development of climate change mitigation policies. Further, results from this research supported the identification of multi-level and multi-faceted opportunities both from within and external to government, which were presented in the previous chapter.

8.3 Research Implications and Final Remarks

This research is predicated on the assumption that health co-benefits resulting from mitigation policies can assist future governments to justify increasingly ambitious climate change policies. Accordingly, further research is required to support efforts to enhance the political traction of co-benefits in the face of a range of barriers. The limitations identified in the previous chapter provide a logical starting point for recommending further research to bolster the findings presented in this thesis.

Additional insights from a larger sample of policy-makers across a larger number of Parties to the UNFCCC, including with policy-makers across levels of government (for example, state and local) would greatly enhance the validity of the conclusions presented in this thesis. Findings indicate that the national level of government may not be the most appropriate level for the consideration of health co-benefits. As such, interviews with policy-makers at the sub-national level may determine that health co-benefits resonate better where the benefits are likely to be more applicable.

Explicitly probing policy-makers on their knowledge and perceptions of health co-benefits in sectors other than energy and transport would be valuable in providing a fuller representation of the role of health co-benefits in the development of climate change mitigation policies. The health co-benefits literature would also benefit from further examination of policy-makers' knowledge and perception of health co-harms – negative health outcomes associated with the implementation of mitigation policies – and whether efforts are made to minimise the risks associated with health co-harms during the policy development process.

Beyond policy-makers, exploring the perspectives of other actors involved in the policy-making process, including experts and practitioners, industry, environmental and health advocacy representatives, may enrich our understanding of the barriers and enablers for the consideration of health co-benefits.

An opportunity exists to examine the role of health co-benefits through other theoretical frameworks, including the political ecology of health, earth system governance, and policy network theory. While these theoretical frameworks are not strikingly dissimilar from the political economy of health framework, their foci are distinct; employing these frameworks may provide additional insights to the literature on health co-benefits.

Current research gaps became evident in my review of the literature. Addressing these existing gaps would help to strengthen an understanding of the barriers inhibiting the role of health co-benefits. Firstly, I have been unable to locate research that specifically analyses the power dynamics between national environment, energy and health ministries. A better understanding of the interactions among these ministries may provide further clarity and insights for enhancing the role of health co-benefits in the development of national climate change mitigation policies.

Research that surveys the relationship between health co-benefits and other multilateral commitments, such as the Sustainable Development Goals, would be useful in contextualising health co-benefits more broadly as well as to more explicitly establish interlinkages between the multiple priorities that governments simultaneously pursue.

Finally, research that extends knowledge and understanding of policy-makers' perceptions of co-benefits in areas beyond climate change, such as benefits derived from nature (ecosystem services), would complement the research presented in this thesis and provide further insights that could assist both researchers and policy-makers to consider strategies for enhancing the political uptake of the co-benefits approach more broadly.

While there is still ample research required to elucidate a comprehensive understanding of the role of health co-benefits in the development of climate change mitigation policies, the insights gained in this thesis provide a strong foundation upon which future researchers can build. Beyond the commitment mandated in the Paris Agreement, it is likely that the increasing severity and frequency of climate-related events being experienced worldwide will eventually compel governments to address climate change and engage with the benefits and opportunities that climate action affords. The better we understand the barriers policy-makers face in embracing the benefits of climate action, the better placed we will be to provide adequate support through the delivery of policy-relevant research.

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Appendix A: Select statistics for Australia, the EU, China and the U.S.

Australia

Key statistics

⇒ GDP: USD$50,263 per capita (as at 2016) (OECD, 2019)
⇒ Population: 23.5 million (as at 2014) (OECD, 2018)
⇒ Urban population: 85.9% (World Bank, 2018)
⇒ Health spending: 9.1% of GDP (OECD, 2018)
⇒ CO_2 emissions per capita: 15.7 tonnes (as at 2014) (OECD, 2018)

Fuel mix

⇒ **Coal** production (501 million tonnes (Mt), provisional 2017 data) and net exports of coal (379 Mt, provisional 2017 data) (IEA, 2018)
⇒ Net imports of **oil products** (25 Mt as at 2016) (IEA, 2018)
⇒ **Natural gas** production (105 billion cubic metres (bcm), provisional 2017 data) and net exports of natural gas (62 bcm, provisional 2017 data) (IEA, 2018)
⇒ **Renewable energy** production (6.46% of primary energy supply as at 2016) (OECD, 2018)
⇒ **Solar energy** production (6 terrawatt hours (TWh); 2.4% of total domestic electricity generation as at 2016) (IEA, 2018)

Key national climate change mitigation legislation (as at 2016)

National Energy Productivity Plan 2015-2030
Carbon Farming Initiative Amendment Act 2014
Clean Energy Finance Corporation Act 2012
Greenhouse and Energy Minimum Standards Act 2012
Australian National Registry of Emissions Units Act 2011
Climate Change Authority Act 2011
Building Energy Efficiency Disclosure Act 2010
National Strategy on Energy Efficiency 2010
Offshore Petroleum and Greenhouse Gas Storage Act 2006
National Greenhouse and Energy Reporting Act 2007
Renewable Energy (Electricity) Act 2000

NDC for the Paris Agreement

⇒ 26-28% below 2005 levels by 2030 (economy-wide reductions including LULUCF)
⇒ No 2050 target

Sources: OECD (2019), Gross domestic product (GDP) (indicator). doi: 10.1787/dc2f7aec-en (Accessed on 13 March 2019); OECD (2018), Air and GHG emissions (indicator). doi: 10.1787/93d10cf7-en (Accessed on 15 November 2018); OECD (2018), Population (indicator). doi: 10.1787/d434f82b-en (Accessed on 15 November 2018); OECD (2018), Renewable energy (indicator). doi: 10.1787/aac7c3f1-en (Accessed on 15 November 2018); Grantham Research Institute on Climate Change and the Environment (2019), *Climate Change Laws of the World*, <http://www.lse.ac.uk/GranthamInstitute/climate-change-laws-of-the-world/>; UNFCCC (2018), *INDCs as communicated by Parties*, <https://www4.unfccc.int/sites/submissions/indc/Submission%20Pages/submissions.aspx>

European Union

Key statistics

⇒ GDP: USD$40,221 per capita (as at 2016) (OECD, 2019)
⇒ Population: 399.7 million (as at 2014) (OECD, 2018)
⇒ Urban population: 75.45% (World Bank, 2018)
⇒ Health spending: between 6.1% and 11.5% of GDP (OECD, 2018)
⇒ CO_2 emissions per capita: 6.2 tonnes (as at 2014) (OECD, 2018)

Fuel mix

⇒ **Coal** production (302 Mt, provisional 2017 data) and net imports of coal (48 Mt, provisional 2017 data) (IEA, 2018)
⇒ **Crude oil** net imports (336 Mt as at 2016) (IEA, 2018)
⇒ **Natural gas** net imports (266 bcm, provisional 2017 data) (IEA, 2018)
⇒ **Renewable energy** production (13.3% of primary energy supply as at 2015) (OECD, 2018)
⇒ **Nuclear energy** production (623 TWh; 73.1% of total domestic electricity generation for France; 40.5% for Sweden; 21.3% for the United Kingdom; and 13.2% for Germany as at 2016) (IEA, 2018)
⇒ **Wind energy** production (204 TWh; 17.8% of total domestic electricity generation for Spain; 12.1% for Germany; 11.0% for the United Kingdom; 6.1% for Italy; 3.9% for France as at 2016) (IEA, 2018)
⇒ **Solar energy** production (86 TWh; 7.6% of total domestic electricity generation for Italy; 5.9% for Germany; 3.1% for the United Kingdom; 2.9% for Spain; 1.5% for France as at 2016) (IEA, 2018)

Key supranational climate change mitigation legislation (as at 2016)

Directive 2014/94/EU 'Alternative Fuels Infrastructure Directive'
Regulation (EU) 2014/517 'Fluorinated Greenhouse Gases'
Decision No 1386/2013/EU 'General Union Environment Action Programme to 2020'
Decision No 529/2013/EU 'Land Use, Land Use Change and Forestry (LULUCF)'
Regulation (EU) 1293/2013 'Programme for the Environment and Climate Action (LIFE)'
Directive 2012/27/EU 'Energy Efficiency Directive'
Regulation (EU) 510/2011 'Emission Performance Standards for New Light Commercial Vehicles'
Directive 2010/75/EU 'Industrial Emissions Directive'
Directive 2010/30/EU 'Energy Labelling'
Directive 2009/125/EC 'Eco-design Directive'
Directive 2009/72/EC 'Third Energy Package'
Directive 2009/33/EC 'Clean Vehicles Directive'
Directive 2009/31/EC 'CCS Directive'
Directive 2009/30/EC 'Fuel Quality Directive'
Directive 2009/29/EC 'EU ETS Directive'
Directive 2009/28/EC 'Renewable Energy Directive'
Regulation (EC) No 443/2009 'Emission Performance Standards for New Passenger Cars'
Decision No 406/2009/EC 'Effort Sharing Decision'
Regulation (EC) No 692/2008 'Emissions from Light Passengers and Commercial Vehicles'

NDC for the Paris Agreement

⇒ >40% below 1990 levels by 2030 (economy-wide, domestic reductions including LULUCF)
⇒ 80-95% below 1990 levels by 2050

Sources: OECD (2019), Gross domestic product (GDP) (indicator). doi: 10.1787/dc2f7aec-en (Accessed on 13 March 2019); OECD (2018), Air and GHG emissions (indicator). doi: 10.1787/93d10cf7-en (Accessed on 15 November 2018); OECD (2018), Population (indicator). doi: 10.1787/d434f82b-en (Accessed on 15 November 2018); OECD (2018), Renewable energy (indicator). doi: 10.1787/aac7c3f1-en (Accessed on 15 November 2018); Grantham Research Institute on Climate Change and the Environment (2019), *Climate Change Laws of the World*, <http://www.lse.ac.uk/GranthamInstitute/climate-change-laws-of-the-world/>; UNFCCC (2018), *INDCs as communicated by Parties*, <https://www4.unfccc.int/sites/submissions/indc/Submission%20Pages/submissions.aspx>

People's Republic of China

Key statistics

⇒ GDP: USD$15,485 per capita (as at 2016) (OECD, 2019)
⇒ Population: 1.39 billion (as at 2013) (OECD, 2018)
⇒ Urban population: 57.9% (World Bank, 2018)
⇒ Health spending: 5.4% of GDP (OECD, 2018)
⇒ CO_2 emissions per capita: 6.7 tonnes (as at 2014) (OECD, 2018)

Fuel mix

⇒ **Coal** production (3,376 Mt, provisional 2017 data) and net imports of coal (263 Mt, provisional 2017 data) (IEA, 2018)
⇒ **Crude oil** production (192 Mt, provisional 2017 data) and net imports of crude oil (378 Mt as at 2016) (IEA, 2018)
⇒ **Natural gas** production (142 bcm, provisional 2017 data) and net imports of natural gas (86 bcm, provisional 2017 data) (IEA, 2018)
⇒ **Renewable energy** production (8.44% of primary energy supply as at 2015) (OECD, 2018)
⇒ **Nuclear energy** production (213 TWh; 3.5% of total domestic electricity generation as at 2016) (IEA, 2018)
⇒ **Hydro energy** production (1,193 TWh; 19.2% of total domestic electricity generation as at 2016) (IEA, 2018)
⇒ **Wind energy** production (237 TWh; 3.8% of total domestic electricity generation as at 2016) (IEA, 2018)
⇒ **Solar energy** production (75 TWh; 1.2% of total domestic electricity generation as at 2016) (IEA, 2018)

Key national climate change mitigation legislation (as at 2016)

13th Five-Year Plan (2016-2020)
Law on the Prevention and Control of Atmospheric Pollution (2015)
Energy Development Strategy Action Plan (2014-2020)
National Plan for Tackling Climate Change (2014-2020)
Energy Conservation Law (2007)
Renewable Energy Act (2006)

NDC for the Paris Agreement

⇒ Peak CO_2 consumption by 2030
⇒ Non-fossil energy share: 20% by 2030
⇒ Carbon intensity: 60-65% below 2005 levels by 2030
⇒ LULUCF unclear; forest stock increase by 4.5 million m^3 by 2030 compared with 2005

Sources: OECD (2019), Gross domestic product (GDP) (indicator). doi: 10.1787/dc2f7aec-en (Accessed on 13 March 2019); OECD (2018), Air and GHG emissions (indicator). doi: 10.1787/93d10cf7-en (Accessed on 15 November 2018); OECD (2018), Population (indicator). doi: 10.1787/d434f82b-en (Accessed on 15 November 2018); OECD (2018), Renewable energy (indicator). doi: 10.1787/aac7c3f1-en (Accessed on 15 November 2018); Grantham Research Institute on Climate Change and the Environment (2019), *Climate Change Laws of the World*, <http://www.lse.ac.uk/GranthamInstitute/climate-change-laws-of-the-world/>; UNFCCC (2018), *INDCs as communicated by Parties*, <https://www4.unfccc.int/sites/submissions/indc/Submission%20Pages/submissions.aspx>

United States of America

Key statistics

⇒ GDP: USD$57,797 per capita (as at 2016) (OECD, 2019)
⇒ Population: 318.9 million (as at 2014) (OECD, 2018)
⇒ Urban population: 82.06% (World Bank, 2018)
⇒ Health spending: 17.1% of GDP (OECD, 2018)
⇒ CO_2 emissions per capita: 15.8 tonnes (as at 2014) (OECD, 2018)

Fuel mix

⇒ **Coal** production (702 Mt, provisional 2017 data) and net exports of coal (81 Mt, provisional 2017 data) (IEA, 2018)
⇒ **Crude oil** production (563 Mt, provisional 2017 data) and net imports (371 Mt as at 2016) (IEA, 2018)
⇒ **Natural gas** production (760 bcm, provisional 2017 data) (IEA, 2018)
⇒ **Renewable energy** production (7% of primary energy supply as at 2016) (OECD, 2018)
⇒ **Nuclear energy** production (840 TWh; 19.5% of total domestic electricity generation as at 2016) (IEA, 2018)
⇒ **Hydro energy** production (292 TWh; 6.8% of total domestic electricity generation as at 2016) (IEA, 2018)
⇒ **Wind energy** production (229 TWh; 5.3% of total domestic electricity generation as at 2016) (IEA, 2018)
⇒ **Solar energy** production (47 TWh; 1.1% of total domestic electricity generation as at 2016) (IEA, 2018)

*Key national climate change mitigation legislation (as at 2016)**

Clean Power Plan (2015)
Consolidated Appropriations Act (2016)
American Recovery and Reinvestment Act (2009)
Clean Energy and Security Act (2009)
Food, Conservation and Energy Act (2008)
Energy Independence and Security Act (2007)
EO 13423: Strengthening Federal Environmental, Energy, and Transportation Management (2007)

NDC for the Paris Agreement#

⇒ 26-28% below 2005 levels by 2030 (economy-wide reductions including LULUCF)
⇒ 76% below 1990 levels by 2050 (including LULUCF)

* The election of the Trump Administration has led to the review of many national mitigation measures. For some of these measures, legislation is currently in the process of being repealed.
# The Trump Administration has indicated its intention to withdraw from the Paris Agreement.

Sources: OECD (2019), Gross domestic product (GDP) (indicator). doi: 10.1787/dc2f7aec-en (Accessed on 13 March 2019); OECD (2018), Air and GHG emissions (indicator). doi: 10.1787/93d10cf7-en (Accessed on 15 November 2018); OECD (2018), Population (indicator). doi: 10.1787/d434f82b-en (Accessed on 15 November 2018); OECD (2018), Renewable energy (indicator). doi: 10.1787/aac7c3f1-en (Accessed on 15 November 2018); Grantham Research Institute on Climate Change and the Environment (2019), *Climate Change Laws of the World*, <http://www.lse.ac.uk/GranthamInstitute/climate-change-laws-of-the-world/>; UNFCCC (2018), *INDCs as communicated by Parties*, <https://www4.unfccc.int/sites/submissions/indc/Submission%20Pages/submissions.aspx>

Appendix B: Details and Rationale on Thesis Scope by Domain

Table 19. Scope outline of thesis by domain

Scope by Domain	Rationale
Geographical	
Australia, the EU, China and the U.S.	There are several key motivations for focusing on Australia, the EU, China and the U.S.: 1. **Emissions and climate change ambition:** In terms of carbon emissions, the three largest global emitters are China, the U.S. and the EU. Australia represents one of the largest emitters per capita. The EU has maintained a comparatively high level of leadership and diplomacy in international climate negotiations. China has clearly signalled its intentions to commit to ambitious climate action. The U.S. was engaged in comparatively ambitious climate action under the Obama Administration and their positive participation at COP21 facilitated the adoption of the Paris Agreement. In contrast, Australia is considered a laggard in terms of climate action. 2. **Impacts of climate change:** All four Parties have experienced climate-related health impacts to varying levels to date, as well as substantial economic costs associated with climate change. Moreover, it is anticipated that future climate-related health impacts will disproportionately affect the most vulnerable populations in each Party, not to mention future generations. 3. **Politico-economic and governance differences:** The four Parties have differing politico-economic systems, governance structures and legislative levers for addressing climate change. These differences may influence whether and how health is accounted for in the development of climate change mitigation policies.
Temporal	
Australia and the EU: 2016 and 2017 respectively (for interviews only) China and the U.S.: 2007 to 2017	Semi-structured interviews will be undertaken with eligible participants at the time of case study development: May to October 2016 and May to October 2017 for Australia and the EU respectively. The temporal parameter exists for interviews only; given actual timeframes associated with policy development, it is highly likely that relevant policy documents and other pertinent information relating to the development of climate change mitigation policies for Australia and the EU will have been developed over the course of a number of years. Given content analysis constitutes the primary source of data for China and the U.S., the timeframe has been extended to include the last decade. In China, this period coincides with a distinct shift in attention and commitment to mitigation, beginning with concerted efforts to reduce pollution in the lead-up to the 2008 Beijing Olympics. For the U.S., this time period coincides with the final year of the Bush Administration, the full eight-year term of the Obama Administration, and the first year of the Trump Administration. A distinct shift in the prioritisation of climate change policies can be seen across the three Administrations.

Spatial	
National policy development	I acknowledge that successful climate change action requires policies across varying scales and much of the effort in climate adaptation and mitigation will be carried out at the sub-national level. However, it is national governments as Parties to the UNFCCC that are primarily responsible for negotiating at the international level, setting the trajectory for climate action for their respective jurisdictions, including sub-national governments, through the submission of NDCs. Further, given time and resource constraints, it would be impossible to achieve adequate depth by attempting to cover more than one governmental level.
Climate Policy Area	
Climate change mitigation	To date, the health co-benefits literature has focused its attention on the benefits associated with mitigation efforts as opposed to the potential co-benefits of adaptation strategies.
Sectoral	
Energy and transport sector-related health co-benefits	Climate change is an economy-wide, cross-sectoral issue. While health co-benefits of climate change mitigation policies are realised across sectors including energy, transport, buildings and housing, urban planning, and agriculture, a majority of health co-benefits studies have quantified and monetised benefits in relation to mitigation measures relevant to the energy and transport sectors as these represent areas where the health impacts have been well established and documented by epidemiological research.
Interview Participants	
Policy-makers directly involved in the development of climate change mitigation policies	I recognise that non-state actors can and do play an integral role in the policy-making process. However, given time and resource constraints, interviews will primarily be carried out with policy-makers involved in the development of mitigation policies at the national level (supranational level in the case of the EU). As individuals ultimately responsible for the policy options presented to senior decision makers, policy-makers are responsible for policy content and can provide insights into the potential relevance of health co-benefits to the policy development process that other stakeholders, including non-state actors and senior decision makers, are unlikely to be able to provide.

Appendix C: Full List of Documents Analysed

The documents listed in Tables 1 and 2 have been identified based on the selection criteria outlined in Appendix D and have been analysed using the qualitative data analysis software NVivo 11 (NVivo, 2014).

Given time constraints, documents with 50 pages or more may only be partially analysed with a focus on the Executive Summary and any sections detailing costs and benefits or health.

