ADDRESSING NEW ZEALAND'S OIL SECURITY IN 2040: POLICYMAKING IN AN UNCERTAIN WORLD

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Abstract

Oil remains one of the most important resources for the operation of New Zealand's economy and society. Having an accurate perception of the country's oil supply security and the effectiveness of security-improving policies is therefore vital. Noting this importance, the aim of this thesis is to determine whether geopolitical uncertainty over the long-term is appropriately addressed within New Zealand's current oil security assessments and policymaking.

This study examines New Zealand's current oil security assessments through document analysis and utilising a scenario-based approach. It identifies a number of assumptions within New Zealand's current assessments regarding the capacity and capability of the market to respond to significant disruptions caused by geopolitical events, and existing policy viability and effectiveness. It also identifies limitations within these assessments, including that the analyses are limited to short time horizons. The study concludes that New Zealand's current oil security assessments and corresponding policy recommendations do not adequately address geopolitical uncertainty. Furthermore, it identifies a number of related variables that are also not adequately considered. To help address these identified shortcomings, this study presents a schedule of recommendations to improve the efficacy of New Zealand's oil security assessments and policymaking.

List of Acronyms

APEC	Asia-Pacific Economic Cooperation
API	American Petroleum Institute
ASEAN	Association of South East Asian Nations
b/d	Barrel (159 litres) of oil (product) per day
BEC	BusinessNZ Energy Council
CERM	Coordinated Emergency Response Mechanism
DoEE	Department of the Environment and Energy (Australia)
EIA	Energy Information Administration
EMF	Energy Modelling Forum
EP	European Parliament
ETS	Emissions Trading Scheme (N.Z)
EU	European Union
EV	Electric Vehicle
FDI	Foreign Direct Investment
IEA	International Energy Agency
IEF	International Energy Forum
IEP	International Energy Programme
IMF	International Monetary Fund
IMO	International Maritime Organization
IMSC	International Maritime Security Construct
Mb	Million barrels
Mb/d	Million barrels per day
MBIE	Ministry of Business, Innovation & Employment
Mt	Millions of tonnes
Mtoe	Million tonnes of oil equivalent
NOC	National Oil Company
NPS	New Policies Scenario (IEA)
NZDF	New Zealand Defence Force
OAPEC	Organization of Arab Petroleum Exporting Countries
OECD	Organization for Economic Cooperation and Development
OERS	Oil Emergency Response Strategy (N.Z.)
OPEC	Organization of the Petroleum Exporting Countries
RNZ	Refining New Zealand (New Zealand Refining Company)
SLOC	Sea Lines of Communication
TFC	Total Final Consumption
TNOC	Transnational Oil Company
TPES	Total Primary Energy Supply
UAE	United Arab Emirates
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNSC	United Nations Security Council
US	United States of America
WEC	World Energy Council
WTO	World Trade Organization
WWII	World War II

1. Introduction

1.1 Overview

On 14 September 2019, state-owned Saudi Aramco oil processing facilities at Abqaiq and Khurais in eastern Saudi Arabia were targeted in a drone attack. Houthi rebels in Yemen claimed responsibility for the attack, but officials from Saudi Arabia, the United States (US), and other nations asserted that Iran was responsible.[1]

The scale of disruption from the above attack was significant: oil production from the world's leading oil exporter was cut by half, representing approximately 5% of global oil production and the largest production disruption in history.[2] This resulted in the biggest surge in global oil prices since the 1990 invasion of Kuwait with oil futures spiking almost 20%.[3] Nevertheless, global markets quickly calmed as the Saudi oil facilities returned to operation and oil reserves were drawn upon to meet the production shortfall.

Although the Saudi Aramco attack constituted a significant geopolitical event, the shock to oil markets was low compared to some geopolitical events in the past. During the Yom Kippur War, members of the Organisation of Arab Petroleum Exporting Countries (OAPEC) placed an oil embargo on nations perceived to have supported Israel, reducing petroleum supply to the market – dramatically so for embargoed states. The ensuing 1973 oil crisis saw numerous oil-importing countries - including New Zealand - experience significant economic and social disruption from fuel shortages and subsequent fuel rationing efforts, as well as from oil prices increasing more than four-fold.[4]

Both events, while different in scale and consequence, demonstrate the impact that geopolitical events can have on the global oil market. Yet despite providing stark evidence to nations of their shared interest in maintaining secure oil supplies, it is equally clear the market has not acquired immunity from future geopolitical disruptions. Following the 2019 Saudi Aramco

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[1] Edith Lederer and Jill Lawless, "UK, France Germany Blame Iran for Saudi Oil Attacks," *AP News*, 24 September 2019, https://apnews.com/ee973164333e44f4b94ea590590f4ed2?

[2] 5.7mb/d of oil processing capacity was temporarily lost: IEA, *World Energy Outlook 2019* (Paris: IEA, 2019), 167, https://www.iea.org/reports/world-energy-outlook-2019.

[3] IEA, *Oil Market Report - October 2019* (IEA, 2019), https://www.iea.org/reports/oil-market-report-october-2019.

[4] Ministry for Culture and Heritage, "1973 - Key Events," updated 9 May, 2018, https://nzhistory.govt.nz/culture/the-1970s/1973; C. John McDermott and Rishab Sethi, "Balance of Payments - a Brief History," Te Ara - The Encyclopedia of New Zealand, accessed 4 April, 2020, http://www.TeAra.govt.nz/en/photograph/23966/locking-the-pumps.

attack and contemporaneous attacks on oil tankers in the Persian Gulf, the International Energy Agency (IEA) warned market participants not to shrug off the attacks as being of little consequence, stating that further incidents in the Gulf region could occur and cause even greater disruption.[5] However, it is not just the Gulf region that presents geopolitical risk to oil security in the future.

There is growing evidence to suggest that the world is moving from a period of relative geopolitical stability towards a new phase of geopolitical uncertainty, and that this change could bring with it new risks.[6] Arguably one of the more compelling signs of this shift is the decline in the influence of the US in international affairs relative to other large economies like China and India, making global governance more complex.[7] As the scale and complexity of international challenges increase, global institutions are finding it increasingly difficult to respond to them.[8] With these multilateral rules-based approaches seen to be fraying, many countries regard re-establishment of the nation state as the primary locus of power and legitimacy an increasingly appealing strategy.[9] As a consequence of this growing prevalence in anti-globalist thinking, once widely accepted international norms and traditional security approaches are also being challenged. As Chipman observes: "As norms and institutions weaken, statecraft is back. Countries that relied on institutional arrangements, or on external security guarantees, are discovering that they need to revive their national strategic skills."[10]

Based upon the historical record, it seems likely the above geopolitical uncertainties have implications for the future oil security of nations. Therefore, the implications of supply disruptions will continue to shape national energy policy. Oil does not dominate the global energy mix to the extent that it did at the time of the 1973 crisis, and economic growth does not drive oil consumption to the extent that it has in the past. Nevertheless, at almost one third

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[5] IEA, *Oil Market Report - October 2019*.
[6] World Economic Forum, *The Global Risks Report 2018* (Geneva: World Economic Forum, 2018), 7, http://www3.weforum.org/docs/WEF_GRR18_Report.pdf.
[7] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report* (Department of the Environment and Energy, 2019), 42, https://www.environment.gov.au/system/files/consultations/7cf6f8e2-fef0-479e-b2dd-3c1d87efb637/files/liquid-fuel-security-review-interim-report.pdf.
[8] Ibid.
[9] World Economic Forum, *The Global Risks Report 2018*, 7.
[10] John Chipman, "A New Geopolitical Challenge to the Rules-Based Order," (International Institute for Strategic Studies, 16 November 2018). https://www.iiss.org/blogs/analysis/2018/11/challenge-rules-based-order.

of the global energy mix oil continues to be the largest single source of energy.[11] As such, oil remains an essential and integral source in the energy systems of virtually all nations. Furthermore, many sectors of modern economies are significantly or totally dependent upon reliable access to oil-based fuels, as are the world's militaries.[12] Consequently, disruptions that result in oil price spikes or physical shortfalls in supply can have significant implications for a nation's economy and national security. For states that rely on oil imports to meet domestic demand, oil market disruptions can be perceived as an even greater risk, given the reliance on supply chain elements beyond their borders.[13] Therefore, security of oil supply is invariably a key objective of importing countries' energy policymaking, typically manifesting as a raft of policies designed to reduce the risk of an oil supply disruption occurring - or at least mitigating the impacts should one occur.

The above realities apply equally to New Zealand. The New Zealand Government considers secure and affordable access to oil as being critical to the nation's economic performance and social wellbeing,[14] and closely linked to overall national security.[15] The criticality of oil security is further amplified by oil being the only non-renewable energy source of which New Zealand is a net importer. Therefore, as a geographically isolated and export-dependent country almost entirely reliant upon imports to meet its current domestic oil demand, a primary security concern for New Zealand is its status as a net consumer within the international oil market. New Zealand's current oil security policies reflect this reality and have remained largely unchanged over the past 40 years.[16] During this time, the country has not experienced any significant disruptions to its oil supply due to geopolitical events - or due to any other cause.

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[11] Oil as share of the global energy mix has declined from 44% in 1971 to 32% in 2017. Oil consumption per unit of economic output has decreased by a third since 2000. IEA, *World Energy Balances 2019* (IEA, 2019), ix-x, https://www.iea.org/reports/world-energy-balances-2019; Tim Gould and Tae-Yoon Kim, "The World Can't Afford to Relax About Oil Security," (IEA, 19 September 2019). https://www.iea.org/commentaries/the-world-cant-afford-to-relax-about-oil-security.

[12] J.G. Van der Linde et al., *Study on Energy Supply Security and Geopolitics* (The Hague: Clingendael Institute for International Relations, 2004), 31, https://www.clingendaelenergy.com/inc/upload/files/Study_on_energy_supply_security_and_geopolitics.pdf. International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities* (U.S. Department of State, 2014), 8-9, https://2009-2017.state.gov/documents/organization/229409.pdf.

[13] This includes petroleum production, refining and international transportation.

[14] Ministry of Economic Development, *New Zealand Energy Strategy 2011-2021* (MED, 2011), 12, https://www.mbie.govt.nz/dmsdocument/142-nz-energy-strategy-lr-pdf.

[15] MBIE, *Review of New Zealand's Oil Security* (MBIE, 2012), 15, https://www.mbie.govt.nz/dmsdocument/2829-review-of-nz-oil-security-discussion-paper-pdf.

[16] Barry Barton, "Reaching the Limits of What the Market Will Provide: Energy Security in New Zealand," in *Energy Security: Managing Risk in a Dynamic Legal and Regulatory Environment*, ed. Barry Barton et al. (New York: Oxford University Press, 2004), 374.

Government actions to date suggest that this past success is considered a strong predictor of future success, and continuation of the current oil security policies is therefore deemed appropriate.

Nevertheless, in light of the recent geopolitical events and larger geopolitical trends described earlier, significant questions emerge as to the efficacy of New Zealand's current domestic and foreign policy approach to maintaining external security of oil supply in an increasingly dynamic global environment. This study therefore proceeds from the premise that robust policymaking demands careful examination of the continued effectiveness of these policies in relation to the geopolitical context of the coming decades. Understanding how the future may unfold enables policymakers to respond appropriately, particularly given the timeframes associated with some policy responses.

1.2 Purpose of Study

There are several approaches used in the literature and by governments to determine energy security and inform policy. Medium-term quantitative model-based energy scenarios are almost universally used to play out possible futures, options, and policy effects, and invariably focus on technical and energy-economic dimensions such as changes in demand and supply, greenhouse gas emissions, and supply costs.[17] While these scenarios are often beneficial for comparative purposes, they are prone to oversimplifying the determinants of oil security. As Weimer-Jehle et al. observe: "Determinants of the energy future located outside the immediate energy system, such as demographic and economic developments, innovation dynamics, changes in public attitudes, social values and consumer behaviour are, despite their deep uncertainty in the long term, mostly treated as fixed framework assumptions."[18] This observation on the persistent exclusion of social parameters in establishing the context-uncertainty of energy security scenarios equally applies to changes in the geopolitical environment. This brings into question the extent to which these conventional models can adequately inform sound oil security policymaking.

Existing oil security reports that guide the New Zealand Government's policymaking on oil security exemplify these limitations. Security assessments are limited to short time-horizons

[17] Wolfgang Weimer-Jehle et al., "Context Scenarios and Their Usage for the Construction of Socio-Technical Energy Scenarios," *Energy* 111 (2016): 956.
[18] Ibid.

and do not assess or account for the potential impact of a changing geopolitical environment on risk, market operation or the performance of existing security policies. Perhaps more surprising is that there has been very little in-depth research examining the exposure and vulnerability of each element of New Zealand's oil supply chain beyond its borders. In contrast, the Australian Government has highlighted geopolitical uncertainty as part of its justification for an ongoing review of its oil supply chain and the appropriateness of its policy settings,[19] given Australia's dependence on specific regions for fuel supplies and potential exposure to disruptions.[20]

Recognising the limitations described above, the purpose of this thesis is therefore *to determine whether geopolitical uncertainty over the long-term is appropriately addressed within New Zealand's current oil security assessments and policymaking*. This purpose constitutes a new perspective with respect to New Zealand's current oil security policymaking and policies, in that it adopts a long time-horizon in which it is accepted that significant geopolitical changes are possible. The findings of this study are intended to inform New Zealand's oil security assessment approach through identification of issues and appropriate responses. This in turn will assist policymakers to make more nuanced assessments of future geopolitical risk, thereby strengthening the energy policymaking process. While this thesis is primarily oriented toward the domain of policy, it also seeks to advance the broader academic literature within the energy and oil security field, utilising an existing framework and findings from within the literature and applying them to the New Zealand case.[21]

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[19] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 58.
[20] Ibid., 42.
[21] This field of research is well established. See for instance: Van der Linde et al., *Study on Energy Supply Security and Geopolitics*; Vlado Vivoda, "Diversification of Oil Import Sources and Energy Security: A Key Strategy or an Elusive Objective?," *Energy Policy* 37, no. 11 (2009); M Mohsin et al., "Assessing Oil Supply Security of South Asia," *Energy* 155 (2018); Bert Kruyt et al., "Indicators for Energy Security," in *The Routledge Handbook of Energy Security*, ed. Benjamin Sovacool (London: Routledge, 2011); Llewelyn Hughes and Austin Long, "Is There an Oil Weapon?: Security Implications of Changes in the Structure of the International Oil Market," *International Security* 39, no. 3 (2015).

1.3 Focus & Constraints of Study

Energy systems are often described as having three core goals, or 'pillars': *affordability*, *reliability* and *sustainability*.[22] Each of these pillars are central to robust energy policymaking. Moreover, these pillars are closely interlinked and policymaking may require trade-offs between them; improving one pillar often involves reducing performance in another. For example, implementing some energy reliability policies may negatively impact energy affordability, while energy affordability policies may run counter to sustainability goals such as reducing New Zealand's greenhouse gas emissions. Policymakers must therefore strike a careful balance between these system goals. The domain of this study is limited to the pillar of reliability. Due to this singular focus, the findings should therefore be considered in the context of New Zealand's broader energy-related goals.

In this study, energy reliability encompasses security of oil supply and mitigation of risk. While a number of variables can affect oil supply security, this study focuses solely on risks to New Zealand's *external* supply security arising from geopolitical events. Furthermore, the focus is not on quantifying or predicting those risks, but rather on exploring how some of the underlying assumptions in current oil security assessments and policymaking might be challenged by future geopolitical developments. Given the uncertainty and unpredictability of those developments, this study does not set out to prescribe a definitive policy mix for ensuring reliability of oil supply into the future.

The findings and associated research of this study were concluded in early 2020. Since then, the world has been and continues to be impacted by the COVID-19 pandemic. While the long-term impacts of this event are still unclear, the pandemic and its associated effects could have a significant and long-lasting impact on the trajectory of global politics and the development path of global energy systems. As such, the relevance of this study's conclusions may potentially be impacted.

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[22] For more information, see: BusinessNZ Energy Council, *New Zealand Energy Scenarios: Navigating Energy Futures to 2050* (BusinessNZ Energy Council, 2015), 11, https://www.bec.org.nz/__data/assets/pdf_file/0014/110309/BEC-Report.pdf; Erik Gawel et al., *Political Economy of Safe-Guarding Security of Supply with High Shares of Renewables: Review of Existing Research and Lessons from Germany* (Energiforsk, 2017), 14-15, https://energiforskmedia.blob.core.windows.net/media/23204/political-economy-of-safe-guarding-security-of-supply-with-high-shares-of-renewables-energiforskrapport-2017-441.pdf.

1.4 Research Question

Consistent with the purpose and focus outlined above, this study seeks to answer the following broad question:

> *How might changes in the geopolitical environment affect the efficacy of New Zealand's current oil security assessments and policies out to 2040?*

1.5 Definitions

Throughout this study, a number of technical terms are frequently used, sometimes interchangeably. For the sake of clarity, key terms are defined below.

Petroleum [technical term for *oil* or *crude oil*]: a naturally occurring liquid hydrocarbon found beneath the earth's surface. Petroleum and oil are used interchangeably throughout this report.

Petroleum industry [also *oil industry*]: the global exploration, production, transportation, storage, refining and distribution of crude oil and oil products.

Oil products: a diverse range of distinct products refined from petroleum; includes petrol, diesel, plastics, asphalt and fertiliser.

Oil security [also *security of oil supply*]: "…the uninterrupted availability of [oil] at an affordable price."[23] In the context of this study, possessing *oil security* refers to nations that are not at risk of experiencing physical supply constraints or significant and damaging price movements.

Oil crisis: situation where in the short term there is *either*:

i. disruption of oil supplies and/or sudden price increases that have significant economic effects on consumer countries; *or*

ii. supplies are suddenly greatly expanded resulting in a drastic price decline that has significant economic effects on producer countries.

Prolonged price collapse can put the continuity of national energy systems at stake, both those of consumer nations dependent upon companies supplying the market, and

[23] IEA, "Energy Security," accessed 6 June, 2018, http://www.iea.org/topics/energysecurity/.

producer nations that see export and government revenues fall below sustainable levels.[24]

Risk [to oil security]: likelihood of adverse events affecting continuity of oil supply. Risk results from the interaction of *exposure* and *vulnerability* to such events.

Geopolitical risk [to oil security]: a change or deterioration in the international political or economic order, or part of that system, that threatens availability and affordability of oil supply.[25]

Dependence: reliance on external sources for oil supply.

Exposure: Being exposed to events that have the potential to affect continuity of oil supply.

Vulnerability: propensity or predisposition to be adversely affected by disruption to oil supply; includes concepts of susceptibility to disruption and capacity to cope and adapt.

Volatility: significant instability in oil prices for suppliers as well as consumers. Volatility confuses or inhibits investment.[26]

1.6 Outline of Chapters

Chapter 2: Methodology & Method

This chapter presents the theoretical and conceptual frameworks of this study. It describes the qualitative methods used and introduces the narratives about alternative futures that are adopted in this study. Finally, a policy instrument-based analytical framework to guide secondary data analysis is presented.

PART I: PRESENT

The first part of this study focuses on the geopolitics of oil security in the present day, both at a global scale and in the specific case of New Zealand.

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[24] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 36.
[25] Ibid., 84.
[26] Robert Mabro, "Does Oil Price Volatility Matter?," (Oxford Institute for Energy Studies). https://www.oxfordenergy.org/publications/does-oil-price-volatility-matter/?v=8e3eb2c69a18

Chapter 3: Geopolitics and Global Oil Security

The geopolitics of global oil supply is explained in this chapter. The oil supply chain is described sector by sector, and the nature of global oil markets analysed. The chapter then discusses the inherent exposure and vulnerabilities of nations to geopolitical supply disruption in the supply chain and markets.

Chapter 4: New Zealand's Oil Security

This chapter describes New Zealand's present-day dependency upon oil. It follows with an in-depth examination of the country's reliance upon oil exporting nations and vulnerabilities in the upstream, midstream and downstream segments of its oil supply chain. The risks associated with these factors are shown to be fundamental to the level of reliability of New Zealand's oil supply system. The implications for government policy are also introduced.

Chapter 5: Security of Oil Supply Policy

This chapter revisits the policy instrument component of this study's analytical framework. Core instruments are described in relation to security of oil supply objectives, with particular emphasis on those most relevant to New Zealand. Finally, the chapter discusses the potential geopolitical consequences of nations adopting either a market-based or strategic approach to their oil security objectives.

Chapter 6: New Zealand's Current Security of Oil Supply Policy

This chapter examines New Zealand's primary reliance upon a particular policy instrument to maintain its oil security. The current government approach to assessing oil supply security and the links to its adopted policy mix are described. The chapter then discusses the underlying core assumptions of these assessments in detail and argues the implications for the efficacy of present-day oil security policymaking.

PART II: FUTURE

The second part of this study focuses on the significance of the geopolitical environment in oil security out to 2040 and the implications for New Zealand.

Chapter 7: Oil Demand and Supply Forecasts

This chapter explores global energy forecasts from leading international and domestic organisations out to mid-century. It identifies likely changes in oil supply and demand at

international and New Zealand scales. The chapter concludes with a discussion of the oil security implications of global energy system mega-trends.

Chapter 8: Geopolitical Storylines and Policy Options

The study's full analytical framework is applied. The chapter examines a contrasting pair of possible future geopolitical environments, and how these might influence security of oil supply. The chapter then discusses the efficacy of a range of policy instruments in relation to these futures, along with the implications for oil security assessments and policymaking.

Chapter 9: Discussion

This chapter integrates the findings of the previous chapters. The complexity of oil security is integrated with geopolitical uncertainty to reveal the strengths and weaknesses of New Zealand's current approach to oil security assessments and policymaking. Potential enhancements and improvements for future oil security resilience are discussed.

Chapter 10: Conclusion

The final chapter revisits the research question, reflecting upon the research undertaken and the study's findings. It then presents a schedule of recommendations for improving security of oil supply assessments and policymaking. Limitations of the study and opportunities for further research are discussed. The chapter concludes with some final thoughts.

2 Methodology & Method

2.1 Introduction

The purpose of this study is to determine whether geopolitical uncertainty is appropriately addressed within New Zealand's current oil security assessments and policymaking. This necessarily involves analysis of the assessments and policies themselves in relation to a range of possible geopolitical contexts over the next two decades. Maintaining rigour in that analysis requires the researcher to inhabit those future contexts in a logically consistent and systematic manner. Achieving this requires that any future study be underpinned by relevant theoretical and conceptual frameworks. These frameworks in turn require the application of appropriate research methods and tools. The methodology and method that inform the assessment central to this study is introduced next.

2.2 Methodology

2.2.1 Theoretical & Conceptual Frameworks

Addressing the research question requires an understanding of the future - or futures. Inayatullah maintains this understanding must be built on cogent theoretical and conceptual frameworks. He identifies four theoretical approaches as being crucial to studying the future. This study adopts the qualitative 'interpretive' approach, which is based upon understanding competing *images* of the future, not *forecasts* of the future.[27]

Progressing from this theoretical framework, Inayatullah presents the 'Six Pillar' conceptual framework for understanding the future. The fifth pillar, 'Creating alternatives', along with its most important method, scenarios, is consistent with the purpose of this study.[28]

2.3 Methods

To answer the research question, this study integrates two methods: scenarios and document analysis.

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[27] Sohail Inayatullah, "Futures Studies: Theories and Methods," in *There's a Future: Visions for a Better World*, ed. Nayef Al-Fodhan (BBVA, 2013), 38. The other three approaches are predictive, critical, and participatory.
[28] Ibid.

2.3.1 Scenarios

Scenarios are the most commonly used descriptive method for creating a picture of how events may unfold in the future. Different types of scenarios are used for different purposes, and it is therefore important to identify the most suitable type for framing the analysis in this study.

Börjeson et al introduce a typology comprising six types of scenario distributed evenly across three categories. The categories are based on three principal questions that may be posed about the future:

i. *Predictive scenarios* answer the question 'What will happen?'

ii. *Explorative scenarios* answer the question 'What can happen?'

iii. *Normative scenarios* answer the question 'How can a specific target be reached'?[29]

This study explores New Zealand's oil security in the context of 'what can happen' to the geopolitical environment. Explorative scenarios should therefore be used to examine possible geopolitical futures.

Explorative scenarios typically adopt different perspectives to explore future situations or developments considered to be possible. Explorative scenarios play out over long time-horizons "…to explicitly allow for structural, and hence more profound, changes"[30], and are well-suited to situations where the functioning of a system is well understood, but the consequences of alternative developments may not be.

Explorative scenarios are of two types:

i. *External scenarios* answer the question 'What can happen to the development of external factors?'

ii. *Strategic scenarios* answer the question 'What can happen if we behave in a certain way'?[31]

Typically qualitative in approach, external scenarios are consistent with the purpose of this study in that they focus solely on factors beyond the control of the affected entity; in this case, New Zealand. Of particular relevance to this study, explorative external scenarios do not

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[29] Lena Börjeson et al., "Scenario Types and Techniques: Towards a User's Guide," *Futures* 38, no. 7 (2006): 726.
[30] Ibid., 727.
[31] Ibid.

incorporate policies, but instead provide a framework for developing and assessing policies and strategies.[32] Therefore, qualitative external scenarios were deemed the most suitable scenario type for this study.

Several methods are used for developing qualitative external scenarios, with storylines - or scenario storylines - the most commonly used.[33] Storylines are qualitative narratives that describe how events may unfold in the future, and the consequences of those events. They are frequently used to explore global scale change in fields such as climate change,[34] biodiversity loss,[35] and energy markets.[36] While storylines do not incorporate quantitative variables, they provide a descriptive framework upon which quantitative explorative scenarios can be subsequently developed. This study uses scenario storylines.

Developing scenario storylines typically involves a facilitated process that brings subject matter experts and multiple stakeholders together to engage in an iterative elicitation of different futures.[37] Conducting such a process was beyond the constraints of this study, necessitating the use of pre-existing storylines to imagine contrasting geopolitical futures. Consequently, this study adopts and adapts storylines developed by Van der Linde et al. in *Study of Energy Supply Security and Geopolitics*,[38] a notable and frequently cited report within the energy security literature.

2.3.2 Document Analysis

This study constitutes secondary research. It involves the collation and synthesis of a diverse and large number of qualitative and quantitative source documents. Documents are logically and systematically analysed using the analytical framework described in this chapter to produce a descriptive narrative about the nexus of oil security and the geopolitical environment in relation to New Zealand.

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[32] Ibid.
[33] Ibid.
[34] Nebojša Nakićenović et al., *IPCC Special Report on Emissions Scenarios (SRES)*, Working Group III, Intergovernmental Panel on Climate Change (Cambridge: Cambridge University Press, 2000).
[35] The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, "Storylines or Scenario Storylines," accessed 25 April, 2020, https://ipbes.net/glossary/storylines-or-scenario-storylines.
[36] Van der Linde et al., "Study on Energy Supply Security and Geopolitics,"
[37] Mark D. A. Rounsevell and Marc J. Metzger, "Developing Qualitative Scenario Storylines for Environmental Change Assessment: Developing Qualitative Scenario Storylines," *Wiley Interdisciplinary Reviews: Climate Change* 1, no. 4 (2010).
[38] Van der Linde et al., "Study on Energy Supply Security and Geopolitics,"

This study analyses various oil security assessments, along with additional relevant supporting and explanatory texts such as government policy briefs and white papers, commercial forecasts and strategies, and academic papers and presentations.

2.4 Analytical Framework

An analytical framework is adopted to inform the secondary research. The framework comprises two core components: storylines and policy instruments.

2.4.1 The Storylines

Van der Linde et al.'s *Study* uses two storylines, each describing alternative geopolitical futures, to assess the effectiveness of European Union (EU) security of supply policies in relation to other countries and regions.[39] The storylines were developed in 2004, looking forward to 2020. While many of Van der Linde et al.'s specific findings are not relevant to this study given their focus and date of publication, the report's storyline logic nevertheless underpins a valuable and largely unchanged explanation of general state behaviour within different geopolitical contexts.

Scenario storylines describe the qualitative assumptions about the underlying causes - or drivers - of change. The assumptions and relationships between different drivers in a storyline are organised and described in a 'logic.' The storyline logic brings order and internal consistency to a diversity of issues and variables, thereby enabling structured comparisons between different narratives.[40]

The storylines' logic in Van der Linde et al.'s study is based upon the following qualitative assumptions about the drivers of change in oil security: increased global oil and gas consumption; greater importing of the resources; and concentration of supplies in a few countries.[41] The relationships between these drivers differ across the two storylines in two important geopolitical dimensions: the extent to which markets or states are the dominant

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[39] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*. A condensed and slightly updated version of this report was published as a journal article by Aad Correlje and Coby Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," *Energy policy* 34, no. 5 (2006). Both of these papers shall be drawn from to form the scenarios used here.
[40] Rounsevell and Metzger, "Developing Qualitative Scenario Storylines for Environmental Change Assessment: Developing Qualitative Scenario Storylines," 609.
[41] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 82.

coordinating device for industry and state behaviour in relation to supply and demand in the oil sector; and the scale of the geographical areas these coordinating devices encompass.[42]

Since the 2004 release of the *Study of Energy Supply Security and Geopolitics* and the arrival of its 2020 time-horizon, significant geopolitical events have occurred, including notable changes in the main oil producer and consumer countries. Yet despite these events, the logic of the scenario storylines as originally developed is deemed still viable today for imagining how the major geopolitical actors will act in the face of a potentially more concentrated market for oil out to 2040.[43]

The two storylines are predicated upon the accepted relationship between the political and socio-economic order, and in part reflect contrasting ideas posited within international relations theory.[44] The first storyline, *Markets and Institutions*, sees an intensification of globalisation and cooperation within international political and economic institutions. The second storyline, *Regions and Empires*, sees the world divided into integrated political and economic blocs with satellite regions, competing for markets and resources. In other words, the storylines can be represented as occupying either end of a theoretical continuum[45] in order to explore the spectrum of possible impacts from broader geopolitical changes. The storylines are revisited in more detail in Chapter 8.