Table 20. List of documents identified as meeting the selection criteria for directed content analysis of Australian and European Union mitigation policies

		Document title and publication date	Author/Source	Comments
Australia	1	Emissions Reduction Fund White Paper (April 2014)	Department of the Environment	**104 pages**
	2	United Nations Framework Convention on Climate Change (UNFCCC) Taskforce Final Report (August 2015)	Department of Prime Minister and Cabinet	**22 pages**
	3	National Climate Resilience and Adaptation Strategy (2015)	Department of the Environment	**80 pages**
	4	National Energy Productivity Plan 2015–2030: Boosting Competitiveness, Managing Costs and Reducing Emissions (December 2015)	Department of Industry, Innovation and Science	**106 pages**
	5	Vehicle Emissions Discussion Paper (February 2016)	Department of Infrastructure and Regional Development	**46 pages**
European Union	6	Impact Assessment accompanying document to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A roadmap for moving to a competitive low carbon economy in 2050. SEC(2011) 288 final (March 2011)	European Commission (Directorate-General for Climate Action (DG CLIMA))	**134 pages**
	7	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Energy Roadmap 2050. COM(2011) 885 final (December 2011)	European Commission (Directorate-General for Energy (DG Energy)/DG CLIMA)	**20 pages**
	8	Green Paper: A 2030 framework for climate and energy policies. COM(2013) 169 final (March 2013)	European Commission (DG CLIMA/DG Energy)	**16 pages**

	9	Impact Assessment accompanying the documents Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and [t]he Committee of the Regions a Clean Air Programme for Europe; Proposal for a Directive of the European Parliament and of the Council on the limitation of emissions of certain pollutants into the air from medium combustion plants; Proposal for a Directive of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC; Proposal for a Council Decision on the acceptance of the Amendment to the 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone. SWD(2013) 531 final/2 (January 2014)	European Commission (Directorate-General of Environment (DG ENV))	**365 pages** Also known as the Clean Air Policy Package
	10	Impact Assessment accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A policy framework for climate and energy in the period from 2020 up to 2030. SWD(2014) 015 final (January 2014)	European Commission (DG CLIMA/DG Energy)	**235 pages**

Table 21. List of documents identified as meeting the selection criteria for directed content analysis of Chinese and American mitigation policies

		Document title and publication date	Author/Source	Comments
China	1	China's Policies and Actions for Addressing Climate Change (October 2017)	National Development and Reform Commission (NDRC)	In English **72 pages**
	2	2016 Report on the State of the Environment in China (May 2017)	Ministry of Environmental Protection (MEP)	In English **59 pages**
	3	People's Republic of China's First Biennial Update Report on Climate Change (December 2016)	People's Republic of China (PRC)	Mandarin, followed by English translation **316 pages**
	4	The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China (December 2016)	NDRC	English translation **219 pages**
	5	The 13th Five-Year Plan for the Protection of Ecological Environment (November 2016)	MEP	Mandarin, followed by English translation **194 pages**
	6	China's Policies and Actions for Addressing Climate Change (November 2013)	NDRC	In English **71 pages**
	7	Action Plan on Prevention and Control of Air Pollution (September 2013)	MEP	In English **HTML only**
	8	China's Policies and Actions for Addressing Climate Change (2012)	NDRC (available through UNT)	In English **30 pages**
	9	Second National Communication on Climate Change of The People's Republic of China (November 2012)	PRC	In English **208 pages**
	10	National "12th Five-Year Plan" for Environmental Protection (2011)	MEP	In English **49 pages**
	11	The 12th Five-Year Plan for the Environmental Health Work of National Environmental Protection (September 2011)	MEP	In English **15 pages**
	12	Action Plan on Environment and Health (2007-2015) (December 2007)	PRC (available through China.org.cn)	In English **6 pages**
	13	China's National Climate Change Programme (June 2007)	NDRC	In English **63 pages**

U.S.	14	State Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units (December 2017)	U.S. Environmental Protection Agency (U.S. EPA)	**13 pages**
	15	Repeal of Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Proposed Rule (October 2017)	U.S. EPA	**15 pages**
	16	Review of the 2016 Oil and Gas New Source Performance Standards for New, Reconstructed, and Modified Sources; Review (April 2017)	U.S. EPA	**2 pages**
	17	Review of the Standards of Performance for Greenhouse Gas Emissions From New, Modified, and Reconstructed Stationary Sources: Electric Generating Units; Review (April 2017)	U.S. EPA	**2 pages**
	18	Review of the Clean Power Plan; Review (April 2017)	U.S. EPA	**2 pages**
	19	Withdrawal of Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews; Notice (April 2017)	U.S. Council on Environmental Quality (CEQ)	**2 pages**
	20	Executive Order 13783: Promoting Energy Independence and Economic Growth (March 2017)	Trump	**5 pages**
	21	United States Mid-Century Strategy for Deep Decarbonization (November 2016)	White House	**111 pages**
	22	Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2 (October 2016)	U.S. EPA/National Highway Traffic Safety Administration (NHTSA), DOT	**797 pages** Currently being repealed by Scott Pruitt. See mid-term evaluation (2018)
	23	Finding That Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution That May Reasonably Be Anticipated to Endanger Public Health and Welfare; Final Rule (August 2016)	U.S. EPA	**55 pages**
	24	Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources; Final Rule (June 2016)	U.S. EPA	**119 pages**
	25	The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment – Executive Summary (April 2016)	U.S. Global Change Research Program (U.S. GCRP)	**24 pages**

	26	2016 Second Biennial Report of the United States of America under the United Nations Framework Convention on Climate Change (December 2015)	U.S. Department of State (DOS)	**80 pages**
	27	Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Final Rule (Clean Power Plan; October 2015)	U.S. EPA	**304 pages**
	28	Federal Plan Requirements for Greenhouse Gas Emissions From Electric Utility Generating Units Constructed on or Before January 8, 2014; Model Trading Rules; Amendments to Framework Regulations; Proposed Rule (Federal implementation rules for the Clean Power Plan; October 2015)	U.S. EPA	**152 pages** Archived. Supporting technical documents available here.
	29	Climate Change: HHS Could Take Further Steps to Enhance Understanding of Public Health Risks (October 2015)	Government Accountability Office (GAO)	**85 pages**
	30	Announcement of Requirements and Registration for the NIEHS Climate Change and Environmental Exposures Challenge (September 2015)	National Institutes of Health (NIH)	**4 pages**
	31	Control of Air Pollution From Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards; Final Rule (April 2014)	U.S. EPA	**474 pages**
	32	United States Climate Action Report 2014: First Biennial Report of the United States; Sixth National Communication of the United States (January 2014)	DOS	**310 pages**
	33	Climate Change Impacts in the United States: The Third National Climate Assessment (2014)	U.S. GCRP	Chapter 27 (**37 pages**) most relevant
	34	The President's Climate Action Plan (2013)	Obama Administration	**21 pages**
	35	National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Final Rule (February 2012)	U.S. EPA	**211 pages** Also known as the Mercury and Air Toxics Standards (MATS) rule
	36	Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals; Final Rule (August 2011)	U.S. EPA	**277 pages**

	37	Benefits and Costs of the Clean Air Act, 1990-2020: Second prospective study (March 2011)	U.S. EPA	**238 pages** Two additional studies undertaken in 1997 and 1999, see here.
	38	EPA's Denial of the Petitions To Reconsider the Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act; Final Rule (August 2010)	U.S. EPA	**40 pages**
	39	U.S. Climate Action Report 2010: Fifth National Communication of the United States of America (May 2010)	DOS	**193 pages**
	40	A Human Health Perspective on Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change (April 2010)	National Institutes of Environmental Health Services (NIEHS)	**80 pages**
	41	Federal Climate Change Programs: Funding History and Policy Issues (March 2010)	Congressional Budget Office (CBO)	**31 pages**
	42	Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act; Final Rule (December 2009)	U.S. EPA	**52 pages**
	43	Mandatory Reporting of Greenhouse Gases; Final Rule (October 2009)	U.S. EPA	**261 pages** Initial ruling; several iterations were made in 2010 and 2011
	44	EO 13514: Federal Leadership in Environmental, Energy, and Economic Performance (October 2009)	Obama	**13 pages**
	45	Regulating Greenhouse Gas Emissions Under the Clean Air Act; Proposed Rule (July 2008)	U.S. EPA	**168 pages** No Final Rule made; rule withdrawn in 2009
	46	U.S. Climate Action Report – 2006: Fourth National Communication of the United States of America (July 2007)	DOS	**145 pages**
	47	Control of Hazardous Air Pollutants From Mobile Sources; Final Rule (February 2007)	U.S. EPA	**144 pages**

Appendix D: Case Study Protocol

The purpose of this document is to detail the processes that will be used to develop two case studies for Australia and the European Union (EU) that examine the role of health co-benefits in the development of climate change mitigation policies. The explicit documentation of details in this protocol which will guide the development of the case studies will assist in the creation of case studies that are not only comparable but are also methodologically robust.

The protocol is based on details included in the ethics application submitted to the University of Melbourne's Human Research Ethics Committee in October 2015 (ID: 1545561.1) and includes four sections:

1. An overview of the proposed study;
2. Field procedures for data collection;
3. Questions that informed the case study; and
4. A guide for the case study report.

1. Study Overview

A knowledge gap exists in our understanding of whether and how policy-makers consider and account for positive health outcomes (health co-benefits) in the development of climate change mitigation policies. Using the political economy of health as a theoretical framework, this research seeks to answer two research questions:

1. Are health co-benefits considered and accounted for in the development of climate change mitigation policies and if so, how?
2. What factors influence how health co-benefits are considered and accounted for?

To answer these questions, an exploratory comparative case study will be carried out that examines the role of health co-benefits in the development of Australian and European Union climate change mitigation policies. Findings from the case study will be supported by additional directed qualitative content analysis performed on select Chinese and American climate change mitigation policy documents. Data collection techniques include: i) interviews; ii) audio-taping interviewees (with prior consent); and iii) directed content analysis of policy documents.

2. Field Procedures

2.1 Interviews

Target interview participants for this study comprise government officials directly involved in the development of mitigation policies in Australia and the EU. Interviewees will be recruited for up to an hour-long semi-structured interview. They will be asked questions about the policy-making process; factors that influence the prioritisation of multiple considerations; potential barriers and enablers; the role of scientific evidence and external stakeholders in the policy-making process; and the communication of climate change policies. Given the scope of the study, of particular interest are officials who can provide health, energy, transport and/or economic expertise or advice.

Given the nature of their work and time pressures, it is likely that accessibility issues will impact the recruitment of participants. Consequently, personal networks will be utilised in the first instance to assist with recruitment. Strategic opportunities to recruit candidates at conferences and events will also be pursued. Further, snowball sampling will be employed as a recruitment method. The Student Researcher (Annabelle Workman) will be primarily responsible for the recruitment of participants.

All prospective participants will be contacted via email. An introductory email will be sent to potential interview participants that includes a Plain Language Statement explaining the study's aims, the researchers involved in the study and the interview process. Non-respondents will be followed up within two weeks of the initial email with a reminder email.

A consent form will be provided to participants who agree to be interviewed. Little to no background information will be sought from participants; only name where permitted and position information will be collected. Prior consent will be received for both the interview being recorded and for the participant's name being used during the interview.

Interviews may be carried out face-to-face, via Skype or by telephone depending on participant preference and timing. The Student Researcher will be solely responsible for interviewing participants. During interviews, the Student Researcher will take notes using an interview note-taking template and where consent is provided, will record interviews in order to allow for accurate transcription of interview data. Both notes and recordings will constitute data for the purposes of the case study report.

While overseas, the Student Researcher will maintain regular contact with the Responsible Researcher (David Karoly) and Co-Researchers (Grant Blashki, Kathryn Bowen

and John Wiseman) in order to ensure that the conduct of the project is adequately monitored and continues to comply with University protocols and guidelines. The Student Researcher will report back as data collection progresses and will inform the Responsible and Co-Researchers as soon as possible should a situation arise. The Student Researcher will promptly seek advice where issues are encountered.

Up to 40 participants will be recruited to participate in the study. No children or legal minors will be eligible for interview. Thematic saturation will primarily inform participant numbers, although the final sample size will also be influenced by time and resource constraints.

2.2 Documents

Documents will be selected for analysis based on the selection criteria outlined in Tables 22 and 23 (refer to Appendix C for a full list of selected documents). Selected documents will be imported into NVivo qualitative data analysis software for the purposes of directed qualitative content analysis (Hsieh & Shannon, 2005) alongside interview data.

Table 22. Selection criteria for documents included for the purposes of directed content analysis of Australian and EU mitigation policies

Parameters	**Inclusion**	**Rationale/Comment**
Authorship	Government documents or publications prepared by an Australian or European Commission agency.	Time constraints require a focus on documents prepared by representatives of the Australian and European Commission agencies. Non-government documents will likely be used as part of context setting and backgrounding.
Geographical	Documents or publications which focus on Australia and the EU.	Australia is one of the largest emitters per capita and the EU constitutes the third largest emitter globally. Further information on the rationale for these two Parties to the UNFCCC is available in Chapter 3 and Appendix B.
Content	Documents or publications relevant to the development of climate mitigation policies for the purpose of determining NDCs.	The focus of this thesis is the analysis of mitigation policies. Consequently, key policy documents relevant to the development of the climate change mitigation policies that underpin NDCs will be the focus of analysis. Where deemed relevant, documents referring to adaptation policies may be analysed.
Spatial	Documents or publications that focus on national policy development.	The focus of this research is the role of health co-benefits at the national level. Documents relating to sub-national mitigation policies may be used as part of context setting and backgrounding.
Language	Documents published in the English language.	Given time constraints, only documents or publications published in English will be analysed.
Accessibility	Documents publicly available in electronic format.	For the purposes of transparency, only documents that are publicly accessible at the time of document identification will be considered for selection.

Table 23. Selection criteria for documents included for the purposes of directed content analysis of Chinese and American mitigation policies

Parameters	Inclusion	Rationale/Comment
Authorship	Government documents (including legislation) or publications prepared by a Chinese or U.S. government department.	Time constraints require a focus on documents prepared by representatives of the Chinese and U.S. governments. Non-government documents will likely be used as part of context setting and backgrounding.
Geographical	Documents or publications which focus on China and the U.S.	China and the U.S. represent the two largest greenhouse gas emitters globally. The policies of these two Parties to the UNFCCC are pivotal to action on climate change.
Content	Documents or publications that detail major Chinese or U.S. mitigation policies and/or health-related mitigation activities.	Time constraints limit the focus of analysis on policies with a major impact on mitigation efforts for China and the U.S.
Temporal	Documents or publications published between 2007 and 2017.	2007 to 2017 represents a decade in which important developments in mitigation policies occurred for many Parties to the UNFCCC, including for China and the U.S.
Spatial	Documents or publications that focus on national climate change mitigation policies.	The focus of this research is the role of health co-benefits at the national level. Documents relating to subnational mitigation policies may be used as part of context setting and backgrounding.
Language	Documents published in the English language.	Given time constraints, only documents or publications published in English will be analysed.
Accessibility	Documents publicly available in electronic format.	For the purposes of transparency, only documents that are publicly accessible at the time of document identification will be considered for selection.

2.3 Data Analysis

De-identified interview recordings will be transcribed verbatim and verified for accuracy three times before being analysed using NVivo 11 qualitative data analysis software (NVivo, 2014). Documents will be analysed using the same themes that inform the interview schedule: i) the policy-making process; ii) factors influencing the prioritisation of multiple considerations; iii) barriers and enablers to the consideration of health; iv) the evidence base of policy development; v) the role of external actors and stakeholders); and vi) the communication of policy decisions. This will facilitate the triangulation of interview and document data in order to verify the accuracy of findings.

Additional themes or sub-themes identified during the analysis of interviews and/or documents will be reported as deemed appropriate by the researchers in the case study reports.

3. Case Study Questions

The case study will be developed around eight questions that fall into six themes and will be presented in an interview schedule (refer to Table 24 below). The interview schedule has been informed by feedback from climate change and health experts. The questions remain as open and as neutral as possible; the term 'health outcomes' has been used to minimise the potential for bias and to allow for discussion on potential adverse health outcomes from the implementation of mitigation policy (often termed co-harms). The interview schedule was piloted three times prior to interviews with selected participants and was not altered between the pilot phase and operational phase.

As previously mentioned, an interview note-taking template will be used to capture notes during the interviews and will constitute a data source for the purposes of the case study report.

Table 24. Interview schedule

Introduction

Thank you for agreeing to be a participant in my research project. As I mentioned when we spoke/I wrote, I am researching the predicted health outcomes that result from the implementation of climate change policy aimed at reducing carbon and other emissions, which I will call mitigation policy. In particular, I am exploring how these predicted health outcomes are accounted for in the development of national and supranational climate change mitigation policy.

The purpose of this interview is to gain insight into how the Australian government/ European Commission accounts for short-term and long-term health consequences in the development of mitigation policy, and what factors influence how health is considered and accounted for.

[You have indicated on your signed consent form that you are happy for the interview to be recorded. The recording will be securely stored and will only be accessible by me and my supervisors, who are listed on the consent form. Any subsequent transcripts will be stored as de-identified data sources to protect your identity].

[You have indicated on your signed consent form that you wish to remain anonymous. I will not use your name during the interview and I will refer to your government position only when using any information from this interview in my research].

You are welcome to clarify, ask and decline to answer questions throughout the interview. May I also remind you that as a voluntary participant, you are welcome to withdraw from the research project at any time.

Main questions	Additional questions	Clarifying questions
Policy-Making Process 1. How are predicted health outcomes accounted for in the development of climate change mitigation policies?	a) What processes are used to account for multiple considerations in policy-making? b) In which sectors and across which Departments do you think health outcomes should be considered in policy-making? c) Where have you seen the consideration of health outcomes used to inform policy-making decisions?	Can you expand on this? Can you give me an example? Can you tell me anything else?
Factors Influencing the Prioritisation of Health given Multiple Considerations 2. In your experience, what factors influence whether and how health outcomes inform climate change policy-making?	a) What processes are used to rank or prioritise the different considerations that inform policy-making? b) Compared to other considerations, how relevant is health in motivating a certain course of action on climate change? c) Are health impact/integrated assessments regularly used to inform climate change policy-making? If yes, how? If not, why not?	

Barriers and Enablers for the Consideration of Health 3. a) What do you consider to be potential barriers in accounting for health outcomes in climate change mitigation policy? 3. b) What do you consider to be potential enablers in accounting for health outcomes in climate change mitigation policy?	c) How has the WHO's Health in All Policies initiative been received as a possible framework for policy-making? d) How relevant are health outcomes when developing policy for climate change mitigation? e) How relevant are health outcomes when developing policy for climate change adaptation?	
The Evidence Base for Policy 4. To what extent is peer reviewed scientific evidence used as a basis for policy development and program design?	a) How is research accessed and utilised in the policy development process? b) Can you provide an example of a policy or program that is strongly evidence-based?	
The Role of External Actors and Stakeholders 5. In what ways do stakeholders and interest groups inform the climate change policy-making process?	a) Are there avenues beyond the formal stakeholder consultation processes that facilitate policy input from stakeholders on climate change policy?	
Communicating Policy Decisions 6. What are the main drivers associated with communicating policy decisions?	a) Are health benefits and healthcare savings a useful communications frame in communicating climate policy decisions? b) Can you provide an example of where they have been used to publicly justify an environmental policy decision?	
Concluding questions		
7. Is there anything we haven't covered that you think might be relevant or of interest?		
8. Can you suggest any other colleagues or Government/Commission employees who you think I might benefit from speaking with?		

Closing

Thank you very much for your time and perspectives.

As mentioned earlier, the data from this interview will be securely stored at the University of Melbourne. This interview constitutes one of a number of data sources that will be analysed to build a case study on how the Australian government/ European Commission considers and accounts for possible health outcomes in the development of climate change mitigation policy.

I will provide an electronic copy of the research findings to your preferred email address once the research has been completed. In the meantime, please don't hesitate to contact me through my contact details supplied on the Plain Language Statement should you have any questions.

4. Case Study Report Guide

The development of each case study report will follow a similar structure comprising six sections:

i) **introduction:** the introductory section will provide the motivation for the case study and a road map outlining the case study structure;

ii) **background:** the background section will provide contextual information surrounding domestic circumstances considered relevant for the case study;

iii) **methods:** the methods section will outline the relevant methods used to collect and analyse data for the development of the case study;

iv) **results:** the results section will present key findings separated into by the six themes that underpin the interview schedule: i) the policy-making process; ii) factors influencing the prioritisation of multiple considerations; iii) barriers and enablers to the consideration of health; iv) the evidence base of policy development; v) the role of external actors and stakeholders; and vi) the communication of policy decisions;

v) **discussion:** the discussion section will outline implications of the findings; and

vi) **conclusion:** the concluding section will summarise findings and where appropriate, suggest further research.

Appendix E: Dissemination Strategy

This dissemination strategy has been prepared to assist in the communication of research findings from this thesis to a variety of target audiences: researchers, policy-makers and community members. Effective communication of research findings requires preparation and planning. This document is structured to articulate an actionable plan by outlining the:

1. context;
2. objectives;
3. target audiences;
4. presentation format;
5. timeline;
6. resources; and
7. process.

1. Context

International climate change politics is at a crossroad. The climate science is unequivocal: we must move toward a zero-carbon world by the end of the century in order to avoid the likelihood of catastrophic climate change. 195 countries have committed to the Paris Agreement, an unprecedented achievement that requires its members to enhance the ambition of climate action every five years. Yet, changing geopolitics and domestic circumstances threaten to undermine this commitment; an increase in the election of populist and right-wing governments across the globe has implications for commitment to international climate diplomacy. For example, the United States of America (U.S.) under the Trump Administration has already signalled its intention to withdraw from the Agreement and has repealed most policies that supported the achievement of the U.S. mitigation pledge.

The development of ambitious climate change mitigation policies at a national level is increasingly difficult to justify when global commitments to climate action remain volatile. With dire warnings from the climate science community on the consequences of delayed action, securing the political will for meaningful action is imperative. Accordingly, my research must diplomatically navigate this international context by remaining cognisant that climate change mitigation is currently situated in a dynamic policy environment.

2. Objectives

The aims of this dissemination strategy are to support the communication of my research findings in a manner that optimises the likelihood of impact and uptake by target audiences. I have identified the following dissemination goals:

- To provide the range of identified targeted audiences with access to my research findings in an appropriate format that supports the use and further communication of findings to broader audiences;
- To establish relationships with identified target audiences in order to maximise the benefit of the research.

While no formal evaluation of the dissemination strategy will be performed, I will personally evaluate the success of research dissemination based on both tangible (i.e. citation counts) and intangible (i.e. additional professional relationships) outcomes.

3. Target audiences

A diverse range of target audiences have been identified as relevant for this research (see Table 25). This dissemination strategy will focus on activities to engage identified primary target audiences. It is anticipated that advocacy groups in particular will communicate the findings more broadly to secondary target audiences.

Table 25. Target audiences relevant for this research

<table>
<tr><th></th><th>Audience</th><th>Potential information sources</th></tr>
<tr><td rowspan="3">Primary</td><td>Policy-makers involved in the development of national emissions reduction policies</td><td rowspan="4">• Peers (domestic and international)
• Peer-reviewed literature
• Intergovernmental agency reports
• Grey literature
• Media</td></tr>
<tr><td>Climate change and health researchers</td></tr>
<tr><td>Climate change and/or health advocacy groups/ non-government organisations</td></tr>
<tr><td rowspan="3">Secondary</td><td>Policy-makers involved in the development of emissions reduction policies across other levels of government (i.e. sub-national)</td></tr>
<tr><td>Urban community members</td><td rowspan="2">• Friends and peers (domestic)
• (Open access) peer-reviewed literature
• Grey literature
• Media</td></tr>
<tr><td>Community members residing near electricity generators (i.e. coal-fired power plants)</td></tr>
</table>

4. Presentation format

The presentation of findings will need to be stylistically tailored in order to effectively communicate to the different target audiences. Accordingly, the following formats will be utilised to disseminate findings:

- **Policy-makers:** I will develop three separate policy briefs using plain language: i) one brief detailing findings and recommendations of the Australian case study for dissemination to Australian policy-makers interviewed for the study; ii) one brief detailing findings and recommendations of the European Union (EU) case study for dissemination to European Commission policy-makers interviewed for the study; and iii) one brief detailing overarching findings and recommendations for dissemination to all policy-makers involved in the study.
- **Researchers:** I will prepare four manuscripts for submission to peer-reviewed journals that detail findings for: i) an Australian case study; ii) an EU case study; iii) a U.S. case study; and iv) a cross-case analysis.
- **Non-government organisations/advocacy groups:** I will prepare a two-page fact sheet using plain language that details overarching findings and recommendations for relevant non-government organisations and advocacy groups.

5. Timeline

The preparation of materials for the dissemination of findings will occur at various stages throughout the study:

- **Manuscripts for peer review** will be prepared throughout my candidature upon completion of the development of each case study and will be submitted to peer-reviewed journals for consideration once they have been prepared.
- **Policy briefs and the fact sheet** will be prepared once my thesis has been submitted for examination. Dissemination of policy briefs and fact sheets will be delayed until comments have been received from reviewers, in case amendments are required.

6. Resources

Limited financial resources are available to support the development of material for dissemination. Given I consider dissemination a core component of my candidature, I will commit to the preparation of material during working hours dedicated to my candidature.

In-kind support for the dissemination of policy briefs and the fact sheet will be sought. Specifically, policy-makers and non-governmental groups who receive the policy briefs and fact sheet via email will be asked to forward the materials accordingly to relevant colleagues.

7. Process

7.1 Risk identification

The politically sensitive nature of climate change policies in Australia is a potential risk that I remain mindful of. It is likely that the completion of my thesis will coincide with political preparations for a federal election. Given climate policy is a partisan issue in Australia, this represents an opportunity to disseminate findings to Members of Parliament and major political parties as they secure their policy platforms in the lead-up to the election.

7.2 Messaging

Keeping in mind the international and domestic contexts in which this research is situated, as well as the potentially sensitive nature of findings, the tone of messaging will remain as positive as possible, emphasising practical opportunities to enhance engagement with health co-benefits.

7.3 Communication methods

The primary communication method for the policy briefs and fact sheet will be email in the first instance. I will seek access to a University website to host the materials longer-term, for example, the Australian-German Climate and Energy College with which I have been affiliated throughout my candidature. I will also seek to host links to any peer-reviewed journal publications at the same website.

I will liaise with the University of Melbourne's Faculty of Science media team following the completion of my thesis to discuss opportunities to disseminate research findings more broadly through media avenues.

Appendix F: Summary of Findings for Australia and the European Union

Table 26. Summary of findings for Australia and the EU, by theme

Theme	Australia	EU
The Policy-Making Process	• An Interdepartmental Committee (IDC) develops a Regulatory Impact Statement (RIS) for a Cabinet submission; • Economic modelling is a core component of the policy development process, with costs regularly quantified and monetised while benefits are generally considered in a qualitative manner; • The federal health department is considered a peripheral agency in climate change mitigation policy development.	• An Inter Service Group (ISG) develops an inception impact assessment followed by an integrated impact assessment for the consideration of legislators; • Integrated assessment modelling is used to determine a range of optimal (least-cost) policy options and health co-benefits are an explicit consideration; • Modelling tools and analyses are shared between DGs to support the harmonisation of mitigation policy options.
Factors Influencing the Prioritisation of Multiple Considerations	• No formal process exists to prioritise or rank multiple considerations; • Individual Ministers are responsible for agenda setting within their portfolio; • The nature of climate change in Australia is political and polarised; • Economic considerations, particularly in relation to competitive advantage, are highly influential in the climate policy development process.	<u>Guiding principles</u>: • The three pillars of sustainable development (economic, social, environmental) guide the development and prioritisation of multiple considerations of impact assessments; • Limiting warming to 2°C sets the parameters for the development of climate policy options. <u>Political priorities</u>: • Economic and energy supply considerations strongly influence the policy options presented and final policies agreed upon.

Barriers Identified by Policy-Makers	• The comparatively small number of influential health champions engaging with the government; • A lack of local data to support impact assessment; • The difficulty associated with attribution of (longer-term) health impacts; • The temporal (longer-term) nature of health impacts; • Health is primarily seen as an adaptation issue; • A lack of funding dedicated to climate change and health research.	• The dominant narrative of costs and growth combined with political short-termism in EU Member States; • The difficulty associated with attribution of (longer-term) health impacts; • Comparatively limited funding specifically for climate change and health research.
Enablers Identified by Policy-Makers	• Incidents with serious community health impacts, for example the Hazelwood mine fire in Victoria.	• Recent exposure to severe weather events with serious health implications; • Transparency and accountability of European Commission policy development process; • The EU's long history of air quality legislation and increasingly ambitious policies; • the Paris Agreement.
Evidence Base of Policy Development	• Peer-reviewed literature is considered to some extent however accessibility issues are a limiting factor; • In the absence of peer-reviewed literature, international research and multilateral organisations such as the International Energy Agency (IEA) and the Organisation for Economic Cooperation and Development (OECD) can inform policy development, as well as domestic think tanks and institutes; • The role of scientific experts is limited due to structural and communication challenges.	• Evidence-based policy development is seen as crucial and financial resources are made readily available in order to support the development of robust, scientific policy options; • Summaries prepared by the Intergovernmental Panel on Climate Change (IPCC), as well as reports prepared by multilateral organisations such as the World Health Organization (WHO) and the OECD inform policy development.

Role of External Actors and Stakeholders	• Formal consultation processes are limited by the resources available; • Informal consultation can be more influential in the policy development process; • Business and industry interests are more influential and better equipped to argue for preferred policy options; • Non-governmental organisations can be influential if they provide information and seek to persuade rather than to embarrass the government.	• Many opportunities exist throughout the policy development process for stakeholder consultation, input and feedback; • Both open and targeted (invite only) opportunities used to inform the development of policy options.
Communicating Policy Decisions	• Aside from vehicle emissions standards and energy efficiency, the use of health co-benefits to justify mitigation policies is limited.	• Health co-benefits are one of several justifications and are perceived to resonate more with the public than with political representatives of Member States; • Acceptance of health as a justification for action can be influenced by population demographics.

Appendix G: Summary of Findings for China and the U.S.

Table 27. Summary of findings for China and the U.S., by theme

Theme	China	U.S.
The Policy-Making Process	• Politico-economic ideologies guide policy development, including Deng Xiaoping Theory and the Scientific Outlook on Development; • Inter-Ministerial approach to climate change policy development, led by the National Leading Group on Climate Change, Energy Conservation and Emissions Reduction.	• Policy development underpinned by economic modelling in order to examine economic impacts and interactions across different sectors; • Aside from costs, there is an explicit consideration both quantitatively and qualitatively of health and other benefits associated with mitigation measures.
Factors Influencing the Prioritisation of Multiple Considerations	• China's coal-dominated fuel mix, employment implications and a transitioning economy, where economic growth is still linked to successful performance at the sub-national level; • The valuation of economic damages and China's vulnerable environment under a changing climate.	• Economic considerations, including costs to industry; • Intra- and inter-generational equity and an obligation to minimise the impacts on those most vulnerable to climate-related health effects; • Energy supply security and the implications of the costs of proposed regulations for vulnerable communities; • Employment impacts, particularly in the aftermath of the global financial crisis.
Barriers	• A lack of local data to support environmental health assessment; • Health is primarily seen as an adaptation issue.	• Limitations in modelling and knowledge in health-emission exposure pathways as well as access to reliable data; • Funding dedicated to climate change and health research; • A review of the social cost of carbon methodology under the Trump Administration;

		• The order in which regulations are implemented may impact their actual efficiency and the estimated net benefits.
Enablers	• Recognition that a changing climate will result in negative consequences for human health; • Expectations for environmental protection for the purposes of public health by an increasingly educated and cognisant Chinese public; • Recognition that reduced coal consumption can positively impact air quality.	• The use of health champions (the Surgeon General and the U.S. EPA Administrator) to communicate the health implications of a changing climate to the public; • The U.S. EPA's determination that GHG emissions endangered human health and welfare and consequently were subject to regulation under the CAA; • The use of methodologies to demonstrate that the (quantifiable) benefits of mitigation measures far outweigh the costs.
Evidence Base of Policy Development	• Role for scientific expertise in the development of climate change mitigation policies with the establishment of the National Panel of Experts on Climate Change.	• Scientific evidence plays a pivotal role in policy development, supported through the inter-departmental collaboration, the U.S. Global Change Research Program which produced assessment that intend to translate research into policy; • Expert panels are also responsible for the independent, robust review of methodologies associated with the climate change mitigation policy development process; • The evidence base played a fundamental role in the U.S. EPA Administrator's finding on the danger of GHG emissions to the human health and welfare of current and future generations and her denial of petitions to reconsider the finding.

External Actors and Stakeholders	• Acknowledgement of the need for a working relationship with business and civil society in order to achieve mitigation goals.	• Both open and targeted opportunities used to inform the development of policy options; • Acknowledgement of the need to accommodate industries affected by regulations, especially where cross-jurisdictional discrepancies exist; • Consultation also occurs at the international level, e.g. in relation to fuel consumption policies.
The Communication of Policy Decisions	• While no evidence of health as a communications frame for climate change, there is acknowledgement of a public mandate supportive of climate action, particularly in relation to mitigation; • There are indications of a commitment to enhancing education about environmental health more broadly.	• Human health is used as one of several frames for climate change mitigation policies; • The impacts of delayed action and environmental justice and equity are additional messages emphasised by the Obama Administration; • The relationship between climate change and health remains tenuous for the public; • A strategic decision was made to rebrand GHG emissions as carbon pollution in an effort to make the concept more tangible for the public.

Appendix H: Publications that Form the Basis of Chapters 2, 4 and 5

International Journal of
Environmental Research and Public Health

MDPI

Article

The Political Economy of Health Co-Benefits: Embedding Health in the Climate Change Agenda

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Abstract: A complex, whole-of-economy issue such as climate change demands an interdisciplinary, multi-sectoral response. However, evidence suggests that human health has remained elusive in its influence on the development of ambitious climate change mitigation policies for many national governments, despite a recognition that the combustion of fossil fuels results in pervasive short- and long-term health consequences. We use insights from literature on the political economy of health and climate change, the science–policy interface and power in policy-making, to identify additional barriers to the meaningful incorporation of health co-benefits into climate change mitigation policy development. Specifically, we identify four key interrelated areas where barriers may exist in relation to health co-benefits: discourse, efficiency, vested interests and structural challenges. With these insights in mind, we argue that the current politico-economic paradigm in which climate change is situated and the processes used to develop climate change mitigation policies do not adequately support accounting for health co-benefits. We present approaches for enhancing the role of health co-benefits in the development of climate change mitigation policies to ensure that health is embedded in the broader climate change agenda.

Keywords: health; co-benefits; climate change; political economy

1. Introduction

Anthropogenic climate change remains a pivotal issue on global, national and sub-national scales given the pervasive adverse consequences that are projected. For decades, national and sub-national governments, multinational agencies and inter-governmental entities, non-governmental organizations (NGOs) and scientists have dedicated substantial time and energy to understand its causes and propose effective mitigation and adaptation solutions. The Paris Agreement, negotiated and adopted in December 2015, represents the latest attempt by national governments and others to commit to emissions reduction targets at a global level in order to adequately address the predicted consequences of climate change. At the 21st Conference of the Parties (COP21), 195 Parties to the United Nations Framework Convention on Climate Change (UNFCCC) adopted the Paris Agreement, an unprecedented achievement in the history of international climate change negotiations which has seen COP21 heralded as a success [1]. Despite the elation surrounding COP21, the nationally

determined contributions (NDCs) pledged by participating Parties are not commensurate to the catastrophic risks posed by climate change, nor are they sufficiently ambitious given the urgent action required. Projections suggest that current national pledges will result in global average surface temperature warming of approximately 2.7 degrees Celsius (°C) by 2100 [2]. This represents a marked departure from a commitment in Paris to "holding the increase in global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change" [3] (p. 3). Appropriate renewable energy technologies and adequate sources of finance are available; the primary challenge for ambitious climate action remains political will [4]. There is now general political consensus that climate change exists, and that a significant proportion of the action needed to drive rapid economic decarbonization is likely to be undertaken at a sub-national level [5]. However, durable solutions remain evasive and agreement on ambitious action at national and global levels continues at a slow pace given the diversity of considerations and perspectives informing the debate.

The predicted health and other impacts of climate change emphasize that there is both an economic and an ethical imperative for urgent action. From an economic perspective, some systematic economic assessments of climate change have indicated that the benefits of early action outweigh the costs of delayed action on climate change [6,7]. Ethically, there are substantial implications for intra- and inter-generational equity, as climate change will have a severe impact on future generations [8]. With this in mind, climate change and human health researchers contend that consideration of the human health implications of climate change has the potential to enhance climate change action by circumventing the political polarization that can often stifle progress. Research conducted in the United States of America (US) concludes that applying a human health frame to climate change positively influences responses to climate action, irrespective of political persuasion [9,10]. Specifically, health co-benefits present an opportunity to positively inform the development and communication of ambitious climate change policies. The health co-benefits of climate change comprise health benefits that occur indirectly as a result of reductions in the emission of greenhouse gases and other climate altering pollutants [11].

Firstly, some health co-benefits have been shown to provide strong and tangible domestic impacts, especially for developing countries, in relatively short time frames [12,13]. Given climate change benefits are often longer-term and diffuse, health co-benefits can attend to "the temporal and geographic mismatch between costs and benefits" [14] (p. 475). Secondly, and on a related note, while uncertainty still exists, some health co-benefit studies can provide a comparatively high level of certainty in the estimated benefits, an unusual advantage of health co-benefits given the uncertainty associated with longer-term estimates relating to climate change [15]. Thirdly, over the past two decades, numerous studies have quantified and monetized local, regional and global health co-benefits of mitigation policies [16]. Notwithstanding the controversy surrounding the monetization approach, these quantifications can be used—and have been by some Parties to the UNFCCC, including the European Union (EU) and the US—to inform the development of mitigation policies, supporting the consideration of health in climate change cost–benefit models [17]. Numerous efforts have been undertaken to strengthen the role of health in the climate change agenda, including enhancing the role of health co-benefits in policy development (see Section 2.2). Despite these efforts, a gap still exists been the potential and actual role of health co-benefits in the development of national climate change mitigation policies. Several explanations have been put forward to explain the lack of political traction of health co-benefits, including a focus on cost minimization and research translation challenges [12,13,18].

In this paper, we use perspectives from the: (i) political economy; (ii) science–policy interface; and (iii) power in policy-making literature to support the proposition that additional barriers inhibit the integration of health co-benefits into climate change mitigation policies. Through an examination of the fields of literature indicated above, we identify four key interrelated areas where barriers may

exist in relation to health co-benefits: discourse, efficiency, vested interests and structural challenges. As a roadmap for this paper, in Section 2, we summarize the health impacts of climate change and outline the health co-benefits of climate change mitigation, then provide an overview of some of the main efforts to enhance the role of health in the climate agenda. In Section 3, we provide details of the methods used to identify the relevant literature. In Section 4, we stratify our findings from a survey of the literature into the four key interrelated areas. With the theoretical basis established, in Section 5, we use the four key interrelated areas and apply insights extrapolated from the literature to health co-benefits. We then identify strategies that may enhance the consideration of health co-benefits in the development of climate change mitigation policies. The paper culminates with suggestions for further research.

2. Background

2.1. The Health Impacts of Climate Change and Health Co-Benefits of Mitigation Measures

In 2009, Costello and colleagues asserted that "climate change is the biggest global health threat of the 21st century" [19] (p. 1693). Climate change is already negatively impacting health, and, if permitted to continue unabated, will exacerbate direct and indirect health impacts to varying degrees across populations [20–24]. Vulnerability to the health impacts of climate change are influenced by various factors including geography, current health status, age, gender, socioeconomic status, and infrastructure that "combine in a complex and place-specific manner" [20] (p. 717). While the attribution of climate change impacts on human health is challenging [25], climate change and health researchers utilize sophisticated scientific methods and long-term datasets, which are increasingly able to quantify and attribute specific health burdens to climate change [26,27]. The IPCC stratifies the health impacts of climate change into one of three classifications: direct impacts, ecosystem-mediated (indirect) impacts, and human institution-mediated impacts [20] (see Table 1).

Table 1. An overview of the health impacts of climate change. Adapted from IPCC AR5 (2014) [20].

Classification	Potential Impacts
Direct	Increased mortality resulting from increased exposure to: hot and cold weather extremes; floods and storms; ultraviolet radiation.
Ecosystem-mediated	Increased morbidity and mortality from increased exposure to: vector-borne and other infectious diseases; food- and water-borne infections; air pollution and aeroallergens.
Human institution-mediated	Increased morbidity and mortality from poor nutrition; occupational health; mental health; violence and conflict.

Understanding the interplay among energy sources, climate change and health is critical to respond to the health impacts of climate change. Accessibility to energy has been fundamental for human development and progress. However, the dominant mode of energy production—the combustion of fossil fuels—has serious ramifications for human health across local, national and global scales [28]. The use of coal, oil and gas for the provision of energy results in the emission of climate-altering pollutants. Longer-term, greenhouse gas (GHG) emissions from the combustion of fossil fuels contribute to climate change, resulting in direct and indirect health impacts as detailed in Table 1. The WHO estimates that climate change will account for 250,000 deaths annually in 2030 given predictions for increasing incidences of malaria, diarrhoea, malnutrition and heat stress [29]. Shorter-term, some emissions affect air quality, which in turn can impact the respiratory and cardiovascular health of populations [30–32]. The WHO estimates that in 2012, seven million deaths were attributable to household and ambient air pollution globally [33]. The interrelationship between air quality and climate change is inextricable, with many air pollutants produced concurrently with greenhouse gases through the combustion of fossil fuels [34,35]. Further, climate change exacerbates

air quality issues, with projections of increasing premature deaths due to ozone and particulate matter 2.5 micrometers or less in diameter ($PM_{2.5}$) in coming years as a result of climate change [36]. It is unsurprising that there are substantial economic costs attributable to climate change and air pollution. Estimates of the economic costs associated with climate change suggest that global annual gross domestic product (GDP) could be impacted by up to 3.3 percent by 2060; labour productivity constitutes one area that will be most significantly impacted [37]. Further modelling by the Organisation for Economic Cooperation and Development (OECD) estimates that the economic consequences of outdoor air pollution will result in health care costs of US$176 billion and 3.7 billion lost working days annually by 2060 [38].

Given the magnitude of current and projected health impacts, the health community has moved to highlight the potential health co-benefits that result from ambitious mitigation efforts. To determine the potential health co-benefits that arise from domestic and global action, complex modelling techniques have been created and are utilized by researchers, government and non-government organizations [17]. The broad methodological processes underpinning health co-benefits studies have been documented [13,39] and several literature reviews on the co-benefits of climate change mitigation policies have been performed [12,40–42]. The findings are consistent; despite the heterogeneity of study methods, prospective health co-benefits studies consistently conclude that the implementation of ambitious mitigation measures can reap significant health benefits for local populations, and partially, if not completely, offset resulting implementation costs [17,43]. A strong appeal of health co-benefits is their immediacy. Specifically, health benefits associated with reduced air pollution can materialise promptly after mitigation measures are implemented [13,44] (see Table 2).

Table 2. Examples of potential health co-benefits from mitigation activities relating to the energy and transport sectors, including the anticipated time lag for the realization of health co-benefits. Adapted from Remais et al. (2014) [13].