It is worth noting that these storylines have parallels in present-day reports from two global energy institutions. The scenario used by the IEA in its market forecasts closely resembles the Markets and Institutions storyline. In contrast, the World Energy Council's (WEC) newly developed 'Hard Rock' scenario is more aligned with the reality portrayed in the Regions and Empires storyline. Arguably more reflective of current circumstances, the WEC scenario is used herein to revise the Regions and Empires storyline to a minor extent.

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[42] Ibid., 85. Van der Linde et al. note that "…a mixed system in which a government coordinates its (security) interests with private companies is also possible. However, this will be a local variation within a wider, global, context in which either 'the market' or the 'state' is the dominant coordinating devices of the economy."
[43] Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 536; Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 82-86. As noted in this research, the international economic and political system is influenced by national, inter and intra governmental and non-governmental organisations and institutions. However, this study primarily focuses on the role of states.
[44] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 84. The authors note that *Markets and Institutions* to some extent reflects the regime building concepts of Joseph Nye, while *Regions and Empires* partly reflects the neo-realist concepts of state-security centred competition for power. See: Joseph S. Nye, Jr., *Bound to Lead: The Changing Nature of American Power* (New York: Basic Books, 1990); Kenneth N. Waltz, *Theory of International Politics* (Princeton: Princeton University Press, 1979).
[45] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 84.

2.4.2 The Policy Instruments

A key purpose of the storylines is to enable an assessment of the effectiveness of different oil security policy instruments under widely divergent geopolitical contexts. Van der Linde et al. identify 21 different instruments available to state actors. They then categorise these policy instruments according to four security of oil supply objectives to provide a policy assessment framework. The categories are:

i. *Prevention* - creating a political environment where there are fewer grounds for oil supply disruptions;

ii. *Deterrence* - preventing or deterring producer states from disrupting oil supplies for political reasons;

iii. *Containment* - reducing the impact of an oil supply disruption on national security and the economy;

iv. *Crisis Management* - mitigating harm during an oil supply disruption.

Specific policy instruments may help to achieve several oil security objectives.[46] A more detailed description and discussion of the predominant policy instruments is provided in Chapter 5.

2.4.3 The Analytical Framework

Following Van der Linde et al., this study integrates the core components of storylines and policy instruments to present a comprehensive and internally consistent analytical framework.

[46] Ibid., 64.

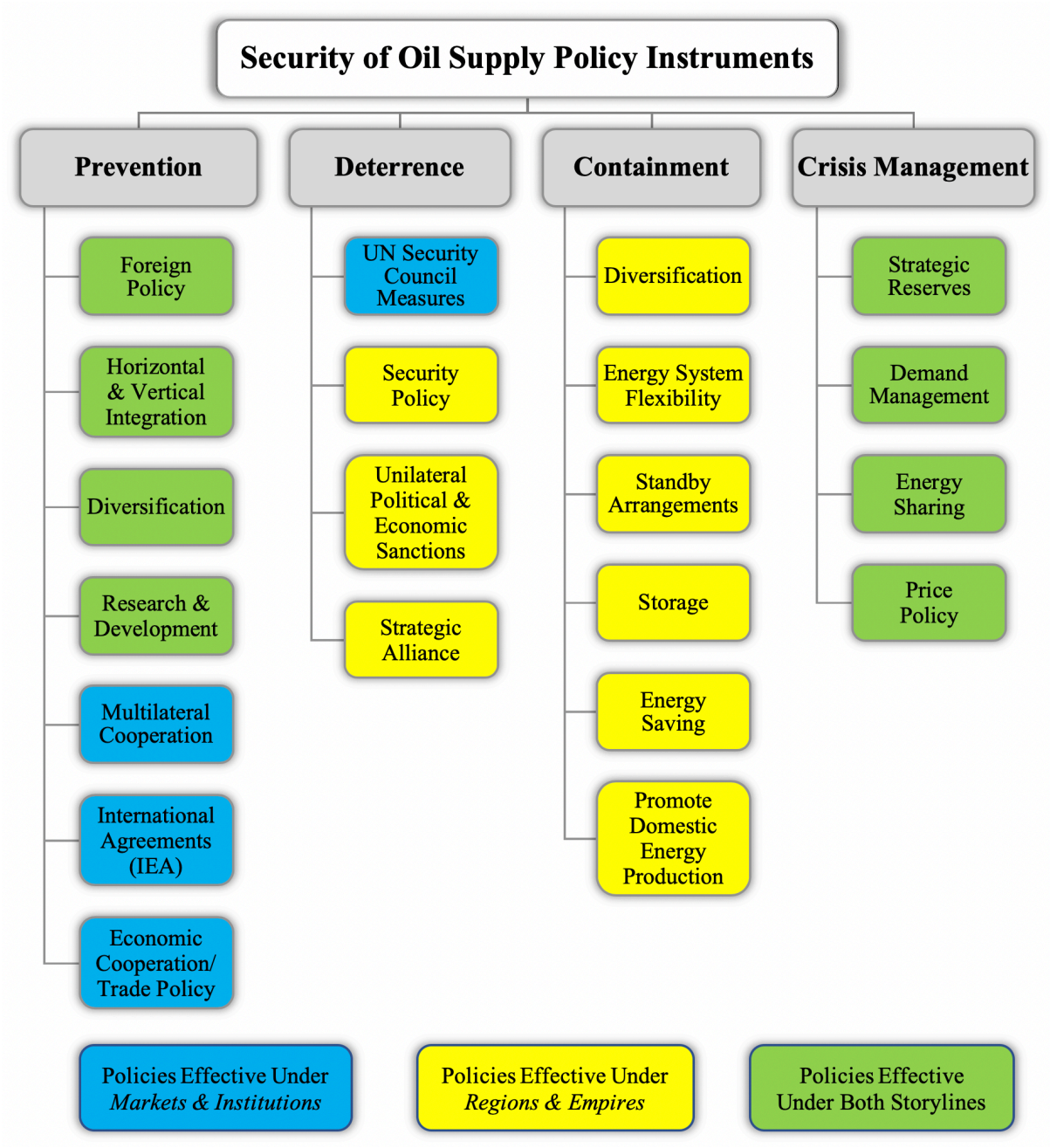

Figure 1: Analytical Framework.[47]

Figure 1 shows a graphic representation of the final analytical framework used in this study. The framework illustrates the distribution of oil security policy instruments across the four oil security objectives, as well as indicating their effectiveness under each of the two storylines.

[47] Adapted from Van der Linde et al., p.115.

2.5 Summary

The methodology for a 'future study' requires consistent and cogent theoretical and conceptual foundations. Understanding competing images of the future is central to this study, and scenarios are identified and adopted as the theoretically consistent method for generating these futures. From a typology of scenarios, this research selects explorative external scenarios in the form of storylines as the specific qualitative approach most consistent with answering the research question. Two storylines with a shared organising logic provide the contrasting future geopolitical contexts necessary for this research to be undertaken. These storylines are combined with four oil security objectives to create an analytical framework. This framework constitutes the analytical tool used in this study to undertake a rigorous assessment of secondary data sources. It will be used to produce a qualitative narrative on the efficacy of New Zealand's oil security assessment and policymaking for the next 20 years.

3 Geopolitics and Global Oil Security

3.1 Introduction

The geopolitics of oil stems from the supply-demand balance between countries active in the petroleum sector. This balance not only influences energy security and the military strength of world powers, but also exporter-importer power relations.[48] This power is rooted in the reliance of net oil importing countries upon oil exporting countries for uninterrupted supply of oil at an affordable price, and the consequent vulnerability to economic and social harm from disruptions to that supply.[49] For net oil importing countries, it is these two inter-linked concepts of oil exposure and vulnerability to oil supply disruptions that form the basis for oil security concerns.[50] The geopolitics of global oil supply is addressed below.

Petroleum is the most traded commodity by value in the world, and the largest single source of energy at 32% of global total primary energy supply (TPES).[51] The size of the crude oil market is substantial; global oil demand averaged 97 million barrels per day (mb/d) in 2018,[52] a volume equivalent to 15.4 billion litres per day. As with other commodities, a mature and expansive petroleum industry meets this demand, with oil production occurring across the globe, and petroleum exploration and production companies alone numbering in the hundreds. However, from a geopolitical perspective the global supply of oil has a unique combination of constraints that differentiate it from other commodities.

Firstly, oil demand is inelastic in the short term; it is difficult for consumers to reduce demand, making a country's consumption largely unresponsive to changes in price. Secondly, oil is extracted from underground, and if available production or supply is insufficient to meet demand, production capacity cannot immediately be increased to meet the shortfall; production only becomes flexible in the long term. Finally, unlike many other strategic resources, production inflexibility cannot be completely resolved through stockpiling of extracted crude

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[48] Indra Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," in *Handbook of Clean Energy Systems*, ed. J. Yan (Wiley, 2015), 1.
[49] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 86.
[50] Bassam Fattouh, *How Secure Are Middle East Oil Supplies?* (Oxford Institute for Energy Studies, 2007), 7, https://ora.ox.ac.uk/objects/uuid:d8bd3302-c023-49aa-bcf8-3d6b94a183c4/.
[51] 2017 TPES Figures.IEA, *World Energy Balances Overview 2019* (IEA, 2019), 5, https://iea.blob.core.windows.net/assets/8bd626f1-a403-4b14-964f-f8d0f61e0677/World_Energy_Balances_2019_Overview.pdf.
[52] IEA, *World Energy Outlook 2019*, 129. Oil volumes are typically measured in barrels. A barrel converts to approximately 159 litres.

oil. The ability to stockpile oil is limited by a number of factors, including the high cost of storage infrastructure and the sheer quantity of oil countries would have to stockpile to cover demand over the long-term.[53]

The above constraints do not necessarily pose concerns for states in and of themselves if each were capable of meeting their own demand through domestic production. However, unlike manufactured goods, geology determines where oil is produced. Furthermore, that geology is not uniformly distributed around the world, with oil production and reserves concentrated within certain countries and regions. As a result, some countries, notably in the Middle East, are able to produce oil relatively cheaply and at levels surplus to requirements. Conversely, some of the largest consuming countries do not have sufficient quantities of economically recoverable oil reserves to meet their domestic demand, and therefore must rely on oil imports from these surplus producers.[54] Consequently, if a major supply source were to be disrupted the effects would be felt widely. As Gholz and Press illustrate, "…the immediate effect of a major supply disruption in the [Persian] Gulf would leave one or more consumers wondering where their next expected oil delivery will come from."[55]

Given the above realities, much of the discussion surrounding oil and geopolitical risk to oil security centres on oil production. However, production is only one sector of the first link of the oil supply chain, and each link and the sectors within must function for supply to reach consumers.

3.2 Geopolitics and the Oil Supply Chain

The physical oil supply chain encompasses all the activities of the petroleum industry. It is commonly described as comprising three broad but distinct inter-connected market links or

Figure 2: Oil Supply Chain

[53] Anand Toprani, "A Primer on the Geopolitics of Oil," *War on the Rocks*, 17 January 2019, https://warontherocks.com/2019/01/a-primer-on-the-geopolitics-of-oil/.
[54] Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 1.
[55] Eugene Gholz and Daryl G. Press, "Protecting 'the Prize': Oil and the U.S. National Interest," *Security Studies* 19, no. 3 (2010): 457.

segments: *upstream*, *midstream* and *downstream*. Each segment in turn comprises two core industry sectors as shown in Figure 2. At the beginning of the supply chain is the upstream link, covering core sectors of oil exploration and its subsequent production from underground via drilling and extraction. This is followed by the midstream segment, which includes the international transportation and storage of crude oil. Finally, the downstream link includes the refining sector, where crude oil is transformed through various processes into usable products for distribution to the final consumer.[56]

Each of these links is vital for the oil supply chain to function, and each sector has its own substantial and established global market, such that the oil industry overall comprises multiple markets for related goods and services. Each of these sectors across all links have proven to be vulnerable to disruption by geopolitical events to a greater or lesser degree. These geopolitical disruptions to the oil supply chain are examined here, link by link.

3.2.1 Upstream Geopolitical Disruption

The potential geopolitical causes of oil supply disruption discussed within the literature frequently focus on the production sector of the upstream supply chain segment. This focus is not only because of oil importers' reliance on certain countries and regions for supply, but also because of the level of state control and interference within the upstream sector. This interference is possible because the vast majority of global oil reserves are controlled by nation states and their national oil companies (NOCs), rather than by the private sector. A 2010 World Bank report estimated that 90% of proven[57] oil reserves are controlled by NOCs.[58] Some of these NOCs are for the most part autonomous and operate like private companies, but many of the largest have strong political and strategic links to their governments. Consequently, they are often subject to significant government interference and do not necessarily pursue market-oriented goals.[59]

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[56] The oil supply chain can be further separated into smaller constituent sectors. For the purposes of simplicity and relevance to this research, discussion is organised herein around the major supply sectors and supply chain links. Due to the limitations of this research, risk to domestic distribution is not examined here.
[57] Proven oil reserves are generally considered to be quantities that information indicated with reasonable certainty exists and can be extracted from known reservoirs under existing operating and economic conditions: BP, *BP Statistical Review of World Energy 2019* (BP, 2019), 14, https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf.
[58] Silvana Tordo, *National Oil Companies and Value Creation* (Washington, DC: The World Bank, 2011), xi. http://siteresources.worldbank.org/INTOGMC/Resources/9780821388310.pdf.
[59] Ibid.

Furthermore, the global oil market is dominated by the world's largest oil producing and exporting nations. Few in number, these nations wield disproportionate influence over supply, with many coordinating their influence through membership of an international cartel - the Organisation of the Petroleum Exporting Countries (OPEC).[60] Each of the 13 OPEC member nations[61] has at least one NOC,[62] with OPEC countries collectively accounting for 42% of global crude oil production and 72% of global oil reserves in 2018.[63] The six Middle East member countries alone account for three quarters of OPEC production and two thirds of its reserves.[64] While OPEC members do not dominate the market to the extent that they have in the past, collectively member states nevertheless still hold significant market power over supply and prices. OPEC's objective has been to manage members' production to maintain oil prices at desired levels through production quotas or by utilising its spare capacity.[65] The cartel also acts collectively to coordinate and unify policies that determine the pricing of oil, as well as coordinating with notable non-OPEC oil exporters to ensure steady revenues and effectiveness of policy choices.[66]

The sizeable role of NOCs and OPEC within the global oil market show that, unlike many other commodities, oil supply is not simply a function of demand. Political and strategic issues play a significant role in how the oil market operates.[67] The global price for oil is not just shaped by cost of production; rather, it is a market distorted by the decisions of the governments of producer countries. In other words, the global oil market is "…strongly influenced by 'rent-seeking' behaviour of states."[68]

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[60] This organisation was initially formed as members wanted greater control over their oil industries and oil export incomes. See: Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 71.
[61] Algeria, Angola, Ecuador, Equatorial Guinea, Gabon, Iran, Iraq, Kuwait, Libya, Nigeria, Saudi Arabia, United Arab Emirates, Venezuela.
[62] BP, *BP Statistical Review of World Energy 2019*, 14. OPEC puts their share of proven world oil reserves at closer to 80%: OPEC, "Oil Data: Upstream," accessed 1 April, 2020, https://asb.opec.org/index.php/interactive-charts/oil-data-upstream.
[63] BP, *BP Statistical Review of World Energy 2019*, 15-16.
[64] IEA, *World Energy Outlook 2019*, 141; OPEC, "Oil Data: Upstream."
[65] Member countries recognise that it is also not in their interest to have prices increase to levels where global economic growth is harmed. The organisation's stated aim is to provide a steady supply of oil to consumers while ensuring prices remain at a level which provides a steady revenue for producers: OPEC, "Our Mission," accessed 20 April, 2020, https://www.opec.org/opec_web/en/about_us/23.htm.
[66] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 73. This larger group is collectively referred to as OPEC+ and notably includes Russia, the world's second largest net-exporter.
[67] Ibid., 49.
[68] Ibid.

Given the upstream realities highlighted above, geopolitical causes of supply disruption often of greatest concern include: oil exporting countries restricting access to their resources to coerce importers into concessions or for ideological reasons - i.e., using the 'oil weapon'; conflict or instability reducing production or harming an exporter's oil sector over the long term; and other countries imposing sanctions or embargoes on key oil exporters.[69]

Geopolitical disruption of upstream sectors can be driven by the internal context of producer countries, or by their external agendas and objectives.

Internal Drivers of Supply Disruption

Disruptions to the oil supply chain can arise from instability or conflict within producer states affecting exploration or production. Perversely, the presence of oil resources and production potential can itself be a factor influencing the degree of instability within a country,[70] with scholars often interlinking oil with civil unrest and intra-state conflict.[71] Conflicts over oil and gas exploitation more commonly arise in countries where oil is the principal source of income, and where exploitation of the resource has not delivered the expected level of welfare to the citizenry.[72] Disputes over the control of oil and gas resources are also often present within conflicts involving economic struggle, ethnic and religious hostility, and political competition.[73] Political instability within oil exporting countries therefore threatens security of supply, with civil wars, terrorism and local conflicts having often caused temporary damage to energy infrastructure and facilities.[74]

These same political economic structures can also mean the stability of oil producing nations is dependent upon sufficiently high oil prices, with many producer states today highly

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[69] See for instance: Fattouh, *How Secure Are Middle East Oil Supplies?*, 9; Anthony H Cordesman and Khalid R Al-Rodhan, *The Changing Risks in Global Oil Supply and Demand: Crisis or Evolving Solutions?* (Center for Strategic and International Studies, 2005), 7-13, https://csis-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/media/csis/pubs/050930_globaloilrisks.pdf; Giacomo Luciani, *Geopolitical Threats to Oil and the Functioning of the International Oil Market*, CEPS Policy Brief no. 221 (Brussels: Centre for European Policy Studies, 2010), https://www.ceps.eu/wp-content/uploads/2010/12/Policy%20Brief%20221%20Luciani%20Secure%20ed.pdf; Arianna Checchi, Arno Behrens, and Christian Egenhofer, *Long-Term Energy Security Risks for Europe: A Sector-Specific Approach*, CEPS Working Document no. 309 (Centre for European Policy Studies, 2009), 3, https://www.ceps.eu/system/files/book/1785.pdf.
[70] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 86.
[71] Jeff D. Colgan, "Fueling the Fire: Pathways from Oil to War," *International Security* 38, no. 2 (2013).
[72] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 86.
[73] Ibid.
[74] Checchi, Behrens, and Egenhofer, *Long-Term Energy Security Risks for Europe: A Sector-Specific Approach*, 3.

dependent on this single commodity for their export revenues. These states often have centralised government structures with immature political institutions and weak civil society, and to maintain support are pressured to spend oil revenues on benefits for the population or select groups, through subsidies, job creation, and other social programmes.[75] Consequently, the ruling structures of these countries rely on oil prices being sufficiently high to fund socioeconomic welfare and ensure their long-term political survival.[76] Therefore, to a greater or lesser extent the level of 'rent' that producer states seek for their oil is often determined more by state budgets than the cost of production. Furthermore, this need to retain oil revenues effectively constrains these states' pricing flexibility.[77] As Fattouh explains, low oil prices can deplete government revenues, inducing economic and social unrest and in turn resulting in production or supply disruptions.[78]

The political economic structures of these countries also have the potential to negatively impact security of supply over the long term. Underinvestment in exploration and production projects by NOCs can often occur as a result of governments' non-profit maximising priorities. NOCs operate as extensions of their respective governments or government agencies, and as such their access to capital may be determined more by government budgetary requirements than the financial viability of available investment opportunities.[79] Furthermore, this can be compounded by a reluctance of a considerable number of oil producing countries to accept foreign direct investment (FDI) in their NOCs.[80] Consequently, underinvestment by NOC's has the potential to become a longer-term destabilising factor in the oil market.[81]

Finally, while the internal drivers of production disruption discussed above may affect producer state actions, they can also influence the actions of external actors. For example, the wider oil industry's willingness to invest in countries and regions with oil producing potential is not just determined by the overall economic viability of the projects, but also by

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[75] Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 534; Robert L Pirog, *The Role of National Oil Companies in the International Oil Market* (US Congressional Research Service, 2007), http://research.policyarchive.org/19433.pdf.
[76] Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 9.
[77] Coby Van Der Linde, *The State and the International Oil Market: Competition and the Changing Ownership of Crude Oil Assets* (London: Kluwer Academic, 2000), 81-96.
[78] Fattouh, *How Secure Are Middle East Oil Supplies?*, 22.
[79] Ibid., 20; Pirog, *The Role of National Oil Companies in the International Oil Market*, 1.
[80] Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 534.
[81] Pirog, *The Role of National Oil Companies in the International Oil Market*, 1.

considerations of political and social stability.[82] Social and political issues, including elite power structures and widespread corruption can make these countries less appealing to potential FDI.

External Drivers of Supply Disruption

Compounding the above, internal instability can in some cases be closely interlinked with external instability.[83] Internal instability and conflict, and the nature and degree of the state's role in generating or responding to it, can lead to external supply disruption through the imposition of economic sanctions by other countries and institutions. Sometimes referred to as the 'reverse oil weapon', unilateral and multilateral sanctions have historically been widely used against oil exporting nations,[84] with the effectiveness determined by the scale of restriction. Long-term production capacity can also be impacted if sanctions restrict FDI in these countries' oil sectors over long periods.[85] Past events show how energy resources including oil can create conflict, insurgencies and generate grievances, and in some cases such disputes can quickly turn into international economic or national security crises.[86] For example, Iraq's invasion of Kuwait in 1990 and the subsequent intervention by the international community not only demonstrates the impact on production that interstate conflict between petrostates can have, but also the concern of oil importing countries at the idea of a single producer gaining oil market dominance.[87] Fattouh notes that war and destructive events like it can have a dual impact on oil supply: damaging a state's ability to produce or export oil in the medium to long-term, and hindering investment thereby impacting long-term productive capacity.[88]

Direct conflict between states is not the only external driver of supply disruption. The most notable oil supply disruptions in recent history have been the result of deliberate reductions in oil supply to market from producer countries. The 1973 OAPEC oil embargo resulted in the most significant oil supply crisis outside of wartime.[89] For oil importing nations, this use of

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[82] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 85.
[83] Ibid., 86.
[84] Fattouh, *How Secure Are Middle East Oil Supplies?*, 17.
[85] Ibid.
[86] International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 22.
[87] Colgan, "Fueling the Fire: Pathways from Oil to War."
[88] Fattouh, *How Secure Are Middle East Oil Supplies?*, 10.
[89] Checchi, Behrens, and Egenhofer, *Long-Term Energy Security Risks for Europe: A Sector-Specific Approach*, 3.

the 'oil weapon' - i.e., the disruption of oil supplies being used against them to achieve a geopolitical end - was an experience not to be forgotten. Consequently, the prospect of their vulnerability to supply disruption yet again being used as a political weapon against them is touted as a strong reason to reduce oil imports.[90] However, the likelihood of the oil weapon being used, or its effectiveness given current market settings, is debated in the literature.[91] Although such action would likely reduce oil producers' revenue, it is often argued that such a reduction would asymmetrically harm consumer states. Furthermore, suppliers can supposedly offset the reduction in income from reduced exports if the oil price increases sufficiently in response to the supply reductions, assuming exports are not completely stopped. Nevertheless, any deliberate reduction in exports from one or more large producers would have significant effects on supply.

3.2.2 Midstream Geopolitical Disruption

The possibility of damaging supply disruptions is not limited to the oil production sector of the upstream supply chain segment. The mid-stream sector of oil transportation is the essential common link between upstream production and downstream refining sectors and is also vulnerable to significant disruptions from geopolitical events.

Oil is predominantly transported and distributed via two modes: pipeline and maritime tanker. The literature on security in this sector often focusses on countries with near total dependence upon pipeline transportation from a single producer nation; for example, land-locked central-European countries dependent upon Russian oil exports transported directly or transiting through other states. This dependency upon pipeline infrastructure makes these nations particularly vulnerable to geopolitically driven supply disruptions such as sabotage, pipeline closures by transiting nations, or cessation of oil shipments by supplying countries.[92] In contrast, countries that receive oil via maritime tanker shipments are not locked into a single source or single transportation route. These importers are free to source petroleum from multiple suppliers, and both exporters and importers can reroute their exports and imports if necessary. In addition to greater flexibility, nations serviced by tanker do not need to contend

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[90] Ibid.
[91] Fattouh, *How Secure Are Middle East Oil Supplies?*, 13-14. For an examination of upstream market concentration, see: Hughes and Long, "Is There an Oil Weapon?: Security Implications of Changes in the Structure of the International Oil Market," 167.
[92] Checchi, Behrens, and Egenhofer, *Long-Term Energy Security Risks for Europe: A Sector-Specific Approach*, 9.

with the geopolitical risks associated with pipeline delivery that transits through other states.[93] Given New Zealand's total dependence upon tanker transport for its oil supply, only geopolitical disruptions of this mode are examined further.

The size of the maritime petroleum tanker fleet is substantial: approximately 4,800 tankers equalling a combined capacity of around 500 million deadweight tonnes,[94] transporting over two thirds of global crude oil and refined product demand to every region on earth.[95] Maritime petroleum tankers are separated into two categories: crude tankers and product tankers, with total capacity split approximately 70% and 30% respectively.[96] Product tankers are generally smaller vessels with specially coated tanks to enable product transport. While product tankers can be reconfigured for crude shipments in times of capacity shortage, the same does not apply to crude tankers. Although petroleum products have traditionally been transported intra-regionally, the shipping of product has become increasingly global.[97]

Participants in the tanker industry include NOCs and transnational oil companies (TNOCs), specialised petroleum trading companies, and public and private companies shipping petroleum as a segment of their broader involvement in the shipping market. Each participant is also diverse in the number and mix of tankers they own or control;[98] most shipping companies own approximately half their fleet, with the balance being chartered.[99] It should be noted however that determining which party actually *controls* a tanker is notoriously difficult to discern, and that this may have implications for security of service during times of geopolitical turmoil. The nationality of the vessel's owner may differ from the shipping company that charters it, and the ship itself may be registered in yet another country; over 70% of the world's commercial fleet is registered under a different flag from the country of ownership.[100]

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[93] On the other hand, the inflexibility of pipelines can in some ways be beneficial to security during disruption in other countries or regions, as supplies may not be easily redirected to preferred consumers: Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 48.
[94] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 24.
[95] Hale & Twomey, *Australia's Maritime Petroleum Supply Chain* (Hale & Twomey, 2013), 2, https://www.energy.gov.au/sites/default/files/aust-maritime-petroleum-supply-chain-report-2013.pdf.
[96] TORM, *Torm Plc Listing Prospectus* (2016), 83, https://torm.gcs-web.com/static-files/52d02e5a-3ead-4449-acb3-724d4d6f69cd. Shuttle tankers make up the remaining 2%.
[97] Ibid., 83-86.
[98] Hale & Twomey, *Australia's Maritime Petroleum Supply Chain*, 33.
[99] UNCTAD, *Review of Maritime Transport 2017* (Geneva: United Nations, 2017), 29, https://unctad.org/en/PublicationChapters/rmt2017ch2_en.pdf.
[100] Ibid., 32.

The above notwithstanding, transport of oil in the shipping sector is generally considered to be globalised.[101] While some of the largest tanker fleets are controlled by state-owned companies, it is a highly competitive market with the top 30 tanker companies representing only 50% of market capacity, and the largest single tanker operator representing less than 4% of capacity.[102] At present, disruption related to any specific tanker market participant therefore appears unlikely. However, this is not to say that geopolitical events affecting specific market participants cannot affect the tanker transportation of oil. For example, the 2019 US sanctioning of four Chinese tanker operators - including the world's largest shipping company - for ignoring sanctions on transporting of Iranian oil exports[103] led to a nearly 350% increase in oil shipping rates.[104] Nevertheless, when examining tanker ownership, the commercial tanker market appears to have insufficient concentration of 'control' to confer the potential for a single actor to coerce others.[105]

In contrast, the locations to which oil tankers must travel to pick up crude deliveries are largely concentrated close to where oil is produced. For nations dependent upon tanker delivery of their oil imports, security of oil transport is therefore necessarily dependent upon the security of international sea lines of communication (SLOCs) - the primary maritime supply routes linking oil exporters and refiners to importing countries. SLOCs can be disrupted by regional instability, non-state violence, and armed maritime conflict. Although the flexibility of maritime transport may allow oil tankers to avoid disruptions to SLOCs, vessels invariably must travel through maritime 'chokepoints' - narrow sea-lanes that become highly congested

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[101] PK Gautam, "Mapping Chinese Oil and Gas Pipelines and Sea Routes," *Strategic Analysis* 35, no. 4 (2011): 603.

[102] When judged by the total deadweight tonnage of the fleet that the company either owns, manages or commercially operates. Compiled from: "Top 30 Owners and Operators," *Tanker Operator*, March, 2017, http://ea45bb970b5c70169c61-0cd083ee92972834b7bec0d968bf8995.r81.cf1.rackcdn.com/TOMar17cj.pdf.; and, Joris Van Roy, "Belgian Euronav World's Largest Crude Oil Tanker Company," *New Mobility News*, 22 December 2017, https://newmobility.news/2017/12/22/belgian-euronav-worlds-largest-crude-oil-tanker-company/.