Mitigation Activity	Potential Health Co-Benefit(s)	Anticipated Time Lag(s)
Reductions in fossil fuel use	Reductions in sudden cardiac death risk; acute respiratory infections; chronic obstructive pulmonary disease exacerbations	Days to weeks; weeks and months; weeks and months
Improvements in fuel economy; incentivize electric vehicle use; tighten vehicle emission standards		
Increases in accessibility to active modes of transport, including walking and cycling	Reductions in type 2 diabetes; depression; breast and colon cancer incidence	Years for all potential health co-benefits identified

There are some important examples that suggest health co-benefits can and do influence the development of climate change mitigation policies. In China, the adverse health impacts of air pollution are driving emissions reduction efforts [45,46]. In the US, climate change mitigation policies have been pursued through clean air legislation in recent years with health co-benefits publicly communicated as a key selling point [47] in an attempt to pursue climate action despite the politically toxic nature of the climate change debate.

However, there is recognition that co-benefits have not gained commensurate political traction in a majority of Parties to the UNFCCC [12,13,18,48,49]. Limited and varying explanations have been proposed. Some of these explanations align with political economy thinking. For example, Nemet and colleagues (2010) argued that a political "focus on cost minimization—rather than comparison of benefits and costs—diminishes the role of benefits in general" [12] (p. 1). In their literature review of co-benefits, Mayrhofer and Gupta (2016) concluded that, given the dominant influence of economists, the application of "co-benefits ends up being a 'business-as-usual' incremental approach which does not adequately call for the structural change needed to address climate change . . . " [18] (p. 28). Our findings on the role of health co-benefits in the development of Australian climate change mitigation policies support the notion that a number of barriers constrain the consideration of health

co-benefits in mitigation policy development, including the disproportionate influence of economic modelling and vested interests [49]. Other conclusions posit alternative explanations. For example, Remais and colleagues (2014) advanced the need to enhance the policy relevance of health co-benefits studies by prompting health co-benefits researchers to "iteratively engage policy makers actively in their work" [13] (p. 453). Others suggest that the science–policy interface presents a number of challenges, and a viable solution requires an integrated approach [50,51]. While the explanations offered to date provide a solid foundation for exploring solutions to enhancing the role of health in the climate change agenda, additional insights may be gleaned from consideration of the political and economic structures and processes that underpin policy development.

2.2. Efforts to Enhance the Role of Health in the Climate Change Agenda

Over the past three decades, extensive efforts have been undertaken to enhance the role of health in the climate change agenda at national and global levels. Firstly, the Intergovernmental Panel on Climate Change's (IPCC) Working Group II on Impacts, Adaptation and Vulnerability has examined the health impacts of climate change in a standalone chapter since the third assessment report was released in 2001, with a dedicated section on health co-benefits in the latest assessment report released in 2014 [20]. Secondly, in the last decade, the prestigious British medical journal, the *Lancet*, has published several extended series that review the health impacts of climate change [19] and the health co-benefits of mitigation activities [52–57]. More recently, the *Lancet* Commission on Climate Change and Health (the Commission) was launched in 2015. Comprising a multidisciplinary consortium of researchers, the Commission provides specific recommendations to government to enhance climate action, and monitors, assesses and reports on progress of health in the climate change agenda [4,58,59]. Thirdly, the health community has an increasingly strong presence in climate change discourse, including at side events that occur concurrently to international negotiations at the COPs [51,60]. Significantly, the "right to health" was explicitly included in the Paris Agreement text. This inclusion constitutes the first time that health has been included in an international climate change instrument since the adoption of the UNFCCC [61]. Finally, the World Health Organization's (WHO) recently elected Director-General, Dr Tedros Adhanom Ghebreyesus, has indicated that addressing the health impacts of climate change is a priority under his leadership, an issue he reportedly discussed with participants at the Hamburg G20 summit in July 2017 [62]. WHO's commitment to integrating health into the climate change agenda saw representatives "engaged fully" at COP23 held in 2017 [8] (p. 4).

These efforts are to be commended and have ensured that health has been a consideration, particularly in the development of adaptation planning at the national level. However, it is important to recognize that significant barriers still exist that challenge the consideration of health in the climate change agenda [63]. For example, the WHO acknowledges that the health sector's access to climate financing remains minimal [8]. Additionally, a 2010 survey of representatives of UN agencies, Parties to the UNFCCC and NGOs found consensus that health has not been of great importance, but should be, in international climate change negotiations and outcomes [64]. Further, in 2016, then Secretary-General of the UNFCCC, Christiana Figueres, addressed the Sixty-ninth World Health Assembly congratulating the public health community for their mobilization in Paris, but also noting that 85 percent of national climate change plans still do not refer to health [65]. The limited traction of health in the climate change agenda is perplexing, given the established biophysical limits to adaptation, as well as the extensive projected costs, including health costs, directly and indirectly associated with climate change [37]. Several solutions to address the discrepancy between the potential and actual traction of health in the climate change agenda have been suggested. These include the need for increased communication, integration, advocacy and leadership efforts by the health community [51,66,67]. However, as Lockwood (2015) rightfully questions, " ... if there are so many 'win-wins' between emissions reduction, economic growth and improvements in well-being, why haven't these already been realized?" [68] (p. 149). There is limited research that analyses the bearings of political, economic

and policy-making structures and processes on the uptake of health in the climate change agenda. In our view, further interdisciplinary assessment is necessary to better understand why health is, or more importantly is not, considered in high level debates about climate change mitigation.

3. Materials and Methods

A literature review was used to identify relevant material for the development of this paper. Until recently, climate change and health research has been relatively sparse. A 2012 inventory of publications indexed in PubMed under "climate change" and "health" identified just over 1500 publications out of almost 20 million total citations [51,69]. Government and non-government agencies have addressed this gap by contributing to the literature with their own research and assessments. Consequently, grey literature, including several government and non-government publications, was identified and included in the paper.

Relevant documents and literature were retrieved between March 2015 and January 2018. To identify relevant peer-reviewed literature, literature searches of three research databases (Web of Science, Scopus, and JSTOR) were performed between May and June 2015. Terms searched included "climate change", "global warming", "mitigation policy", "political economy", "health", "health co-benefit", "public health" and "human health". Monthly alerts were created for each database to identify additional relevant papers published after June 2015. Additional relevant publications and reports were identified through the review of bibliographies. In total, 1600 documents spanning books, peer-reviewed literature and grey literature were identified. It was not possible to include all documents in this paper. To identify the most relevant documents given the paper's scope and focus, we initially screened abstracts and executive summaries, searched for key words and phrases, and scanned the documents to familiarize ourselves with the content. This rapid thematic analysis enabled us to establish the four key interrelated areas and identify the final documents that were included in this paper.

4. Results

A review of the literature on the political economy of health and climate change, the science–policy interface and power in the policy-making process facilitated the identification of four key interrelated areas where barriers may exist for health co-benefits: discourse, efficiency, vested interests and structural challenges. The literature in these fields is expansive and contested, and the overview presented below is by no means exhaustive. We highlight some of the central tenets and examples from these fields to guide a meaningful discussion on the implications for health co-benefits and to aid the consideration of strategies to enhance their uptake in the development of national climate change mitigation policies.

4.1. Discourse

The political economy literature portrays the dominant discourses for both climate change and health as unduly influenced by economic forces. In relation to climate change, for example, at both national and global levels, climate change discourse is embedded in an economic frame, where the problems and the primary solutions are economic in nature. Climate change can be viewed as an economic problem given failures of the market to internalize the costs of using certain environmental "goods" [70]. In relation to solutions, it has been asserted that policy-makers have relied heavily upon economic approaches to solve climate change by focusing on efforts to internalize externalities via market-based interventions such as pricing mechanisms, including emissions trading schemes, cap-and-trade systems and carbon taxes. In this way, "climate change action has been transformed, largely through the agency of the state, into the generation of tradable, priced and ownable units of molecular 'mitigation'" [71] (p. 481). In pursuing an economic solution, there are claims that governments perpetuate neoclassical economic practices [72].

In relation to health, some political economists argue that in societies where profit primarily motivates economic and social decision-making, health is defined in a functional manner. This perspective critiques the capitalist system by presenting it as reducing an asset-less individual's value to their capacity to generate productivity through labour. In other words, health is inextricably linked with an individual's value to society; sickness is symbolic of " ... an inability to produce profit ... " [73] (p. 8). Further, within this profit-driven structure, a political focus on short-term, quantifiable outcomes poses "particular problems for public health, which is, by its very essence, concerned with long-term outcomes" [74] (p. 95). The neoliberal pursuit of individualism, which "holds individuals totally responsible for their actions and the consequences, including health" [74] (p. 74), has serious implications for health outcomes. By focusing on individual experiences of illness, political, economic, social and environmental factors that may contribute to ill health are easily overlooked [75]. An individualistic approach to health encourages victim blaming [74], which oversimplifies the often complex and convoluted nature of illness, ignoring "the social, cultural and economic context in which decisions are taken" [74] (p. 80).

4.2. Efficiency

As an extension of the economic dominance of climate change and health discourse, and in line with mainstream economic principles regarding resource allocation, the political economy literature tends to argue that economic efficiency is central to climate change policy decisions. Climate change negotiations are preoccupied with questions surrounding the economic optimization of emissions reduction and the distribution of responsibility in achieving this outcome [76] (p. 915). There is recognition that, to determine "optimal" carbon reduction commitments, that is the most efficient policy option, economic instruments laden with neoclassical assumptions are regularly used as the basis for determining policy options. These instruments, often integrated assessment models (IAM) such cost–benefit analysis (CBA) and computable general equilibrium (CGE) models, are used to determine policies that are politically and economically pragmatic as opposed to optimal for environmental and social outcomes [77] by mixing "descriptive analysis and value judgements in ways that deserve close and critical scrutiny" [78] (p. 299). The assumptions embedded into these instruments critically inform the final policy outcome, and are regularly contested (e.g., [79]). While it is not feasible here to review all of the contestations around modelling, two notable examples are worth highlighting. The first example relates to the "optimal" discount rate to apply to future benefits and costs. A discount rate is used to account for the discrepancy between current and future costs and benefits, by reducing the current value of a cost or benefit that will not be realized for a period of time [80]. Put differently, a discount rate "implies that the well-being of this generation matters more than that of its children, who in turn matter more than their children" [78] (pp. 300–301). The discount rate used significantly influences the economic output that ultimately informs the preferred policy outcome [81], with far-reaching consequences for inter-generational equity. For this reason, the 2006 Stern Review—one of the most comprehensive and longer-term economic cost–benefit analyses of climate change—used a comparatively low average discount rate [6], a decision that was criticized by a number of economists [82].

A second example relates to the technically and ethically complex processes used to assign monetary values to "invaluable assets", such as human life and health. Currently, different models use different estimates to determine the valuation of a human life, such as an individual's willingness to pay, or national income levels. This has resulted in some economic assessments valuing the lives of individuals in richer countries more than the lives of individuals in poorer countries [78]. Such approaches reaffirm that intra-generational inequity remains a key issue in the development of climate change policies.

4.3. Vested Interests

An overlapping area covered in the political economy and power in policy-making literature is the role of vested interests in influencing policy outcomes. Despite repeated efforts to demonstrate the economic efficiency of implementing climate change policies, "in reality governments inevitably get it wrong, in part because they are in hock to vested interests" [68] (p. 149). Some political economists explain this as partially the result of another relevant yet contested principle underlying economic considerations in the development of policies: the Pareto Principle. The principle holds that any economic change or redistribution is permissible only if the situation improves for one or more individuals without negatively impacting the situation of another. With the reality that almost every change results in winners and losers, the consideration of this principle often reasserts a neoclassical perspective that non-intervention in the market is the optimal response [83]. There is a cognizance of the importance of who wins and who loses in climate change action. For example, in his thesis on the political economy of the environment, Boyce (2002) hypothesizes that the power dynamic between the winners—that is, those who experience net benefits from an activity—and the losers, or those who endure net costs, directly influences the level of environmental degradation that ensues; environmental degradation is greater if the winners are relatively powerful compared to the losers [84]. This hypothesis again highlights issues of intra- and inter-generational equity. Boyce's hypothesis is confirmed by Steves and Teytelboym (2013), whose comparative assessment of the climate change mitigation policies of 95 countries concluded that the size of a country's carbon-intensive industry was a major factor influencing climate change policy adoption [85]. This has led some political economists to support the position that " ... the capitalist market economy is the problem, not the solution. In its modern form, shaped by corporate power, consumerist practices, and the prevailing ethos of individualism, it stands as the antithesis of ecological sustainability" [70] (p. 334). Similarly, with health, there is recognition that powerful vested interests exist that can and have influenced public health interventions. Tobacco control policy represents one example where vested interests have been implicated in delaying meaningful policy development. Consequently, parallels between tobacco control and climate change policies have been drawn by climate change and health researchers [86].

The role of power and vested interests in policy-making is further elucidated when examining key theoretical explanations of the policy-making process. Theoretical positions on the policy-making process exist on a continuum. At one end exist idealistic theories, such as the "rational actor model" that presents policy-making as a logical, linear and tidy process involving a comprehensive assessment of all information in order to produce an optimal policy outcome [87]. The middle ground is populated by theories such as incrementalism and bounded rationality, which suggest the policy-making process is more opportunistic and iterative in nature, occurring within pragmatic parameters, such as time, information and individual abilities [87]. At the other end, theories such as Cohen and colleagues' (1972) "garbage can model" and Kingdon's (1984, 1995, 2011) "multiple streams" approach to policy-making are found. These understandings of the policy-making process conceptualize a messy combination of problems, solutions and participants that interact in a non-linear and almost serendipitous manner to produce policy outcomes. The latter theories support the notion that many actors are involved in the development of policy, none of whom can be considered to hold neutral positions [88].

While governments are ultimately responsible for making policies, it is well understood that the various actors contributing to the policy-making process use resources at their disposal in an attempt to influence the final policy outcome. In this way, "governments set the field of play and the rules for debate ... but energy comes from actors on the field" [89] (p. 1086). As such, the concept of power is central to the policy-making process [90]. Accordingly, there are additional theoretical perspectives on who wields power in the policy-making process. Dahl's (1961) pluralist perspective, considered the dominant theory in liberal democracies, understands power to be distributed among individuals and groups within society. The role of the state is to act as adjudicator in managing competing interests inevitable in the policy development process [90]. Public choice theory extends this understanding of

power in the policy-making process by recognizing the state as an interest group, with elected officials and bureaucrats pursuing their own self-interests, resulting in distorted policies that benefit certain groups at the expense of the public interest [90]. Critiques of the pluralist perspective, most notably put forward by Bachrach and Baratz (1962), assert that power is not always overt; "much power is exercised more covertly and through subtle cultural processes . . . " [91] (p. 31). Bachrach and Baratz coined the term non-decision making to capture this concept, arguing that power "often is exercised by confining the scope of decision-making to relatively 'safe' issues" [92] (p. 948). These analyses of the policy-making process illuminate the ways in which many actors, including experts and those with vested interests, can inform the final policy outcome.

4.4. Structural Challenges

The literature identifies that several structural and procedural challenges exist in relation to health and climate change. Firstly, in relation to health, there is an acknowledgement that complex and dynamic interactions between various domains—political, economic, social, and cultural—inform an individual's or a population's health status [93]. These determinants of health often fall outside of what is generally considered the realms of the health sector [94]. As a result, the health sector is limited in its capacity to address in totality many health issues experienced. In relation to climate change, a "web of stakeholders" are relevant to climate change policy decisions [95] (p. 1034). Included in the list of actors often recognized as influencing the policy-making process are scientists or experts, who legitimize the process by providing objective, evidence-based inputs [96]. Researchers have considered the ways in which scientific knowledge can be used in the policy-making process. Schrefler (2014) proposed that the use of expert knowledge in regulatory policies falls into one of three categories: instrumental, strategic or symbolic. The *instrumental* use of experts sees them engaged in the policy process to determine the best solution to a problem. The *strategic* use of experts sees them involved in the policy process to support a pre-defined policy position. The *symbolic* use of experts sees them contribute in order to strengthen the legitimacy of the policy makers [96]. Schrefler outlines a number of potential explanations for the exclusion of expert knowledge in the policy-making process, including that "pre-existing approaches to tackle and decide on a given policy issue are so entrenched . . . that expertise does not really make a difference when decisions are taken, particularly when these decisions trigger only small incremental changes in existing policies" [96] (p. 71). While scientific evidence does not always gain the political traction it warrants, there are opportunities to enhance the role of scientific knowledge in the policy-making process.

Cáceres and colleagues (2016) provided insight gained from their research in Argentina. The "science deficit model" maintains that low uptake of scientific research in policy development can be explained by poor communication of scientific findings by scientists to policy-makers, or the inability of policy-makers to interpret scientific findings appropriately; "it is basically a technical-communicational problem" [97] (p. 57). Cáceres et al. determined that this theory is problematic in its oversimplicity of the policy-making process. They identified the "power dynamics model" as more representative; this conceptualization of the policy-making process recognizes that while pivotal, science knowledge represents just one element in a "highly contested, non-linear and multi-sectoral field where institutions, subjectivities, values, interests, power relationships as well as knowledge, play a role" [97] (p. 62). Based on their experiences, the authors offered four considerations for enhancing the role of science in the policy-making process. Scientific knowledge is most likely to be incorporated when: (i) "it aligns with the interests of sectors that concentrate the larger shares of political power in society"; (ii) it is "encapsulated in compelling, widely-communicated storylines . . . well understood and appropriated by society"; (iii) "it has been appropriated by, and is well integrated into the agenda of a wide range of social actors with active representation in the negotiation process"; and (iv) it can "contribute to create or take advantage of social-political windows of opportunity" [97] (p. 63).

These considerations are pertinent when searching for additional explanations to understand the undervalued role of health in the climate change agenda. We now turn our attention to considering how the four key interrelated areas explored above can be extrapolated to provide a better understanding of the barriers and opportunities for health co-benefits in the development of climate change mitigation policies.

5. Discussion

Applying insights from the literature on the political economy of health and climate change, the science–policy interface, and power in the policy-making process supports the proposition that current political and economic structures and processes create several barriers for the inclusion of health co-benefits in the development of climate change mitigation policies. It is imperative that researchers are aware of the implications of these challenges; if researchers wish to enhance the political traction of health co-benefits, understanding the complex politico-economic paradigm is vital. Using the four interrelated key areas identified in Section 4, we transpose insights from the literature to illuminate additional barriers for health co-benefits in the development of climate change mitigation policies.

5.1. Discourse

In a globalized, market-oriented environment, the dominant climate change discourse has focused on the shorter-term costs of action and on "fair" calculations of burden sharing at the expense of meaningfully incorporating the costs of inaction into the policy-making process. This global framing permeates national levels of policy-making, where "economic growth remains so central to political legitimacy" [68] (p. 149). Consequently, many national governments are beholden to the supremacy of economic guidance that focuses on least-cost pathways and the identification of the most "efficient" policy options. Further, in a policy-making environment where the benefits can be difficult (but not impossible) to quantify, it is simpler for policy-makers to disregard the qualitative evidence than to try and justify its inclusion in the policy development process. In Australia, a lack of domestic quantitative health co-benefits assessments has undermined the role of health co-benefits in the development of climate change mitigation policies [49]. These barriers are exacerbated by the realities of perceptions around health; with individuals considered ultimately responsible for their health, attributing and communicating the health impacts of shorter- and longer-term climate change becomes increasingly challenging. The dominant discourse is further compounded by the reality that the policy agendas of health ministers are often "crowded with many demands, and influenced by competing and conflicting interest groups" [98] (p. 142). Such political realities support the de-prioritization of health co-benefits in the development of climate change mitigation policies.

5.2. Efficiency

For many governments, a focus on optimizing cost-effectiveness results in policy-makers pursuing health gains through direct policies. A notable example is in relation to air quality, where it is cheaper to implement measures to reduce local air pollution than to address air quality through climate policies [12]. An exception to this view, as mentioned above, relates to the Obama Administration's pursuit of climate change mitigation policies through air quality legislation in 2015 to avoid a politically hostile Congress in the lead-up to COP21. In the EU, however, health remains a primary justification for the pursuit of stringent clean air standards [99]. While health co-benefits are accounted for in the development of climate change mitigation policies in the EU through the use of IAMs, they do not significantly inform the final policy outcome. In Australia, health co-benefits have only been considered meaningfully in the development of national vehicle emissions standards [49]. The influence of health outcomes as a clearly defined justification for air quality policies is noteworthy, yet this can undermine the consideration of health co-benefits in the development of climate change mitigation policies.

This is especially problematic given there can be substantial trade-offs between isolated policy goals of reducing air pollution and abating climate change [100–102].

5.3. Vested Interests

The structure of the Paris Agreement, which requires each Party to the UNFCCC to make regular emissions reduction pledges of increasing ambition, will create economic conflicts of interest between stakeholders and sectors domestically [103]. The implementation of mitigation policies, often regulatory in nature, naturally creates winners and losers [96]. Longer-term, winners of ambitious climate change mitigation policies comprise nearly all sectors, including the renewable energy sector, as well as current and future populations, with benefits diffuse across space and time, and difficult to measure. Losers are likely to be big corporations as well as extractive industries, often able to exert undue power and influence over the policy-making process [103]. In Australia, for example, there is acknowledgement that business and industry stakeholders are highly influential in the climate change policy-making process as a result of corporate contributions to economic growth and stability [49]. Conversely, those who suffer most from a delay in effective climate change policies are the most vulnerable populations with minimal to no power in the policy-making process: children, economically disadvantaged populations and future generations. Vested interests are not limited to corporate interests eager to maintain the status quo. Outside of the more obvious economic motivations that exist for the extractive industry, strong ideological motivations have been linked to the climate change denial movement that has particularly strong roots in the US. Specifically, "a staunch commitment to free markets and disdain of governmental regulations" remains a defining feature of climate change denialists, who appear determined to uphold the "modern Western social order" that is often characterized by political and economic conservatism [104] (p. 144). This perspective is supported by analysis performed by Jacques and colleagues (2008), which confirmed a strong link between environmentally sceptic publications and conservative think tanks [105].

5.4. Structural Challenges

While an integrated approach is optimal for the development of a cross-sectoral issue such as climate change, the politico-economic realities limit this approach in practice. Different approaches to problems, the use of diverse technical language, and the political reality of bounded rationality complicates cross-sectoral integration efforts. In federated systems, integration challenges are exacerbated given "the potential for differences of ideology and political interests between levels of government . . . have provided fertile ground for blame-shifting and regulatory complexity" [98] (p. 139). Further, environmental health concerns have tended to be addressed by proposals from environmental agencies, departments and NGOs, as opposed to health departments. In the US, for example, the US Environmental Protection Agency (EPA) was responsible for developing the *Clean Power Plan* and disseminating the health co-benefits [47]. Similarly, in the EU, the Directorate-General for Climate Action and the Directorate-General for Environment coordinate the development of mitigation policies, with the quantification of health co-benefits supported by the European Commission's Joint Research Centre and other external research institutes, such as the International Institute for Applied Systems Analysis. While national health ministries may logically be considered best placed to provide in-house expertise and to advocate for health in the climate change agenda, often acute health care concerns are dominant for health ministries [98,106]. Political short-termism and a pragmatic governance style can also undermine optimal policy outcomes, particularly for a cross-sectoral, longstanding policy area such as climate change. For example, analysis of the United Kingdom's climate policy development by Gillard (2016, 2017) determined that, in the aftermath of the global financial crisis in 2008, climate change policy was considered too expensive to pursue and austerity measures inevitably de-prioritized the implementation of ambitious climate action [107,108].

5.5. Strategies for Enhancing Health Co-Benefits in Climate Change Mitigation Policies

The identification of additional barriers for health co-benefits based on insights from the literature helps to further elucidate the lack of traction they have garnered in policy development to date. These barriers are substantial, and have led some researchers to conclude that "the immediate *perceived* costs and political barriers (in spite of net co-benefits) are likely to remain substantial, until serious impacts of warming become so obvious after a dangerously long period of further business as usual, that public perceptions change and political resistance also collapses" [109] (p. 188). However, armed with the knowledge that the policy-making process is regularly "ruled by dominant narratives, economic and political structures, or by the interests of the most powerful players" [97] (p. 63) provides opportunities to explore strategies to exploit the political and economic structures and policy-making processes that undermine the role of sectors such as health in the climate change agenda. Returning to Cáceres and colleagues' four considerations for enhancing the role of scientific knowledge in the policy-making process, we propose four strategies that may enhance the relevance and influence of health co-benefits in the development of national climate change mitigation policies.

First, aligning the health co-benefits of mitigation with the pursuit of national renewable energy goals is essential. Signatories to the Paris Agreement have in principle committed to transitioning to low-carbon economies [3]. As identified in Section 5.3, the climate change action associated with this shift will inevitably produce winners and losers. With energy security of paramount importance to many national governments [110], emphasizing the dual benefits to energy security and health that result from ambitious climate change action may appeal to policy-makers. In their multi-model analysis of the co-benefits of a suite of mitigation measures in the EU, Scwanitz and colleagues (2015) conclude that the immediate implementation of mitigation measures would see the EU reduce its dependence on imported fossil fuels, thereby enhancing energy security in Europe [111]. There is an opportunity for an increasingly powerful alliance to be built between winners of climate change action—such as the health sector and the renewable energy sector—to destabilize the undue influence of the extractive industries in the policy-making process.

Second, and closely related to the first strategy, strengthening the position of health in the climate policy community through the identification of several influential champions for health would greatly assist in embedding health in the climate change agenda. Positioned across the private and public sectors, such champions may not necessarily sit within the health sector but they would need to be "at the table" or consulted during climate change mitigation policy development.

Third, developing and maintaining a compelling narrative with several threads that resonate with diverse groups within the community is necessary. The first, and arguably the most important, narrative must directly challenge the misconception that climate action is primarily a burden by firmly shifting attention to the many benefits, including those relating to health, that result from climate action. Given the dominance of neoclassical economic thinking, highlighting the positive implications for businesses that arise from climate action may enhance traction. The US EPA estimated the labour productivity gains that would result from the implementation of the *Clean Power Plan*—300,000 fewer missed work days—and used this statistic as one of five key selling points for the emissions reduction initiative [47].

Finally, continuing to utilize opportune occasions to communicate the health consequences of climate change, and the health co-benefits that result from strong climate action, to both the politicians and the community is pivotal if the role of health co-benefits in mitigation policy development is to be enhanced. The WHO and others continue to estimate morbidity and mortality rates attributable to environmental risk factors, including climate change (e.g., [112,113]). Ensuring that robust, timely evidence is accessible for champions and other knowledge brokers at times when climate change is thrust back to the top of the political agenda will maximize the prospect of firmly embedding health in the climate change agenda.

6. Conclusions

Current efforts to address climate change are inadequate given the projected health and other impacts. Consideration of health, specifically health co-benefits, has been recognized by climate change and health researchers as a strong strategy to encourage more ambitious climate change action. However, evidence suggests that health co-benefits have not gained the political traction they warrant. While several barriers have been identified, we applied insights from literature on the political economy of health and climate change, the science–policy interface and power in the policy-making process to identify additional barriers for health co-benefits. This approach provides a unique perspective on the challenges of meaningfully incorporating health into the climate change agenda. Based on the literature, we identified four key interrelated areas where barriers are likely to exist and inhibit the role of health co-benefits in the development of climate change mitigation policies. Based on insights in these areas, we proposed implications for health co-benefits and provided potential strategies that may assist in enhancing the uptake of health co-benefits in the development of climate change mitigation policies.

Our review of the literature identified current gaps in research that would help to strengthen an understanding of the barriers inhibiting the role of health co-benefits. Firstly, we have been unable to locate research that specifically analyses the power dynamics between national environment, energy and health ministries. A better understanding of the interactions among these ministries may provide further clarity and insights for enhancing the role of health co-benefits in the development of national climate change mitigation policies. Secondly, as previously mentioned, there is limited research that investigates the role of health co-benefits in the development of national climate change mitigation policies for individual Parties to the UNFCCC. This research is imperative for reinforcing our current understanding of the barriers impacting the traction of health co-benefits in the development of climate change mitigation policies, and health in the climate change agenda more broadly.

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The Role of Health Co-Benefits in the Development of Australian Climate Change Mitigation Policies

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Abstract: Reducing domestic carbon dioxide and other associated emissions can lead to short-term, localized health benefits. Quantifying and incorporating these health co-benefits into the development of national climate change mitigation policies may facilitate the adoption of stronger policies. There is, however, a dearth of research exploring the role of health co-benefits on the development of such policies. To address this knowledge gap, research was conducted in Australia involving the analysis of several data sources, including interviews carried out with Australian federal government employees directly involved in the development of mitigation policies. The resulting case study determined that, in Australia, health co-benefits play a minimal role in the development of climate change mitigation policies. Several factors influence the extent to which health co-benefits inform the development of mitigation policies. Understanding these factors may help to increase the political utility of future health co-benefits studies.

Keywords: climate change; mitigation policy; Australia; health; co-benefits

1. Introduction

The twenty-first United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP21), held in Paris in December 2015, has been heralded as a key milestone in global climate change negotiations [1]. In the days following the conclusion of COP21, United Nations Secretary-General Ban Ki-moon asserted that the resulting climate accord, the Paris Agreement, represented a 'health insurance policy for the planet' [2]. Despite widespread enthusiasm for the achievements of COP21, there is also broad acknowledgement that, in combination, the Intended Nationally Determined Contributions (INDCs) submitted by Parties to the UNFCCC prior to COP21 fall well short of the agreed pledge in Paris to limit global temperature rise to well below two degrees Celsius above pre-industrial temperatures. UNFCCC estimates suggest current INDC pledges will lead to a temperature increase of approximately 2.7 degrees by 2100 [3]. This dilemma reinforces findings in the latest Intergovernmental Panel on Climate Change (IPCC) report. The IPCC's Fifth Assessment Report Synthesis Report asserts that action on climate change is not commensurate to the severity and likelihood of anticipated impacts, given "global increases in anthropogenic emissions and climate impacts have occurred, even while mitigation activities have taken place in many parts of the world" [4] (p. 54).

The combustion of fossil fuels has both longer-term and shorter-term impacts on health. In the longer term, fossil fuel use contributes to climate change, with significant health impacts on populations. For example, it is anticipated that climate change will impact human health through increased frequency of extreme weather events and increased prevalence and distribution of infectious diseases [5–7]. In the shorter term, fossil fuel use creates air pollution through the release of particulates and climate altering pollutants. Both ambient and indoor air pollution can significantly affect respiratory and cardiovascular health outcomes for populations [8–10].

With this in mind, research has explored the role that health outcomes can play in providing a justification for enhanced domestic climate change action. Research undertaken around climate change communication has found that framing climate change from a health perspective can positively influence an individual's acceptance of robust climate policies, irrespective of political preferences [11,12]. Further, the health co-benefits literature has established that there are significant, shorter-term, and localized health—and consequently economic—benefits that result from the implementation of emissions reduction (mitigation) policies [13]. For example, in justifying the implementation of the Clean Power Plan in 2015, the United States (US) Environmental Protection Agency estimated that, by 2030, health benefits for the US would include up to 3600 fewer premature deaths and up to 90,000 fewer pediatric asthma attacks, totaling an economic saving of up to USD$54 billion in 2030 alone [14]. These health co-benefits have been quantified to allow for comparison with economic costs often considered in the development of climate change mitigation policies. While environmental health impacts researchers acknowledge that health co-benefits have not gained the political traction they potentially warrant in the development of climate policy [15–17], there is minimal research examining the role of health co-benefits in the development of national climate change mitigation policies. To begin to address this knowledge gap, we have explored how health co-benefits have been considered and accounted for in the development of Australian climate change mitigation policies.

Australia provides an interesting case study for exploring the role of health co-benefits in the development of national mitigation policies. Economically, its strong and influential fossil fuel resource sector significantly contributes to gross domestic product. Politically, climate change has proven to be a polarizing and controversial policy area, implicated in several political leadership changes and federal election results [18,19]. Australia is the first country to repeal a carbon pricing mechanism, following the rise to power of the Coalition government in 2014. Instead of a price on carbon, the Coalition government has pursued a direct action approach to meet domestic and international carbon abatement targets, a scheme that involves government purchases of domestic abatement opportunities. Internationally and domestically, it has been described as being a laggard in its climate policy ambition [20]. In the lead-up to the most recent federal election, held in July 2016, polling suggested public support for action on climate change was the strongest it has been since 2008 [21]. As is explored in the case study below, these and other factors have influenced the Australian narrative on climate change, as well as the role and influence of multiple considerations, including health, in the development of Australian climate change mitigation policy.

2. Methods

Theoretically, we situate this research within the political economy of health, which provides a robust framework in which to explore health within the climate change agenda. Health is inherently political in nature given "power is exercised over it as part of a wider economic, social and political system" [22] (p. 187). The political economy of health framework contends that both good and ill health are a "result of social, political, and economic structures and relations" [23] (p. 134) that can be easily overlooked given health is often defined in a functional and individualistic manner [24] (pp. 34–35). To support the application of this theoretical framework, a complementary analytical framework was identified and used to inform the research project. A previous analysis of health factors in climate change policy has been undertaken by Morrow and Bowen [25] who investigated the

consideration of health in Fijian climate change policies. In line with their approach, the development of this case study is underpinned by Walt and Gilson's [26] policy analysis framework (see Figure 1).

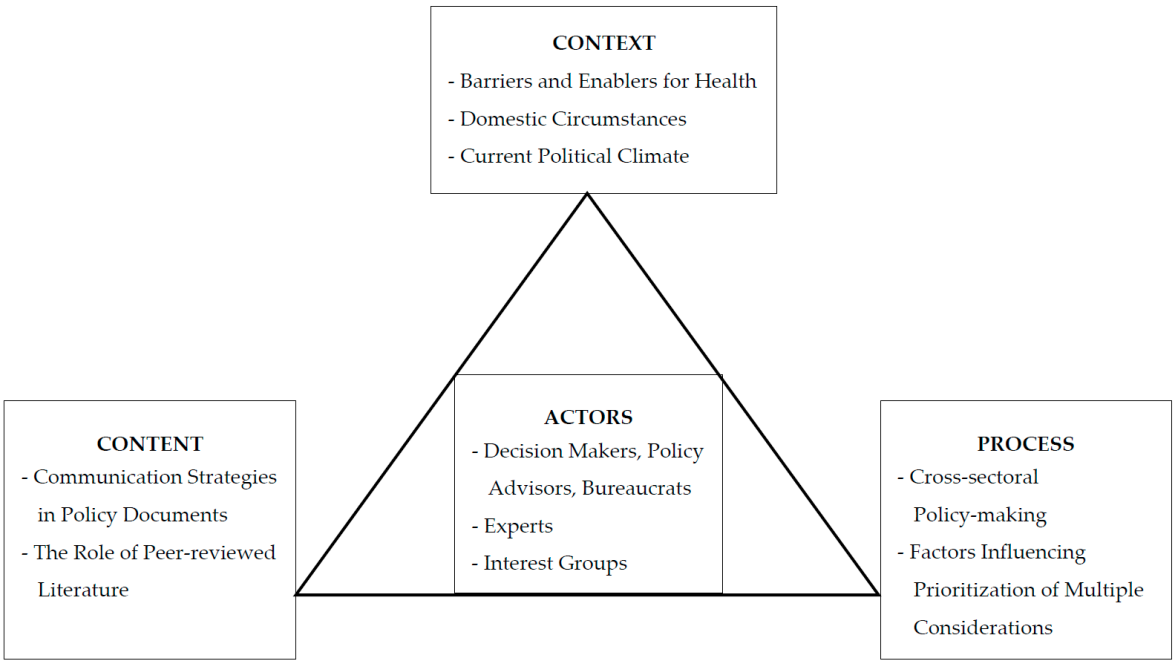

Figure 1. Modified from Walt and Gilson's model for health policy analysis.

This model provides a holistic approach to the consideration of the policy-making process, by moving beyond purely content analysis to consider broader contextual and process factors that are likely to influence the policy development process. While the model above provides a simple, schematic representation of what are inherently complex relationships, Walt and Gilson assert it can be used to facilitate the exploration of policy as an "outcome of complex social, political and economic interactions" [26] (p. 359). With this in mind, key factors influencing the development of mitigation policy have been incorporated into our assessment of Australia's mitigation policy development, including Australia's politico-economic context; governance structures and policy processes; cultural factors and public attitudes toward climate change; the role of external actors and stakeholders; as well as the climate change narrative and drivers for mitigation policy communication.

2.1. Study Design

A case study approach was chosen to undertake this research, as it is the preferred approach when posing "how" and "why" questions in an attempt to "understand social complex phenomena" [27] (pp. 13–14). With Walt and Gilson's model in mind, several data sources were used to develop a comprehensive Australian case study. Semi-structured interviews constitute the primary data source, and were undertaken with individuals who met the eligibility criteria: federal government employees involved in the development of mitigation policies. Interviews are supplemented by secondary sources, primarily key recent federal government policy documents (see Table 1) that were identified prior to and during interviews.

Feedback on the semi-structured interview schedule was sought from four academic experts and one environmental health policy expert; the policy expert provided feedback, suggesting minor changes, which were incorporated. The interview schedule comprises eight questions that fall into one of six key themes: the policy-making process; factors influencing the prioritization of multiple considerations; barriers and enablers for the consideration of health in mitigation policy; the evidence base for policy; the role of external actors and stakeholders; and the communication of policy decisions.

The themes loosely correlate to one of the four elements identified in Walt and Gilson's policy analysis model (see Figure 1). The interview schedule was submitted along with an ethics application to the University of Melbourne Faculty of Science Human Ethics Advisory Group. Ethics approval was obtained in November 2015 (Research Project 1545561.1).

Table 1. Key policy documents informing case study identified prior and during interviews.

Policy Document Title (Year of Publication)	Department Responsible for Publication
Emissions Reduction Fund White Paper (2014) [28]	Department of the Environment
United Nations Framework Convention on Climate Change (UNFCCC) Taskforce Final Report (2015) [29]	Department of the Prime Minister and Cabinet
National Climate Resilience and Adaptation Strategy (2015) [30]	Department of the Environment
National Energy Productivity Plan 2015–2030 (2015) [31]	Department of Industry, Innovation and Science
Vehicle Emissions Discussion Paper (2016) [32]	Department of Infrastructure and Regional Development

2.2. Recruitment of Stakeholders

Given the political sensitivity that has surrounded Australian climate policy in recent years, we anticipated that the recruitment of federal government employees might be challenging. Consequently, we utilized personal networks and networking at conferences in the first instance followed by snowball sampling to recruit participants. We sought to recruit at least one employee who met the eligibility criteria outlined above from across six departments associated with the development of national energy- and transport-related mitigation policies (see Table 2). Permission was sought to record interviews to aid in the transcription process. No participants objected to the recording of their interview. Individuals who agreed to participate were informed that transcripts would be de-identified in order to protect their identity. Consent forms were received from all interviewees prior to interviews being conducted. We transcribed all interviews verbatim, and then verified all interview transcripts to ensure accuracy of the transcription process.

Table 2. Departments approached during the recruitment of interview participants.

Federal Government Department
Department of the Environment
Department of the Prime Minister and Cabinet (PM & C)
Department of Foreign Affairs and Trade (DFAT)
Department of Industry, Innovation and Science
Department of Infrastructure and Regional Development (DIRD)
Department of Health

2.3. Data Collection

The interview schedule was piloted three times between April and May 2016 by participants with a background in either Australian health or climate change policy. Two of the three participants provided permission for their interview data to be incorporated into the case study. The interview schedule did not change between the pilot and formal phase of interviews. The first author conducted all formal interviews with federal government employees who met the eligibility criteria between June and July 2016. This period coincided with the Australian government assuming a caretaker role in the lead-up to the July 2016 federal election. In total, eighteen individuals were approached for interview. Four individuals declined, suggesting more appropriately placed colleagues to participate. Two individuals were non-responsive and one individual left their respective Department prior to the interview. Of the eleven interviews that eventuated, six interviews were carried out face-to-face in

either workplaces (n = 5) or at neutral locations (n = 1), and five interviews were conducted by phone. Interview lengths ranged from 38 to 75 min.

Snowball sampling identified one additional individual who did not meet the eligibility criteria but who nevertheless had relevant expertise in the development of Australian climate change mitigation policies given a previous high-level position in federal climate change policy development. Interviews with this participant followed the same process as the formal interviews, and data from this interview informed the development of the case study. While the number of interviews carried out was effectively determined by time constraints, despite the small sample size, we assessed that data saturation was achieved as evidenced by the repetition of themes and a lack of new themes emerging.

2.4. Data Analysis

De-identified transcripts were imported into NVivo 11 and initially coded based on the themes identified in the interview schedule. Additional sub-themes were identified during the coding process and have been integrated into the results and discussion sections below.

2.5. Limitations

There are some limitations to the methodological approach utilized for this research. Firstly, as a matter of practicality, single coding of interviews was solely undertaken by the first author. Given coding was guided by the structure of the interview schedule, we do not consider this to be methodologically compromising.

Secondly, using a semi-structured interview schedule allowed a level of flexibility in question order based on the natural flow of the conversation; however, for most interviews, the question order primarily aligned with the interview schedule question order. This may have influenced responses and further discussion. For example, barriers to health considerations within climate policy were generally discussed before enablers, given a majority of interviewees openly acknowledged that health was not a significant consideration in the policy development process. It is possible that question order in this instance influenced the ability of interviewees to consider enablers.

Finally, conversation often led to discussion of co-benefits; discussion of potential health co-harms from the development of mitigation policy did not ensue. We acknowledge this as a limitation of the research, and suggest that future research explore the consideration of health co-harms in the development of climate change mitigation policy.

3. Results

The analysis of interviews and secondary sources provides a level of insight into the role of health co-benefits as a consideration in the development of Australian climate change mitigation policy. The results are presented below in line with the themes used during the interview schedule. We elaborate on sub-themes where they have been identified during the coding process.

3.1. Policy-Making Process

Most interviews began with broad policy-making discussions, exploring the processes used to account for multiple considerations in cross-sectoral policy areas, and how who is "at the table" is determined. Most interviewees outlined the whole of the government approach that is used at the federal level to develop cross-sectoral policies. Interviewees described the cabinet submission development process. In line with Australian Administrative Orders, the Department of the Environment is the line (or central) agency for domestic climate change mitigation policy, while the Department of Foreign Affairs and Trade was primarily responsible for the development of Australia's INDC that was taken to COP21. To inform the Cabinet submission, the line agency may decide to establish an interdepartmental committee (IDC) for the purpose of seeking input from other relevant agencies. A regulatory impact statement (RIS)—a form of impact assessment—would generally be included as part of the cabinet submission process, and may be accompanied by a cost–benefit analysis.