[103] US Department of the Treasury, "Iran-Related Designations; Issuance of Iran-Related Frequently Asked Question," updated 25 September, 2019, https://www.treasury.gov/resource-center/sanctions/OFAC-Enforcement/Pages/20190925.aspx.

[104] Adi Imsirovic and Michal Meidan, *Sanctions, Shipping, and Oil Markets* (Oxford Institute for Energy Studies, 2019), https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/10/Sanctions-Shipping-and-Oil-Markets.pdf.

[105] Hughes and Long, "Is There an Oil Weapon?: Security Implications of Changes in the Structure of the International Oil Market." Tanker ownership is also dispersed among countries. Greece is by far the largest country of ownership despite being neither a significant importer or exporter of crude. UNCTAD, *Review of Maritime Transport 2019* (Geneva: United Nations, 2019), 39, https://unctad.org/en/PublicationsLibrary/rmt2019_en.pdf.

due to their strategic locations. The highly strategic nature of choke points arises from the inability of shipping to detour around them, or where doing so requires the use of significantly

Figure 3: Oil Supply Chain Maritime Choke Points - Ranked by Daily Volume.[106]

longer sea routes. Figure 3 shows the primary chokepoints of the global oil supply chain. SLOCs are especially vulnerable at choke points relative to the open seas due to the comparative ease with which a malign actor can use sea and land-based military assets on proximate coasts to disrupt shipping.[107] For example, belligerent state actors may declare a blockade, a war zone or a maritime exclusion zone centred on a choke point.[108] Non-state actors engaging in piracy and terrorism typically target choke points for the same reasons.[109] Even temporary blocking of a chokepoint can result in significant increases in global oil prices.[110]

Notable geopolitical disruptions to maritime transportation of oil have occurred in the past, often as the result of interstate conflict. The disruption to global oil supplies as a result of these events has at times been profound. The 1967 Six Day War between Egypt and Israel resulted in the closure of the Suez Canal choke point for a period of eight years, resulting in significant

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[106] Brett Wetzel, "Oil in Motion: Visibility into Crude Oil Transportation," (Breakthrough, 1 November 2019). https://www.breakthroughfuel.com/blog/oil-in-motion-visibility-into-crude-oil-transportation/.
[107] Tim Sweijs et al., *The Maritime Future of the Indian Ocean* (The Hague Centre for Strategic Studies, 2010), 38, https://hcss.nl/sites/default/files/files/reports/HCSS_FI-13_09_10_Indian_Ocean.pdf.
[108] Gautam, "Mapping Chinese Oil and Gas Pipelines and Sea Routes," 604.
[109] Checchi, Behrens, and Egenhofer, *Long-Term Energy Security Risks for Europe: A Sector-Specific Approach*, 9.
[110] EIA, "World Oil Transit Chokepoints," updated 25 July, 2017, https://www.eia.gov/international/analysis/special-topics/World_Oil_Transit_Chokepoints.

impacts on oil markets at the time, and permanent changes to maritime trading patterns.[111] Furthermore, while there is generally less risk on the open sea, tanker transportation is not immune from disruption away from SLOC choke points. The blockade of Japan during WWII led to nearly all the country's tanker capacity being disabled or destroyed and its oil imports dropping to virtually zero.[112] Therefore maritime transport – and choke points in particular – present a perpetual concern for oil supply security.

3.2.3 Downstream Geopolitical Disruption

Unlike the upstream exploration and production sectors, oil refining is not constrained to or concentrated in regions where oil reserves are present. Refineries are located in all regions of the globe, and this absence of high geographical concentration suggests that direct interruption of refining infrastructure serious enough to significantly reduce global capacity could only occur in the most extreme circumstances.

Furthermore, global refining capacity is held under diverse ownership structures, and consequently disruptions arising from a concentration of supply in this sector appear unlikely. A 2015 assessment of concentration within each segment of the international oil supply chain finds that no state or firm in the refining industry is sufficiently large enough to impose a sustained reduction in supply of crude products on others, nor does the market exhibit cartel-like behaviour such as that seen in the upstream sectors. Therefore, at present there is minimal potential for an oil refining market player or players to effectively coerce a state.[113]

While a significant reduction in global oil refining capacity is unlikely, this does not mean that access to refining services is assured. For countries that import refined product as well as petroleum, delivery to the end consumer is reliant upon international transport. It is the potential for disruption in this midstream sector of the supply chain described earlier that represents the most likely geopolitically induced disruption to downstream supply chain sectors of refining and distribution. The above notwithstanding, it should be noted that while market concentration within the oil refining sector is not significant today, it has been significantly

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[111] James Feyrer, *Distance, Trade, and Income - the 1967 to 1975 Closing of the Suez Canal as a Natural Experiment* (National Bureau of Economic Research, 2009), https://www.nber.org/papers/w15557.pdf.
[112] Stephen L Wolborsky, *Choke Hold: The Attack on Japanese Oil in World War II* (Auckland: Pickle Partners, 2014).
[113] Hughes and Long, "Is There an Oil Weapon?: Security Implications of Changes in the Structure of the International Oil Market."

higher at times in the past.[114] Although less likely considering current market conditions, a marked increase in concentration and state control of refining capacity could create additional oil security concerns.

The above examination of the oil supply chain shows that geopolitical events can significantly disrupt oil supplies to states in a myriad of ways. Furthermore, those disruptions are not just limited to upstream sectors; they can also occur both midstream and downstream in the oil supply chain.

3.3 Industry Response to Supply Disruption

As already noted, the concerns of net importer states largely centre on their exposure and vulnerability to large disruptions in the production sector, and much less so with respect to disruptions in midstream and downstream sectors of the supply chain. Responses to disruptions are typically the domain of oil industry markets, but when disruptions become crises state intervention may be necessary. The capacity of markets to respond to disruptions is discussed below; state responses are discussed in Chapter 5.

3.3.1 Petroleum Market Overview

The structure of oil industry markets is fundamental to their ability to respond to routine disruptions. The petroleum market is both substantial and established. Market participants can sell and buy oil either via long-term supply contracts or through the spot market. Long-term contracts account for approximately two thirds of all exported oil, and tend to lock in supply and terms for two to five years.[115] These contracts generally base their pricing on the prices reported in the spot market for crude or refined product.[116] Spot markets provide for 'on-the-spot' one-off trades of large physical consignments - or parcels - of oil for near-term delivery.[117] TNOCs use a combination of spot contracts and long-term contracts to provide

[114] Ibid.
[115] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 48.
[116] John van Schaik, *How Governments Sell Their Oil* (New York: Revenue Watch Institute, 2012), 5, https://resourcegovernance.org/sites/default/files/OilSales-HowGovtsSellOil.pdf.
[117] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 42.

reliability and flexibility of supply.[118] Crude oil futures markets operate in parallel with the physical market, providing market participants a means to manage pricing risk.[119]

A complicating factor in the petroleum market is that crude oil produced across the world is not homogeneous; it comes in hundreds of different grades.[120] The quality characteristics of the grade determine the difficulty of the refining process and the yields of the respective refined petroleum products, which in turn influences the market value of the oil grade. Select 'benchmark' crude oils[121] are regularly used as a pricing reference for other crude types. A further complicating factor is that trade in petroleum is paralleled by trade in petroleum products. There are also substantial and established commodity markets for each of the major refined fuels – petrol, diesel, and aviation turbine fuel – and product is readily available for purchase from refineries across Asia, the Middle East, North America and Europe.

It is the size and maturity of the international crude and refined petroleum markets that makes them sufficiently robust to reliably balance global supply and demand, as well as provide a level of protection from disruption.[122] It is for this reason that having access to a functioning international oil market is identified in some security reports as the best tool for maintaining oil security.[123]

3.3.2 Petroleum Market Responses

The maturity and global reach of the petroleum industry markets makes them highly capable of resolving most disruptions with minimal impact on consumers, negating the need for intervention by governments in nearly all circumstances. Disruptions occur regularly within a country's oil supply chain but are usually small, such as a delayed tanker shipment. These more common disruptions have minimal impact on production or supply volumes, and the oil

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[118] Ibid.; Schaik, *How Governments Sell Their Oil*.
[119] For more information, see: American Petroleum Institute, *Understanding Crude Oil and Products Markets* (American Petroleum Institute, 2014), https://www.api.org/~/media/Files/Oil-and-Natural-Gas/Crude-Oil-Product-Markets/Crude-Oil-Primer/Understanding-Crude-Oil-and-Product-Markets-Primer-High.pdf.
[120] McKinsey Energy Insights, "Crude Grades," accessed 5 April, 2020, https://www.mckinseyenergyinsights.com/resources/refinery-reference-desk/crude-grades/. A crude oil's grade refers to its chemical attributes and determines its value. The most important attributes from a grading perspective are the crude's specific gravity and sulphur content.
[121] Ibid. The oil market's three most quoted – or 'benchmark' - crudes are West Texas Intermediate (WTI), Brent, and Dubai.
[122] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 42.
[123] See for instance: ACIL Tasman, *Liquid Fuels Vulnerability Assessment* (Australian Department of Resources Energy and Tourism, 2011); Australian Department of Resources Energy and Tourism, *National Energy Security Assessment 2011* (2011), https://www.energy.gov.au/sites/default/files/national-energy-security-assessment-2011_0.pdf.

industry is generally considered robust and mature enough to respond to most of these commonly occurring supply disruptions. For TNOCs importing fuel, penalty clauses in contracts and reputational risk incentivise reliability.[124] In the event of a disruption in their supply chain, these companies use their global networks to source alternative supplies to minimise disruption. If a company cannot resolve a shortage using its own supply chain, it will enter into commercial arrangements with other suppliers to fill contracts.[125]

While the size of disruption in any oil sector - especially production - is clearly an important factor in determining the extent and distribution of market impact, so too is the timeframe over which disruptions both emerge and endure. Sudden extended supply shortages in upstream, midstream or downstream sectors may be beyond markets' capability to ameliorate before a crisis manifests in one or more countries. By contrast, disruptions that emerge over time may allow markets to adjust and adapt, avoiding the need for state intervention. In addition to the size and likely duration of the disruption, a main determinant relates to the ability of the market to meet the supply shortfall. According to Smith, the smaller the supply buffer is, the higher the likelihood that a large disruption will result in a situation where demand exceeds supply and oil buyers cannot purchase sufficient product.[126] Therefore, the impact of a disruption to a notable extent depends on the availability of existing commercial inventories, and unaffected spare capacity.[127] Spare capacity is considered a particularly important response mechanism, given its ability to compensate for disruption over longer time periods.[128] Leiby and Bowman's assessment of oil supply disruptions since 1951 supports this conclusion, finding that a key factor determining the duration of disruption and impact on price is not necessarily the disruption volume per se, but the availability of undisrupted excess production capacity and the willingness of suppliers to bring this production capacity online.[129] The tightness of supply therefore determines the vulnerability of the oil market in the short-term.[130]

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[124] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 42.
[125] Ibid.
[126] Clint Smith, *The Next Oil Shock?* (Wellington: NZ Parliamentary Library, 2010), 8, https://www.parliament.nz/resource/en-NZ/00PLEco10041/a773c72d17c6ff74e2bb6e221f837d224695ca78.
[127] IEA, *Energy Security in ASEAN+6* (IEA, 2019), 21, https://webstore.iea.org/download/direct/2818.
[128] Gholz and Press, "Protecting 'the Prize': Oil and the U.S. National Interest," 457.
[129] Paul N Leiby and David Bowman, *The Value of Expanding the US Strategic Petroleum Reserve* (Oak Ridge: Oak Ridge National Laboratory, 2000), 13.
[130] The level of spare production capacity can also affect prices over the long term; the smaller the production buffer, the higher the risk and hence the higher the price: Smith, *The Next Oil Shock?*, 7-8.

3.4 Assumptions of Markets

Conventional market economics asserts that the global balance of supply relative to demand largely determines the severity of price impacts generated by a disruption to supply.[131] The greater the imbalance, the more severe the impact on prices will be. In the case of petroleum, this argument is based on the proposition that oil is a fungible good; oil from one location can be substituted with oil from another location. Additionally, the petroleum market is generally characterised as a globally integrated market – "…one great pool"[132] or 'bathtub' of oil – rather than a large but unconnected network of buyers and sellers. This characterisation means that any additions to, or subtractions from, one part of the bathtub will affect the total pool and thus prices for all market participants, with oil flowing to the highest bidder. Balance between supply and demand is thereby restored. In summary, in a functioning 'free' market the global sum of oil demand relative to the global sum of oil supply largely determines the price of oil, with all buyers paying the same price once transport costs and crude quality characteristics are accounted for.

This description of the petroleum supply chain and industry markets, and their interconnectedness in relation to supply security, can be regarded as constituting a widely held conventional economic perspective often adopted in oil security assessments, including those focussing on New Zealand.[133] Inherent in this perspective is a fundamental assumption about the structural integrity of oil markets, and underlying assumptions about the physical characteristics of oil, and the constraints of oil logistics. The veracity of these assumptions is examined here.

3.4.1 Integrated Oil Market

A review of the oil security and energy economics literatures reveals significant and ongoing debate over whether the oil market is more fragmented than the conventional characterisation

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[131] For example, see: William Nordhaus, "The Economics of an Integrated Oil Market" (paper presented at the International energy workshop, Venice, Italy, June 17-19 2009), 1-2.
[132] M. A. Adelman, "International Oil Agreements," *The Energy Journal* 5, no. 3 (1984): 5.
[133] See: NZIER, *New Zealand Oil Security Assessment Update* (NZIER, 2012), https://www.mbie.govt.nz/assets/87ddd35df2/nz-oil-security-assessment-update.pdf; Hale & Twomey, *New Zealand Petroleum Supply Security 2017 Update* (Hale & Twomey, 2017), https://www.mbie.govt.nz/assets/c3a1dee1b0/petroleum-supply-security-september-2017.pdf. The approaches of New Zealand's existing oil security assessments are examined in chapter 6.

asserts.[134] Similar questioning of the integrated market assumption is also found in foreign policy discussions.[135] The integrated and regionalised perspectives incorporate differing positions on which factors influence market responses to disruption, how they influence it, and to what extent. As such, whichever perspective is adopted has major implications for oil security and the importance of related policies.

An integrated oil market operates as one great pool, where the source of oil is of no consequence and the price mechanism effectively resolves disruptions to supply. Any supply disruption would simply lead to higher prices for all, and the market would then provide all importing countries their desired demand at this higher price.[136] For countries with open markets such as New Zealand, disruptions in an integrated oil market are therefore likely to be reflected through higher prices rather than physical shortages, given purchasers are able to bid as high as necessary to procure scarcer supply.[137] Furthermore, an integrated market likely affects the overall distribution of impacts from any disruption. Gholz and Press argue that, compared to a fragmented oil market, countries' oil security is enhanced by an integrated market. This is because supply adjustments are spread globally in response to a disruption, and markets, firms and consumers therefore have a greater ability to adapt than if adjustments had to be concentrated in a single country or region.[138] Only in the most extreme circumstances would a country or countries experience a physical shortage of oil or prices reach unacceptable levels.

The degree to which the oil market is integrated has implications for the efficacy of a state's interventions in pursuit of increased oil supply security. Devices such as long-term contracts between importers and exporters, increased supplier diversification, or procurement only from 'secure' sources less prone to disruption would yield minimal gains in an integrated market

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[134] See for instance: Robert J. Weiner, "Is the World Oil Market "One Great Pool"?," *The Energy Journal* 12, no. 3 (1991); M. A. Adelman, ""Is the World Oil Market One Great Pool'?" -- Comment," *The Energy Journal* 13, no. 1 (1992); Adelman, "International Oil Agreements." Bhanja Niyati, Dar Arif Billah, and Tiwari Aviral Kumar, "Do Global Crude Oil Markets Behave as One Great Pool? A Cyclical Analysis," *Journal of Business Cycle Research* 14, no. 2 (2018).
[135] Luciani, *Geopolitical Threats to Oil and the Functioning of the International Oil Market*; James M. Griffin, "Petro-Nationalism: The Futile Search for Oil Security," *The Energy Journal* 36, no. 1 (2015).
[136] Weiner, "Is the World Oil Market "One Great Pool"?," 96.
[137] Anthony Andrews and Robert Pirog, *The Strategic Petroleum Reserve and Refined Product Reserves: Authorization and Drawdown Policy* (US Congressional Research Service, 2011), 9, https://fas.org/sgp/crs/misc/R41687.pdf.
[138] Gholz and Press, "Protecting 'the Prize': Oil and the U.S. National Interest."

where the source of oil is of no consequence.[139] By extension, any country developing additional oil sources would be beneficial to its supply security only in that it increases supply for the global market, rather than to the country itself. Similarly, the degree of market integration can also affect the efficacy of inventory sharing agreements. The more regionalised the market is, the less likely a large stock release from one country will have spill over benefits to other oil importing countries in different regions. Thus, the storage location of emergency petroleum reserves becomes more important.[140]

Arguments in the energy economics literature supporting the case for an integrated global oil market often rely on quantitative comparisons of crude prices.[141] In contrast, Chanis adopts a qualitative approach to critique oil market integration. His in-depth explanation of how, in practice, oil is physically traded on the market lends strong support to the notion that, at the very least over intermediate time periods, the petroleum market is not integrated.[142]

Fungibility of Oil

Chanis firstly points out that although there are elements of fungibility between some types of crude oil, petroleum cannot be considered fungible for practical purposes due to the variability in crude characteristics described earlier.[143] This is because oil refineries are configured toward processing certain grades of crude, and it can take months or years for a refinery to convert to using different grades. As the IEA's *World Energy Outlook 2019* notes: "Asian refineries are configured to use crude oil grades produced in the Middle East…If a sudden disruption in the Middle East were to occur, these supplies in theory could be replaced by increased output from other regions…Asian refiners could switch…but this would take time [and] would also require a careful assessment of a number of technical and economic factors."[144]

Furthermore, because the number of crudes currently produced and traded has increased significantly, oil today is considerably less interchangeable when compared with that of

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[139] Nordhaus, "The Economics of an Integrated Oil Market," 1-2; Weiner, "Is the World Oil Market "One Great Pool"?," 96.
[140] Weiner, "Is the World Oil Market "One Great Pool"?," 96.
[141] See for instance: ibid.; Niyati, Billah, and Kumar, "Do Global Crude Oil Markets Behave as One Great Pool? A Cyclical Analysis."
[142] Jonathan Chanis, "Crude Oil Is Not Fungible, Where It Comes from Does Matter, and Global Markets Are More Fragmented Than Many Think," *American Foreign Policy Interests* 34, no. 3 (2012): 147.
[143] Ibid.
[144] IEA, *World Energy Outlook 2019*, 168-69.

previous decades.[145] Now constituting a large proportion of deliverable supply, these new crudes vary significantly by their processing characteristics and quality. As a result, they are not easily substituted except within the most advanced oil refineries. In circumstances where substitution is possible, there can nevertheless be undesirable changes in both the value and mix of the refined products yielded. Blending of different grades can alleviate some of these issues and allow refiners to use suboptimal crudes, but the significant differences in the types of crudes means that there are additional limitations on the crudes that can be blended and in what quantities. Similarly, while refined petroleum products can be considered more fungible than crude within a region, even then there are limits given differing product specifications between countries.[146]

Conditional Trades

Chanis also poses a further challenge to the notion of integrated oil markets by highlighting that states' interference often impedes free trade between producers and consumers, and that these actions of major suppliers can drive regional fragmentation. This is particularly true of Saudi Arabia which has significant market power through its long-standing position as the largest player in the maritime trade of petroleum. It uses this position to further the Kingdom's long-term interests by extracting the highest price from each customer rather than keep prices aligned between them and will often demand higher prices from some customers than from others. Furthermore, it will impose import destination and resale restrictions on its crude which enforces this selling approach, ultimately restricting market allocation mechanisms.[147]

Constraint of Logistics

Chanis further substantiates his claim that markets are more regionally fragmented than many believe by arguing that oil is neither as mobile nor cheap to transport as commonly suggested.[148] While it is relatively cheap to transport oil by tanker, only about half of all crude is transported in this way.[149] Furthermore, capacity constraints of pipelines also restrict how

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[145] Chanis, "Crude Oil Is Not Fungible, Where It Comes from Does Matter, and Global Markets Are More Fragmented Than Many Think."
[146] Ibid.
[147] Ibid., 147.
[148] Ibid., 146.
[149] Statistica, "Transport Volume of Crude Oil in Seaborne Trade 2010-2018," updated 20 March, 2020, https://www.statista.com/statistics/264013/transport-volume-of-crude-oil-in-seaborne-trade/.

much oil can be delivered to port, regardless of what price the oil would sell for.[150] In addition to the above, oil supply and demand patterns generally change faster than changes in delivery logistics and pipeline infrastructure. These limitations of logistics can result in supply bottlenecks and inhibit producers and traders from shifting large volumes of petroleum between regions. This results in regionalisation of petroleum markets over intermediate time periods, in turn limiting the size of producers' customer bases, and thereby affecting the price crude sells for. These logistics limitations do not mean a region is completely isolated from the global market, and can often be resolved over the long-term, but in the interim there can be significant differences in price dynamics between each market.[151]

The above notwithstanding, the inherent flexibility of tanker transport means this midstream sector functions as an integrated market. However, like the upstream production sector, the supply of tanker capacity is inelastic in the short run.[152] Consequently, scholars disagree on how effectively the tanker market would respond to a situation where an important sea lane had to be detoured, or what the subsequent impact on cost and capacity would be, but levels of spare capacity in the market would be a key determinant.[153]

In addition, the limitations of logistics can result in price increases being unequally distributed during an oil supply disruption.[154] The friction costs of an oil transaction – that is, the total direct and indirect costs associated with the purchase of a barrel of oil – include transportation and refining costs. Griffin notes that the friction cost differentials that contribute to price differences between crudes are minimal during stable market conditions, but that this is not necessarily the case during a disruption to oil supply. If a supply disruption requires crude to be shipped further from unaffected regions to consumer countries leading to shortages in tanker capacity, or disrupts the flow of particular crudes that a refinery's configuration is optimised to use, friction costs can rise and lead to substantial increases in the price differentials between crudes.[155]

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[150] Chanis, "Crude Oil Is Not Fungible, Where It Comes from Does Matter, and Global Markets Are More Fragmented Than Many Think," 145.
[151] Ibid.
[152] It takes approximately 2-3 years to bring a tanker to market. Michael Levi, "The Enduring Vulnerabilities of Oil Markets," *Security Studies* 22, no. 1 (2013): 136.
[153] See for instance: Eugene Gholz and Daryl G. Press, "Enduring Resilience: How Oil Markets Handle Disruptions," *Security Studies* 22, no. 1 (2013); Levi, "The Enduring Vulnerabilities of Oil Markets."
[154] Chanis, "Crude Oil Is Not Fungible, Where It Comes from Does Matter, and Global Markets Are More Fragmented Than Many Think," 145.
[155] Griffin, "Petro-Nationalism: The Futile Search for Oil Security," 31.

Chanis concludes that the integrated market perspective is an oversimplification of physical market realities; oil is not fungible, nor is the petroleum market integrated.[156]

3.4.2 Off-market Trades

An additional reality of oil trading that also impedes allocation of supply between consumers is the phenomenon of off-market trading. As a result of some states' policies, a significant portion of the world's current oil production is not allocated through markets. While trades of this nature are opaque, Chanis estimates that 20% of oil traded in 2012 was done outside commodity markets. These quantities cannot be considered available for global consumption and consequently have no influence on market liquidity and oil price.[157] While Chanis finds that this oil production bypassing the market has not had sufficient impact on trade volumes to substantially affect the liquidity of the market,[158] this is but one more factor that can impact the free flow of oil.

The above discussion suggests that the assumption about market integration - along with subordinate assumptions about the fungibility of oil and unconstrained oil logistics - are far from being givens, at least in the short run. This has significant implications for assumptions regarding oil security. The conclusion drawn is that the petroleum market tends toward fragmentation rather than integration, especially during large supply disruptions. Therefore, factors impacting cumulative global oil supply or demand levels do not determine the severity of a disruption on their own. This conclusion is supported by the IEA, which notes that the grade of crude oil lost to the market and associated logistics issues can play a role in determining the severity of a disruption.[159] These other factors must therefore also be considered when determining the impacts of disruptions and the ability of market participants to adequately respond to them without state intervention. A fragmented market also means that in the event of a significant disruption, some oil importing countries or regions could be impacted disproportionately more than others, and instances of physical shortages become more likely.

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[156] Chanis, "Crude Oil Is Not Fungible, Where It Comes from Does Matter, and Global Markets Are More Fragmented Than Many Think."
[157] Ibid., 147.
[158] Ibid.
[159] IEA, *Energy Security in ASEAN+6*, 21.

3.5 Summary

The geopolitics of global oil supply can be understood through the lens of supply-demand balance. This balance constitutes the underlying dynamic of exporter-importer power relations, which are rooted in the reliance of oil importing countries on exporting countries and the exposure to harm or coercion arising from that reliance. This reality exposes the oil market and the global oil supply chain to geopolitically induced disruption, particularly the upstream production sector. The vulnerability of an importer state arising from this reliance is a function of the resilience of its entire oil supply chain. While oil sector markets are well able to respond to small-medium scale disruptions to production and supply and thereby maintain oil security, this is less the case as disruptions become larger and more enduring with complicating factors increasingly coming to bear. A robust assessment of a state's external oil security therefore needs to account for the specific vulnerabilities in the country's oil supply chain.

4 New Zealand's Oil Security

4.1 Introduction

The security of a nation's oil supply is a function of exposure and vulnerability throughout its entire oil supply chain. As discussed in the previous chapter, along with all net importer states, New Zealand's reliance on foreign exporters exposes its petroleum and refined product supply chains to potential disruption within the upstream, midstream and downstream sectors. Any assessment of the efficacy of oil security policymaking therefore requires an understanding of: the significance of oil in a nation's energy mix; the scale of reliance upon oil imports; and the nature and distribution of exposure and vulnerability within the supply chain that must be accounted for.

Analyses using quantitative metrics are a common approach in the literature to compare a country's energy and oil security with that of other countries.[160] Most of these comparative studies assess the security of larger states or regional groups like the EU, although New Zealand has been a country examined at times.[161] Studies of this type can be very useful in that they can focus on a particular aspect of security of supply to indicate a direction of change or relative position between countries.[162] However, this approach is limited in its ability to determine a country's objective level of security.

Given the complexity and somewhat subjective nature of the problem, there is no agreed upon approach within the literature for measuring energy security, or oil security specifically. As an example of this complexity, Sovacool and Mukherjee identify 320 simple indicators and 52 complex indicators across multiple fields that can be used to measure a country's energy security.[163] However, some variables that influence supply security, such as geopolitical relations, are extremely hard to quantify. Furthermore, there is no fundamental basis upon

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[160] See for example: Benjamin K Sovacool and Ishani Mukherjee, "Conceptualizing and Measuring Energy Security: A Synthesized Approach," *Energy* 36, no. 8 (2011); Eshita Gupta, "Oil Vulnerability Index of Oil-Importing Countries," *Energy policy* 36, no. 3 (2008); Benjamin K. Sovacool et al., "Evaluating Energy Security Performance from 1990 to 2010 for Eighteen Countries," *Energy* 36, no. 10 (2011); Jingzheng Ren and Benjamin K. Sovacool, "Quantifying, Measuring, and Strategizing Energy Security: Determining the Most Meaningful Dimensions and Metrics," *Energy* 76 (2014); Chloe Le Coq and Elena Paltseva, "Measuring the Security of External Energy Supply in the European Union," *Energy policy* 37, no. 11 (2009).
[161] Gupta, "Oil Vulnerability Index of Oil-Importing Countries."; Sovacool et al., "Evaluating Energy Security Performance from 1990 to 2010 for Eighteen Countries."
[162] Bert Kruyt et al., "Indicators for Energy Security," *Energy policy* 37, no. 6 (2009): 2168.
[163] Sovacool and Mukherjee, "Conceptualizing and Measuring Energy Security: A Synthesized Approach."

which to assign weightings to quantitative variables.[164] Finally, and perhaps most importantly from a policymaking perspective, determining a country's security of supply through indicators alone and in isolation from a country's context inevitably leads to oversimplification.[165]

Acknowledging the above limitations of quantitative analyses, this study adopts a different approach to describe the security of New Zealand's oil supply. A review of the literature reveals there are sectors of the oil supply chain that are generally regarded as deterministic of a country's oil security, and assessments at this scale are commonly qualitative or mixed method. Sector-specific variables that introduce risk into the supply chain include: domestic production; political stability of supplier states; resilience and diversity of transportation infrastructure; and domestic refinery capacity and flexibility. These elements are used below to frame an examination of New Zealand's petroleum supply chain.

4.2 Oil in New Zealand's Energy Mix

Demand-side indicators are metrics often used in relation to security of oil supply, as they are relevant for determining the impact of a supply shortage on a country's overall energy supply.[166] Metrics including the share of oil in the total primary energy supply (TPES), total final consumption (TFC) of fuel in an economy, and the transport sector's share of total oil consumption are used here to illustrate New Zealand's reliance on the uninterrupted and affordable supply of petroleum and refined products.