The Office of Best Practice Regulation (OBPR) was identified as the gatekeeper of RIS development, responsible for determining the robustness of the quantitative data underpinning a RIS, as well as RIS approval. Interviewees noted that, irrespective of an IDC, all departments are provided an opportunity to provide input, comment, or both on each cabinet submission prior to its consideration by cabinet ministers. Many interviewees emphasized that quantifying and monetizing multiple considerations, particularly costs, constituted an integral component of the policy development process:

> " . . . what we're encouraged to do as often as we can is to monetize things, not necessarily because money is how the world goes round, but because money is a common um, it's a common way of measuring things . . . we're often encouraged to do an economic analysis because what it does is it allows us to compare otherwise quite disparate things . . . " (I_01)

A number of interviewees also made the distinction between quantifying costs and benefits, and how this impacts upon their consideration in a RIS:

> " . . . usually you can quantify the costs relatively well . . . and then, you can usually quantify some benefits relatively easily but then there tends to be a whole class of benefits that are difficult to quantify, and what you will often do in a regulatory impact statement is reference them qualitatively but not try and quantitatively [value] them . . . Now sometimes that would be because your benefits already exceed your costs, so you can consider them upside, but other times that's purely because you don't have the data, and if you try to put the case up, then, you know, if you, if you depend on that and you don't, you don't have enough actual support, then it could undermine your policy because, you know, it's a piece, it's like better not to . . . depend on something if you can't defend it." (I_03)

A number of interviewees noted that the Department of Health would not have been considered one of the core agencies during the development of mitigation policy. For example, while the Department of Health did provide comment on the proposed INDC that was taken to cabinet in the lead-up to COP21, several interviewees from across departments stated that they were a peripheral agency in the target development process:

> " . . . so . . . when we convened IDCs invited health, um, ah, to those meetings, and the comments that health made at the time, you know, they were engaged, which was um, good, but they were very generalized statements . . . " (I_04)

3.2. Factors Influencing the Prioritization of Multiple Considerations

Interviewees were asked to comment on the different processes used to rank or prioritize different considerations that inform policy development. Economic and employment considerations were primarily discussed as informing the development of mitigation policy in Australia. Several factors will influence the extent to which these considerations are prioritized in the development of mitigation policies, although bureaucrats do not overtly rank or prioritize considerations themselves:

> " . . . we didn't rank particular um, aspects as more important than others in, in the decision-making process, like we didn't rank economic over um, social well-being . . . or the climate impacts. Um, so, so we didn't but you can bet that the people making the decisions were weighing those things up in their minds and assigned different values to them." (I_10)

One factor influencing the prioritization of multiple considerations is that ministers are individually responsible for agenda setting within their own department or portfolio, which inevitably informs the direction of policy development, and the consideration and prioritization of multiple considerations:

> " ... there are a number of ... criteria the government use. How they actually in the end come up with that is, is, is hard to distinguish, so each, each minister and each, each portfolio would come to it with their own ah, priorities, set of priorities ... we're really focused on making sure that we are ... we, we know exactly what the rest of the world is doing, and that we are, you know, we're in the pack and ... we compare well to the rest of the world essentially. Um, Treasury will have a different view. Um, Environment will, you know, want to know that whatever policies we set we can meet domestically ... " (I_02)

The political reality of Australian climate change policy is another factor that influences how considerations are prioritized in the development of mitigation policy. A number of interviewees conceded that the politicized nature of the climate change debate in Australia has in part determined which considerations are included in the development of mitigation policy, and how these considerations influence policy development:

> " ... it becomes a political judgment amongst the policy-maker essentially about um, how much pain am I going to suffer as a result of choosing a particular outcome and because the current environment of climate policy in Australia is so politically toxic it makes them, everyone risk averse" (PI_02)
>
> " ... the problem Australia's had ... is just how toxic the debate has been and how politicized the debate has been, and therefore it has been hard to have that considered um, there hasn't been the bandwidth to have that kind of conversation with the public about this." (I_02)

The core climate change narrative in Australia is a third factor that influences which and how multiple considerations are prioritized. Almost all interviewees acknowledged the crucial role that economic considerations play during the development of mitigation policies, asserting that economic factors are always first order. Economic analysis or modeling, or both, is often used to inform the development of policy and can strongly influence the government's priorities and choices. This is in part explained by the relative ease of quantifying the impacts, particularly costs, to the economy of mitigation action. However, it can also be in part explained by the government's current narrative on climate change, which according to some interviewees, frames climate change action as an economic burden with the potential to create issues for the competitiveness of major industries:

> " ... it really depends a bit on the government of the day. I mean the government we had last year was about um ... economic growth and, and jobs and preserving industry and making sure we do what the rest of the world's doing and you know, a range of those factors ... " (I_02)
>
> " ... if you read for example, the um, issues paper produced by PM & C last year before the decision was taken on what Australia's 2030 target should be ... if you read that, you'll see it's still, you know, all about burdens and competitiveness, and if we cut back, if we put in a carbon price, you know, what happens to our aluminium sector ... when others don't do it, leakage, all that sort of stuff, that's all the old argument." (I_07)

The UNFCCC Taskforce final report [29] (p. 21) mentions that, during the submission process, some individual submissions highlighted the 'consequences of inaction, such as environmental and health impacts ... ', but there is no indication of whether or how these impacts were taken into account during the INDC target setting process. A direct query about this during one of the interviews elicited the following response:

> "I think that the um, to the extent, things like health were factored in, it was this general ah, vibe if you like, of um, there's a cost of not doing anything, um, and it was, and that um, in my view, wasn't a particularly strong factor and it certainly wasn't a ah, a consideration that was unpacked in a very detailed and systematic way, it was just a, as I say a general thing of, there are costs of not taking action." (I_04)

In relation to the consideration of health, interviewees determined that it is currently a second- or third-order issue, similar to other sectors of the economy that are inevitably affected by climate change but do not significantly influence policy decisions:

> "I think at the moment health is seen as . . . relevant to climate change in the same way that infrastructure, and you know, numerous other things are, and they're all grouped together in this sort of, climate change is going to have broad impacts across the whole scope of our economy and public policy . . . so there just becomes this sort of homogenous mass of stuff . . . " (I_04)

The de-prioritization of health as a potential co-benefit of mitigation measures becomes evident when analyzing key policy documents, such as the Emissions Reduction Fund White Paper [28] (p. 7):

> "The Emissions Reduction Fund will help reduce Australia's greenhouse gas emissions while delivering valuable co-benefits to Australian businesses, households and the environment. For example, households and businesses will save money by improving their energy efficiency. Revegetation will improve water quality, and reduce erosion and salinity. Replenishing the carbon content of soils will improve the health and productivity of Australian farms."

As one interviewee noted when discussing the Emissions Reduction Fund White Paper:

> " . . . what's useful to look at is the communications . . . you'll often see phrases along the lines of um, um, this policy is reducing emissions while um, improving the productivity of farms, cutting costs, and um, increasing the productivity of, of businesses . . . you can see that what, what is being done there is very overtly talking up the co-benefits as a way of saying this is a great policy and it's ticking lots of the boxes . . . Now there's no obvious reason why, why health benefits couldn't be included in that, in that list of dot points . . . in this instance, we, you know, at the moment we talk up the productivity or economic benefits . . . " (I_01)

The same government rhetoric emphasizing reduced emissions while improving productivity and competitiveness is evident in Australia's National Energy Productivity Plan 2015–2030 [31] (p. 6):

> "By increasing our energy productivity we strengthen our economy and help safeguard our environment. Businesses reduce their energy costs through innovation and modernizing their infrastructure—improving their output and making them more competitive. Household consumers benefit through lower energy bills and increased home comfort. At the same time, Australia reduces its carbon footprint and contributes to the global challenge of mitigating climate change. It's a win, win, win for Australia."

3.3. Barriers and Enablers for the Consideration of Health in Mitigation Policy

3.3.1. Barriers

Interviewees were asked what they considered to be potential barriers and enablers in accounting for health in the development of mitigation policies. Several barriers that impact the consideration of health co-benefits in the development of climate change mitigation policy were identified.

These fall into two broad areas:

1. A lack of expertise within government, advocates outside of government, and context-specific robust data; and
2. The long-term nature of health impacts, the shorter-term issue of an "invisible" problem, the challenges of distinguishing and articulating the link between the combustion of fossil fuels and health impacts, and the primary consideration of health within climate change adaptation policy.

In the first area, interviewees identified a lack of strong advocacy from within and outside of government for the inclusion of health co-benefits in the development of mitigation policy. A number of interviewees acknowledged that federal government employees tasked with the scoping and development of mitigation policy were unlikely to have a health background and relied on the Department of Health to provide relevant input:

> " . . . it's not this department's, it's not PM & C's, it's not DFAT's job to understand the health impacts of climate change, it's the Health Department's job to bring those considerations to bear, and so it kind of depends on them prioritizing it and having the capability around, around that function." (I_04)

Interviewees also raised the issue that the number and prominence of Australian climate change and health experts and advocates from the health sphere presented a challenge. The late Tony McMichael, a leading Australian epidemiologist and environmental health expert, was acknowledged as a well-regarded Australian climate change and health expert with a level of influence. However, some interviewees felt that there were now few resounding academic champions on the issue of climate change and health within Australia, and those who were in the space were yet to genuinely capture the government's attention:

> " . . . a key actor in the field, like um . . . Anthony McMichael was massive in his day . . . we worked quite a lot with him, so if someone wanted to get to us, they'd go through him and then he'd raise it with us and then that would be taken notice of . . . " (I_09)
> " . . . yes you have, you know, a few, a few very visible and, and expert ah, public health officials talking about the climate in public, ah the climate and health debate, but you don't have them um, linking that to the core government narrative on climate change . . . that's one about the economics, it's around what other countries are doing, and essentially I think you want to flip it from being a defensive and problematic issue to an opportunity issue . . . " (I_02)

In addition, interviewees conveyed that the lack of local, robust evidence inhibited the inclusion of health co-benefits in policy development in any meaningful way. It was recognized that, while health co-benefits had the potential to be used to bolster the rationale for ambitious action, in the absence of a defensible evidence base situated within the Australian context, the inclusion of health co-benefits as a consideration in mitigation policy may actually undermine any policy proposal put forward to cabinet:

> " . . . the data, quality data just doesn't seem to be in existence, particularly for Australia . . . there's stuff out of the US and the EU, ah, and all that data is done in a contextual environment, bigger cities, different weather conditions, all those sorts of things, so it's not directly translatable to Australia necessarily." (I_05)
> " . . . if it's not strongly defendable or robust data, it comes under criticism, undermines a whole lot of the argument, not just the health bit of the argument . . . " (I_05)

In the second area, interviewees identified the conundrum of longer-term health impacts from climate change and the challenge of drawing clear, defensible links between health co-benefits, climate change, and the combustion of fossil fuels. While some interviewees were able to articulate the distinction between the longer-term health co-benefits associated with climate change and the shorter-term health co-benefits associated with the mitigation of fossil fuel use, some interviewees found it difficult to acknowledge that Australia would see any domestic health gains from the implementation mitigation measures, reiterating that avoided health costs from climate change would only result from concerted global effort to address climate change:

> " ... yes it's true that if you cleaned up the ah, if you reduced emissions in the, in the Latrobe Valley it would also clean up the Latrobe Valley, but the materiality of these things is just very different from, I mean you just have to go to Beijing to realize that um, quite apart from global warming they've got to do something about the smog in Beijing and that's true of lots of big um, big ah, Chinese cities, so um, it, it absolutely makes sense from their point of view to talk about the co-benefits. That absolutely makes sense, but I don't think it makes anything like the same amount of sense, for the sort of things we're going to do to reduce emissions, ah, changing the source, changing the um, the energy mix that goes into electricity generation, making fuel, cars more fuel efficient, you think about the various things we're going to do ... there may be co-benefits but they're going to be tiny by comparison with other countries ... " (I_06)

Interviewees suggested that the longer-term impacts to health from climate change increase the challenge of considering health during the development of mitigation policies:

> " ... so the government line is that because there's no sort of direct links with um, well there are links, there are actually inalienable links, links between climate change and health, but you, you can't put it down on paper and say this, this degree of change in heat will definitely arrange in this sort of um, illness or that sort of thing ... I do think it generally acts as a barrier but I don't think that's anyone's fault, I just think it's the nature of the game because it's all, it's all concomitant and variation so, it's all a case of, you know, there's a change in the climate, and then there's a corresponding change in ... prevalence of respiratory diseases and only then do you get the corresponding change of ... health, health is sort of at the bottom. And it's, there's so many, there's so many easy ways to break the links between the two that ... you're never going to get anyone to agree that climate change is to, is to um, is to blame." (I_09)
>
> " ... when people say you die of a heat wave ... a lot of people don't associate it with, you know, their, their gran had a heart attack. They thought she was old, she had a heart attack ... " (I_03)

There was also an acknowledgement from some interviewees that competing priorities, particularly in the health domain, exacerbate the de-prioritization of health co-benefits:

> " ... you go to the health department and it's not their biggest issue, right, it's their fiftieth issue. And you go to the local government, and it may not be their biggest issue, it's their fiftieth issue ... " (I_03)
>
> " ... who's got the most pressure on which particular areas, I mean, that's why in health in many ways, treatment is so much easier than prevention ... you can't make money in prevention, I mean you can, you know, you lift taxes, you know, sure, but that's not, that's not intrinsically the prevention industry producing that ... " (PI_01)

Finally, numerous interviewees spoke about health's inclusion within the realm of climate change adaptation policy:

> " ... I think, within public policy in, in the Australian public service, the extent to which health is relevant to climate change is seen through an adaptation lens primarily, not through a mitigation lens." (I_04)
>
> " ... I've done a little bit of work in adaptation, only, only bits and pieces, briefly, and a lot of health issues obviously are in the adaptation rather than the mitigation side ... " (I_03)
>
> " ... in terms of making decisions about the target, I don't think other than as one of the many things that adds up, um, health played a big part. Where we see most of its activity is more kind of in that, that adaptation side." (I_10)

Health as a key focus of adaptation policy is reiterated in the Australian government's National Climate Resilience and Adaptation Strategy [30] (pp. 58–59):

> " . . . climate change poses challenges to the health of Australians through stresses such as heatwaves, droughts and an increase risk of food and water borne diseases. . . . Australia is responding to the health effects of climate change within the overall context of existing health services and the preventive health mechanisms that help provide a healthy and safe environment—for example, clean water and air, safe food and housing, and protection from pollutants and the spread of disease. State and territory governments play a crucial role in delivering health services across Australia . . . "

Of note, cross-jurisdictional governance structures within Australia see health and adaptation policy primarily the responsibility of state and local governments. While the inclusion of health in adaptation policy was not explicitly discussed with interviewees as a potential barrier to its consideration in mitigation policy development, the statement above from the National Climate Resilience and Adaptation Strategy reinforces that positioning health as an adaptation issue facilitates the transfer of responsibility for health in the climate change agenda from the federal government to state and local governments. This inevitably acts as a barrier to any meaningful consideration of health in national climate change mitigation policy development.

3.3.2. Enablers

Interviewees found it difficult to identify current enablers for the consideration of health co-benefits in the development of climate change mitigation policies. A number of potential or prospective enablers were identified, but these were primarily based around a visible increase in impacts over the coming decades and decreasing technological costs in the energy and transport sectors. While not necessarily pertinent to national policy, one interviewee raised the recent Hazelwood coalmine fire in the state of Victoria as a potential enabler for increasing the role of health co-benefits in the development of mitigation policy:

> " . . . It will be fascinating to see what happens with the Latrobe Valley post the Hazelwood mine fire . . . if you're a politician who needs to make a decision about closing a coal-fired generator on the back of something like that happening . . . and there's people dying from coal pollution, it makes your job a hell of a lot easier . . . " (PI_02)

Opportunities to increase the role of health co-benefits in the development of mitigation policy were discussed during interviews, and are outlined in further detail in the Discussion section below.

3.4. The Evidence Base for Policy Development

Interviewees were asked about the extent to which peer-reviewed scientific literature is used in the development of policy, in order to determine whether the health co-benefits literature may have the potential to inform mitigation policy development. Opinions varied on the importance and inclusion of peer-reviewed literature in the policy development process. Most interviewees felt that peer-reviewed literature was considered to some extent in policy development; however, accessibility issues at times presented a challenge to its consideration and inclusion. In the absence of good quality domestic research, interviewees indicated that international research from reputable organizations and agencies, such as the International Energy Agency or the Organization for Economic Cooperation and Development, was also considered and utilized during policy development.

Beyond the peer-reviewed literature, interviewees indicated that synthesized information products from domestic think tanks and institutes were often useful and included in ministerial briefings or policy documents. There was also recognition that time constraints were imperative for the consideration of research and peer-reviewed literature:

> " . . . it takes sometimes a while for peer-reviewed literature to get out, and sometimes you want a quick answer, and I sometimes say that . . . there's either a three-minute answer, a three-month answer or a three-year answer, and you've got to be really clear about, you know, what you're looking for . . . " (I_02)

Many interviewees highlighted that relevant experts and peer-reviewed authors at times provided direct input into policy development. There was an acknowledgement that experts represented one group of key stakeholders in the policy process (discussed further below); however, their level of influence on the policy decisions was relatively limited due to structural and communication issues:

> " . . . the kind of incentives and milestones that are placed on academics are very, unique um, and the sort of timeframes that I have on things are also very unique, and . . . people in the academic world wouldn't know what I'm working on until later, but, I mean, what, what we've tended to is you know, find academics who are particularly relevant to us, and become really good mates with them. Um, so I have had academics who've had a lot of influence over what we're doing, but regularly, they're a subset of the academics that could be influencing us . . . " (I_03)

> "I think academics um . . . at least some of them that I've spoken to especially recently seem to expect that public servants will have the same sort of depth of um, understanding and analytical rigor as, as them, um, which we don't, like we're not, we're not academics um, and so what we actually need is for academics to understand that we're different and, um, to, there's a bit of a, it's almost a language barrier between, you know, academic speak and public policy speak . . . " (I_04)

3.5. The Role of External Actors and Stakeholders

Interviewees were asked in what ways external actors and stakeholders inform the policy-making process, and whether there are avenues beyond the formal consultation processes that facilitate stakeholder input. Three key groups of stakeholders relevant to the development of Australian mitigation policy were discussed: business and industry stakeholders; non-governmental organizations (NGOs); and experts. The role of community stakeholders and public attitudes were touched on briefly by some interviewees, but did not provide any real insight into their role in policy development. Broadly, there was recognition of the importance of stakeholders in the political process:

> " . . . in government you need to have stakeholders and you need to know who's out in the field, and you need to be well-networked . . . ministers and minister's offices ah, have meetings with these people, and they, and then they ask us to come along and, or give briefing, and or say, we've just met with this person, you know, and it filters down to us to, to action it. Or it's, as I said earlier, us through our network, gathering those ideas, and, part of that is self-preservation for bureaucrats because it's a contestable space and if we're not providing advice, they'll go, the government will go looking for it elsewhere . . . " (I_02)

In relation to formal consultation processes, many interviewees indicated that discussion and other government policy papers released for consultation would likely have already had a level of input through targeted consultations and direct engagement with a number of influential and relevant external actors and stakeholders. It was recognized that there are resource limitations which impact the amount of consultation that is undertaken, but also that the process can become less valuable over time as the same issues are raised time and time again. Many interviewees also noted that informal processes tended to provide a greater level of influence than formal processes:

> " . . . direct engagement with policy-makers, be they at the political level or the bureaucratic level is probably um, as influential if not more influential than the formal um, public submission processes . . . " (I_04)

A number of interviewees accepted that business and industry stakeholders are the most influential in the policy development process, given their role in economic growth and stability and alignment in values and ideology. There was also recognition that business stakeholders are well-equipped to provide a strong rationale for their preferred policy proposals:

> " . . . business has a paved road rather than one they have to hoe themselves. They can get access to the Prime Minister and ministers . . . pretty much anytime they want to. So, if they've got a beef, they can be very influential . . . .governments here just see business quite rightly as, you know, basically carrying the economy, and so if they've got a particular point of view, then they're going to be able to make it . . . " (I_07)
>
> " . . . for better or worse, they run really good campaigns, and they put together, you know, ah, put together a war chest, put together champions, they put together um, the narrative and a, and a policy menu for government, and they, they run hard and they do it . . . " (I_02)

NGOs can also play a role in the development of mitigation policy; however, it depends on the strategies they employ as to how influential they can be:

> "...environment stakeholders if you like, to cast it a bit broader, are in my view most influential when they're providing information-rich input. Ah, if they're just sort of stating positions and lobbying, then it's, it's helpful and, you know, it helps in terms of the atmospherics around public policy and the realm of what's possible, but in terms of informing a, actually information a policy process, it's, it's the . . . the more rigorous analytical stuff that's helpful . . . " (I_04)
>
> " . . . the ones that are traditionally heard best are the ones that ah, have the strongest, most intellectually robust arguments ah, and cases, and that are not seeking out to embarrass, that are seeking out to persuade rather than embarrass." (I_07)

The role of experts in mitigation policy development has already been discussed in the section above. In addition to involvement through technical working groups or advisory panels, the importance of being perceived as objective and a good communicator can influence the level of input an expert has in the policy development process:

> " . . . you'd be looking for somebody who's, who's, a scientist who's policy neutral if you like, or as close to it as possible . . . if you're an expert and you can craft an argument that's of interest to, policy-makers and advisers, you know, in a highly, highly contested um, area such as climate change, you can find the, the policy-makers and advisers who think your point is relevant and the ministers ought to know, then you can be called in . . . experts can be heard if they can, if they can state, put their message in terms that are relevant to ah, the policy process . . . " (I_07)

3.6. The Communication of Policy Decisions

Interviewees were asked about the drivers associated with the communication of climate policy, and whether health benefits and healthcare savings might be a useful communications frame in communicating policy decisions. Aside from the policy areas of vehicle emissions standards and energy efficiency, most interviewees argued that the use of health co-benefits to justify the implementation of mitigation policies would be limited. Most reasons provided focused on the same issues identified as barriers for the consideration of health co-benefits in the development of mitigation policies—issues around a lack of robust domestic data, the indirect nature of health co-benefits, as well as Australia's current climate change narrative and mitigation policy approach:

> "I think in general terms, it, it absolutely would help but I think, um, you need to look at it in the context of what, what policies you're communicating. Um, I think with the current

> government's policies as they are, you know, the reason they're emphasizing things like agricultural productivity and energy productivity is because, as you know, it's a sort of very direct action approach, and the, the communications are emphasizing that um, we can reduce emissions um, by taking direct action, and by taking direct action we're actually helping farmers and um, and we're helping businesses to continue to grow ... I don't think selling health um, outcome, or telling, talking about health outcome would work in the context of the government's current policies and, and targets, cos I, I suspect um, any analysis of health benefits of action would probably say the targets aren't high enough to achieve much benefit ... " (I_04)

4. Discussion

The results presented above indicate that health co-benefits currently play a minimal role in the development of national climate change mitigation policies in Australia. As the results outline, there are several factors that determine the extent to which multiple considerations, including health co-benefits, influence the mitigation policy development process. The case study above identifies that economic factors are one of, if not the most, significant consideration in the development of mitigation policy. This finding is similar to work undertaken by Baum and colleagues [33] on the social determinants of health, and aligns with the theoretical underpinnings of the political economy of health framework.