New Zealand's TPES[167] has followed an upward trend over the last four decades, growing 21% between 2005 and 2015. In 2017, TPES reached 20.7 million tonnes of oil-equivalent (Mtoe),[168] with oil and oil products accounting for 6.8 Mtoe, or approximately one third of this amount.[169] Moreover, as with many developed economies, oil has declined as a share of New

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[164] Kruyt et al., "Indicators for Energy Security," 2176-77.
[165] Ibid., 2176.
[166] Ibid., 2170.
[167] Total Primary Energy Supply (TPES) is the total energy available and is derived from this equation: production + imports – exports – stock change. In other words, it is the amount of energy available for use in New Zealand.
[168] IEA, *New Zealand 2017 Review* (IEA, 2017), 26, https://webstore.iea.org/energy-policies-of-iea-countries-new-zealand-2017-review.
[169] IEA, *World Energy Balances 2019*, 123-24. Figures based on net calorific values.

Zealand's TPES over the same time period.[170] However, total oil consumption continues to grow, and to date oil remains New Zealand's dominant energy source.[171] Oil products

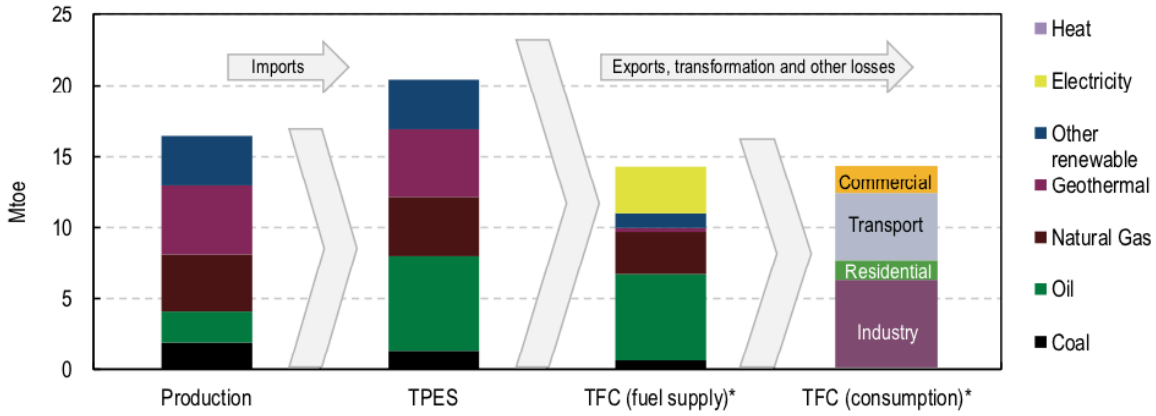

Figure 4: New Zealand energy supply and demand 2015.[172]

accounted for approximately 45% of Total Final Consumption (TFC) in 2015 as shown in Figure 4.[173]

New Zealand's total oil demand is comparatively small on the global scale, with 2017 oil consumption of 6.8 Mtoe constituting just 0.15% of global consumption. This figure is dwarfed by the amount consumed by the largest consumer, the US, at 790.3 Mtoe.[174] New Zealand's overall per capita oil consumption is also relatively moderate when compared with other developed countries.[175] Unlike some other countries, oil is not used as a fuel source within New Zealand's electricity generation sector.[176] By contrast, petroleum products meet virtually all energy demand within New Zealand's transport sector, and also account for a notable proportion of energy consumption within the primary economic sector.[177] An additional 1.5

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[170] IEA, *New Zealand 2017 Review*, 26.
[171] MBIE, *Energy in New Zealand 2018* (MBIE, 2018), 33, https://www.mbie.govt.nz/assets/d7c93162b8/energy-in-nz-18.pdf.
[172] IEA, *New Zealand 2017 Review*, 21.
[173] IEA, *World Energy Balances 2019*, 123. 6.64 out of 14.65 Mtoe. TPES is a commonly used measure to compare energy use between countries, although it is somewhat misleading, as many of the primary energy sources measured are not consumed in that form. Consumer energy on the other hand is the energy used by final consumers, excluding energy lost in the process of transforming energy into other forms and distributing to users; for instance, energy transformation of crude oil refined into petrol, geothermal heat converted to electricity, and in bringing the energy to the final consumer. For a more comprehensive explanation see: MBIE, *Energy in New Zealand 2017* (MBIE, 2017), 10, https://www.mbie.govt.nz/assets/bc14c2778b/energy-in-nz-2017.pdf.
[174] IEA, *World Energy Balances 2019*, III.51.
[175] IndexMundi, "Oil Consumption Per Capita by Country," accessed 15 April, 2020, https://www.indexmundi.com/g/r.aspx?v=91000.
[176] IEA, *World Energy Balances 2019*, 123.
[177] Ibid.

Mtoe of petroleum products were also supplied in New Zealand in 2017 for use in international maritime and aviation transport.[178] New Zealand's per-capita transport energy consumption is relatively high compared to other large energy consuming states. Of the 25 countries that make up the large energy user group index in 2014, New Zealand ranks poorly in transport energy use per capita beating only Canada and the US.[179] As well as an energy intensive transport sector powered almost entirely by petroleum-based fuels, New Zealand also has one of the oldest and therefore least fuel-efficient vehicle fleets, combined with one of the highest vehicle ownership rates in the developed world.[180] Petroleum product consumption is split predominantly between petrol and diesel, both at similar levels of total consumption, with aviation jet fuel/kerosene consumption a distant third place.[181] Petrol is predominantly used in light passenger vehicles, whereas diesel consumption predominates within the commercial transport, agriculture, forestry and fishing, industrial, and commercial sectors.[182]

As previously noted, oil demand is notoriously inflexible and price inelastic. New Zealand is no exception, with petrol, jet fuel and diesel consumption highly price inelastic.[183] One study finds that New Zealand's petrol demand is particularly price inelastic compared to many countries: a 100% increase in price would only result in a 10% reduction in demand over the short-term (1 year or less), and a 13% reduction over the medium term (2 years or more). These figures indicate that New Zealand's consumers have a limited ability to reduce their fuel consumption when faced with significant price increases,[184] and that influencing demand for transport fuel through price-based measures would be a difficult task.[185] Samuelson notes this is to be expected given the limited attractive alternatives to driving in New Zealand compared

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[178] Ibid. By convention, fuel used for international transport is excluded in TPES.
[179] Institute for 21st Century Energy, *International Index of Energy Security Risk: 2016 Edition* (US Chamber of Commerce, 2016), 18, https://www.globalenergyinstitute.org/international-index-energy-security-risk-2016-edition.
[180] BusinessNZ Energy Council, *New Zealand Energy Scenarios: Navigating Energy Futures to 2050*, 22.
[181] MBIE, *Energy in New Zealand 2018*. When measured by energy content values (joules), not volume. Oil product types like diesel and petrol have different energy contents.
[182] Ibid., 14.
[183] NZIER, *New Zealand Oil Security Assessment Update*, 22.
[184] David Kennedy and Ian Wallis, *Impacts of Fuel Price Changes on New Zealand Transport* (Land Transport New Zealand, 2007), https://www.nzta.govt.nz/assets/resources/research/reports/331/docs/331.pdf. Kennedy and Wallis found the price elasticity of petrol was -0.15 in the short term (less than 1 year) and -0.20 in the medium-term (greater than 2 years).
[185] Ralph Dale Samuelson, *Oil: An Introduction for New Zealanders* (Wellington: Ministry of Economic Development, 2008), 71.

to other countries, due to factors including limited public transport and cities less suited to walking and cycling.[186]

New Zealand's tourism export sector along with exports of bulk primary goods including dairy, meat, and timber all rely on affordable international transport. Smith argues that New Zealand's dependence on these industries for a large portion of export earnings, coupled with its reliance on oil imports, makes the country highly vulnerable to oil price shocks.[187] Another study comes to similar conclusions, finding that the country's demand for oil imports is price-inelastic both over the short and long term, and that New Zealand's economy is vulnerable to shocks in the world oil market.[188] These figures show that oil is clearly a critically important energy source for New Zealand's social and economic prosperity.

4.3 Supply Chain Exposure & Vulnerability

4.3.1 Upstream Exposure & Vulnerability

Generally, domestically sourced oil is preferred over imports as this avoids geopolitical risks to supply.[189] However, New Zealand has historically been a net-importer of oil, and while it does have some domestic production, the contribution of domestic oil sources to the country's TPES has been relatively small. New Zealand has therefore always had to rely on imported oil to ensure security of supply.[190] Notably, domestic oil production and self-sufficiency has been in decline, with self-sufficiency dropping from 44% in 2010 to 25% in 2019.[191] Furthermore, while these figures are technically correct, they understate the extent of New Zealand's import dependence. In reality, 99.5% of all petroleum produced in New Zealand was exported in 2019,[192] with domestic crude accounting for less than 1% of annual feedstock to the country's sole refinery at Marsden Point.[193]

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[186] Ibid.
[187] Smith, *The Next Oil Shock?*, 1.
[188] Mohammad Jaforullah and Alan King, *Is New Zealand's Economy Vulnerable to World Oil Market Shocks?*, University of Otago Economics Discussion Paper 1503 (2015), https://www.otago.ac.nz/economics/otago089971.pdf.
[189] Gupta, "Oil Vulnerability Index of Oil-Importing Countries," 1197.
[190] Ministry for the Environment, *Environment New Zealand 2007* (MFE, 2007), 116, https://www.mfe.govt.nz/sites/default/files/environment-nz07-dec07.pdf.
[191] IEA, *World Energy Balances 2019*, 124. Domestic production was down to 1.66 Mtoe in 2017, and net-imports (imports minus exports) subsequently increased to 6.4 Mtoe.
[192] Calculated using data from: MBIE, "Oil Data Tables," (2019). https://www.mbie.govt.nz/assets/Data-Files/Energy/nz-energy-quarterly-and-energy-in-nz/Oil.xlsx.
[193] MBIE, *Energy in New Zealand 2018*, 2.; Personal communications with Refining New Zealand.

Domestically extracted crude is not generally used by Refining New Zealand (RNZ) at its Marsden Point facility because it is not an optimal feedstock for the refinery's configuration.[194] The refinery is specifically configured for refining grades of crude oil from the Middle East, the longstanding primary source of New Zealand's oil imports. Middle East crudes are predominantly medium API gravity[195] with high sulphur content, otherwise known as 'medium-sour' crude, whereas the oil extracted domestically has a relatively high API gravity with low sulphur content, or 'light-sweet' crude.[196] Oil companies purchase crude oil based upon price and the quality, mix and yield of refined product that can be produced from each barrel – a combination of these factors is the reason why oil companies operating in New Zealand avoid purchasing domestic crude.[197] Imported crude is thus essentially the only feedstock used at RNZ's facility, while domestically produced crude is largely shipped overseas where it usually earns a premium on international markets.[198] Greater domestic processing of New Zealand crude is therefore not commercially viable under normal market conditions.

Under abnormal market conditions however, commercial viability may be less of a consideration. A 2005 assessment of New Zealand's oil security notes that the refinery is capable of processing domestic crude in an emergency.[199] While technically accurate that larger volumes of domestic crude could be refined, the crude's characteristics nevertheless still present some limitations. New Zealand crude is high in petrol-making components but generally has poor cold properties for making diesel to New Zealand specifications. Furthermore, these cold properties restrict some grades of domestic crude to summer delivery.[200] Therefore, to meet the nation's transport requirements domestic crude must be blended with imported crudes possessing complementary properties and product yields. Consequently, given domestic crude characteristics, product yields, and associated blending

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[194] IEA, *New Zealand 2017 Review*, 28, 50.; Personal communication with Refining New Zealand.
[195] American Petroleum Institute (API) sets global standards for the petroleum industry. 'Gravity' is the most commonly used index for measuring petroleum density (specific gravity).
[196] IEA, *New Zealand 2017 Review*, 28, 50.
[197] Personal communications with Refining NZ.
[198] New Zealand crude is predominantly shipped to Australian refineries (91% in 2015) and the remainder to countries in Asia (Korea 2%, Singapore 3% and Malaysia 4%). IEA, *New Zealand 2017 Review*, 28, 50; MBIE, "Oil Statistics," MBIE, accessed 2 October, 2019, https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/oil-statistics/.
[199] Hale & Twomey and Covec, *Oil Security* (Covec, 2005), 37, http://www.haletwomey.co.nz/wp-content/uploads/2014/08/Oil-security-Feb-2005.pdf.
[200] Personal communication with Refining New Zealand. Cold properties include the cloud point and pour point.

requirements, it can be concluded that even in an emergency New Zealand's oil self-sufficiency would be lower than current net import values suggest.

Supply concentration

As noted, refineries configured to use one type of crude are either incapable of refining other types of crude, or have the capability to do so but would entail economically sub-optimal

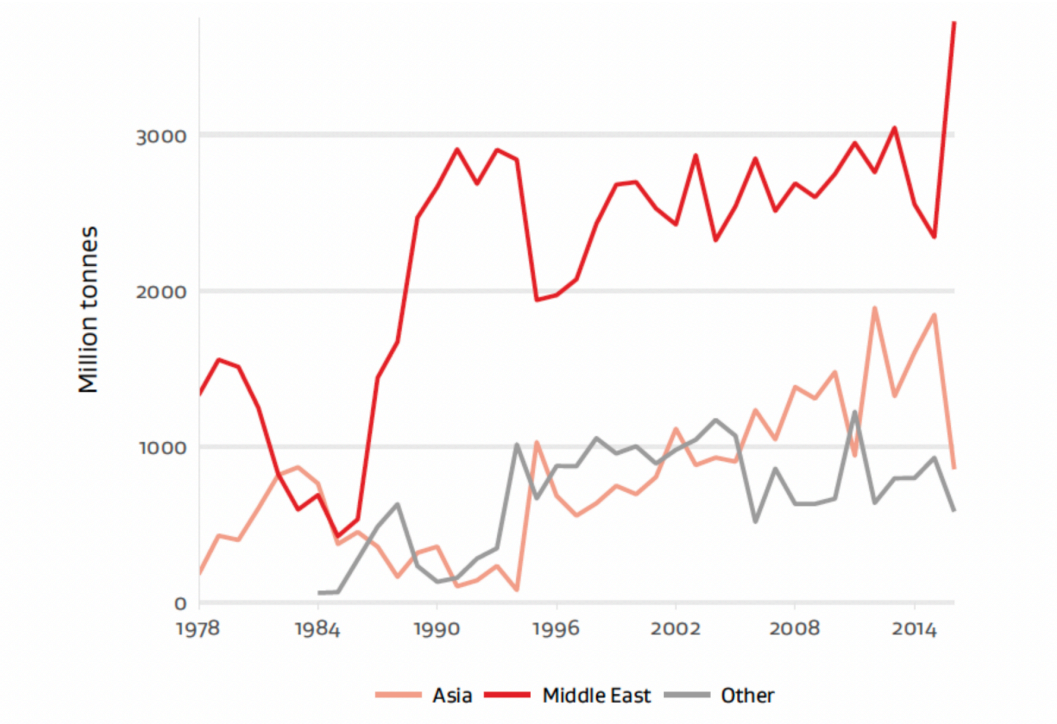

Figure 5: New Zealand crude oil imports by origin (Mt).[201]

operation.[202] Refinery configurations therefore determine to a major extent which countries are viable suppliers, and thereby are an important determinant of a state's resilience to supply shocks and ability to minimise the related costs.[203] The crudes refined at Marsden Point come from numerous sources, with quantities purchased from producer countries varying each year. Figure 5 illustrates that New Zealand has historically sourced crude predominantly from the Middle East, and South-east and Central Asia, consistent with the Marsden Point refinery's configuration. Saudi Arabia, the United Arab Emirates (UAE), Qatar, Kuwait, Brunei,

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[201] MBIE, *Energy in New Zealand 2017*, 24.
[202] Inwook Kim, "Refining the Prize: Chinese Oil Refineries and Its Energy Security," *The Pacific Review* 29, no. 3 (2016): 362.
[203] Ibid., 361.

Malaysia, Indonesia, the Russian Federation and Australia have been common sources of crude oil over the past two decades.[204] Nevertheless, continuing this pattern, over the last five years

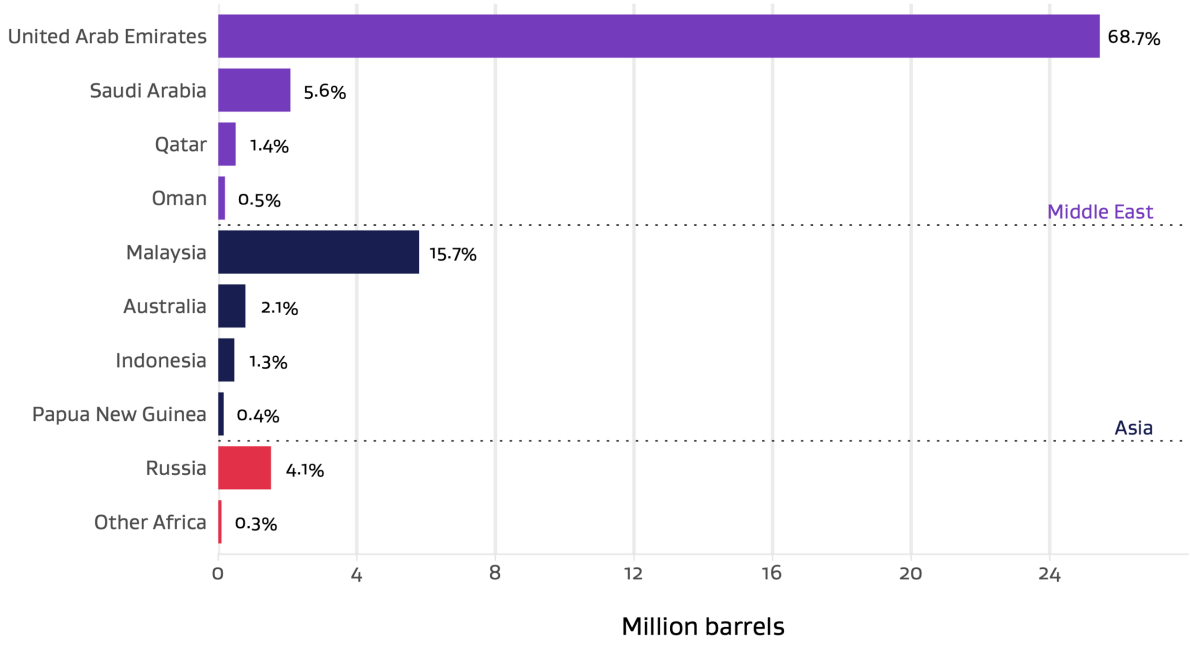

Figure 6: New Zealand 2018 crude oil imports by origin (Mb).[205]

more than half of annual crude oil imports have been sourced from countries in the Middle East, particularly the Persian Gulf countries.[206] Furthermore, supplies from this region have consolidated since 2015, with Figure 6 showing 76% of crude imports in 2018 coming from Gulf states.[207] Notably, crude oil imports from Australia – New Zealand's closest external source and once a prominent supplier – have fallen substantially over time, accounting for just 2% of New Zealand's total imports in 2018.[208]

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[204] MBIE, *Energy in New Zealand 2018*, 31; MBIE, *Energy in New Zealand 2017*, 24; MBIE, *Energy in New Zealand 2016*, MBIE (MBIE, 2016), 35, https://www.mbie.govt.nz/assets/3b750c2ecc/energy-in-nz-2016.pdf; MBIE, *Energy in New Zealand 2015*, MBIE (MBIE, 2015), 27, https://www.mbie.govt.nz/assets/1c22f85721/energy-in-new-zealand-2015.pdf; MBIE, *Energy in New Zealand 2014* (MBIE, 2014), 36, https://www.mbie.govt.nz/assets/3318904e46/energy-in-new-zealand-2014.pdf; IEA, *New Zealand 2017 Review*, 51; MBIE, *Energy in New Zealand 2019* (MBIE, 2019), 45, https://www.mbie.govt.nz/dmsdocument/7040-energy-in-new-zealand-2019. Import levels for each country can vary considerably between years. In 2018, 69% of crude oil imports came from the UAE, followed by 16% from Malaysia, 6% Saudi Arabia, 4% Russian Federation, 2% Australia, and 3.9% from other countries in the Middle East, Asia and Africa. In 2017: 44% UAE, Singapore 24% (transited), Malaysia 12%, Saudi Arabia 5%, 3% Qatar, 3% Russia, 2% Abu Dhabi, 1% Kuwait, 1% Australia, and 4% from other countries in the Middle East. In 2015: Qatar 21%, Brunei Darussalam 16%, Russia 16%, Malaysia 15%, United Arab Emirates 10%, Saudi Arabia 9%, Indonesia 5%, Kuwait 4%, Australia 2% and others.
[205] MBIE, *Energy in New Zealand 2019*, 45.
[206] MBIE, "Oil Statistics."
[207] MBIE, *Energy in New Zealand 2019*, 45.
[208] Ibid.

In the event of a major disruption to Middle East supply, petroleum sourced from other countries and regions can be used where available, but again New Zealand's options are limited by the compatibility of the crudes these suppliers produce with the configuration of Marsden Point. RNZ reports that its refinery's current crude diet is lighter than in the past, but the diet is still blended to be optimal for the existing facility. However, changing to an even lighter diet would require major investment in refinery upgrades that RNZ would struggle to justify on a commercial basis.[209] Consequently, some lighter grades of crude on today's market may not constitute suitable alternatives to the refinery's usual feedstock. For example, the US might be considered an alternative source given the significant flows of 'tight' shale oil now being extracted within the country. However, many of these tight crudes are relatively light,[210] and therefore may not constitute a viable alternative source of supply for New Zealand.[211] Therefore, like many other oil importing countries in the Asia Pacific, New Zealand remains highly dependent on supplies of Middle East petroleum. Thus, any sizeable disruption in exports from its suppliers in this region will have a comparatively large impact on the nation's oil supply. While the internal stability of each Middle East supplier varies, the region as a whole has historically been unstable, with a number of the drivers of that instability still present today.[212]

4.3.2 Midstream Dependency & Vulnerability

Transportation

As a geographically isolated island nation, New Zealand has a comparatively greater reliance on shipping within its oil supply chain than the global average. The integrity of New Zealand's SLOCs is therefore critically important for the country's security of oil supply and economic security overall. However, maritime trade is far from risk free, and threats to shipping such as piracy and blockade have negatively impacted the New Zealand economy in the past.[213]

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[209] Personal communication with Refining NZ.
[210] Emily Geary, "The United States Tends to Produce Lighter Crude Oil and Import Heavier Crude Oil," (EIA, 23 August 2019). https://www.eia.gov/todayinenergy/detail.php?id=41033.
[211] Refining NZ and the companies that use the facility are still determining the appropriateness of certain grades of shale oil for processing at the refinery: Personal communication with Refining NZ.
[212] Anthony H. Cordesman, *Stability in the MENA Region: The Range of Forces Shaping Stability* (Center for Strategic and International Studies, 2018), http://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/180403_Stability_in_MENA_Region_slides.pdf.
[213] Royal New Zealand Navy, *RNZN Plan: 2017-2025* (NZDF, 2017), 9, http://navy.mil.nz/downloads/pdf/public-docs/rnzn-plan-2017-2025.pdf.

Flexibility of crude transport routes can be an important consideration when determining a nation's supply security as it influences the ability of a state to mitigate some disruptions. With maritime transport, greater supply line flexibility is generally considered a security advantage as it allows disruptions to SLOCs to be managed by sailing different shipping routes.[214] While modelling of responses to maritime transport disruption does not appear within New Zealand's existing fuel security reports, the country's island geography provides flexibility through greater choice of shipping routes. Open sea interdiction of petroleum or refined product bound for New Zealand waters would therefore be relatively difficult to achieve. However, while

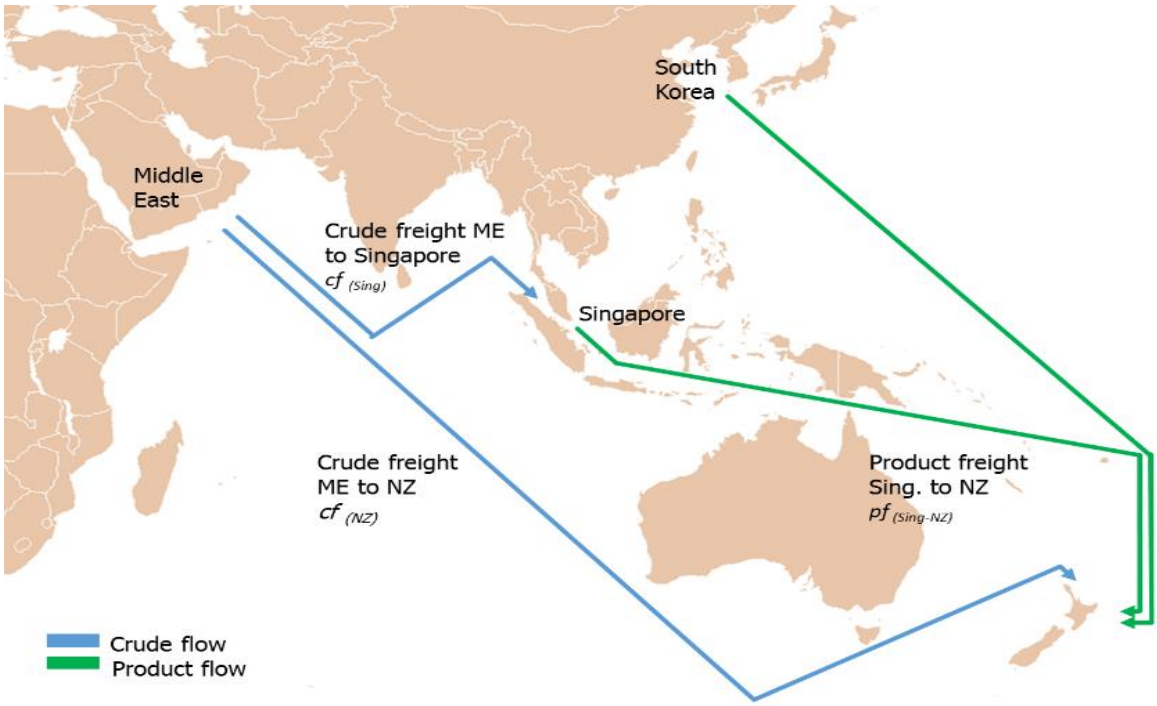

Figure 7: New Zealand crude and product supply.[215]

New Zealand's geography may offer flexibility in theory, in practice the nation's dependency on sources of supply from the Indo-Pacific region means the diversity of standard transport routes is low. The majority of crude and refined product bound for the country travels via key shipping routes through the Indian Ocean as shown in Figure 7; a primary transit region for international petroleum trade.[216]

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[214] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 21, 24.
[215] Hale & Twomey, *Independent Review of the Refining NZ Processing Agreement* (Hale & Twomey, 2014), 2, https://www.refiningnz.com/refininglogin/wp-content/uploads/2018/06/review-of-processingagreement-haletwomey-2014.pdf.
[216] Sweijs et al., *The Maritime Future of the Indian Ocean*, 7-9.

Supply Chain Length

The length of New Zealand's petroleum transport routes is also of significance to its security of oil supply. New Zealand is geographically isolated and at the very end of global crude and refined product supply chains. Shipments departing from Middle East oil terminals take approximately 25-30 days to reach New Zealand, while crude and product shipments from South East and East Asia take 15-20 days.[217] The length of New Zealand's supply chain necessitates there be numerous vessels at any one time on route to New Zealand. In 2012, Marsden point required a vessel carrying 105-145 million litres every 7-10 days to meet demand.[218]

From one perspective, shipments in transit could be considered additional crude and product reserves stored on the high seas. As such, in the instance of a significant disruption to exports from supplier nations, New Zealand may be one of the last countries to feel the effects, thus offering time to respond to a supply disruption. Conversely, it may take longer for supplies to recommence delivery to New Zealand once the disruption has been resolved. Moreover, it is also isolated from other countries that New Zealand might expect to receive additional supplies from in an emergency.[219] Regarding crude or product on water as additional supply also requires there be no possibility these shipments could be interdicted or diverted to an alternate country en route - an assumption remaining to be tested.[220] A longer supply chain may also mean a higher likelihood of supply disruption in certain circumstances,[221] and an amplification of impacts if the maritime supply line itself is compromised. Regardless of whether stock on sea can be relied upon, it is clear New Zealand's security of supply is largely predicated on uninterrupted functioning of the SLOCs through which the country sources the majority of its petroleum and refined products. The IEA concludes that New Zealand's geographical

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[217] Hale & Twomey and Covec, *Oil Security*, 12.
[218] Ministry of Civil Defence & Emergency Management, *National Civil Defence Emergency Management Fuel Plan: Supporting Plan [Sp 03/12]* (2012), 28, https://www.civildefence.govt.nz/assets/Uploads/publications/sp-03-12-national-cdem-fuel-plan-part-a.pdf.
[219] Hale & Twomey and Covec, *Oil Security*, 10.
[220] Hale & Twomey, *Australia's Maritime Petroleum Supply Chain*, 36; Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 30. Hale & Twomey address such a possibility in their report on Australia's petroleum supply chain. They conclude that it is unlikely to happen given the "free on board" status of most shipments as this would have significant practical, legal, commercial and reputational issues associated with it for the domestic importing company, unless directed by the government to do so. Whether these would be a sufficient deterrent within the New Zealand market setting is not examined here.
[221] Vivoda, "Diversification of Oil Import Sources and Energy Security: A Key Strategy or an Elusive Objective?."

remoteness and physical distance from its primary supply sources necessitates the country be highly resilient to sudden changes in supply and demand.[222]

Chokepoints

New Zealand's imported petroleum and refined product transport routes contain a number of chokepoints, with the vast majority of imports transiting through either the Strait of Hormuz, the Strait of Malacca, or both. These chokepoints rank one and two in the world respectively in volume of oil transits, and thus are the most strategically important maritime chokepoints for petroleum transportation.[223] Any partial or total closure of either of these Straits would therefore lead to significant interruption of New Zealand's tanker shipments, and those of many other countries. Both chokepoints are highly vulnerable to disruptive attacks from state and non-state actors, including through terrorism or piracy.[224] Furthermore, Tunsjø notes that the Strait of Hormuz and the Strait of Malacca are also vulnerable to collisions, oil spills or grounding – deliberate or otherwise – which could force either strait's closure and interrupt oil shipments.[225]

The Strait of Hormuz between the Persian Gulf and the Gulf of Oman is the largest chokepoint by volume of petroleum and refined product transit in the world, with the vast majority of exports from Iran, Iraq, Qatar, Kuwait, Saudi Arabia and UAE passing through the Strait. Approximately 16 mb/d of crude and 4 mb/d of products shipped through the Strait in 2018,[226] accounting for approximately 30% of global maritime trade in these commodities.[227] While the Strait at its narrowest point is 34 kilometres wide, the shipping lane in either direction is only 3.2 kilometres wide.[228] There has been a history of significant geopolitical incidents both in the Strait and the broader region, with the most recent noteworthy disruption to oil transport being the targeted disabling of five tankers within the Strait and surrounding area in 2019.[229]

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[222] IEA, *New Zealand 2017 Review*, 18.
[223] EIA, "World Oil Transit Chokepoints."
[224] Sweijs et al., *The Maritime Future of the Indian Ocean*, 7.
[225] Øystein Tunsjø, *Security and Profit in China's Energy Policy* (New York: Columbia University Press, 2013), 140.
[226] IEA, *Energy Security in ASEAN+6*, 10.
[227] EIA, "World Oil Transit Chokepoints."
[228] Ibid.
[229] International Maritime Organization, "International Maritime Organization Council Condemns Tanker Attacks in Strait of Hormuz and Sea of Oman," news release, 18 July, 2019, http://www.imo.org/en/MediaCentre/PressBriefings/Pages/15-IMO-Council-condemns-tanker-attacks.aspx.