4.1. A Preoccupation with Economic Modeling

Several interviewees stated that economic modeling and analysis is seen as a crucial input that informs policy development, and has the potential to encourage the exclusion of certain considerations during mitigation policy development. One reason offered for the focus on modeling was that often the resulting numbers are considered objective, factual evidence, useful for justifying policy decisions:

> "But the trouble is, as I said earlier, the trouble is, and, and this is really, really relevant in the Australian case, whenever you produce numbers, ministers think they're facts. The only thing you can know about those number is they're wrong, but ministers seem them as, as factual. You can stand in front of them and you can make, you know, an elegant and compelling argument ah, about why things should be done ... in the interest of the Australian economy, the Australian people, the global commons, um, you know, the universe, love, death, everything, ah, but it will count for nothing against some joker who's pulled out his phone ah, and uses the calculator and produces a list of numbers." (I_07)

In this way, quantitative inputs are prioritized over qualitative inputs in the policy development process. Some interviewees recognized the limitations of economic models, and the difficulty of addressing those limitations given the current institutional policy-making process, where the OBPR are required to approve a RIS and accompanying CBA prior to its submission to cabinet:

> "The numbers of problems in the RIS process ... I mean, mostly because it's, you, you know, you're often working in a social or in an energy, you end up, you know, some sort of policy area, and then you've got to put it in the right terms for the economists, then you've got to go and argue with the economists that their assumptions are not better than yours, and you've got to get them to approve it." (I_03)

A number of interviewees reinforced the contribution of modeling to the recent INDC target setting policy process. Ultimately, of the four target scenarios modeled—13%, 26%, 35%, and 45% absolute emission reductions compared with 2005 levels—the government settled on a target of 26%–28%:

> " . . . the economic modeling that we did was about ah, the um, estimates of the economic cost to the economy of different um, different targets, with a kind of understanding that the whole point of this exercise was for Australia to, to play its fair share in um, in achieving global um, reductions in emissions, um and signing up to various um, if you like, commitments, like, um, the two degree commitment . . . but ultimately the um, the work was in, the work was designed to try and give a sense of how much, um, cost would be imposed on the domestic economy by signing up to different um, emissions reductions targets, and also to get a sense of what other countries were doing . . . that's not completely straightforward because we've got different population growth from other countries, so it depends how you measure it . . . So um, we presented a lot of those sort of comparisons . . . " (I_07)

> " . . . my view is that way too much emphasis gets put on modeling outputs, um, especially . . . the 2030 target, it's, it was all done last year, so you're projecting fifteen years out, and um, the, the modeling um, you know, in terms of GDP impact, um, in 2030 associated with the four, five scenarios that were drawn from that modeling were all within the bounds of the margin of error anyway, so you can't predict GDP fifteen years in advance with enough precision to . . . given, given the, the numbers that were coming out at the end of it, cos they were all, you know, 0.7, 0.4, and if it was, you know, if it was six compared to seventeen, then it's meaningful . . . but there was um, in the target process, there was a lot of discussion about whether there should or shouldn't be economic modeling and eventually there was ah, modeling, and a lot of the reason why there was discussion about should there be was um, because of the exact point of once you're doing modeling and once there's numbers, people just get fixated on those numbers and lose sight of um, the limitations of those numbers and the assumptions that are sitting behind them, um, and the lose sight of all the, the other considerations that sit around it . . . " (I_04)

Bearing in mind the significant role of economic modeling and analysis to the policy development process, several interviewees suggested that numerous opportunities exist to increase the role of health co-benefits as a consideration in Australian climate change mitigation policy development.

4.2. Increasing the Role of Health Co-Benefits as a Consideration in the Development of Mitigation Policy

Firstly, there is an opportunity to integrate health more meaningfully into climate change mitigation policy in a comprehensive review of Australian climate change policy. A comprehensive review of climate change impacts on Australia has not been undertaken since the Garnaut Climate Change Review was commissioned by the Australian Labor Party and Australian state and territory governments in 2007, and as one interviewee lamented, the INDC target setting process had provided a platform but was not utilized:

> " . . . so the INDC process was a missed opportunity essentially because what it, it, in theory those processes should provide an opportunity for national governments to assess what's in their broader national interest . . . and I think the, the, one of the biggest failings in domestic policy, and it's broader than health, is that we haven't for a while um, attempted a systemic assessment of what climate change means for the systems which we um, need, whether they be health system or financial system or, you know, what the impact of global action is on our long-term prospects for our, our exports, for example . . . " (PI_02)

The Coalition government, recently returned to power following a federal election in July 2016, has pledged to undertake a comprehensive review of Australian climate change policies in 2017. A number of interviewees identified this audit as a strategic time to raise the profile of health co-benefits and advocate for their inclusion in the mitigation policy development process.

In particular, areas of energy efficiency and sustainable transport were identified as key policy areas where health co-benefits are quantifiable and could be well received in Australia:

> " . . . it's only in relation to energy efficiency where you can claim, um, I think in Australia, where you can claim um, a, a carbon reduction measure as having a public health benefit. . . . A move to electrified transport would have a big impact on public health, because you've got . . . we've got all sorts of, of air pollution problems from ah, from combustion, internal combustion engines ah, in the cities." (I_07)
>
> " . . . the benefit is those costs are avoided, um, and, and these are, you know, usually done on . . . the basis of ah, deaths and, and other kind of respiratory ill effects . . . and what the, the costs are there. . . . so we've been using it for a, a long time in the, the pollution space and . . . it'll pull over into motor vehicle efficiency as well . . . " (I_10)

The area of vehicle emissions is one where the Australian government appears to be genuinely considering health impacts. Following on from the establishment of a Ministerial Forum on Vehicle Emissions in late 2015, the Australian government released a Vehicle Emissions Discussion Paper in early 2016 [32]. The first paragraph of the Discussion Paper demonstrates a clear understanding of the link between the combustion of fossil fuels, health impacts, and climate change (p. 2):

> "Emissions from motor vehicles can affect our health by polluting the air we breathe and can also contribute to climate change. To explore options to reduce the environmental and health impacts of emissions from motor vehicles, the Australian Government has established a Ministerial Forum to coordinate a whole of government approach to this important issue."

Beyond the scheduled 2017 climate change policy review, the Council of Australian Governments (COAG) was suggested as an alternative avenue for promoting health co-benefits given the cross-jurisdictional nature of health in Australia's federal system. While the Department of Health is responsible for the Environmental Health Standing Committee (enHealth), it has not recently provided any advice on health in climate change policy. enHealth's Secretariat reports that a new national environmental health strategy is in the process of being prepared [34]. Interviewees also advised that a more cohesive awareness raising campaign was required to elevate the prioritization of health co-benefits as a consideration in the development of mitigation policy:

> "You need, you need to marry, like the ideal world is you'd marry . . . a lobbying group like AMA . . . a policy advocate group on climate change . . . and the academic sector . . . it does need a level of credibility . . . and it also needs to be able to judge any policy that's put forward against political pragmatism . . . " (PI_02)

5. Conclusions

The case study presented here provides a level of insight into the role of health co-benefits in the development of Australian climate change mitigation policies. To do so, we explored the policy-making process; factors influencing the prioritization of multiple considerations; barriers and enablers to the consideration of health; the evidence base for policy; the role of external actors and stakeholders; and the communication of policy decisions. Results indicate that health co-benefits are not meaningfully considered in the development of mitigation policies in Australia. Explanations include a lack of local, robust data and champions both within and outside of government; the current Australian climate change narrative and a focus on domestic economic costs in mitigation policy development; as well as challenges associated with the long-term nature of health impacts and linking health co-benefits to climate change and fossil fuel use.

Based on responses from interviewees, a number of opportunities were identified for increasing the role of health co-benefits in the development of Australian climate change mitigation policies. Beyond addressing the acknowledged barriers, an upcoming government review of climate change policy in 2017 provides an opportunity for health co-benefits to be more meaningfully integrated into mitigation policy. This would require an environmental health champion to coordinate a cohesive

and strategic policy campaign that speaks to the dominant climate change narrative within which policy-makers are currently embedded. Further, COAG was identified as a cross-jurisdictional avenue through which health co-benefits might be able to gain some political traction.

While the federal government is ultimately responsible for the development and implementation of climate change mitigation policies in order to meet international emissions reduction obligations, given Australian state and local governments are largely responsible for the development and implementation of health and adaptation policy, interviews with relevant state and local government employees may provide additional insight regarding the role of health co-benefits as a consideration in the development of climate change policy more broadly.

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Title: Health Co-Benefits and the Development of Climate Change Mitigation Policies in the European Union

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Abstract: The 2015 Paris Agreement requires increasingly ambitious emissions reduction efforts from its member countries. Accounting for ancillary positive health outcomes (health co-benefits) that result from implementing climate change mitigation policies can provide Parties to the Paris Agreement with a sound rationale for introducing stronger mitigation strategies. Despite this recognition, a knowledge gap exists on the role of health co-benefits in the development of climate change mitigation policies. To address this gap, the case study presented here investigates the role of health co-benefits in the development of European Union (EU) climate change mitigation policies through analysis and consideration of semi-structured interview data, government documents, journal articles and media releases. We find that while health co-benefits are an explicit consideration in the development of EU climate change mitigation policies, their influence on final policy outcomes has been limited. Our analysis suggests that whilst health co-benefits are a key driver of air pollution mitigation policies, climate mitigation policies are primarily driven by other factors, including economic costs and energy implications.

Key policy insights

- Health co-benefits are quantified and monetized as part of the development of EU climate change mitigation policies but their influence on the final policies agreed upon is limited.
- Barriers, such as the immediate economic costs associated with climate action, inhibit the influence of health co-benefits on the development of mitigation policies.
- Health co-benefits primarily drive the development of EU air pollution mitigation policies.
- The separation of responsibility for GHG and non-GHG emissions across Directorate Generals has decoupled climate change and air pollution mitigation policies, with consequences for the integration of health co-benefits in climate policy.

Keywords: climate change mitigation; public health; ancillary benefits; policy formation.

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1. Introduction

1.1. The Paris Agreement and human health

The Paris Agreement, adopted in December 2015 at the 21st Conference of the Parties (COP 21) to the United Nations Framework Convention on Climate Change (UNFCCC), commits its Parties to limiting global average temperature rise to 'well below' 2°C above pre-industrial levels and preferably to 1.5 °C. The "right to health" was explicitly incorporated into the preamble of the Paris Agreement, representing the first such inclusion in an international climate change instrument since the UNFCCC was initially developed in 1992 (Schütte et al., 2017). Implementing the Paris Agreement carries political, economic and social challenges for governments, particularly given the commitment to pursue increasingly ambitious greenhouse gas (GHG) emissions reduction targets through a five-yearly pledge and review mechanism. Now more than ever, as governments consider the energy transition needed to secure longer-term low-carbon economies, it is imperative to pursue win-win climate change policies through an integrated, cross-sectoral approach to policy development. Remaining cognisant of managing possible trade-offs, human health has the potential to play an important role in justifying climate change mitigation strategies (Smith et al., 2016).

The combustion of fossil fuels will increasingly contribute to adverse health outcomes across populations as a result of longer-term climate change, disproportionately affecting some of the world's most vulnerable people (A. McMichael et al., 2004; A. J. McMichael & Haines, 1997). In the shorter-term, fossil fuel-related emissions are responsible for increasing premature mortality and morbidity outcomes in populations, especially through compromised air quality (Brook et al., 2010). Both GHG and non-GHG emissions that adversely impact health are primarily attributable to the energy and transport sectors (IEA, 2016). Further, GHG and non-GHG emissions often originate from the same stationary and mobile sources (Fiore, Naik, & Leibensperger, 2015). Adverse health outcomes have considerable economic implications. For example, the Organization for Economic Cooperation and Development (OECD) estimates that the economic costs from outdoor air pollution will represent 1% of global gross domestic product (GDP) by 2060; the OECD projects air pollution-related health care costs of US$176 billion in 2060 and 3.7 billion lost working days annually in the same year (OECD, 2016, p. 14).

Where there are health impacts from GHG and non-GHG emissions related to the use of fossil fuels, it follows that health benefits are attainable through the implementation of emissions reduction measures. Various environmental health researchers and national government agencies have investigated potential health co-benefits and co-harms, with many focusing on outcomes associated with air quality (e.g. Nemet, Holloway, & Meier, 2010) given its substantial impact on health and economic costs. If devised carefully, climate change mitigation policies can provide shorter-term, domestic benefits to health for various populations as a result of reduced emissions. Sophisticated models and methodologies have been utilized to quantify and monetize the shorter-term health benefits of climate change mitigation policies (e.g. Bell et al., 2008;

Costello et al., 2009). For example, the United States Environmental Protection Agency (EPA) has historically used the social cost of carbon methodology, a monetary measure that estimates the damage resulting from one tonne of carbon dioxide emissions per year. In 2015, the EPA determined that implementing mitigation measures associated with the 'Clean Power Plan' would lead to cumulative social benefits, including health co-benefits, worth US$54 billion annually by 2030 (Jacob, 2015). Despite this recent example, however, minimal research has been undertaken to explore if and how health co-benefits actually inform the development of climate change mitigation policies.

Accordingly, this paper investigates how health co-benefits are considered in the EU climate change mitigation policy development process, and what factors influence their consideration. As a supranational, politico-economic organisation with 28 Member States, the EU constitutes the third largest GHG emitter globally. In 2014, just under half (48.8%) of EU emissions were generated from the energy supply and transport sectors (European Environment Agency, 2016b). Consequently, numerous studies have analysed the health co-benefits of improved air quality that result from the implementation of climate change mitigation policies (e.g. Rive, 2010; Schucht et al., 2015; van Vuuren et al., 2006). While the EU has often been regarded as a global leader on climate action with a suite of mitigation policies, the effectiveness of some mitigation policies has come into question. For example, the European Union Emissions Trading System (EU ETS) was launched in 2005 and represents the first and largest trading market in carbon dioxide (European Commission, 2016). Yet, carbon price volatility resulting from internal and external challenges has led to criticism of the EU ETS (Edenhofer et al., 2017; Narassimhan, Gallagher, Koester, & Alejo, 2018). Additionally, the effectiveness of EU air pollution mitigation policies has also been questioned, given considerable non-compliance by Member States (Yamineva & Romppanen, 2017).

1.2. EU governance structures relevant to climate change and human health

The EU is a Party to the UNFCCC in its own right, and since 2007, climate change has formally been an issue of shared responsibility for Member Sates and the EU's principal policy-making body, the European Commission (Commission). In 2010, the Commission established a Directorate-General (DG) for Climate Action (DG CLIMA). Prior to the establishment of DG CLIMA, DG Environment (DG ENV) was responsible for climate-related policies. DG CLIMA now leads the development of climate change mitigation policies and responsibilities for emissions have been split: DG CLIMA is responsible for policies covering the six GHGs covered by the Kyoto Protocol while DG ENV is responsible for policies relating to non-GHGs that impact air quality. The two DGs share responsibility for policies relating to methane emissions. Air quality policies in the EU focus heavily on the health impacts of air pollution, and for good reason: 2013 estimates determined that exposure to particulate matter with a diameter smaller than 2.5 micrometres ($PM_{2.5}$), nitrogen dioxide (NO_2) and ozone (O_3) concentrations have been responsible for approximately 436,000, 17,000 and 16,000 premature deaths respectively across the EU Member States annually (European Environment Agency, 2016a). With these contextual factors in mind, the following case study examines the role and influence of considerations such as health co-benefits in the development of EU climate change mitigation policies.

2. Materials and Methods

This study is theoretically grounded in the political economy of health framework (Bambra, Fox, & Scott-Samuel, 2005). This framework suggests that 'health' can usefully be conceptualized 'as a function and reflection of linked determinants that operate at multiple levels: individual, household, community, workplace, social class,

nation, and the global political and economic context' (Birn, Pillay, & Holtz, 2009). Further, many determinants of health are often situated outside of the health sector and require policy action in other sectors (Whitehead, Diderichsen, & Burstrom, 2000, p. 203).

Climate change represents a whole-of-economy issue; every sector will be impacted. With this in mind, Walt and Gilson's (Walt & Gilson, 1994) health policy analysis model provided the analytical guide for the evaluation of EU climate change policies in this paper. The model has been utilised elsewhere for this purpose (Bowen, Miller, Dany, McMichael, & Friel, 2013; Workman, Blashki, Karoly, & Wiseman, 2016) given its capacity to support the holistic assessment of policies. Specifically, beyond policy content, the model prescribes examination of the context, process and actors of policy development as key elements informing the final policies agreed upon.

2.1. Study Design. Semi-structured interviews comprised the primary data source for the development of the case study and were supported by analysis and consideration of secondary data sources, including relevant policy documents (see Table 1), journal articles and media releases. Consideration of Walt and Gilson's health policy analysis model and a review of the literature on the political economy of health and climate change, the science-policy interface and power in policy-making facilitated the identification of six themes that comprised the interview schedule. Questions in the interview schedule were stratified into one of these six themes: i) the policy-making process; ii) factors influencing the prioritization of multiple considerations; iii) barriers and enablers for the consideration of health in mitigation policy; iv) the evidence base for policy; v) the role of external actors and stakeholders; and vi) the communication of policy decisions. The semi-structured interview questions were peer-reviewed and subsequently revised (see supplementary material).

Insert Table 1. Key European Commission documents informing case study development

2.2. Recruitment of Participants. Commission officials directly involved in the development of EU climate change and air pollution mitigation policies were the targets of recruitment, given their intimate knowledge as the primary makers of policy and their capacity to provide insight into the role of health co-benefits. However, it was anticipated that Commission policy-makers would be difficult to recruit given competing time pressures. Consequently, political advisors and expert consultants were also approached given their involvement in and knowledge of climate change and air pollution mitigation policy development. Participants were initially approached for interview by email from March 2017. DG organisation charts and individual connections were used to identify potential participants. Political advisors for members of the European Parliament's *Environment, Public Health and Food Safety Committee* (ENVI Committee) and experts supporting the development of impact assessments for EU climate mitigation policy were also approached. Participants were offered anonymity and no demographic data were collected on individuals that participated.

2.3. Data Collection and Analysis. The first author conducted all interviews between April and October 2017. In total, 46 individuals were contacted for interview. Ultimately, 14 individuals were interviewed and two individuals provided information via email. Interviews were conducted both face-to-face (n=7) and via online videoconferencing (n=7). The average interview length was 43 minutes. Interviews were transcribed and verified for accuracy. Transcriptions were imported into QSR International's NVivo 11 Software (NVivo, 2014), where they were coded based on the six themes identified in the literature review. Key mitigation policy documents selected for analysis (see Table 1) were also imported into NVivo, where directed qualitative

content analysis was performed (as described in Hsieh & Shannon, 2005) based on the same six themes identified in the literature review.

3. Results

Overall, this study determined that health co-benefits are an explicit consideration in the development of EU air pollution and climate change mitigation policies. They are incorporated into integrated impact assessments for mitigation policy proposals through a suite of models that support their quantification and monetization. They are recognized as a key driver for air quality policies and regularly underpin the communication of these policies to the public. However, they are less relevant and influential in climate change mitigation policies. The economic costs associated with policy implementation and energy supply security remain more powerful influences on climate change mitigation policy outcomes, as Member States pursue their own national interests and agendas. A more detailed examination of the role of health co-benefits in the development of EU climate change mitigation policies is provided below. Interview and policy document data are presented together, stratified by interview theme.