Closure of the Strait of Hormuz would be particularly disruptive, as unlike many other chokepoints there is no alternative shipping route. Any closure would therefore effectively trap in the bulk of Arabian Gulf producer exports and OPEC spare capacity.[230] Alternative pipeline routes are available but their capacity only enables the transport of a fraction of the volumes that normally transit the Strait; pipeline capacity stood at 6.6 mb/d at the end of 2018.[231] Furthermore, only Saudi Arabia and the UAE have pipelines that bypass the Strait to the Red Sea and the Gulf of Oman respectively.[232] The IEA estimates that in the event of a total closure of the Strait of Hormuz, 16 mb/d of oil would be blocked in even if all existing pipeline spare capacity was utilised.[233] A petroleum supply disruption of this size would be almost three times greater than the largest global disruption to date.

With three quarters of its petroleum imports coming from Gulf producers, any restriction of tanker shipments through the Strait of Hormuz would likely impact New Zealand's supply. From a regional perspective, oil supplies to the Asia-Pacific would be particularly hard hit given that approximately 80% of the oil heading through this chokepoint is destined for the region.[234] Were a significant disruption of oil flows through the Strait to occur for an extended period of time, the Asia-Pacific would also face particular difficulty regarding tanker capacity. As Mitchell notes, there would be logistical constraints to the shifts in trade required to respond to such a disruption, because alternative sources of oil from Africa and South America take longer to ship to the Asia-Pacific than from the Middle East. In addition, many tankers could be trapped in the Gulf and others might be in the wrong locations. The initial result would be a period of acute tanker capacity shortage before substitute oil supplies could be redirected from the Atlantic market, even in the case where the U.S. or Europe released emergency oil stocks.[235] Therefore, given the importance of Gulf oil exports as a proportion of global supply, a closure of the Strait of Hormuz would lead to a severe spike in petroleum and product prices and shipping and insurance rates, imposing a large shock on the global economy.[236]

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[230] IEA, *Energy Security in ASEAN+6*, 10.
[231] Ibid.
[232] Ibid.
[233] Ibid.
[234] EIA, "World Oil Transit Chokepoints."
[235] John Mitchell, *Asia's Oil Supply: Risks and Pragmatic Remedies* (Chatham House, 2014), 3, https://www.chathamhouse.org/publication/asia-s-oil-supply-risks-and-pragmatic-remedies.
[236]International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 16.

The Strait of Malacca is the second largest oil trade chokepoint in the world, and at only 2.8 kilometres wide at its narrowest point, generates one of the world's largest maritime traffic bottlenecks.[237] It is the shortest sea route between Arabian Gulf oil suppliers and Asian consumer markets, with approximately 16 mb/d of crude and petroleum products transiting the strait in 2016.[238] Given their dependence on Middle East exporters, a significant proportion of crude used by the Asian refineries that supply petroleum products to New Zealand travels through the Strait. Compared to the Strait of Hormuz, the region surrounding the Strait of Malacca has been relatively stable. While piracy in the Strait has been an issue in the past, incidents have declined notably since the 1990s and 2000s as a result of intensive enforcement programmes by the region's littoral states.[239] In the broader maritime region there are ongoing tensions over competing territorial claims within the South China Sea, raising maritime security concerns.[240] In recent years, tensions have risen further as a result of China's land reclamation and island building activities in the area, and subsequent building and placement of military assets on the new landmasses.[241] These developments are in addition to wider regional security issues, such as Taiwan's independence and a nuclear-armed North Korea.

A disruption in the strait of Malacca poses less risk to New Zealand than a closure of Hormuz as there are several ways to circumnavigate it. However, tanker rerouting would result in longer journeys and thus shipping costs, which would be reflected in oil prices.[242] By one estimate, a Malacca strait closure would lead to shipping times between the Middle East and East Asia increased by 4 to 16 days one-way depending on the alternative route available,[243] and would result in much higher shipping costs.[244] As a result, any disruption of maritime traffic within the Strait and surrounding area would add significant transport time and distance to New Zealand's already lengthy petroleum and refined product supply chains. Rerouting around the Strait of Malacca would also tie up global shipping capacity, further increasing shipping costs and affecting oil prices.[245] An outright shortage of tanker capacity could occur in a more

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[237] Tunsjø, *Security and Profit in China's Energy Policy*, 140.
[238] IEA, *Energy Security in ASEAN+6*, 10.
[239] Tunsjø, *Security and Profit in China's Energy Policy*, 142.
[240] International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 21.
[241] Council on Foreign Relations, "Global Conflict Tracker: Territorial Disputes in the South China Sea," updated 25 June, 2020, https://www.cfr.org/global-conflict-tracker/conflict/territorial-disputes-south-china-sea.
[242] Tunsjø, *Security and Profit in China's Energy Policy*, 140.
[243] Gabriel B Collins and William S Murray, "No Oil for the Lamps of China?," *Naval War College Review* 61, no. 2 (2008): 84.
[244] Fattouh, *How Secure Are Middle East Oil Supplies?*, 15.
[245] EIA, "World Oil Transit Chokepoints."

extreme scenario if shipping access to the South China Sea was restricted and tankers were forced to a detour around the Philippines.[246]

In contrast to the above, fears of closure of either Strait through deliberate state actions are thought by some to be exaggerated, as most states have a shared interest in continual flows through them.[247] Fattouh for instance notes that a closure of the Strait of Hormuz would only occur in the most extreme scenario, given the damage from a closure would be indiscriminate; all exporters would suffer. Moreover, if a state actor were to do so it would face alienation, retaliation or retribution from many consuming countries.[248] But while states may have significant shared interest in maintaining trade flows through either chokepoint, non-state actors could also cause significant disruption, and the motivation of such actors engaged in piracy or terrorism could be very different.[249] Moreover, despite a generally shared interest in freedom of navigation between nations, Neel and Barnes note that this does not mean that there is a consensus on how to cooperate to ensure this outcome.[250] At present there remain significant and ongoing questions as to who should be responsible for maintaining SLOC security between the Middle East and Southeast Asia, and who should bear the costs.[251]

4.3.3 Downstream Dependency & Vulnerability

Refining

Refining capacity is also regarded as a factor influencing oil security.[252] As with crude oil import dependence, a lower reliance on other countries for refined product is considered to be a more secure position.

RNZ's Marsden Point refinery is generally considered capable of meeting the majority of domestic demand.[253] It has a crude oil capacity of 135,000 barrels per day,[254] and its 2018 crude

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[246] John H Noer and David Gregory, *Chokepoints: Maritime Economic Concerns in Southeast Asia* (Washington, DC: National Defence University Institute for National Strategic Studies, 1996), 43.
[247] International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 21.
[248] Fattouh, *How Secure Are Middle East Oil Supplies?*, 15.
[249] International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 21.
[250] Neel Greet and Paul Barnes, *The Challenge of Energy Resilience in Australia: Strategic Options for Continuity of Supply* (Australian Strategic Policy Institute, 2017), 20, https://www.aspi.org.au/report/challenge-energy-resilience-australia-strategic-options-continuity-supply?
[251] Energy Studies Institute, *The Future of Sea Lane Security between the Middle East and Southeast Asia*, Meeting Summary (Singapore and London: Energy Studies Institute and Chatham House, 2015).
[252] Mohsin et al., "Assessing Oil Supply Security of South Asia," 5261.
[253] MBIE, "Oil Statistics."
[254] Refining New Zealand, "Refining Key Facts," accessed 24 April, 2020, https://www.refiningnz.com/media/key-facts/.

intake of 42.7 million barrels of crude oil equates to approximately 87% of nominal processing capacity.[255] In 2018, the refinery produced 85% of the country's jet fuel, 67% of diesel, 58% of petrol and all fuel oil for maritime vessels,[256] with 2019 combined fuel product volumes equivalent to 70% of all fuel consumed in New Zealand.[257]

The balance of demand is satisfied by imported refined product. The main suppliers in the Asia Pacific able to meet New Zealand's quality standards are located in South Korea, Singapore, Japan and Taiwan,[258] with refined product being predominantly imported from Singapore and Korea in recent years.[259] Sourcing from Asian refineries as close as possible to New Zealand generally makes sense economically as this reduces shipping costs, but more distant locations can be economical from time to time.[260]

The reason a portion of New Zealand's fuel requirements are imported relate to the capacity and capabilities of the refinery and commercial decisions, but also because of the refinery's ownership structure. RNZ is a tolling refinery company, charging a fee to process crude oil delivered to it by customer shareholders. Z Energy, BP and Mobil own a combined 65% stake in the refinery, with the remainder owned by the public. A processing agreement in place since the refinery was built dictates that only these three companies are entitled to take products from the refinery.[261] This leaves New Zealand's independent wholesaler, Gull, in the position of relying on imported oil products.[262] All the refinery customers also meet some of their demand by directly importing finished product cargoes from refineries in Asia, and occasionally further abroad, when it is economical to do so.[263]

Given that the majority of New Zealand's demand is met by fuel refined domestically, disruption to overseas refining capabilities is less of a consideration for New Zealand than disruption to crude supply. This is in contrast to countries like Australia that rely on external

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[255] Refining New Zealand, *Refining New Zealand Annual Report 2019* (2019), 36, https://www.refiningnz.com/wp-content/uploads/2020/03/Refining-NZ-Annual-Report-2019.pdf.
[256] Refining New Zealand, *Refining New Zealand Annual Report 2018* (2018), 19, https://www.refiningnz.com/wp-content/uploads/2019/03/Annual-Report-2018.pdf.
[257] Refining New Zealand, *Refining New Zealand Annual Report 2019*, 14.
[258] Hale & Twomey, *Independent Review of the Refining NZ Processing Agreement*, 2.
[259] MBIE, *Energy in New Zealand 2016*, 36; MBIE, *Energy in New Zealand 2018*, 32. in 2017, 55% from Singapore, 35% from Korea, 4.5% USA. in 2015, Singapore 56%, Korea 33%, U.S. 6%, Japan 3%, Australia 2%.
[260] Hale & Twomey, *Independent Review of the Refining NZ Processing Agreement*, 2.
[261] IEA, *New Zealand 2017 Review*, 54.
[262] Ibid., 56.
[263] Hale & Twomey, *Independent Review of the Refining NZ Processing Agreement*, 1.

suppliers to meet a much greater proportion of their refined product demand.[264] Nevertheless, New Zealand imports a notable portion of its petroleum-based fuel needs. A significant disruption to refining within Asia could therefore have a sizeable impact on New Zealand's product supply.

A significant reduction in regional availability to refined product would almost certainly impact companies operating in the Asia-Pacific market in addition to oil companies operating in New Zealand, be it directly through loss of expected supply or indirectly through price spikes.[265] In their assessment of Australia's fuel supply chain, Hale & Twomey note that a higher price would incentivise product flows from other markets such as the Atlantic Basin or Europe, but Australian importing companies could experience a lag in availability particularly if there was a need to switch to new supply points.[266] Companies operating in New Zealand would likely face a similar situation. In New Zealand's case, refined products from some alternative sources may be usable but not meet New Zealand fuel specifications, and so may require certain specification requirements to be waived in an emergency.[267]

Fuel importing companies operating in New Zealand therefore have options to procure refined product should a significant disruption to product supply occur. New Zealand's ability to purchase from alternative sources and the level of price increase would depend on the scale of the disruption to regional supply, as well as the level of unaffected spare refining capacity available and spare capacity within the product shipping market.

Regional uncertainties aside, the Asian countries from where New Zealand predominantly sources refined product are generally considered politically stable.[268] Refining capacity in Japan, Singapore and South Korea is also split between multiple refineries. Sustained and significant loss of refining capacity in one or more of these countries would likely only occur in the most extreme circumstances. However, like Marsden Point, the vast majority of refinery feedstock used by New Zealand's overseas product suppliers is sourced from the Middle East,

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[264] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 3.
[265] Hale & Twomey, *Australia's Maritime Petroleum Supply Chain*, 34.
[266] Ibid.
[267] Hale & Twomey, *New Zealand Petroleum Supply Security 2017 Update*, 11.
[268] The Fund for Peace, "Fragile States Index," accessed 3 April, 2020, https://fragilestatesindex.org/analytics/fsi-heat-map/.

and often at levels higher than New Zealand.[269] Many Asian refineries are configured to process grades of oil sourced from the Middle East, and would face difficulties in converting to using alternative grades.[270]

4.4 Summary

Despite consuming a moderate amount of oil per capita when compared to other developed countries, oil remains the dominant energy source within New Zealand's energy mix. New Zealand's domestically produced crude is not suited to the country's current refining capabilities nor is it produced in sufficient quantities to satisfy national demand. New Zealand is therefore almost entirely dependent upon petroleum imports. The critical role that oil plays in New Zealand's wellbeing and in conjunction with the country's highly inelastic demand, leave it particularly vulnerable to oil price shocks and physical supply disruptions. New Zealand relies solely on the international oil market to source crudes in the volumes and grades required. While participation in this market offers access to multiple suppliers, New Zealand's imports have historically been, and remain, heavily concentrated on Middle East producers. Consequently, New Zealand's only refinery is specifically configured for Middle East petroleum grades, as are the refineries in Asia from which the country sources refined product. Importing petroleum from the Middle East and refined product from Asia introduces more complex and longer maritime supply lines that in the event of geopolitical turmoil could be subject to significant disruption. These disruptions could impact both New Zealand and Asia, and because of the country's geographic isolation be disproportionately impactful on New Zealand. These factors are fundamental to the reliability of New Zealand's oil supply system, and therefore should be an integral part of any robust assessment of oil security intended to inform policymaking.

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[269] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 23. This report states that over 80% of feedstock for refineries in Singapore and Korea and Japan are sourced from the Middle East.
[270] IEA, *World Energy Outlook 2019*, 168-69.

5 Security of Oil Supply Policy

5.1 Introduction

As has been demonstrated, risks to the integrity of the oil supply chain and oil markets are beyond the capacity of nation states to eliminate, either individually or collectively. However, a country's dependence on imported oil supplies and vulnerability to disruptions of that supply can be minimised and mitigated by the energy policies adopted. Oil importing states currently adopt a mix of security policies, and any assessment of policy mix efficacy requires an understanding of both each policy's instrumentality, and the specific actions entailed.

The field of energy policy is complex; there are a range of policy elements that can directly or indirectly relate to oil security objectives. Furthermore, energy policy is inextricably intertwined with other key state policy agendas, including resource management, economic competitiveness, environmental well-being, technology investment, research expenditure, export competitiveness, tax regimes, and export competitiveness.[271]

Borrowing from Van der Linde et al, Chapter 2 introduced a schedule of 21 oil security policy instruments available to state actors. These instruments can be used to achieve four security of oil supply objectives:[272]

i. *Prevention* - creating a political environment where there are fewer grounds for oil supply disruptions;

ii. *Deterrence* - preventing or deterring producer states from disrupting oil supplies for political reasons;

iii. *Containment* - reducing the impact of an oil supply disruption on national security and the economy;

iv. *Crisis Management* - mitigating harm during an oil supply disruption.

Specific policy instruments can often help achieve prevention and containment, and sometimes even deterrence objectives. In addition, they may also represent necessary precursors to effective crisis management.[273] The most consequential policy instruments that directly relate

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[271] Brian Lynch, "The Foreign Policy Implications of Energy Security," *New Zealand International Review* 33, no. 2 (2008): 26.
[272] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 64.
[273] Ibid.

to the security objectives – including those that involve changing relevant energy system characteristics over time – are examined below.

5.2 Import Substitution

Adopting policies to promote domestic energy production and limit import dependence is perhaps the most effective method for a country to reduce the risk associated with dependence upon external oil supply. Developing and using domestically produced energy rather than relying on imports from other countries can greatly increase security,[274] reducing external supply risks while also potentially increasing diversification by providing alternative supply sources.[275]

Such security-boosting policies include incentivising the use of domestic petroleum sources and refining infrastructure. If domestic sources are not internationally competitive, governments can encourage their use or development by enacting supporting policies including subsidies or tariffs.[276] A heavier handed approach may be to implement an export ban on domestically produced oil, as the US did to reduce vulnerability in response to the 1973 oil crisis.[277] If there are insufficient domestic supplies a country can compensate to some extent by instead substituting with other domestically produced energy sources where possible; for example, through use of renewables or nuclear power.[278]

Reducing oil import dependency through expansion of domestic sources can be an expensive approach, and one that may not necessarily provide a net benefit. Policies promoting domestic energy production may not be beneficial if it results in consumers paying stable yet consistently higher domestic supply costs that are cumulatively over and above the cost associated with disruptions and price spikes.[279] Furthermore, domestic energy supplies are not always safer than imported sources. Domestic risks may lead to shortages - the UK industrial action of the 1980s that resulted in coal shortages is a case in point.[280] Van der Linde et al. also note that

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[274] Ibid., 65.
[275] Hale & Twomey and Covec, *Oil Security*, 82, 89.
[276] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 65.
[277] Robert Rapier, "Why the U.S. Exports Oil," *Forbes*, 30 September 2017, https://www.forbes.com/sites/rrapier/2017/09/30/why-the-u-s-exports-oil/#2f1642f23b07; Gerald R. Ford, Address before a Joint Session of the Congress Reporting on the State of the Union, 15 January 1975, Speech, Gerald R. Ford Library.
[278] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 65, 224.
[279] NZIER, *New Zealand Oil Security Assessment Update*, 11.
[280] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 64.

reducing import dependency does not necessarily lead to a proportional drop in the importance of external security of supply: "The assumption that security of supply is less an issue with an import dependency of 30 or 40 percent of domestic demand than with 50 percent or 60 percent can be false, when the ability to switch fuels is almost absent in the first situation and when one particular sector, for example transport or electricity generation, is entirely dependent on certain supplies."[281]

5.3 Diversification

Policies to improve diversification relate to the range of available fuel types and sources and technology types and sources.[282] Generally, improving diversification of oil source and energy type are considered to increase supply security the most.[283]

5.3.1 By Source

The greater the national and geographical diversification of petroleum supplies, the lower the risk associated with losing supply from any one source.[284] By extension, a diversified supplier base also hedges against market power.[285] This applies even where the oil market is considered fully integrated, given the majority of oil is sold on a term contract basis and is not immediately available even when higher prices are offered.[286] Diversification of supply toward more politically stable countries can also shield an importing country from some geopolitical risks.[287]

Diversification of oil sources can be encouraged in a number of ways. A state may impose limits on the quantities of oil that importing companies can acquire from certain regions or countries and thus force purchases from other suppliers. Alternatively, economic policies can be used to incentivise widening the corporate or regional supplier base, as some countries like South Korea have done to reduce their reliance on Middle East oil.[288] Similarly, to mitigate

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[281] Ibid., 44.
[282] Ibid., 65.
[283] NERA, *Security in Gas and Electricity Markets: Final Report for the Department of Trade and Industry* (London: NERA, 2002), 7.
[284] Gupta, "Oil Vulnerability Index of Oil-Importing Countries," 1198.
[285] Kruyt et al., "Indicators for Energy Security," 2168.
[286] Gupta, "Oil Vulnerability Index of Oil-Importing Countries," 1198.
[287] Kruyt et al., "Indicators for Energy Security," 295.
[288] To reduce dependence, South Korea has agreed to free trade agreements with non-Middle East oil producers which reduces tariffs on oil from these countries, and provides rebates for importers' shipping costs for oil from the Americas, Europe and Africa: Charles Lee, "S. Korea to Offer Refiners Incentives to Diversify Crude Import

exposure to Middle East supply, China and India have bought crude oil from more distant sources in the Atlantic basin, with the differential in delivery costs regarded as an 'insurance' premium.[289] Pursuing diversification policy may also require modification to the technological configuration of a country's refineries, which allows the state a broader range of crude oil to import in both normal operation and in a crisis to substitute lost supplies.[290]

For NOCs with government backing and sufficient economic power, diversification of source may include FDI in development of new sources of oil, and pursuing horizontal and vertical integration. Some countries use their NOCs to address or at least mitigate security of supply concerns, as well as to balance against the power of exporting countries and their NOCs as well as prominent private oil companies.[291] For example, the Chinese government has explicitly supported and set targets for Chinese NOCs to secure overseas production and long-term supply contracts.[292] This policy has been accompanied by an expansion and upgrading of refining capacity to enable the processing of a wider range of oil grades from different regions.[293] Diversification of source approaches like the above can therefore entail significant cost and risk and thus are generally restricted to large economies, although even for these countries success is not assured; Japanese oil companies' prior failings with similar policies show the cost and risk associated with this approach.[294]

5.3.2 By type

Diversification of energy types to reduce a nation's dependence upon petroleum can improve both energy security and resilience to shocks.[295] When consumers have multiple energy supply

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Sources," *S&P Global Platts*, 11 July 2014, https://www.spglobal.com/platts/en/market-insights/latest-news/oil/071114-s-korea-to-offer-refiners-incentives-to-diversify-crude-import-sources; Meeyoung Cho, "S.Korea Pressures Mideast Suppliers with American, European Crude Buys," *Reuters*, 20 April 2015, https://www.reuters.com/article/south-korea-crude-supplies/s-korea-pressures-mideast-suppliers-with-american-european-crude-buys-idUSL3N0WZ08H20150420.

[289] Nersesian, Roy 2016. "Energy Economics: Markets, History & Policy". Routledge New York

[290] Kim, "Refining the Prize: Chinese Oil Refineries and Its Energy Security," 367.

[291] Tordo, *National Oil Companies and Value Creation*, 23.

[292] Tunsjø, *Security and Profit in China's Energy Policy*, 133.

[293] Kim, "Refining the Prize: Chinese Oil Refineries and Its Energy Security."

[294] Loftur Thorarinsson, *A Review of the Evolution of the Japanese Oil Industry, Oil Policy and Its Relationship with the Middle East* (Oxford Institute for Energy Studies, 2018), https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018/02/A-Review-of-the-Evolution-of-the-Japanese-Oil-Industry-Oil-Policy-and-its-Relationship-with-the-Middle-East-WPM-76.pdf.

[295] NZIER, *New Zealand Oil Security Assessment Update*, 10.

options available - for example, to heat buildings or to transport people and goods - the impact of oil supply disruptions can be reduced.[296]

Again however, diversification of energy types is not inherently positive. Security is not improved if less reliable sources of energy are introduced into the mix;[297] for example, wind and solar generation are intermittent, creating different energy security challenges.[298] Attempts at diversification of fuel types can also be difficult and take time, particularly in the case of oil. The costs of diversification and making substitutes available in sufficient quantities must also be measured against the cost of disruption. [299]

5.4 Flexibility

Improving energy system flexibility can significantly enhance energy security. Improving flexibility requires enacting measures that allow for alternative fuels or an alternative energy mix to be temporarily used when necessary, such as in the case of an oil supply disruption. The greatest opportunity for improving flexibility is within the electricity sector; for example, thermal generators having dual or multi-fuel firing capacity for electricity.[300] Building spare capacity and storage capacity into an energy system also improves system flexibility. Governments can incentivise energy companies to increase and maintain system flexibility.[301] In contrast, there is generally minimal opportunity to fuel switch within the transport sector, as very few vehicles have the technology to accommodate such changes.

5.5 Crisis Management

There are various policies governments can implement that are designed to mitigate harm caused in the event of an energy crisis.

5.5.1 Strategic Reserves

Perhaps one of the most effective and widely used crisis management policy instruments within developed importing countries is the maintenance of strategic reserves of oil; emergency stocks that allow for a shortfall in supply to be dealt with in the short term. In the event of a disruption

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[296] Ministry of Economic Development, *New Zealand Energy Strategy 2011-2021*.
[297] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 66.
[298] Checchi, Behrens, and Egenhofer, *Long-Term Energy Security Risks for Europe: A Sector-Specific Approach*, 42; Gawel et al., *Political Economy of Safe-Guarding Security of Supply with High Shares of Renewables: Review of Existing Research and Lessons from Germany*, 5.
[299] NZIER, *New Zealand Oil Security Assessment Update*, 10.
[300] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*.
[301] Ibid.

to the external supply chain, domestically held stocks become critically important. If new supply is unable to be secured before domestic stocks deplete, then rationing and shortages would occur.[302] Holding emergency oil stocks is therefore the only way to avoid these impacts in some circumstances.[303]

The effectiveness of strategic oil reserves as a response to a disruption is not just dependent upon the volume of the stockholding, but also upon the availability of transport and oil processing facilities when the shortfall occurs. Supply disruptions may also coincide with a decline in transport and refining capacity in the market, a situation faced by the US in 1990 when Kuwait's refining capacity was unavailable following the Iraqi invasion, and the US had insufficient domestic refining capacity for its strategic petroleum reserve.[304] As such, possible crisis management policies may also include strategic reserves of refining and transportation capacity.

Strategic Transportation Reserve

While strategic reserves of oil are typically held within a country's borders, eventually these stocks will need to be replenished. The guaranteed availability of transportation capacity then becomes a critical strategic consideration. There are a variety of policy instruments used to secure strategic reserves of oil transport capacity for access in an emergency. States may achieve this by maintaining transport capacity separate from the international market, as is the case with the US National Defense Reserve Fleet.[305] An alternative approach is to integrate state-controlled shipping capacity within the international shipping market that can then be called upon by the state when needed. China is the most notable example of this strategic approach, successfully enacting a 2005 policy to develop its own large state-owned tanker fleet and have the majority of its imported oil transported in Chinese flagged tankers.[306] The aim of building this domestic tanker fleet is to insure against future threats to oil shipments and maintain uninterrupted oil supply, as well as developing a new Chinese maritime shipping

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[302] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 5.
[303] Hale & Twomey and Covec, *Oil Security*, ii,iii; Fattouh, *How Secure Are Middle East Oil Supplies?*, 23.
[304] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 68.
[305] NERA, *Security in Gas and Electricity Markets: Final Report for the Department of Trade and Industry*; US Department of Transportation, "National Defense Reserve Fleet Inventory," updated 31 January, 2020, https://www.maritime.dot.gov/sites/marad.dot.gov/files/docs/national-defense-reserve-fleet/ndrf-inventory-archive/12276/i200131.pdf. While the size of this fleet was substantial immediately following WWII, its size has declined markedly and the number of tankers still in operation is minimal.
[306] Tunsjø, *Security and Profit in China's Energy Policy*, 136.

industry.[307] China has approached this by integrating state-owned tanker capacity with the international shipping market through NOCs and tanker operators, while maintaining a standby arrangement to 'call on' such capacity for domestic requirements if needed.[308]

Such an approach may not necessarily improve security in all circumstances, however. Some authors have suggested that given the realities of a massive and highly internationalised oil shipping sector, and practices relating to oil on-selling while at sea, relying on private third-party tankers would be a more secure option in circumstances where a country is involved in a conflict. This is because it would be difficult for a hostile state to identify and intercept oil shipments bound for an adversary when carried by private tanker.[309]

On the other hand, access to state-controlled tanker capacity can be a strategic advantage during a conflict in which the country is not involved, or as a way to deal with peacetime risks. Governments can direct state-owned shipping companies to cooperate with specific oil companies or to operate in a war exclusion zone to access terminals during times of crisis. Such emergency measures have not been taken in recent history, although China implemented a similar policy in 2008 that involved diverting shipping capacity for domestic coal needs during a power shortage.[310] State-flagging also provides the legal predicate for providing military protection of maritime vessels.[311]

A country can also use its tankers to work around sanctions or embargoes of one of its major suppliers, as in the above case of China.[312] By having a state-controlled tanker fleet, the country therefore gains access to oil supplies by having the ability to operate where other countries and ship owners refuse to or are prevented from doing so.[313] Furthermore, in times of an emergency or wartime, commercial shipping prices can escalate sharply as operators extract a premium; having state-controlled companies could conceivably allow nations to forego paying such premiums to maintain continued delivery to the home country.[314]

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[307] James R Holmes and Toshi Yoshihara, *Chinese Naval Strategy in the 21st Century: The Turn to Mahan* (New York: Routledge, 2008), 4.
[308] Tunsjø, *Security and Profit in China's Energy Policy*, 132-35.
[309] Ibid., 130-31.
[310] Ibid., 131-32.
[311] Gautam, "Mapping Chinese Oil and Gas Pipelines and Sea Routes," 603-04.
[312] Tunsjø, *Security and Profit in China's Energy Policy*, 135.
[313] Ibid.
[314] Collins and Murray, "No Oil for the Lamps of China?," 86.

5.5.2 Price Policy

Price policy can provide the consumer with protection for a short period of time in the event of a supply disruption.[315] It is possible for a price ceiling to be an efficient crisis management tool in instances where the market fails to absorb a shock, as long as there is a strict and transparent definition of when controls come into effect to avoid unnecessary uncertainty for market players. A maximum price can be used to temporarily protect consumers and can be gradually increased according to an agreed schedule if the shortage becomes prolonged.

Minimum price policy can also be enacted if energy prices fall so low that it endangers producers' investments and the security of the energy system. In the case of oil prices, producers are often able to absorb shocks temporarily as long as variable costs are recovered, however they can be hurt by prolonged low prices.[316]

5.6 Foreign Policy

Foreign policy can be an important part of safeguarding the security of a nation's energy system.[317] By maintaining positive political and economic relations between consuming and producing countries, foreign policy can play an important part in crisis prevention and discouraging states from engaging in hurtful acts.[318] These policies can be bilateral or multilateral in nature.

5.6.1 Bilateral relationships

Major oil producers willingly or unwillingly receive special attention from major oil consumers, including China and the US. Van der Linde et al. state it is evident that these relationships between large producer and consumer countries can clearly have a benefit on energy security. One prominent example includes the US-Saudi Arabia strategic alliance which improved US security of supply in exchange for providing Saudi Arabia protection from external threats.[319]

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[315] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 68.
[316] Ibid., 69.
[317] Ibid.
[318] Ibid.
[319] Ibid., 70.

5.6.2 Multilateral cooperation

There are a significant number of multilateral organisations and initiatives that operate within the energy sphere. Three of the organisations that are considered to have the most relevance within oil security issues will be discussed here.

International Energy Agency

The International Energy Agency (IEA) sits at the centre of developed countries' oil security initiatives. It is an international energy organisation comprising 30 industrialised countries – including New Zealand – established under the auspices of the Organisation for Economic Cooperation and Development (OECD). Established in 1974 following the 1973 oil crisis, the IEA's original mandate was to coordinate response measures in the event of an oil supply emergency.[320] Today, it is an intergovernmental organisation with expertise in energy modelling and research, and is an important source for energy information sharing.[321]

The legal basis for the IEA is the International Energy Programme (IEP), an international agreement on oil crisis management which gives the IEA authority to coordinate collective actions of member states in response to a supply disruption.[322] Central to the implementation of this crisis management instrument is the activation of an oil sharing mechanism and demand management measures, and the establishment of strategic oil reserves.[323]

The strategic stockholding portion of this agreement has been described as the "backbone" of OECD member states' international energy cooperation.[324] IEA members are required to hold reserves of crude or refined product equivalent to 90 days of their prior year's average net oil imports, excluding bunker fuel used by international shipping.[325] Members meet their obligations through stocks held by either government, industry, or agency, or a combination

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[320] This mandate has since expanded to include energy security in general, as well as economic development and environmental protection as they relate to energy use.
[321] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 74.
[322] MBIE, "New Zealand's Participation in the International Energy Programme," accessed 17 March, 2020, https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/international-engagement-on-energy/new-zealands-participation-in-the-international-energy-programme/.
[323] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 74.
[324] Ibid., 68.
[325] MBIE, *Energy in New Zealand 2018*, 34. It should be noted that days of net imports differs from days of consumption, which has been suggested may be a more appropriate measure of a country's security given that it is predicated on how many days stocks of crude and products would last under normal use (Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 30.). The European Union's emergency stock directive for example requires member countries to hold the stock equivalent of 90 days of imports, or 61 days of consumption, whichever is higher.

thereof. Oil stockholdings can be released on to the international oil market for use in the event of a supply emergency in order to stabilise the oil price.[326] The IEA monitors the market and if concerned can call on members to release additional supply when needed. Since its inception, the IEA has initiated three such collective actions to stabilise oil prices following international events: 1991 in the build-up to the Gulf War; 2005 following the damage to offshore and onshore oil infrastructure caused by Hurricanes Katrina and Rita; and 2011 as a response to prolonged disruption of Libyan oil supply resulting from the Libyan civil war.[327] The strategic stockholding also mitigates the market-power of oil producing countries, being described as "…an important policy tool to constrain OPEC in its price ambitions."[328]

The IEP's allocation procedures are designed so that member states collectively share the impact of a disruption. In an instance of an IEP triggering event,[329] members may be required to release or share stocks, implement demand management, and where possible, increase domestic oil production and activate energy system flexibility measures to encourage the switch to other fuels if necessary. All IEA members are required to have procedures in place that allow such transfers to be undertaken if called upon by the IEA.[330] While the emergency allocation procedures have been in place from inception, the IEA's rules for triggering the release and sharing of stocks between members have proven to be unworkable and have yet to be used, despite large disruptions occurring since their establishment.[331]

Acknowledging these issues, the IEA instead developed the Coordinated Emergency Response Mechanism (CERM), which offered a more rapid and flexible approach for managing supply

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[326] New Zealand oil security reports have made note that these strategic stocks should only be used during collective IEA action and to avoid forms of quantity rationing, not as a tool to try and shelter the country from international price spikes: Hale & Twomey and Covec, *Oil Security*, 37.
[327] IEA, "Oil Security," updated 27 November, 2019, https://www.iea.org/areas-of-work/ensuring-energy-security/oil-security.
[328] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 75.
[329] This is where one, several or all IEA members incur or can be reasonably expected to incur a reduction in oil supplies of 7% or more
[330] Hale & Twomey and Covec, *Oil Security*, 7.
[331] Alex Wilson, *International Energy Agency: Origins and Developments* (European Parliament, 2016), 1,11, https://www.europarl.europa.eu/RegData/etudes/IDAN/2016/582015/EPRS_IDA(2016)582015_EN.pdf. Woolrich and Conant note a number of challenges in successfully implementing the emergency programme in practice. Most notable is the high 7% threshold, despite a reduction of less than 7% being capable of causing significant damage to some IEA member's economies. Moreover, even when the threshold has been met, the process is not automatic, meaning the response can potentially be slow, and the governing board can overturn decisions. Mason Willrich and Melvin A Conant, "The International Energy Agency: An Interpretation and Assessment," *American Journal of International Law* 71, no. 2 (1977).

risks and guaranteeing oil supplies.[332] Members are able to have different national responses, as all members do not have to release their emergency stocks or in equal proportions.[333] This is the approach that was used in each IEA intervention, and is considered the main way that the organisation responds to serious risks to supply.[334] Although CERM allows for a more flexible response to supply risks, it has relatively weak enforcement mechanisms, as illustrated when some member countries failed to meet their demand constraint obligations during the Hurricane Katrina intervention, yet suffered no sanctions as a result.[335] One European Parliament report noted that the absence of an enforcement mechanism could result in CERM struggling to be effective during a prolonged supply crisis.[336]

To provide further context, during the three instances of IEA intervention crude and refined product were still available to those willing to pay higher prices, and none of the collective actions drew upon all of the emergency stocks.[337] These facts could be interpreted in two ways: firstly, the level of emergency stocks are excessive given the size of disruptions presently experienced; and secondly, the IEP has not yet been tested to a meaningful extent in a full crisis. The conclusion drawn is that while the IEA undoubtedly provides insurance against supply disruption, it remains in question to what extent it does so.[338]

In terms of its ongoing utility as an oil security policy instrument, there are increasing concerns the collective power of the IEA may be declining as its members begin to account for a smaller proportion of global oil consumption. IEA membership is restricted to OECD countries, and non-OECD countries like China and India that have grown to be among the largest oil consumers are therefore excluded. As a result, the IEA membership's cumulative oil consumption has declined to 46% of the global oil market.[339] More significantly, the IEA's

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[332] Glen Toner, "The International Energy Agency and the Development of the Stocks Decision," *Energy policy* 15, no. 1 (1987); IEA, *Energy Supply Security: Emergency Response of IEA Countries*, IEA (2014), 39, https://www.energy.gov/sites/prod/files/2016/08/f33/IEA%20Emergency%20Response%20of%20IEA%20Countries_2014.pdf.
[333] Wilson, *International Energy Agency: Origins and Developments*, 11.
[334] The IEP does not mention CERM and it requires unanimity of the governing board to be activated. For more information on IEA responses to disruption and the operation of CERM, see: IEA, *Energy Supply Security: Emergency Response of IEA Countries*.
[335] Thijs Van de Graaf and Dries Lesage, "The International Energy Agency after 35 Years: Reform Needs and Institutional Adaptability," *The Review of International Organizations* 4, no. 3 (2009).
[336] Wilson, *International Energy Agency: Origins and Developments*, 1.
[337] NZIER, *New Zealand Oil Security Assessment Update*, 12.
[338] Despite not being tested in instances of a larger disruption, the IEA has assessed the efficacy of each response following each event and, in the case of the 1991 release, reviewed its Emergency Management Manual. IEA, "Oil Security."
[339] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 32.

cumulative stockholding has declined from approximately 40% of the 90-day global oil demand in 1974 to 20% today.[340] The IEA's ability to mitigate or prevent disruptions via coordinated stock release or demand control measures may therefore be in decline.

Some non-OECD countries such as China have become IEA 'Association Countries',[341] but this status entails no obligation to follow IEP stockholding requirements or to coordinate with IEA efforts in a crisis. The response of these high-demand non-IEA countries to a significant disruption is therefore unknown, and there is no guarantee that countries will follow suit with the organisation.[342] As an example of this possible reluctance, Griffin argues that China's domestic price controls on petroleum products signal an unwillingness to let prices rise in the event of a disruption and thereby participate in necessary demand reductions.[343] One report concludes that, in the event of a global oil disruption, IEA members would likely be unwilling to endure the pain of implementing demand restraint measures if the rest of the world did not do so as well.[344]

OPEC

As a multilateral cooperation policy instrument, OPEC's market influence is not inherently negative for supply security. While the cartel's ability to stabilise the oil market has been mixed,[345] it is often argued that the market would have been much less stable without OPEC members acting as swing producers and absorbing supply shocks.[346] This is largely made possible through the flexibility provided by the spare production capacity of the wealthier Arabian Gulf member states.[347] In particular, the largest net exporter of oil - Saudi Arabia - often acts as swing producer, maintaining the largest share of spare production capacity at significant investment cost.[348] Consequently, market power - and hence economic and political power - is particularly concentrated within Saudi Arabia, the UAE and Kuwait as these countries have the financial strength to voluntarily reduce production.

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[340] IEA, *Energy Security in ASEAN+6*, 24.
[341] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 32.
[342] Hale & Twomey and Covec, *Oil Security*, 37.
[343] Griffin, "Petro-Nationalism: The Futile Search for Oil Security."
[344] Hale & Twomey and Covec, *Oil Security*, 37.
[345] Axel Pierru, James L Smith, and Tamim Zamrik, "OPEC's Impact on Oil Price Volatility: The Role of Spare Capacity," *The Energy Journal* 39, no. 2 (2018).
[346] Fattouh, *How Secure Are Middle East Oil Supplies?*, 2.
[347] Pierru, Smith, and Zamrik, "OPEC's Impact on Oil Price Volatility: The Role of Spare Capacity."
[348] Luciani, *Geopolitical Threats to Oil and the Functioning of the International Oil Market*, 2.

In contrast, poorer OPEC member states rely on maintaining maximum production and high prices to balance state budgets.[349] For these countries, multilateral cooperation provides greater economic security through stabilisation of their petroleum export revenues. Conversely, Overland argues the benefits of this policy are not uniformly shared, asserting that were these oil resources not controlled by OPEC NOCs but instead by western-based TNOCs pursuing revenue maximisation, it is likely that global oil prices would be much lower.[350]

International Energy Forum

The International Energy Forum (IEF) is an intergovernmental organisation comprising 72 producer, consumer and transit states - including New Zealand - that collectively account for over 90% of global oil and gas supply and demand.[351] Acting as a neutral facilitator of dialogue, the Forum aims to foster communication and understanding between its members on energy issues to ensure global energy security by finding solutions in the common interest. The IEF was established as a Secretariat in 1991, with its members participating in biennial Ministerial Meetings.[352]

While there has historically been tension between large producer and consumer states (particularly during the 1970s), relations between these groups began to normalise in the late 1980s.[353] During the 1990's and 2000s, the producer-consumer dialogue was institutionalised in the IEF.[354] Consumer countries aim to create security of supply, while producers aim to create security of demand. These priority objectives have increasingly brought these two groups closer together, as both groups have a common interest to stabilise markets.[355] In time, Van der Linde et al. notes that "…the IEF has become an important channel for co-operation and creating a far better understanding of the vital interests and problems of the participating countries."[356] Nevertheless, the IEF has struggled to facilitate agreements between groups on some key policies. Like other multilateral organisations, effectiveness of the Forum relies on

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[349] Fred B Olayele, "The Geopolitics of Oil and Gas," *Energy Forum* 2nd Quarter (2015): 30-31.
[350] Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 10.
[351] IEF, "Member Countries," accessed 5 April, 2020, https://www.ief.org/about-ief/organisation/member-countries.aspx.
[352] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 75.
[353] Ibid.
[354] Ibid.
[355] Ibid., 75,112.
[356] Ibid., 75.

members' willingness to communicate and cooperate; a more confrontational environment between consumer and producer countries may therefore leave the IEF less effective.

5.6.3 Security Policy

Security and military policies are a close companion of foreign policy, but also of energy policy for major powers. Energy security is vital for these states, and if superpowers' energy security is jeopardised then military intervention is always an option.[357] This policy instrument is usually reserved for larger powers, although smaller states can benefit from such interventions through actively or passively supporting same.

The threat of military force can be a strong tool for influencing inter-state relations. Military power can influence oil security in a number of respects. The first is through providing security to oil producing countries in exchange for supply, sometimes formally codified in a strategic alliance. By the same token, military power can be used by major powers to deter purposeful supply disruptions and to procure new sources of petroleum. In situations where these policies increase global oil supply and secure the related transport network, less militarily powerful states can stand to benefit from access to these public goods without necessarily supporting the policies that delivered them. However, in other circumstances where the benefits are excludable, larger powers may not let other states benefit from their costly foreign and security policies if they do not contribute.[358]

Other security policies that have improved oil security have centred upon security of transport. This includes military capability and actions to ensure security of SLOCs, or escorting tankers through insecure areas. Given shared vulnerabilities to disruption of shipping, it is in most circumstances mutually beneficial for maritime powers to cooperate to ensure security of SLOCs. The responsibility and associated cost of maintaining shipping lane security largely falls on larger states, particularly the US which has the greatest naval power projection and control over SLOCs.[359] Multilateral actions are also used to secure transport routes. The most recent example is the International Maritime Security Construct (IMSC), an alliance of countries formed in response to the 2019 tanker attacks near the Strait of Hormuz. The IMSC

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[357] Ibid., 76.
[358] Ibid., 48.
[359] International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 21; Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 9.

is tasked with maintaining maritime security in the Gulf of Oman and Strait of Hormuz, particularly regarding oil shipments.[360]

Strategic Alliances

Oil security relationships can take the form of a more comprehensive strategic alliance formally acknowledging and aligning the broader mutual interests that exist between producer and customer countries. The already highlighted US-Saudi Arabia strategic alliance is arguably the most significant and long-standing oil security relationship in the world. The 1951 Mutual Defense Assistance Agreement formalised this relationship between the two states, and effectively guarantees oil security in exchange for military security.[361] It promises US military intervention in the event of an attack on Saudi territory, particularly one that disrupts Saudi oil and gas supplies, and is given credibility by investments in major US military bases in the Kingdom, as well as elsewhere in the Gulf and around the world.[362] Similarly during the Cold War for example, producing countries were pressured to align with one power bloc or the other, and in so doing fell under the protective military umbrella of one of the global superpowers.[363]

5.7 Policy Choices and Consequences

The mix of policy instruments that consumer states can choose to implement to best advance the four security of oil supply objectives are diverse. However, it should be noted that these policy choices do not occur in a vacuum and can have consequences for the security of other consumer states. Certain policies like strategic reserves or diversification through development of new oil sources can prove beneficial for the security of others. Conversely, some policies may offer no benefit, or in some cases even reduce the security of other consuming countries. While importing countries have the shared goal of maintaining security of oil supply, this does not necessarily mean they will cooperate to achieve this goal; in some instances, these states may actually compete. Therefore, countries may choose to pursue a mix of security policies that are essentially beneficial, prejudicial or both with respect to the oil security of other states.

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[360] Members include Australia, UK, Saudi Arabia, Albania, Bahrain, UAE and the United States (which leads the initiative). IMSC, *International Maritime Security Construct* (2019), https://www.register-iri.com/wp-content/uploads/IMSC-Brochure-SSA-01-20.pdf.
[361] United States Government, *Mutual Defense Assistance: Agreement between the United States of America and Saudi Arabia Effected by Exchange of Notes Signed at Jidda and at Mecca June 18, 1951, Entered into Force June 18, 1951* (U.S. Government Printing Office, 1951).
[362] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 76.
[363] Ibid.

5.7.1 Petro-nationalism & Market Integrity

It is a common opinion that there is continuous geopolitical competition for petroleum resources between large consuming countries.[364] The various forms of US political and military involvement in the Middle East is regarded as one example of this,[365] as is the competition between Indian, Chinese and Western oil companies within Latin America and Africa.[366] While most of the oil that is secured by these countries and companies makes its way onto the international oil market, some countries – most notably China – have pursued a more strategic approach using certain policy tools to guarantee state control over these resources. These policies have the potential to affect the security provided by the oil market.

The effectiveness of the market to respond to disruptions depends on the extent that oil is being traded via the international market versus other mechanisms. This factor is largely determined by state policy choices. Over the last 30 plus years, most consumer countries have generally preferred international trade in oil via the market, reducing their state control over oil and gas supply.[367] However, as noted earlier, approximately one fifth of the world's oil production is not allocated through markets and has no market price.[368] It is instead allocated through other mechanisms including bilateral agreements between governments, and cannot be considered available for global consumption.[369] These off-market trades are the result of the policy choices of producing and consuming countries. Griffin highlights the relatively new form of petro-nationalism by consuming states, notably China. In China's case this has involved

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[364] Roy Allison, "Strategic Reassertion in Russia's Central Asia Policy," *International Affairs* 80, no. 2 (2004): 277; Michael T Klare, *Rising Powers, Shrinking Planet: How Scarce Energy Is Creating a New World Order* (New York: Oneworld Publications, 2008), 7.

[365] Rachel Bronson, *Thicker Than Oil: America's Uneasy Partnership with Saudi Arabia* (New York: Oxford University Press, 2008); Mohammed Shareef, *The United States, Iraq and the Kurds: Shock, Awe and Aftermath* (Routledge, 2014); Donette Murray, *US Foreign Policy and Iran: American-Iranian Relations since the Islamic Revolution* (Routledge, 2009).

[366] Pádraig Carmody, *The New Scramble for Africa* (Cambridge: Polity Press, 2011); Steven Woehrel, *Russian Energy Policy toward Neighboring Countries* (US Congressional Research Service, 2009), https://apps.dtic.mil/dtic/tr/fulltext/u2/a506412.pdf; Alex E Fernández Jilberto and Barbara Hogenboom, eds., *Latin America Facing China: South-South Relations Beyond the Washington Consensus* (n.p: Berghahn books, 2010). Yet another example is competition between China and Japan to secure resources within Africa, Central Asia and the Middle East: Yoichiro Sato, *Lining up a Persuasive Friend: Japan's Expectations of How New Zealand Can Contribute to Asian Security* (Asia NZ Foundation, 2011), 7, https://www.asianz.org.nz/assets/Uploads/Japans-expectations-of-how-New-Zealand-can-contribute-to-Asian-security.pdf; Mikkal Herberg, "Energy Cooperation and Competition in Northeast Asia," in *Energy Security Cooperation in Northeast Asia*, ed. Bo Kong and Jae H Ku (London: Routledge, 2015), 22-23.

[367] Tordo, *National Oil Companies and Value Creation*, 19-20.

[368] Chanis, "Crude Oil Is Not Fungible, Where It Comes from Does Matter, and Global Markets Are More Fragmented Than Many Think," 147.

[369] Ibid.

circumventing market institutions by 'locking up' oil supplies in producer states, either through bilateral agreements or via the actions of China's NOCs.[370]

The level of oil that is being traded outside of the market is an important factor determining the market's ability to respond to disruption. If oil supplies are being predominantly traded through the market, then in the event of a disruption the market can respond to the shortfall by allowing the allocation of unaffected supply between consumers. The market price mechanism mediates the disruption (albeit limited, at least in the short term, by the factors identified in Chapter 3). However, if substantial quantities of oil were no longer being traded on the open market but were instead being channelled to consumer states via bilateral contracts (government-government, state company-government or state company) then liquidity in the global oil market would decline heavily.[371] In a disruption, unaffected oil production would be mostly locked in. The market would therefore have less capability to meet a shortfall, and states suffering disruptions to their supply would likely have difficulty procuring oil from other sources.

At present, countries like China that have chosen to take a more strategic approach to the market do not have a significant enough impact on trade flows and have not substantially changed the liquidity of the market.[372] Nevertheless, a country's decision to secure oil outside of the market – especially large oil consuming countries – has the potential to affect the ability of the oil market to respond to disruption. Thus, it can also affect the security of other states that rely on the market to provide a steady and secure supply.[373] This point is illustrated in a recent assessment of potential challenges to Australia's energy supply. The report highlights the dominance of NOCs from importer countries using the same suppliers in the Arabian Gulf, and notes that Australia's confidence in the stability of the global supply chain could be "sorely tested" if NOCs make their decisions based on security rather than commercial interests in the future.[374]

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[370] Griffin, "Petro-Nationalism: The Futile Search for Oil Security."
[371] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 87.
[372] Ibid.
[373] Vlado Vivoda, "Evaluating Energy Security in the Asia-Pacific Region: A Novel Methodological Approach," *Energy policy* 38, no. 9 (2010): 5262.
[374] Greet and Barnes, *The Challenge of Energy Resilience in Australia: Strategic Options for Continuity of Supply*, 20.

States respond to the level of security they believe the market provides. If a state considers the market to provide insufficient levels of security, it may attempt to procure supply through other means. Griffin argues that oil consuming countries pursuing petro-nationalist polices – including exclusive bilateral contracts – implicitly believe that markets do not provide sufficient oil security or might not do so in the future.[375] A state may therefore take a competitive approach to accessing supply if it believes that changes in the market or changes in the geopolitical environment could harm supply security.[376] For example, in a situation where import dependence and supply concentration is increasing, competition and conflict between states to control oil and gas resources would occur more often.[377] States may also take this approach believing it provides a security advantage relative to their rivals, even if relying on the market would provide greater security overall.[378]

Consumer states' petro-nationalist policies could also ultimately result in oil consuming countries attempting to adopt similar policies. Such a situation could occur if states taking a strategic approach to the oil or broader energy market begin to dominate trade, leading to a cascade of other states adopting a similar approach in response.[379] For this reason, Griffin concludes that the petro-nationalist approaches currently adopted by some countries could potentially lead to an undermining of the international oil markets, and thus global oil security.[380]

Should both a market approach and a strategic approach fail to provide sufficient oil security, states might resort to taking physical control of resources through military means, at least temporarily, to create conditions necessary for the oil industry to effectively function. If a government preferred a market approach, it would allow access for international oil companies to develop oil resources, whereas a government favouring a strategic approach would ensure state companies gained resource access.[381] Van der Linde et al. argue that a scenario like those above are not considered far-fetched, as demonstrated by the establishment in the 1980s of the US Rapid Deployment Joint Task Force that was established with the purpose of remedying an

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[375] Griffin, "Petro-Nationalism: The Futile Search for Oil Security."
[376] Ibid., 40.
[377] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 86.
[378] Griffin, "Petro-Nationalism: The Futile Search for Oil Security," 40.
[379] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 87.
[380] Griffin, "Petro-Nationalism: The Futile Search for Oil Security," 40.
[381] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 87.

oil supply disruption in the Persian Gulf.[382] Despite such possibilities, most consumer states today favour cooperation between one another, even though more powerful states continue to want to maintain military capability to defend their interests, "…hidden behind the veil of a market orientated approach."[383]

5.7.2 Security and crisis response

Equally, a state's absence of appropriate oil security policies can shape their crisis response, which can affect the oil security of other countries. Mitchell notes that the resilience and exposure to a major Middle East disruption varies widely among Asian importing countries, highlighting that Japan and Korea are the only two major importers in the region that are part of the IEA's emergency response mechanisms. Given this variation of resilience and exposure, he predicts that conflict between government interventions could occur if countries fail to adequately account for the interests of others in the region.[384] In response to a large supply disruption, governments might even adopt policies that impede the flow of oil and products to other countries.[385]

It is clear the oil security policy choices of importing countries can therefore have consequences for the oil supply security of other states. Furthermore, policy changes affecting the oil market and geopolitical environment are not only capable of increasing the likelihood and severity of an oil supply disruption, but can also erode states' willingness to cooperate on maintaining supply security. Yet many of the above policies intended to prevent or mitigate disruptions require cooperation between states. Therefore, geopolitics shapes the level of cooperation or competition between states, and also plays a part in the viability and effectiveness of policy responses.

5.8 Summary

States can choose from a framework of policy instruments to achieve several interrelated security of oil supply objectives. These objectives are to prevent and deter a supply crisis from

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[382] Ibid.
[383] Ibid., 88.
[384] Mitchell, *Asia's Oil Supply: Risks and Pragmatic Remedies*, 31.
[385] Ibid., 3,6.

occurring, to contain the expected damage from a crisis, and to more effectively manage the crisis when one occurs. Many of the policy instruments can be highly effective but may be difficult and expensive to implement or may require long-term strategies to properly execute. The policy instruments that states choose may have positive, neutral or negative consequences for the supply security of other states, with some also requiring a certain level of cooperation between consuming nations - although this cooperation is not a certainty. The mix of policy instruments that states choose is influenced by both the perceived integrity of the petroleum market, and the geopolitical environment. Effective oil security policymaking relies on identifying the optimal mix of policy instruments.

6 New Zealand's Current Security of Oil Supply Policy

6.1 Introduction

As has been shown, countries have a mix of different policy instruments available to enhance the security of their oil supplies. However, not all policy instruments are available to or viable for a country to use, and this is particularly so for smaller states such as New Zealand. For example, New Zealand does not have the military capability to pursue a suite of deterrence policies, and this is highly unlikely to change in the future. Small states in general depend upon organisations like the United Nations (UN) and the International Maritime Organization to preserve international norms of behaviour.[386] Similarly, New Zealand does not have sufficient market power to have any discernible influence on international oil market prices.[387] Nevertheless, countries often have a number of different policies available to support security of their oil supplies.

Generally, the specific mix of instruments chosen largely depends upon the degree of confidence a country has in the resilience of the oil markets; essentially countries either rely on the market to maintain energy security or take a more strategic approach.[388] In the case of New Zealand, the government has consistently pursued a singular approach to oil security that focusses on mitigating some vulnerabilities rather than eliminating any of them, and on reacting in the event of an oil supply crisis rather than reducing exposure to such events. It can be argued that the current approach has remained largely unchanged because it has proven to be 'fit for purpose'. The question remains however, whether the current mix of oil security policy instruments is optimal given New Zealand's particular combination of dependence upon oil and oil imports, and vulnerabilities in the upstream, midstream and downstream sectors of the country's supply chain. This question is addressed here.

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[386] Royal New Zealand Navy, *RNZN Plan: 2017-2025*, 9.
[387] NZIER, *New Zealand Oil Security Assessment Update*, 11-12.
[388] C. P. Andrews-Speed, Xuanli Liao, and Roland Dannreuther, *The Strategic Implications of China's Energy Needs*, vol. 346, Adelphi Paper, (London: Oxford University Press for The International Institute for Strategic Studies, 2002), 43. Other OECD countries including the US, Japan, EU and South Korea also rely on competitive markets but take additional measures including large strategic stockholding domestically: Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 6.

6.2 Oil Security Policy

The New Zealand Government's approach to oil security can be characterised as largely laissez-faire for several decades. There is minimal state intervention and participation within the domestic oil market; decisions on where to source New Zealand's oil supplies are left to private sector petroleum importing and distribution companies. Similarly, security of oil supplies is not a significant focus within New Zealand's bilateral foreign or trade relations.[389] The only exceptions are multilateral cooperation through the IEF and an international agreement in the form of the IEA's IEP. These constitute the country's formal security of oil supply policy instrument mix.