3.1. Policy-Making Process

The first theme regularly discussed in interviews was the policy development process used by the Commission, particularly for cross-sectoral policy issues such as climate change mitigation. Interviewees identified key steps in the policy development process, emphasizing concerted efforts by the Commission to harmonize the development of cross-sectoral policies. Interviewees discussed the process used to develop climate change policies, explaining that an Inter Service Group is established for a cross-sectoral policy issue to support a coordinated approach to policy-making by providing a formal avenue through which the various DGs impacted can provide input and remain informed

as policy is developed. Some interviewees highlighted the integrated nature of policy-making and close working relationships between DGs, with modelling tools and analyses shared and incorporated into integrated impact assessments across policy files to support the harmonization of policy proposals across DGs:

> And within the EU, I think…we have full coherence between…climate policy and air pollution policy. We speak with each other on a…daily basis, in order to understand where we stand and we use each other's material, the same methodologies, the same models…to drive…the policies. (I_03)

Further and related, many interviewees acknowledged that a key component of robust and transparent policy development involved the use of publicly accessible integrated assessment models that explore cost-effective strategies to reduce both GHG and non-GHG emissions:

> So the principle of cost-effectiveness is very strong in climate policy and in air pollution policies. And for that reason, we use…very advanced modelling… (I_03)
> And very important is that…the GAINS model…is online…so you can actually go and…play around with it yourself…and you can see how this can…influence the policy options for your country… (I_03)

Some interviewees also demonstrated an understanding of the complex relationship between climate change and air pollution mitigation policies and the need to carefully consider the implications and potential trade-offs:

> …if you do ambitious air pollution, it's good for…not always actually, it tends to be good…for climate and the same for climate. Most climate policies tend to be good for air pollution, not all, I mean biomass, some of the biomass is actually quite, quite bad for air pollution… (I_01)

The Commission's impact assessment for the *Clean Air Policy Package* (European Commission, 2014c, p. 245) outlines the synergistic and antagonistic interactions that can exist between air pollution and climate change policies:

> …there are substantial interactions between climate change and air pollution policies. A more ambitious climate policy is expected to make reaching the new air quality objectives cheaper by removing highly polluting sources such as coal plants or reducing domestic coal use; however, expanded biomass combustion can result in detrimental health impacts unless sufficiently stringent emissions standards are in place.

Finally, some interviewees explained that mitigation policy development requires an awareness of balancing optimal and politically pragmatic policy options given diverse views within the legislator:

> …that's what the policy-making process is about…we think we can show that achieving quite ambitious greenhouse gas reduction can be done…some will say this is too expensive and some will say, you haven't looked enough at the health impacts… (I_01)

3.2. Factors Influencing the Prioritization of Multiple Considerations

Interviewees were asked about the processes and factors that influence the prioritisation of multiple considerations in the climate change mitigation policy development process. Interviewees identified four factors as pertinent to the development of cross-sectoral policies with multiple considerations. These four factors can be stratified into two categories: guiding principles and political priorities. Interviewees identified two guiding principles that underpin the development of climate change policies. Firstly, some interviewees explained that development of impact assessments are guided by sustainable development principles:

> …an impact assessment should look really at the three pillars of sustainable development, so consider the economic, social and environmental impacts, they're put on an equal footing. (I_02)

Interviewees identified a second guiding principle of limiting global warming to below 2˚C as central to climate change policy development. The determination of the EU's Council of Ministers, as early as 1996, that a rise in average surface temperature of 2˚C compared with pre-industrial levels would constitute 'dangerous' levels of anthropogenic climate change is an integral value that forms the basis of the Commission's climate change policy development for the EU:

> Two degrees…has been extremely important because…once you don't have that first high-level guiding principle, you can imagine everything you want. (I_05)

Interviewees also identified two key political priorities that inform the final policies agreed upon. First, interviewees reiterated that costs are a powerful influence on the development of policy proposals:

> Member States that have to implement these measures, they don't look at the positive side. They only look at the cost. They have a very conservative view on this. …even if you show that there were billions saved and so on…if you look at value of statistical life or life years lost and so on, huge benefits. The Member States completely ignored that in the debate. They only looked at the cost figures. (I_03)

In relation to climate change mitigation policies, the Commission's Green Paper on *A 2030 framework for climate and energy policies* (European Commission, 2013b, p. 10) acknowledges perceived existing tensions between ambitious climate and energy policies and the economic impacts:

> Energy and climate policies can drive demand and growth in the low carbon economy. The EU is a frontrunner in clean and more energy-efficient technologies,

> products and services and eco-technologies which together are expected to generate some 5 million jobs in the period up to 2020. Moreover, many of these policies contribute to reduced air pollution and health improvements. At the same time, the policies have been criticised for having a negative impact on energy prices, adversely impacting affordability of energy for vulnerable households and the competitiveness of energy intensive sectors even though they may reduce industry's exposure to energy costs and improve resilience to energy price peaks.

Energy supply security is a second political priority that influences climate change mitigation policy development. Interviewees advised that for the EU, energy supply security is paramount and is a central policy focus for both the EU and Member States:

> …there are issues relating to energy security, when it's about oil or gas, it is a major import bill. …when the integration of the thinking about climate and energy really happened was in 2006, 2007, when the EU was confronted with…a price spike in oil prices and then suddenly people…and politicians started to see this interaction, OK, if I do more on efficiency or if I do more on renewable energy…it's also an economic hedge against troubles on [the] energy side. (I_05)

The importance of energy supply security is evident in the Commission's press release on the presentation of *A framework on climate and energy for 2030* (European Commission, 2014d) to the European Parliament and the Council in January 2014:

> Supported by a detailed analysis on energy prices and costs…the framework aims to drive continued progress towards a low-carbon economy and a competitive and secure energy system that ensures affordable energy for all consumers, increases the security of the EU's energy supplies, reduces our dependence on energy imports and creates new opportunities for growth and jobs…

3.3. Barriers and Enablers to the Consideration of Health in Mitigation Policy

While health co-benefits are an explicit consideration in the development of EU mitigation policies, interviewees acknowledged that while health is the primary driver of air pollution mitigation policies it does not play the same integral role in the

development of climate change mitigation policies. Interviewees raised three barriers and three enablers to the consideration of health co-benefits in mitigation policy development (summarized in Table 2 and discussed in further detail below).

Table 2. Summary of barriers and enablers to the consideration of health in the development of EU climate change mitigation policies

3.3.1. Barriers

Firstly, the dominant narrative of costs and growth and the political reality of short-termism was identified as a barrier:

> …I think it's mostly because the priorities are growth, jobs, economy so the mitigation policy is geared towards that… (I_09)
> …the barrier there is…decision makers like, OK well, what can I do about that in the next four years I'm in charge. …this long-term uncertainty…is a barrier… (I_09)

In the Commission's Green Paper on *A 2030 framework for climate and energy policies* (European Commission, 2013b, p. 10), the Commission acknowledges criticism of the 2020 climate and energy package, given the 'negative impact on energy prices, adversely impacting affordability of energy for vulnerable households and the competitiveness of energy intensive sectors even though they may reduce industry's exposure to energy costs and improve resilience to energy price peaks.' The Commission's subsequent impact assessment on *A policy framework for climate and energy in the period from 2020 up to 2030* (European Commission, 2014b, p. 131), concludes that:

> 'if 2030 climate and energy targets are met in a cost-efficient manner on the aggregate EU level, costs relative to GDP are typically highest in lower income Member States and in scenarios that require highest investment expenditures due to ambitious EE [energy efficiency] and RES [renewable energy sources]. At the

> same time, environmental and health benefits as well as fuel savings are also highest in these countries.'

Second, some interviewees acknowledged that there are still difficulties with attributing and quantifying some of the longer-term health outcomes resulting from climate change:

> the work on…infectious diseases is a bit more complicated because those impacts are more indirect. We can't really draw direct conclusion of climatic events to infectious disease event because of the…complexity of the disease transmission pathways... (I_06)

Third, some interviewees suggested that the amount of funding dedicated to climate change and health research acts as a barrier:

> …because health [funding] is traditionally oriented towards…pharmaceuticals research…end-of-pipe solutions, so they don't really…look at health determinants as much… (I_09)
>
> …I don't think that health has a big weight, I don't think it's…a sector that gets a lot of attention and I think it's definitely underfunded… (I_06)

Funding of environmental health research has been assessed by the Commission. In 2014, the Commission completed an analysis of environment and health-funded research under the Seventh Framework Programme from 2007-2013 (European Commission, 2014a). Cumulatively, 147 environmental health projects were provided €550 million (€79 million per annum) during the six-year period. Of these, 22 were air quality-related and 13 were climate change-related. In particular, two research projects investigated health co-benefits – PURGE and URGENCHE – with EU financial contributions of approximately €3.4 million to each project. Funding dedicated to climate change and health research under the Seventh Framework Programme represents 0.08% of the total programme budget (Ebi, Semenza, & Rocklöv, 2016).

3.3.2. Enablers

There were also a number of enablers identified that support the consideration of health in the development of climate change mitigation policy. Firstly, interviewees discussed some of the severe weather experiences in Europe over the past two decades with serious health implications:

> …we also have these massive climate change impacts in Europe that have a dramatic impact on public health in Europe. If you think back to the 2003 heatwave that claimed something like 70,000 excess deaths… (I_06)

A second enabler identified was the fundamental importance of transparency and accountability in legitimising the Commission's policy proposals:

> …it is a fact maybe that it's sometimes more straightforward to…assess your economic impacts of the policy than the health impacts, and that shows sometimes in the impact assessment but…if from the…screening stage…when you discuss whether or not things are likely to have an impact, you identify health as…likely to be significant, efforts will have to be…put into…assessing them seriously…in terms of accountability the impact assessment has to, has to, cannot just ignore them. (I_02)

Third, some interviewees indicated that the long history of increasingly ambitious air quality policies in Europe provided supportive structures for the consideration of health in climate change mitigation policies:

> …the major finding for air quality and health…there are massive long-term, massive, massive effects to long-term exposure. And…that got accepted pretty quickly…so we…put those numbers into the…Clean Air for Europe programme…and round about the same time also started putting numbers together for the climate policies. …the climate people I think were very ready to take them on board…and, they liked the…whole issue about…the air quality benefits being in the near-term and also within Europe as opposed to…impacts in 2050… (I_08)

In the Commission's impact assessment for *A Roadmap for moving to a competitive low carbon economy in 2050* (European Commission, 2011, p. 92), the synergies between climate change mitigation and air pollution mitigation policies are highlighted, with the quantification and monetization of health co-benefits incorporated into the assessment:

> …Effective decarbonisation will reduce the number of life years lost due to $PM_{2.5}$ by €2.6 million in 2020, €6.3 million in 2030 and €14.3 million in 2050. …effective decarbonisation reduces this type of health damage due to air pollution by €3 to 7 billion in 2020 compared to the reference. …In 2030 the damage reduction increases to around €7-17 billion and in 2050 to €17-38 billion.

3.4. The Evidence Base for Policy Development

Interviewees were asked about the role of peer-reviewed literature in the policy development process. Almost all interviewees noted that it is vital that the Commission transparently develop evidence-based policy. Some interviewees noted that evidence summaries prepared by the IPCC inform the policy development process:

> When it comes to the collective action the EU thinks should be done on climate change we base ourselves on the IPCC… (I_01)

Interviewees clarified that both internal – and external where needed – resources are readily available in order to ensure that the best available modelling and analysis tools are used to support the development of policy proposals:

> The DGs have…a budget…for…contracting studies…a budget to basically have the…models and the contractors…at our disposal when we need them…we are safe in terms of being able to do the work. (I_05)

3.5. The Role of External Actors and Stakeholders

Interviewees were asked about the role of external actors and stakeholders in the policy development process. Interviewees discussed the regular opportunities that exist for

formal stakeholder consultation throughout the policy proposal development, noting that these can be open or targeted (invite only) consultation opportunities, and can be used as a litmus test of the Commission's policy proposal prior to its consideration by the Council and the European Parliament:

> …so we have numerous…moments we have [to] consult stakeholders and I have to say it matters, I mean it's not that it's…ignored. …when you do a stakeholder consultation you get a very good view of …the pros and cons regarding your policies out there. (I_01)

In the Commission's impact assessment for *A Clean Air Policy Package* (European Commission, 2014c, p. 88), the Commission included summaries of consultation input, which highlights the diverse stakeholder perspectives on synergies between air quality and climate and energy policies:

> In terms of how future EU air pollution policy should interact with EU climate and energy policy, over 90% of respondents to the questionnaire for the general public, along with over 80% of government, NGO and individual expert respondents to the questionnaire for experts and stakeholders, support the option that EU air pollution undertakes *additional measures beyond synergies with climate and energy policy*. A majority of business respondents, however, feel that a new air pollution action should not go beyond synergies with climate and energy policy.

The role of multilateral organisations in supporting the policy development process was discussed, particularly work undertaken by the World Health Organization (WHO) and the OECD:

> …the human health benefits are based on WHO recommendations and on very…comprehensive work by…OECD on the value of life and value of statistical life and life years lost and combining…these information sources, we can quantify the effects, impacts as well as the monetized…impacts and effects… (I_03)
> …the OECD is taken very seriously…the workings of the OECD do have quite a lot of influence over people. (I_09)

The role of the WHO in informing EU air policies is reaffirmed in the impact assessment for the *Clean Air Policy Package* (European Commission, 2014c, p. 17), which notes that the WHO played a role in the policy review process:

> For the Ambient Air Quality Directives, the health relevance of the pollutants and standards of the original policy has been reviewed by the WHO, and confirmed, with the caveat that the level at which certain standards are currently set (mainly for PM) provides only incomplete protection for human health.

3.6. The Communication of Policy Decisions

The final theme discussed with interviewees explored the communication of policy decisions and whether health co-benefits have the potential to be a useful communications frame. Interviewees advised that health co-benefits are included as one of several justifications for implementing climate change mitigation policies, however they likely resonate more with the broader public than with Member State representatives:

> I don't think many Member States would think that…whatever they have to do on climate action…that they would be convinced by…health…perhaps a few would, would take it into account…but overall…I think towards the public, yes…it's something that perhaps they can relate more closely to. (I_05)

Interviewees also articulated the challenges of developing policies for populations with different socio-economic characteristics:

> …in Europe…it matters where you live. In some places air pollution is a bigger problem than others…to some extent, the worst air pollution in Europe is also in the places with the lowest income levels…and that actually makes it more difficult because it's, the lower your income level, the less willingness to pay… (I_01)

4. Discussion and conclusions

The results detailed above indicate that the EU has a defined policy development process and supporting governance structures in place to develop evidence-based, integrated policies with opportunities for input from diverse stakeholders. Specifically, impact assessments developed for climate change mitigation policies are explicit in their consideration of health and other impacts, and can offer other Parties to the UNFCCC with a good example of processes and tools that can support the incorporation of multiple considerations into the development of a cross-sectoral policy issue.

The results above also demonstrate, however, that despite a robust policy development process, health co-benefits ultimately play a limited role in the development of climate change mitigation policies. In spite of the EU's commitment to the equal consideration of economic, social and environmental impacts, the 'realpolitik' sees economic costs and energy supply security considerations as particularly influential in final climate change mitigation policies. These results reaffirm previous findings on the overarching influence of the material costs of implementing climate change policies (Harrison & Sundstrom, 2007; Skjærseth, 2016) and a preoccupation with cost minimization in climate policy assessment (Williams, 2012). The framing of climate change as a security issue in the EU has also been examined, although perspectives vary; some suggest that security has not been a core component of EU climate discourse (Hayes & Knox-Hayes, 2014) whereas others contend it has been pivotal for DG Energy and the Central and Eastern European states (Skjærseth, 2016).

Theoretically, these findings are consistent with political economy of health conclusions that a robust evidence-base and a morally defensible position are often insufficient to achieve optimal policy outcomes for health (Baum, Laris, Fisher, Newman, & MacDougall, 2013). In reality, the Commission's role in policy

development requires balancing the provision of cost-effective and evidence-based policy options with politically palatable policy choices for Member States with their own national interests and diverse stakeholder groups to assuage. These stakeholders include non-state actors, such as business groups with fossil fuel interests, that directly engage with energy and industry departments at the national level (Downie, 2016), as well as representatives of the vehicle manufacturing industry, who have been influential at the Commission level (Čavoški, 2017).

The Commission's focus on evidence base and cost-effectiveness may also help to explain the distinction between the role of health co-benefits in air pollution mitigation policies and climate change mitigation policies. Scientific expertise has been a cornerstone of air pollution mitigation policies since the establishment of the regional air pollution treaty, the Convention on Long-Range Transboundary Air Pollution (CLRTAP) in 1979 (Reis et al., 2012) and studies on the dangers of short- and long-term exposure to air pollutants have been informing air quality policies since the 1990s (Cohen et al., 2004). Comparatively, cultivation of the scientific evidence base for the health impacts of climate change has been more recent. In Europe, limitations of health impact studies inhibit the utilisation of such research by policy-makers (Hutton & Menne, 2014). While there have been recent novel methodological advances to support the detection and attribution of climate change health impacts (Ebi, 2014; Ebi, Ogden, Semenza, & Woodward, 2017), the diffusion of health between climate change mitigation and adaptation research and policies coupled with challenging research funding environments (Ebi et al., 2016) exacerbates the limited uptake of health in climate change mitigation policy development. Conversely, health co-benefits that result from improved air quality are primarily achieved through mitigation measures alone.

Cost-effectiveness remains a key principle in the Commission's economic analysis of environmental policy-making (Delbeke, Klaassen, van Ierland, & Zapfel, 2010). To date, mitigation of air pollutants has been pursued primarily through end-of-pipe measures, which are cost-effective compared with the structural shifts in the energy sector and the economy that are required to reduce GHG emissions (Bollen & Brink, 2014). Accordingly, the health co-benefits that result from mitigation measures are most cost-effectively achieved through air pollution mitigation policies, enhancing their appeal as a key justification. However, end-of-pipe measures can only reduce air pollutants to an extent. Structural changes, such as those achieved through climate change mitigation, are necessary in order to achieve air quality policy objectives (Bollen & Brink, 2014; Braspenning Radu et al., 2016). Importantly, the more ambitious the GHG emission reductions, the greater the likelihood that air quality co-benefits will be realised (Williams, 2012). Integrating climate change and air pollution mitigation policies is not without its challenges (Maione et al., 2016; Reis et al., 2012). Yet, opportunities exist to enhance the current role of health co-benefits in the development of climate change mitigation policies, consequently justifying more ambitious EU climate change mitigation policies (Day, Höhne, & Gonzales, 2015).

4.1. Future research and concluding remarks

Analysis of interview data, policy documents, peer-reviewed articles and news releases that considered the context and process of policy-making as well as actors involved in the process facilitated a comprehensive examination of EU climate change mitigation policy development. Given the dearth of qualitative literature exploring this particular topic, interviewing policy-makers directly involved in the EU policy development process presented a logical starting point for gaining insight into perspectives on health co-benefits in the mitigation policy development process. While the participant sample

of 14 is small, the proximity of the interviewees to climate change policy development and their detailed knowledge of EU air pollution and climate change mitigation policies provides a useful basis for this research. To further enhance the validity of findings, the interview data was augmented by triangulated analysis of secondary sources including relevant policy reports and peer reviewed research. Triangulated analysis of interview data and secondary data sources reveals consensus across most of the themes. For example, Commission programmes, as detailed in Commission publications, demonstrate and reaffirm interviewee perspectives that the three pillars of sustainable development are explicit considerations that inform the development of policy options and recommendations. Additionally, while government documents are not as direct as interviewees in acknowledging the overarching role of upfront costs in determining the final policy outcome, statements on affordability and competitiveness are regularly included and addressed in publications through the inclusion of economic benefits. Future research examining the role of health co-benefits in policy development for other governments and at the subnational level has the capacity to supplement and extend the findings of this study. Further, research efforts should be invested in establishing opportunities to alleviate the identified barriers and promote the enablers of health co-benefits in climate change mitigation policies.

The development of this study involved analysis of semi-structured interviews and secondary data sources across six themes, using an analytical framework that considered policy context, content, process and actors. Results indicated that health co-benefits are incorporated into the development of EU climate change mitigation policies and quantified, along with other relevant economic, social and environmental considerations. However, the extent to which they inform the final policy outcome is limited; material costs and energy considerations are more influential in climate change

mitigation policy-making. The separation of responsibility for GHG and non-GHG emissions across DGs decouples climate change and air pollution mitigation policies. As such, health co-benefits remain a primary motivation for the implementation of air pollution mitigation policies but are not considered a major driver of climate change mitigation policies.

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Table 1. Key Commission documents informing case study development

Document title (year of publication)	DG(s) responsible fo policy
Impact Assessment: A roadmap for moving to a competitive low carbon economy in 2050 (2011)	DG CLIMA
Energy Roadmap 2050 (2011)	DG Energy/DG CLIMA
Green Paper: A 2030 framework for climate and energy policies (2013)	DG CLIMA/DG Energy
Impact Assessment: the Clean Air Policy Package (2014)	DG ENV
Impact Assessment: A policy framework for climate and energy in the period from 2020 up to 2030 (2014)	DG CLIMA/DG Energy

Table 2. Summary of barriers and enablers to the consideration of health in the development of EU climate change mitigation policies

Barriers	Enablers
Dominant narrative of economic costs and growth in climate change discourse	Well-established and increasingly ambitious air quality policies based on direct health impacts
Challenges with the attribution of (longer-term) health outcomes	Transparency and accountability mechanisms of the Commission's policy-making process
Limited funding dedicated to climate change and health research	Historic weather events with signficant health implications

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