Having joined in 1976, the IEA now forms the foundation of New Zealand's approach to maintaining oil security. The New Zealand Government considers IEA membership to be the "…principal mechanism for mitigating the effects of international supply disruption,"[390] characterising it as valuable 'insurance' against disruption to international energy supplies.[391] As explained in the previous chapter, through its IEA membership New Zealand is a signatory to the IEP, an agreement that obliges the country to maintain strategic reserves as well as implementing a schedule of responses in the event of an IEA emergency collective action. These obligations are central to the New Zealand Government's *Oil Emergency Response Strategy* (OERS), which details the country's official crisis response policy and associated operational framework. Last updated in 2008, the OERS has the objectives of minimising the impacts of a disruption to New Zealand's petroleum supplies in a non-IEA declared oil emergency, and to ensure the country can meet its IEA obligations. Importantly, the OERS details the Government's statutory power to implement the suite of IEP collective action responses under an IEA declared emergency. [392] While New Zealand is limited in its ability to implement the responses of increasing domestic oil production and switching to other fuels, it can restrain demand and release stocks to the market, as well as theoretically share oil in the event of a major disruption. However, the principal IEP obligation addressed by the OERS

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[389] Barton, "Reaching the Limits of What the Market Will Provide: Energy Security in New Zealand," 378.
[390] MBIE, *Review of New Zealand's Oil Security*, 7.
[391] MBIE, "New Zealand's Participation in the International Energy Programme."
[392] For further information, see: Ministry of Economic Development, *Oil Emergency Response Strategy* (MED, 2008), 4, https://www.mbie.govt.nz/assets/9930eabdda/oil-emergency-response-strategy.pdf. The oil emergency response policy is based upon a series of escalating responses, with the most significant being 'demand restraint measures' which would likely be used as a last resort.

remains the maintenance of strategic reserves equivalent to 90 days net crude and refined product imports.

Notably however, New Zealand does not meet the stockholding portion of the IEP through physical in-country stocks. As described earlier, the majority of countries meet their obligations through a mix of government, industry and agency stocks. New Zealand does not have any government-owned strategic reserves onshore; all oil stocks held in-country are owned by TNOCs and domestic oil companies. Furthermore, the government places no stockholding obligation upon industry, such that privately held onshore stocks typically only constitute approximately two thirds of New Zealand's 90 days' obligation.[393] In fact, New Zealand and Australia are the only two net importing countries that are signatories to the IEA that do not have industry-mandated or government-owned stocks; other members in this position being net-exporters.[394]

Instead, since 2007[395] the New Zealand Government has met its stockholding obligations by routinely purchasing oil stock ticket contracts from industry and agency companies operating within other IEA countries. In exchange for an annual fee, these tickets provide New Zealand with the contractual right to purchase specified quantities of petroleum and refined product at market prices in the event of an IEA mandated drawdown on reserves. The other party to the contract guarantees the stock will be held in reserve, and the country in which the reserves are held guarantees the reserves will be released. Oil stock tickets therefore require New Zealand to establish bilateral agreements with other IEA countries specifying these countries will not impede the release of stock in the event of an IEA emergency. To date New Zealand has entered into such agreements with Australia, the UK, Denmark, the Netherlands, Spain and Japan.[396] Based on these contractual and bilateral commitments, the IEA allows these 'paper' stocks to count toward New Zealand's stockholding obligation.[397] During 2016, the government held oil stock tickets purchased from industry and agents in Denmark, Spain and the Netherlands.[398]

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[393] IEA, *New Zealand 2017 Review*, 18.
[394] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 51.
[395] Prior to 2007, the country relied on the industry's normal stockholding practices to meet these requirements, which was insufficient to meet requirements. IEA, "New Zealand Information," accessed 6 December, 2017, https://www.iea.org/countries/membercountries/newzealand/oilstocks/; IEA, *New Zealand 2017 Review*, 59-60.
[396] MBIE, *Review of New Zealand's Oil Security*, 13. Although a bilateral agreement with Australia exists, no stocks are actually held in the country.
[397] IEA, "New Zealand Information."
[398] Yoshikazu Kobayashi and Venkatchalam Anbumozhi, *Cooperation Framework for Oil Stockpiling and Emergency Response System* (Economic Research Institute for ASEAN and East Asia, 2016), 45, https://www.eria.org/RPR_FY2015_07.pdf.

These public stocks in other countries are both crude and refined product, the majority of which is petrol.[399] Tickets consistently account for a major portion of New Zealand's strategic oil reserve: as of February 2020, more than one third (34 days') of the country's 94 days' of net imports comprised government-owned ticket reserves held offshore.[400]

In the event of an IEA coordinated emergency action, the New Zealand Government may exercise the purchase rights contracted in the oil stock tickets, and release the stock onto the global market. This would be done without New Zealand ever taking physical delivery of the oil or refined product. On the other hand, should New Zealand itself need these stocks due to supply shortfalls, it can in theory purchase and take delivery of the stocks for transportation directly from the supplier nation, or exchange same for stocks closer to New Zealand to reduce transport costs and delivery times.[401] While clearly less secure than physical in-country stocks, the New Zealand Government has persisted with the stock ticket approach to meeting its IEP strategic reserve obligations on the basis of cost. Quarterly stock ticket fees are of significantly lower cost when compared to the costs associated with both building and maintaining greater domestic storage capacity, and owning the physical stock to be stored within it.[402]

In summary, for all practical purposes IEA membership and the associated IEP agreement constitute the entirety of New Zealand's current external security of oil supply policy. To meet its IEP strategic oil reserve obligations, the Government leaves it to the commercial sector to determine appropriate physical stocks to hold onshore, and tops these up to the 90-days' net imports level with contractual stocks held offshore.

6.3 Oil Security Assessments

The New Zealand Government has commissioned a series of assessments of New Zealand's oil security in recent years as shown in Table 1, and each has, for the most part, supported New Zealand's existing oil security policy settings described above. The first report in the current series was published in 2005. A second report was released in 2012, and subsequently partially

[399] IEA, "New Zealand Information."
[400] IEA, "Oil Stocks of IEA Countries," updated 14 May, 2020, https://www.iea.org/articles/oil-stocks-of-iea-countries. It should also be noted that this total is notably lower than many other members in the Asia-Pacific.
[401] IEA, "New Zealand Information."
[402] NZIER, *New Zealand Oil Security Assessment Update*, i.

updated in 2017.[403] Although the aims of these reports differ slightly, each undertakes their respective assessments of New Zealand's present or short-term oil security using cost-benefit analyses; that is, they aim to determine the best policy settings by calculating the cost of security policies against the benefit to security they are expected to provide.

Table 1: Schedule of New Zealand Government Oil Security Assessments

Year	Method	Time Horizon	Core Assumptions	Security of Supply Policy Mix
2005	• Quantitative only • Cost-benefit & risk analyses	• Short term	• Integrated market • Oil is fungible • Logistics is constant	• International Agreements (IEA)
2012	• Quantitative only • Cost-benefit & risk analyses	• Short term	• Integrated market • Oil is fungible • Logistics is constant	• International Agreements (IEA)
2017	• Quantitative only • Cost-benefit & risk analyses	• Short term	• Integrated market • Oil is fungible • Logistics is constant	• International Agreements (IEA)

The aim of the 2005 report was to determine the best approach for New Zealand to meet its emergency oil reserve stockholding commitments as a member of the IEA. In addition, the report also aimed to determine whether the country had sufficient domestic stockholding to maintain an adequate level of oil security. Although the first report is somewhat limited by its research framing and now less relevant given its publication date, it nevertheless provides some valuable insights into New Zealand's supply security. It details the elements within New Zealand's oil import supply chain, including New Zealand's international supply regions, and the nature and length of the corresponding supply chains. The report hypothesises several disruption events and their risk of occurrence using information gathered from market participants.[404] Informed estimates of the likelihood and economic cost of each disruption are then compared against the expected cost of oil stockholding to derive an optimal level of strategic reserves.[405]

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[403] A further report on the economics of fuel supply disruptions was published in 2019, but applies the approach and findings of the 2017 assessment into an alternative economic model rather than conducting its own assessment of New Zealand's oil security. See: Nicola Smith et al., *Economics of Fuel Supply Disruptions and Mitigations* (Market Economics, 2019), https://www.mbie.govt.nz/assets/economics-of-fuel-supply-disruptions-and-mitigations.pdf.
[404] Hale & Twomey and Covec, *Oil Security*, 23.
[405] Ibid., 46.

The report also examines a number of internal disruption scenarios affecting different domestic downstream sectors, including refining and distribution of refined product.[406] However, a less granular approach is used to examine risks of disruption external to the country. Rather than examining the impact and likelihood of disruption on a supply chain sector by sector basis, the report instead examines a generic external disruption scenario where a set proportion of global oil supply is interrupted. Furthermore, this reduction in supply is assumed to affect each market participant to the same extent. The scale and duration of this international oil supply shortfall adopts probabilities from a diversity of assessments compiled in an Oak Ridge National Laboratory report titled *The Value of Expanding the US Strategic Petroleum Reserve*.[407] The economic cost of such a disruption is then quantified for use in the stockholding cost-benefit analysis, taking account of anticipated international oil market responses which are expected to minimise the impact somewhat.

The 2005 report justifies its sole use of a generic supply disruption scenario to determine external supply risk. It argues that New Zealand is reasonably secure against minor isolated external events - for example, the loss of a single tanker - because of the country's diverse range of suppliers, and its practice of importing crude for domestic refining and supplementing this with imports of refined product.[408] However, the underlying reasoning behind this argument is not provided; specifically, the degree of diversification of suppliers or the ratio of domestic refining to imported product necessary to confer 'security' is not elaborated upon. Based on the above assertion, the report proceeds on the assumption that New Zealand's supply would likely only be significantly impacted by an event that was also affecting many other countries; for example, the loss of production from a major global oil supplier such as Saudi Arabia. Furthermore, a supply disruption on this scale is considered likely to trigger an IEA collective action, requiring a response from members.[409] The report also finds the IEA emergency stockholding measure to be a reasonable indicator of how long onshore stocks would last;[410] however, this finding is necessarily predicated on the IEA's emergency response mechanism working as intended. The above limitations notwithstanding, the 2005 report concludes that stockholdings at the time are below the storage volume necessary to provide a

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[406] Ibid., 27.
[407] See Leiby and Bowman, *The Value of Expanding the US Strategic Petroleum Reserve*.
[408] Hale & Twomey and Covec, *Oil Security*, 26.
[409] Ibid., 27.
[410] Ibid., 35.

socially efficient level of supply security. Notably, the singular external event examined in the report is considered by orders of magnitude more likely than any internal disruption, and while acknowledging the difficulties associated with accurately determining all of the associated costs of a disruption,[411] the report nevertheless calculates an external supply disruption to be the most economically damaging.[412]

The subsequent 2012 assessment is directly framed around the question of whether New Zealand's current security policies are sufficient.[413] The assessment effectively adopts the same approach as the 2005 report, while using updated probabilities and a more comprehensive approach to the cost-benefit calculations. The 2012 assessment determines external risk by modelling the impact of a large disruption to global oil supplies. Disruption risk is derived using estimated probabilities taken from a 2005 Energy Modelling Forum (EMF) report that considered events of a certain size over a specified time period.[414] The 2012 New Zealand assessment borrows these EMF report data to represent a range of likely events for modelling purposes.[415] It then determines the cost of such a disruption to New Zealand, accounting for the anticipated market responses and the release of IEA emergency stockholdings on the international market, both of which are expected to minimise the impact of a disruption.[416] Ultimately, any international supply chain disruption is expected to be mediated through the oil market price mechanism.[417] The report states this finding clearly: in an integrated global oil market, the price mechanism mediates any fluctuation in supply.[418]

While the 2012 report does not explicitly discuss the reason for adopting the 2005 approach to measure external risk, it nevertheless expects that an international disruption will cause a sharp increase in international prices rather than a physical shortage of oil. While the report does acknowledge circumstances where deep quantity constraints exist and customers are unable to procure stock even if willing to pay the price, it states that this is a rarer occurrence and does

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[411] Ibid., 73.
[412] Ibid., 60.
[413] See NZIER, *New Zealand Oil Security Assessment Update*; MBIE, *Review of New Zealand's Oil Security*; Hale & Twomey, *New Zealand Petroleum Supply Security 2017 Update*; Hale & Twomey, *Information for NZIER Report on Oil Security* (Hale & Twomey, 2012), https://www.mbie.govt.nz/assets/7cad526263/information-for-nzier-report-on-oil-security.pdf.
[414] Hillard Huntington and Phil Beccue, *An Assessment of Oil Market Disruption Risks* (Stanford: Stanford University Energy Modeling Forum, 2005).
[415] Hale & Twomey, *Information for NZIER Report on Oil Security*, 3.
[416] Ibid.; NZIER, *New Zealand Oil Security Assessment Update*, 15.
[417] NZIER, *New Zealand Oil Security Assessment Update*, 14.
[418] Ibid., 11-12.

not assess this further.[419] This conclusion is made despite the fact that between the 2005 and 2012 assessments the New Zealand government had met its IEA stockholding obligations not by holding physical stocks onshore, but by taking out stock ticket contracts with suppliers in other IEA countries.[420] This effective dismissal of a specific supply risk is reflected in the assessment's deliberations, with New Zealand's IEA-mandated demand restraint measures and net 90-days of imports stockholding the only policy instruments relating to external security that are discussed. The report asserts that New Zealand is not a large enough player to influence the international oil market on its own, and must therefore rely on collective agreements like the IEA to mitigate the effects of significant international disruptions and manage the consequences.[421] As international disruptions are mediated primarily through the market price mechanism, the conclusion is that there is little New Zealand can do in the short term to ameliorate the effects of such disruptions.[422]

In contrast to the 2005 assessment, the 2012 report determines that New Zealand has sufficient oil stockholding volumes to maintain an efficient level of oil security. While this determination is due to the New Zealand Government addressing the stockholding shortfall highlighted in the 2005 report, the fact that a large proportion of those stockholdings comprises stock ticket contracts with overseas suppliers is not found to be problematic. The reasons are twofold: domestic stocks are found to be at an acceptable level given the likelihood and impact of internal events that might cause physical disruption to supply; and in the event of an external disruption like the one assessed, the IEA member stockholdings would be released onto the international oil market to lessen price spikes and mitigate the impact on members. For the latter reason, it is argued that it is irrelevant where the reserve stockholding is physically held. Offshore ticket contracts are therefore considered optimal because they constitute the lowest cost option.[423] Of note, external disruptions are once again considered to be by far the most damaging. In total, the international disruption scenario examined is calculated to cost New Zealand approximately $2 billion at the time.[424]

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[419] Ibid., 12.
[420] Ibid., i.
[421] Ibid., 29.
[422] Ibid., 12.
[423] Ibid., i.
[424] Ibid., 21.

The third and final New Zealand oil security assessment in 2017 comprises a partial update of the 2012 assessment, with the 2005 methodology, assumptions and proscriptions remaining essentially unchanged. The benefits of stockholding are discussed in the update for the first time, but done so in the context of global rather than New Zealand-specific security given the research cited examines stockholding benefits globally.[425]

6.4 Assessments & Policymaking

The three government-commissioned assessments of New Zealand's oil security described above are used to substantiate the mix of policy instruments ultimately adopted, and currently enacted through the OERS. The scope and foundational assumptions of the assessments therefore have a profound influence upon their findings, and consequently the policy mix eventually chosen. This raises the question as to what extent the pre-existing mix of policy instruments determined the framing and therefore the findings of the 2005, 2012 and 2017 oil security assessments, as distinct from the assessments influencing the policy mix itself. It is therefore necessary to understand the limitations of the assessments in order to reach any conclusions on their efficacy for policymaking.

The assessments provide cost-benefit frameworks necessary for policymakers to in-part determine the best mix of oil security policy instruments for New Zealand to maintain an acceptable level of energy security. Approaching external disruptions as a percentage reduction in total supply to the global oil market does provide a quantifiable metric to determine the associated costs. Furthermore, it tests the impacts of the most common form of external disruption New Zealand is currently likely to experience – the manifestation of increased supply insecurity in the form of less affordable prices. However, while the underlying assumptions adopted for these frameworks likely give a robust estimation of present-day risk, that risk is assessed solely with respect to the upstream production sector of the supply chain.

While affordability is a factor of security, the assessments do not undertake a comprehensive examination of the second element of security - availability. Although considered less likely, physical disruption of New Zealand's external supply lines are not addressed. Such events that disrupt or interrupt the transportation of oil may result in the country not just having to pay a premium to procure supply, but perhaps even struggling to procure - and have delivered - oil

[425] Hale & Twomey, *New Zealand Petroleum Supply Security 2017 Update*, 10.

and refined product at any price. By the same token, the assessments do not examine the capability of New Zealand to second-source oil supplies in the event of a significant upstream and midstream disruption. The 2012 report highlights this point, acknowledging that a wider indication of New Zealand's oil security could be gained from supplementing 'days cover' with other indicators, including the ability to second-source imports in the event of a disruption of normal supply.[426]

Further to the above, the assessments are predicated on the notions that the oil market is integrated, and that oil is fungible. These assumptions are that the oil market is fluid and fungible enough to ensure shortfalls and thus price rises would be shared across the market equally, regardless of the disruption or underlying circumstances. As the 2012 report notes, disruptions are regular occurrences in the international market, and the price variations that result are spread across the international market. It takes exceptional circumstances for the equilibrating function of the market to be put under real stress.[427] However, as discussed in Chapter 3, this understanding of the market is an oversimplification that hides the complex conditionality of oil markets' reliability and predictability. In addition, changes to the structure of the oil markets themselves have the potential to weaken their ability to equilibrate prices during disruptions to supply. The above notwithstanding, confidence in the ability of the markets to adequately respond to disruption is an element of any reliance upon certain security of supply policy instruments, most notably in New Zealand's case being multi-lateral cooperation (IEA) and international agreements (IEF).

The IEA and associated IEP stockholding obligations are a central focus of the three assessments, yet there is no discussion as to whether New Zealand should remain an IEA member, nor is there robust analysis of the benefits to oil security these policy instruments actually provide - these are accepted as givens. Similarly, the MBIE discussion document that accompanies the 2012 report states that IEA membership is the best mechanism for dealing with international oil security risks,[428] and deems it unacceptable for New Zealand to withdraw from the agreement and rely on other IEA countries to maintain collective oil security; that is, to 'freeride'. However, this position is largely justified by geopolitical considerations

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[426] NZIER, *New Zealand Oil Security Assessment Update*, 7.
[427] Ibid., 6.
[428] MBIE, *Review of New Zealand's Oil Security*.

associated with the reputational damage to the nation that such a withdrawal would engender, rather than any impact to domestic oil security.[429]

Finally, given the present or short-term focus of the assessments, there is no examination of the potential risks to New Zealand's oil security over the long-term. As the 2005 report states, oil security is not a constant – it can change over time.[430] By extension, changing the time horizon may influence the conclusions drawn on New Zealand's oil import dependency and vulnerability. For example, a situation might occur where the international oil market is currently characterised as being stable, yet is forecast to experience significant production shortfalls in the coming decades. In such a situation, an import-dependent country considered adequately secure at present would likely be considered insecure over the longer term, all other things remaining equal.

6.5 Policy & Security

Given the limitations of the assessments discussed above, a question arises as to whether the current mix of oil security policy instruments substantiated by these assessments is optimal, given New Zealand's particular combination of dependence upon oil and oil imports and its previously described vulnerabilities in upstream, midstream and downstream sectors of the supply chain. New Zealand relies solely on the international oil market to source its crudes and refined product. The country's import dependency is heavily concentrated on Middle East producers. Its only refinery is specifically configured for these crudes, as are the refineries in Asia from which the country sources refined product. Transporting petroleum from the Middle East and product from Asia introduces long and complex maritime supply lines that are inherently vulnerable, especially at choke points. All these external factors constitute fundamental elements of New Zealand's oil supply chain.

Any robust assessment of oil security intended to inform policymaking should therefore ideally analyse these specific external factors directly, given they can materially impact the perceived nature and degree of risks that New Zealand is exposed to. By extension, this impacts the perceived viability and effectiveness of policies. For example, if New Zealand's external oil transport network was found not to be adequately secure then the option of holding strategic reserve stock overseas would be considered a less viable option. Conversely, a commitment to

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[429] Ibid., 15.
[430] Hale & Twomey and Covec, *Oil Security*, 19.

long-term stockholding agreements may no longer be considered appropriate if oil is expected to become a significantly less important energy source for New Zealand or if short-term substitutability is expected to improve. It is therefore clear that a more comprehensive understanding of New Zealand's energy system, and awareness of the expected changes within areas that could affect this system, can impact conclusions regarding effectiveness and viability of different oil security policy instruments or mix thereof. However, for any assessment to be effective there needs to be an understanding of what the requirements actually *are* for policies to have the intended effect.

This is particularly true when examining the long-term viability of policies, as policy-affecting elements of the geopolitical and energy spheres considered unlikely to change to any meaningful extent over the short-term may do so over longer periods. When energy security is assessed over a longer time horizon, new policy options become viable. From a short-term perspective, the assessment that New Zealand is too small to have any market or strategic influence over its external oil security is almost certainly correct. However, over the long-term it may not necessarily follow that the country has no control over the structure of its own supply chain, or that policy responses to external risks cannot be more comprehensive. While long-term policy options are not addressed in existing assessments, the 2012 report indirectly highlights the existence of these options by noting that longer term exposure to risk can be reduced by lowering oil dependency in the transport sector.[431]

6.5.1 IEA & IEP

As noted above, IEA membership and the IEP agreement effectively constitute the extent of New Zealand's mix of security of oil supply policy instruments. The IEP's strategic reserve requirement of 90 days' net imports is the core provision of security through its supposed ability to stabilise markets. However, as mentioned in Chapter 5, the IEA's cumulative stockholding has declined as a proportion of 90-day global oil demand, potentially reducing its ability to mitigate or prevent disruptions via coordinated stock release or other measures. While there is broad agreement that maintaining strategic reserves is a crucial oil security policy instrument for crisis management, some reservations have been raised regarding New Zealand's reliance upon oil stock tickets to meet its IEP obligations. As the IEA's 2017 review of New Zealand's energy security notes, the significant geographical distances between New

[431] NZIER, *New Zealand Oil Security Assessment Update*, iv.

Zealand and the countries with which it has bilateral stockholding agreements means that repatriating stocks would take a number of weeks in shipping time. [432] MBIE estimates that it would take one to two months for stock to arrive in New Zealand, depending upon location.[433] The conclusion therefore is that strategic reserves in the form of offshore oil stock tickets do not improve New Zealand's short-term resilience to disruption.

There are also reservations regarding the efficacy of stock ticket contracts in practice. In their feedback on the 2012 *Review of New Zealand's Oil Security* discussion paper, Z Energy (New Zealand's only non-TNOC involved in petroleum importing, refining and distribution) argues that tickets are much less effective than physical stockholding. Z Energy notes that in the event of a substantial international outage it is uncertain whether oil supply would be available to honour the tickets. Moreover, they argue that in an event where other IEA members are also facing shortages, there are significant doubts that contracts would be honoured even if stocks are at hand: "…it is difficult to imagine the likes of Spain allowing product to be loaded to ship to New Zealand to meet our domestic ticket obligations."[434] Z Energy therefore concludes that publicly funded stock tickets alone cannot resolve the international oil security issue, and that ultimately there is no equally secure substitute for physical stock stored within the country.[435] Questions of whether current levels of domestically stored stockholding is sufficient have also been raised within recent Civil Defence documents, but have yet to receive further enquiry.[436]

Further to the above concerns, it is also unlikely that the closest IEA partner country, Australia, would be capable of meeting the IEP commitment of stock sharing in the event of a disruption given that it has consistently fallen well below its IEA stockholding obligations for a number of years.[437] Furthermore, TNOCs and domestic oil companies operating in Australia secure

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[432] IEA, *New Zealand 2017 Review*, 60. While internal disruptions to supply are not examined within this paper, it should be noted that ticket contracts also pose the same short-term issues in these circumstances compared to physical stockholding, a fact that has been highlighted in existing security reports: NZIER, *New Zealand Oil Security Assessment Update*, i.
[433] MBIE, *Review of New Zealand's Oil Security*, 13.
[434] Z Energy, *Submission on the Review of New Zealand's Oil Security* (2012), 6, https://z.co.nz/assets/PDFs/Review-of-New-Zealands-oil-securitySubmission-from-Z-Energy.pdf.
[435] Ibid.
[436] New Zealand Lifelines Council, *New Zealand Lifelines Infrastructure Vulnerability Assessment: Stage 1* (2017), https://www.civildefence.govt.nz/assets/Uploads/lifelines/National-Vulnerability-Assessment-Stage-1-September-2017.pdf.
[437] Australian Department of Industry, Science, Energy and Resources, "International Energy Agency (IEA) Program Treaty," accessed May 10, 2020, https://www.energy.gov.au/government-priorities/international-activity/international-energy-agency-iea-program-treaty

their petroleum from similar sources and using similar transport routes to their New Zealand counterparts.[438]

From the 1980s to the present, New Zealand has not experienced a disruption at the level of severity experienced during the 1970s oil crisis. In this regard, it may be considered that New Zealand's oil security policy mix has been appropriate for the security environment over this time. However, it can be argued that this is likely less because of the security policies New Zealand has enacted, and more because of the relatively stable geopolitical environment and wider structural changes within the oil industry itself. Changes in the oil markets and geopolitical environment could therefore lead to a reconsideration. As one of New Zealand's earlier reports notes, "…the fact that the existing system has been providing this level of security is no guarantee that it will continue to do so… it makes sense to periodically reconsider whether oil security is adequate for New Zealand as a whole."[439] The 2019 events in the Gulf described in Chapter 1 attest to the wisdom of this advice, with an Australian Department of Environment & Energy (DoEE) report stating that while a full cut of oil supply from Iran could be met with increased supply from Saudi Arabia, a large-scale Middle East conflict would likely impact oil markets far more severely.[440] It can therefore be concluded that oil security policymaking based upon assessments that assume the geopolitical status quo will continue to prevail may be subject to failure due to a lack of imagination.

6.6 Summary

Countries have a mix of different policy instruments available to enhance the security of their oil supplies. The specific mix of instruments chosen generally reflects the degree of confidence a country has in the resilience of oil markets. The New Zealand Government has consistently pursued a largely laissez-faire and singular approach to oil security over several decades. IEA membership and the associated IEP agreement effectively constitute the entirety of New Zealand's current external security of oil supply policy. The IEP obligates signatories to maintain a strategic reserve of specific volumes of crude and refined product. New Zealand meets this obligation through both physical in-country stocks and off-shore oil stock tickets

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[438] Hale & Twomey, *Australia's Maritime Petroleum Supply Chain*, 22-23.
[439] Hale & Twomey and Covec, *Oil Security*, 19.
[440] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 43.

guaranteed by other IEA countries. New Zealand's dependence on IEA membership essentially leaves it accepting the country's current levels of exposure to supply disruption, and largely reliant on resilient markets. The ability of the IEP to maintain market stability has not yet been tested by a major disruption, nor the fidelity of stock ticket arrangements. The New Zealand Government has commissioned a series of assessments of the nation's oil security that substantiates the mix of policy instruments ultimately adopted. These assessments are significantly limited by their common reliance upon cost-benefit analyses, short time horizons, and core assumptions about oil markets, fungibility and logistics. This results in a mix of oil security policy instruments characterised by a heavy reliance on IEA membership and the IEP agreement. The efficacy of oil security policymaking is fundamentally a product of the assessments that inform it.

PART II: The Future

7 Oil Demand & Supply Forecasts

7.1 Introduction

As shown in Part I, the future stability and structure of the geopolitical environment represents a prominent driver of the risk to global and national scale petroleum supply. However, national energy systems do not remain static, and strongly influence states' exposure to supply risk and the mix of security of supply policy instruments available to them. New Zealand is no different in this respect. Therefore, to reach a comprehensive understanding of the impact of geopolitics on oil security requires an equal understanding of the dynamics of the global and domestic energy system.

The world's energy system as a whole is undergoing change. The ratio of the various energy sources within the global supply has remained fairly stable since the 1960s, but energy mega-trends suggest a comprehensive transformation of the sector may be underway.[441] Development within the fields of renewable energy, energy storage, AI and smart grid connectivity are changing the long-established structure of the global energy system.[442] Means of producing and consuming energy that were formerly cost prohibitive for widescale use have become economically viable; new-found provision of alternatives to oil in turn enable adoption of a different mix of policy instruments for improving energy security. Nevertheless, the global substitution away from oil within energy systems has so far been slow, and this is the case for New Zealand. Furthermore, while there is significant uncertainty about the future scale and pace of this transition, evidence suggests that substitution away from oil is likely to increase. For example, although still a comparatively small amount of the global fleet, sales of EVs globally have increased substantially, largely due to favourable government policies.[443] The substitution megatrend raises the question as to whether oil security will become less of a concern over the 2040 time horizon, rendering existing security policies excessive or obsolete.

Paralleling this transformation of the energy system, the global oil market itself has also experienced some profound changes in the last decade. On the supply side, tight oil production technology has completely changed oil market dynamics, making some oil sources now economically viable to extract. As a result, the US has rapidly grown its petroleum production

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[441] Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 22.
[442] BusinessNZ Energy Council, *New Zealand Energy Scenarios: Navigating Energy Futures to 2050*, 8.
[443] IEA, *World Energy Outlook 2018* (IEA, 2018), 135, https://www.iea.org/reports/world-energy-outlook-2018.

to become one of the largest global producers, bringing greater diversity to oil supplies. The corresponding change in market dynamics has led some to question whether the oil security concerns of importing countries are now less of an issue.[444] This boom in tight oil has however been offset by declines in conventional crude production, which peaked in 2008 and is now in decline.[445] Investment in more conventional sources has also declined, reinforcing this trend.[446] New oil discoveries have been declining as most prospective areas are already well explored, with levels of new discoveries at the end of 2017 being the lowest since the 1950s and accounting for only 10% of global demand.[447] Within the Asia-Pacific, the region's primary exporters Malaysia and Indonesia are facing a changing market as demand is outstripping production.[448]

On the other side of the equation, demand for liquid petroleum-based fuels in other OECD countries in Europe and the Americas has begun to stagnate, whereas the level of oil demand within developing nations has continued to rise, particularly within Asia. This has over time changed the patterns of the global oil trade: while the Atlantic basin was the primary destination for Middle East oil in the 1970s, today approximately 80% of Middle East exports are destined for Asian destinations.[449] The Asia-Pacific region's growing dependence on fossil fuel imports has raised energy security concerns, not only because of a growing import bill.[450] Consequently, the immediate challenge of how to diversify suppliers and supply routes away from the Middle East is shared by countries in the region, including New Zealand.[451]

The above changes to global oil production and within the broader energy system are likely to have significant implications for oil markets into the future. Furthermore, they have the capacity to change the geopolitical landscape. Overland highlights that past transitions, such as the introduction of the steam engine in the 18th century, or the shift from coal to oil with the invention of the internal combustion engine in the 19th century, have been associated with transformations of international politics.[452] The above notwithstanding, the part oil is

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[444] IEA, *World Energy Outlook 2019*, 165-70.
[445] IEA, *World Energy Outlook 2018*, 142.
[446] Giorgio Biscardini et al., *Oil and Gas Trends 2018-19* (Strategy&, 2018), 8, https://www.strategyand.pwc.com/gx/en/trends/2018-oil-gas-industry-trends.pdf.
[447] Ibid., 7.
[448] International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 19.
[449] Roy L Nersesian, *Energy Economics: Markets, History and Policy* (New York: Routledge, 2016).
[450] IEA, *Energy Security in ASEAN+6*, 8-9.
[451] Ibid.
[452] Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 22.

anticipated to play within the world's and New Zealand's energy mix to 2040 will determine the priority of maintaining oil security regardless of what is happening in the geopolitical environment, and will impact the viability of oil security policy instruments, both individually and as a mix. The anticipated broad changes within the domestic and international oil markets, and how these may impact the risk of disruptions in the future and the effectiveness of the various security policy instruments, are addressed next.

7.2 Forecasting Overview

Changes in the petroleum market and supply chain are very difficult to predict. Factors that both directly and indirectly influence the size and location of future oil production are numerous, and the factors influencing future supply and demand are equally complex.[453] Adding to this complexity is how to weight the respective probabilities of various events, and which events to exclude from forecasts altogether. The consequences of these assumptions can be particularly profound in the event of so-called 'black swan' events, which are typically excluded from industry scenarios. For example, while futurists may have imagined a global pandemic in their scenarios, the implications of any regional or global response to such an event does not appear in any industry forecast, although this will now likely change.

Even absent the pandemic, this difficulty in finding clarity in forecasting has led some to note that at there is currently a heightened level of uncertainty over what will happen within oil markets both over the short and the long term,[454] and that the energy sector as a whole is changing faster than it ever has before.[455] Changes within the geopolitical environment can also cause a notable impact on oil market trends. For example, the WEC's *World Energy Scenarios 2019* report predicts that in a context where there is comparatively greater nationalism and less cooperation and coordination between states, there will be much slower electric vehicle (EV) and alternative fuel use, and less investment in energy transformation efforts overall.[456] Nevertheless, while it is impossible to be certain of the changes that will

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[453] For an outline of the main factors that can influence where oil is produced, and oil supply and demand, see: Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 83-84.
[454] IEA, "World Energy Outlook 2018 Examines Future Patterns of Global Energy System at a Time of Increasing Uncertainties," news release, 13 November, 2018, https://www.iea.org/news/world-energy-outlook-2018-examines-future-patterns-of-global-energy-system-at-a-time-of-increasing-uncertainties; World Energy Council, *World Energy Issues Monitor 2017: Executive Summary* (World Energy Council, 2017), 1, http://wec-france.org/DocumentsPDF/Etudes_CME/2017-WEIM-Executive-Summary.pdf.
[455] BusinessNZ Energy Council, *New Zealand Energy Scenarios: Navigating Energy Futures to 2050*, 8.
[456] World Energy Council, *World Energy Scenarios 2019* (World Energy Council, 2019), 7, 49, https://www.worldenergy.org/assets/downloads/Scenarios_Report_FINAL_for_website.pdf.

occur within the oil market, leading energy industry bodies regularly produce informed forecasts and scenarios based upon today's realities, including policy setting trends.

7.2.1 IEA Forecasts

The analysis of the global market changes presented here are drawn from the IEA's annual *World Energy Outlook* (WEO) – one of the most well-regarded forecasting reports. The report provides forecasts under three different scenarios, but only the primary forecast - the 'New Policies Scenario' (NPS) - is referenced here. This scenario generates forecasts of anticipated global energy market changes based upon continued growth in oil demand, moderated by states' declarations of new and planned policies.[457]

Limitations

All petroleum forecasting exercises have limitations arising from the need to reduce the complexity of the system they are endeavouring to predict. In the case of the NPS, limitations relate to the core assumptions of the scenario and significant uncertainties associated with oil production.

There are two assumptions made in the NPS that are important to note for the purposes of this research. Firstly, the NPS should be considered 'business as usual' in geopolitical terms given it does not account for any significant changes in the structure of the political and economic system. The scenario does acknowledge that geopolitical changes are an important factor in determining the trajectory of oil markets, noting how the adverse political and security environments of some OPEC members are affecting oil production and investment Nevertheless, the forecast assumes a gradual improvement in the geopolitical context.[458] Secondly, the NPS assumes new oil supplies come online at the right time to meet demand and maintain system equilibrium. However, as has been shown this is often not how markets work in practice, with the report noting that in reality upstream oil investments may not materialise in time to meet demand.[459]

In addition to the above assumptions, the NPS is also limited by significant emerging uncertainties relating to oil supply. This uncertainty does not arise from the sufficiency of industry's production reserves but from the forecast slowing of growth in demand, and eventual

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[457] IEA, *World Energy Outlook 2018*, 135; IEA, *World Energy Outlook 2019*, 132.
[458] IEA, *World Energy Outlook 2018*, 144.
[459] Ibid., 156.

decline in demand, for oil. The WEC points to this predicted peaking of demand as a critical issue for industry participants in terms of both high uncertainty and high impact. It notes that this change will likely result in increased price volatility as NOCs and TNOCs reduce their capital investment in anticipation of falling demand, particularly in long lead time projects. Any decline in upstream investment in turn raises concerns about the possibility of oil producers being left with stranded assets.[460] Similarly, the IEA has previously warned that current investment levels in new conventional production capacity are insufficient to keep up with anticipated demand, noting that one likely reason for this shortfall is because of oil producers' concerns over the trajectory of oil demand.[461] The IEA notes that if this mismatch between projected supply and demand is not rectified there will be a growing risk of damaging price spikes and increased volatility in the medium term.[462]

A further significant uncertainty pertains to the forecasts of tight oil production in the US.[463] This uncertainty results from a number of factors, but many relate to the technical realities of the extraction method. Production from a tight oil well declines at a significantly higher rate than from conventional wells, meaning that in addition to output being capable of increasing relatively quickly using this technology, it can also decrease relatively quickly. To illustrate, 40% of the tight oil wells drilled in the US in 2018 were needed just to maintain production levels.[464] In addition, tight oil production generally has a higher break-even point for production costs than conventional projects, and as of 2018 the tight oil industry as a whole had yet to achieve positive cash flow.[465] The industry today has significant levels of debt,

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[460] World Energy Council, *World Energy Issues Monitor 2017: Executive Summary*, 1.
[461] IEA, *World Energy Outlook 2018*, 163.
[462] A brief explanation of the link between production and reserves should be given here. Production must be replenished as existing bores and fields deplete. Thus, it is not only increased demand which needs to be covered by new production; new projects also need to be commissioned to replace existing production as it depletes. The level of investment required to maintain production is dependent on the sources used. The IEA estimates that if there was no further capital expenditure, global production would fall by over 8% per year to 2025, an average loss of nearly 6 mb/d every year, and that global production by 2040 would be just above 15 mb/d. (ibid., 134,58.) Natural decline is therefore a significant factor to be considered when assessing future production security of supply.
[463] IEA, *World Energy Outlook 2019*, 24. This is both highlighted and demonstrated in the 2019 scenario update, where tight oil production is revised upwards by 35%, meaning production peaks later and decreases slower in the later years of the outlook. This results in the US meeting 85% of the increase in global oil production to 2030.
[464] Ibid., 156. A tight oil well's production usually declines by 60-70% within the first year of production, compared to roughly 6% for conventional production. Following this initial steep decline, the decline rate slows and these wells can have a long tail of low-level production, which can provide an important production baseload.
[465] Ibid., 155. Just 35% of US shale oil companies have achieved this objective.

experiencing bankruptcies that have been accelerated by recent plunges in crude prices associated with a Saudi Arabia and Russia production war, and the economic contraction from the COVID-19 pandemic.[466]

Other significant uncertainties that could positively or negatively affect global oil production include changing demand patterns, assumptions regarding technology development, recoverable resource levels, infrastructure constraints and concerns over the social and environmental impacts.[467] Short to medium-term demand patterns in particular are now especially uncertain. The COVID-19 pandemic has seen global oil demand plummet to 1999 levels, throwing oil markets into turmoil and potentially bringing a paradigm-shift in consumption patterns, with the IEA not forecasting a return to pre-crisis demand until 2021 at the earliest.[468] The choices of other producers could also affect production. For example, the NPS forecast assumes that OPEC continues to regulate production in an attempt to manage the market. However, the IEA notes that OPEC could take an alternative approach, attempting to maintain their production share by increasing production.[469] This approach would lead to a marked fall in oil prices and subsequently production from other sources like tight oil.

The extent to which the above assumptions and production uncertainties hold true or not will almost certainly affect the trajectory of oil markets, and in turn the oil security of New Zealand and that of other consumer nations. Nevertheless, underlying, and in some cases transformative, changes to long-term oil market dynamics are likely to occur regardless of the geopolitical context. These forecast developments, and their potential impact on petroleum supply risk and security of supply policy effectiveness are discussed next.

7.3 Global Forecasts

7.3.1 Demand

Under the NPS, global demand for oil is expected to grow by around 1 mb/d year on year on average to 2025. Oil demand growth is expected to slow beyond this point, but global demand does not peak before 2040 and will be approximately 12% higher than demand today.[470]After

[466] Haynes & Boone, *Oil Patch Bankruptcy Monitor* (Haynes & Boone, 2020).
[467] IEA, *World Energy Outlook 2019*, 129, 55.
[468] IEA, *Global Energy Review 2020* (IEA, 2020), https://www.iea.org/reports/global-energy-review-2020/.
[469] IEA, *World Energy Outlook 2019*, 160-61.

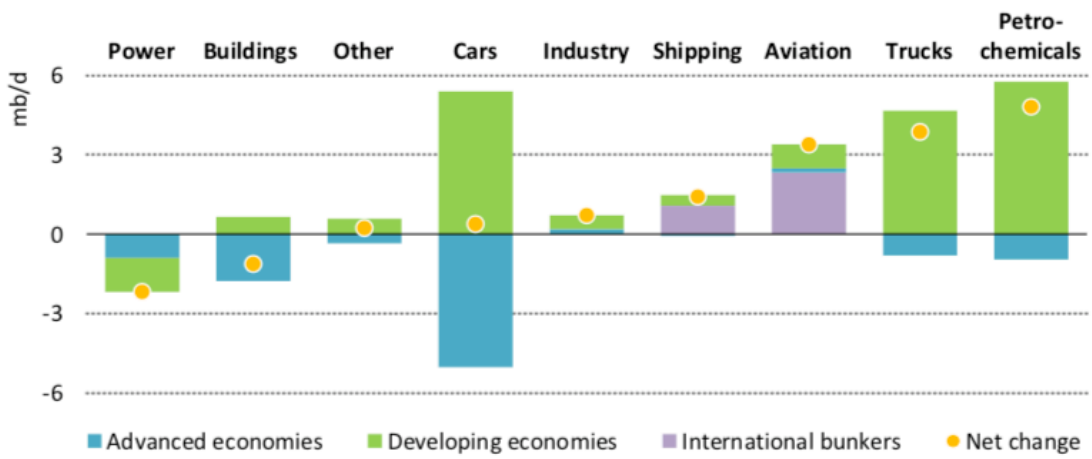

Figure 8: Change in global oil demand by sector in the New Policies Scenario, 2017-2040[471]

2040, demand is expected to very gradually decline. As Figure 8 shows, this growth is expected to come almost exclusively from developing economies, driven in large part by road transport. In contrast, demand from developed economies is expected to drop over the period to 2040, declining by 10 mb/d overall.[472]

Table 2 shows oil demand becoming notably more concentrated in the Asia-Pacific, where consumption taking roughly two-thirds of global crude oil exports by 2040 compared with one

Table 2:Oil trade by region in the New Policies Scenario[473]

Net importer in 2040	Net imports (mb/d)				As a share of demand			
	2000	2017	2025	2040	2000	2017	2025	2040
China	1.7	8.9	12.2	13.3	34%	69%	77%	79%
Other Asia Pacific	2.1	5.5	7.6	10.2	40%	67%	77%	84%
India	1.5	3.4	5.4	8.4	65%	74%	84%	88%
European Union	10.7	11.0	10.3	7.5	73%	85%	86%	88%
Japan and Korea	7.3	6.2	5.9	4.5	97%	95%	97%	96%
Rest of world	-1.4	1.1	0.5	0.8	n.a.	30%	14%	21%
Net exporter in 2040	**Net exports (mb/d)**				**As a share of production**			
	2000	2017	2025	2040	2000	2017	2025	2040
Middle East	18.9	23.1	23.6	25.8	80%	74%	71%	69%
Russia	3.9	8.2	7.9	5.9	59%	71%	69%	62%
North America	-9.7	-2.3	4.1	5.6	n.a.	n.a.	15%	22%
Central and South America	2.4	1.1	1.0	3.1	33%	15%	13%	31%
Caspian	0.8	2.2	2.2	2.2	59%	74%	72%	68%
Africa	5.3	4.0	3.0	2.1	68%	48%	37%	23%

[471] IEA, *World Energy Outlook 2018*, 133.
[472] Ibid., 139; ibid., 133.
[473] Ibid., 149.

half today.[474] China dominates demand growth to 2025, and then India and the Middle East dominate growth between the late 2020s and 2040.[475] This growth results in China overtaking the US to become the world's largest oil consumer, and the largest oil importer in history. The Middle East and India overtake EU demand around 2030,[476] becoming the third and fourth largest oil consuming markets by 2040.[477] Most net importer regions are expected to import a greater share of their demand, particularly the Asia-Pacific where oil production is expected to decline steeply, such that by the early 2020s there will be no country in the region that is a net-exporter.[478] Reflecting this, South-East Asia's import dependence is expected to grow from approximately 60% today to 80% by 2040.

The profile of consumption by sector is also expected to change. In advanced economies, oil demand for road transport declines notably between 2017 and 2040. However, demand in the trucking sector continues to grow alongside significant growth in demand for petrochemicals production. Similarly, aviation and maritime shipping grow as a proportion of global demand, with oil demand in aviation alone increasing over 50% by 2040. Oil is therefore forecast to still dominate in international transport to 2040, with minimal biofuels use over the same period.[479] Overall, aviation and shipping, trucks and petrochemicals grow from approximately one third of total oil demand in 2000 to one half by 2040.[480]

7.3.2 Supply

Under the NPS, the Middle East is forecast to remain the largest petroleum producing region by a significant margin.[481] Production gradually declines in Europe, Africa, non-OPEC Middle East, Eurasia and Asia-Pacific regions as conventional production depletes. In contrast, North and South America are the only regions outside the Middle East expected to see increases in production,[482] with the largest increases in these regions - and globally - coming from the US

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[474] IEA, *Energy Security in ASEAN+6*, 16.
[475] IEA, *World Energy Outlook 2018*, 136-7.
[476] Ibid., 133. China's oil imports grow to over 13 mb/d over this period.
[477] Ibid., 138.
[478] IEA, *Energy Security in ASEAN+6*, 8-9.
[479] IEA, *World Energy Outlook 2018*, 141, 66.
[480] Ibid., 140-41.
[481] Ibid., 149.
[482] Ibid., 144. Production growth in central and south America after 2025 is largely expected to come from Brazil.

and Brazil.[483] While there are notable increases in oil flows from North and South America to Asia, the crude oil trade from the Middle East to Asia remains critical.

The NPS forecasts fewer countries will remain surplus producers in the future. Over the long term, production is increasingly concentrated in Middle East OPEC members, with all these countries, especially Saudi Arabia and Iraq, expected to deliver production growth equivalent to an additional 6 mb/d combined; only 0.7 mb/d of additional production is expected from non-Middle East OPEC members.[484] The US accounts for 75% of global production growth to 2025, with tight oil production subsequently peaking at 9.2 mb/d before slowly declining through depletion of core areas. Tight oil production ramps up elsewhere after 2025, particularly in Argentina, Russia, Canada and Mexico, with Australia, China and the UAE also having tight oil potential.[485] As a result, by 2040 a forecast 3.5 mb/d of tight oil production occurs outside of the US,[486] and conventional oil continues to decrease as a proportion of the global supply mix from 72% in 2017 to 62%.[487]

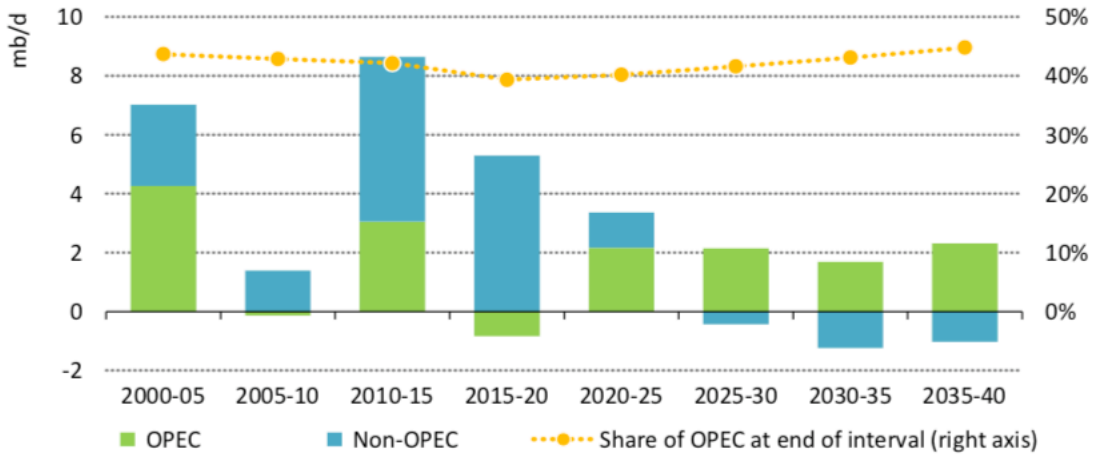

Figure 9: Change in global oil production in the New Policies Scenario.[488]

Despite the forecast growth in tight oil supply, after 2025 OPEC nations remain essential to meeting increases in oil demand.[489] Comprising many of the least-cost suppliers, under NPS OPEC is assumed to continue a policy of market management rather than choosing to seek

[483] IEA, *World Energy Outlook 2019*, 132.
[484] IEA, *World Energy Outlook 2018*, 145.
[485] Ibid., 134, 43.
[486] Ibid., 143.
[487] Ibid., 142.
[488] Ibid., 134.
[489] Ibid.

greater market share.[490] This sees the cartel's proportion of global supply dipping in the medium term before rebounding, but limiting itself to 45% of global oil supply by 2040 as shown in Figure 9. Finally, commensurate with the above growth in global crude supply, 17 mb/d of new refining capacity comes online by 2040. This is located predominantly in Asia and the Middle East,[491] continuing a recent trend of refining centres increasingly being concentrated in the Middle East, China and India.[492]

7.4 New Zealand Forecasts

While New Zealand's petroleum supply and demand is not specifically covered within the IEA's forecasts, there are alternative scenario-based demand forecasts that provide indications of what New Zealand's future oil consumption might be. This study refers to publications from the New Zealand Government, the Asia-Pacific Economic Cooperation (APEC) forum and BusinessNZ Energy Council (BEC) to discern the anticipated role oil will have in New Zealand's future energy mix.

The New Zealand Government's report, *New Zealand's Energy Outlook 2011*, adopts a 'business-as-usual' reference scenario that assumes a continuation of the then-existing broad trends of policy settings, core economic drivers, technologies and fuel choices.[493] In this scenario oil demand continues to grow through to 2040, and still accounts for approximately 44% of TFC. The transport sector remains dependent on oil through to 2030 with alternative fuels still meeting only a small proportion of transport energy demand. Notably, just six years after publication New Zealand's oil and refined product consumption was already higher than predicted in the reference scenario.[494] A subsequent 2017 New Zealand Government report, *Transport Outlook: Future State*, sheds light on possible oil demand, although it does not specifically address oil consumption. In the report's 'base case' scenario[495], given New Zealand's comparatively old vehicle fleet and high vehicle ownership, EVs are expected to

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[490] Ibid., 137.
[491] Ibid., 134, 48.
[492] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 4.
[493] Ministry of Economic Development, *New Zealand's Energy Outlook 2011: Reference Scenario and Sensitivity Analysis* (2011), https://www.mbie.govt.nz/assets/64061a5af0/reference-scenario-sensitivity-analysis-2011.pdf; Ministry of Economic Development, "Summary of 2010 Modelling Results," (2011). https://www.mbie.govt.nz/assets/Data-Files/Energy/d15d7464fd/energy-supply-and-demand-2-mb-2010.xls.
[494] 259.1 PJ forecasted versus 282 PJ in 2017: MBIE, *Energy in New Zealand 2018*.
[495] The 'Base Case' scenario is based upon conservative assumptions that current trends and transport demand patterns continue slowly, and that technology evolves in a non-disruptive manner: Ministry of Transport, *Transport Outlook: Future State* (Ministry of Transport, 2017), 15, https://www.transport.govt.nz/assets/Uploads/Research/Documents/b41c266676/GOTO-Future-State-A4.pdf.

make up only 40% of the light vehicle fleet by 2040, with petrol and diesel vehicle numbers falling from 3.8 million in 2015 to 2.4 million.[496]

Similarly, the *APEC Energy Demand and Supply Outlook 7th Edition 2019* report adopts a 'business as usual' (BAU) model that forecasts a 20% increase in New Zealand's TFC by 2050.[497] This growth is driven primarily by the transport sector, with its share of TFC disproportionately growing by 34%, largely through expansion of freight and aviation activity. Consequently, despite the BAU model forecasting increasing transport sector fuel efficiency and uptake of EVs, petroleum-based products continue to dominate, with demand over this period forecast to increase by 26%.[498]

Two scenarios that examine future oil consumption in more detail developed outside of the state government sector come from BEC's 2015 report, *New Zealand Energy Scenarios*.[499] These scenarios are based upon two quite different futures to 2050. The 'Kayak' scenario is one where markets drive supply chain decisions and innovation, and consumers make their decisions in their own interests based on price and quality. 'Waka' is a scenario where businesses, consumers and the government are driven to make decisions in the national interest due to environmental considerations and changing global circumstances. Under the Kayak scenario, oil consumption peaks in 2030 and begins to decline, accounting for 38% of TFC by 2050.[500] Diesel and petrol still dominate land transport, and aviation fuel consumption increases by 87% between 2010 and 2050. Alternative fuels make up 13% of total fuel use in transport.[501] By contrast in the Waka scenario, oil consumption is reduced further to meet environmental commitments, with oil-based fuel use declining by 31% between 2010 and 2050. While the majority of the light vehicle fleet is using alternative fuels, other transport types still rely on petroleum-based fuels. Aviation fuel still sees a significant 70% increase in consumption between 2010 and 2050.[502] In both scenarios, domestic petroleum production in 2040 is expected to be a small fraction of what it is today.[503]

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[496] Ibid., 5, 72.
[497] APEC, *APEC Energy Demand and Supply Outlook 7th Edition* (APEC, 2019), 239, https://www.apec.org/Publications/2019/05/APEC-Energy-Demand-and-Supply-Outlook-7th-Edition---Volume-II.
[498] Ibid., 242.
[499] BusinessNZ Energy Council, *New Zealand Energy Scenarios: Navigating Energy Futures to 2050*.
[500] Ibid., 71.
[501] Ibid., 50-54.
[502] Ibid., 63-68.
[503] Ibid., 50.

The variations in the scenarios examined above illustrate two things. Firstly, the scenarios demonstrate the importance of government policies in shaping New Zealand's future energy system and level of dependence upon oil. Secondly, and of more relevance for this research, the switch to alternative fuels in the transport sector will likely be a long process.[504] Consequently, petroleum is expected to remain the predominant fuel source for New Zealand's domestic transport sector to 2040 and beyond. A significant government intervention in the energy market could reduce this domestic dominance, but even then, oil security will still be of high importance if international transport – on which the country relies – remains powered by oil in the absence of viable alternatives in sufficient volumes. This reality is reflected in the BEC scenarios, where a greater proportion of the oil consumed will be used in heavy and international transport - a development that could have implications for flexibility of consumption. Security of external oil supply will therefore remain an important objective for New Zealand into the future.

7.5 Mega-Trends

The trajectory of the oil market is unlikely to exactly follow the IEA outlook presented here. However, an analysis of this scenario reveals some broader energy 'mega-trends' that are likely to occur over the next two decades regardless of the context. A number of these trends are relevant for New Zealand's oil security.

7.5.1 Oil Demand

Perhaps the most important conclusion is that petroleum is expected to remain a highly important energy source for the world over the next two decades. In fact, none of the IEA scenarios paint a picture where oil is no longer an essential energy source. Technological advances are providing alternatives to oil but will not immediately replace it. To the contrary, oil consumption is likely to increase further, albeit at a slower pace. Moreover, once decline of demand occurs it is likely to be a gradual process. Therefore, not only will oil security remain a priority for countries across the world generally, so will continued investment in the exploration and development of new sources, the aforementioned issues relating to stranded assets notwithstanding.

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[504] Ibid., 22.

The anticipated changes in consumption profile by sector is also of note here. Oil consumption appears set to become proportionately more concentrated within trucking, international transport (maritime shipping and aviation) and petrochemicals. This change in the future consumption profile may suggest less global demand flexibility to respond to a disruption, a comparatively greater economic impact relative to the disruption magnitude, or both. Alternative fuels are also unlikely to replace petroleum's dominance within international transport over this time.

Future Demand in the Asia-Pacific

The current and expected future demand growth coming from Asia will, as one commentator describes, "…change the global geography of energy."[505] The market influence of large consumer countries in this region will continue to grow, and refining capacity is expected to expand further in Asia and the Middle East, allowing New Zealand to affordably diversify its imported refined product supply sources. However, as previously shown many net-importing regions and large consumer countries are expected to import a greater proportion of their supplies or maintain already high levels of import dependence, as is the case with New Zealand. The Asia-Pacific is most notable in forecast demand figures, with the region seeing an increase in its import dependency as demand significantly grows while at the same time its oil production declines. A greater import dependence necessitates a heavier reliance on certain exporting countries into the future, with commensurate implications for the supply security of the region, and New Zealand's crude and refined product security specifically.

7.5.2 Oil Supply

The trends described within this outlook hold both reassurance and concern for future oil exploration and production. The emergence and successful adoption of tight oil production indicates that peak supply is unlikely to occur within the next two decades, with economically viable reserves expected to be available in sufficient quantities to meet global demand. To the contrary, it appears far more likely that peak demand will occur over this timeframe. Nevertheless, these changes should not be interpreted as New Zealand's supply security concerns disappearing over the next 20 years.

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[505] International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 19.

Emerging Exporters & Tight Oil Production

The above indicates that tight oil production will play a lasting role in global oil supplies. Despite the boom witnessed in shale production, the outlook also shows that unconventional oil will not be replacing crude production from traditional exporting countries in the time period examined, with US tight oil production expected to peak in the medium term. The outlook also shows that the shale boom in the US is unlikely to be replicated at similar scales within other states,[506] and that many of the identified shale reserves are within countries that are already major oil and gas exporters.[507] It should also be noted that growth in tight oil production within the US is expected to be accompanied by production declines in other non-OPEC countries. Therefore, while tight oil production technology may revolutionise oil production, it is unlikely to affect market structures to the same extent. Long-term, given its concentration of spare production capacity OPEC will continue to play a central role within the oil market and in maintaining market stability.[508] Finally, the majority of production and reserves will almost certainly remain state controlled; unconventional sources will not be an issue in an era of pure economically-driven oil prices devoid of state-driven strategic pricing.

The above notwithstanding and as the IEA states, crude grades need to be kept in mind when considering the country-level oil security benefits of the US becoming a net-exporter; most US-produced oil is light and sweet, with only 20% being light and medium-sour.[509] From a regional perspective, these light sweet grades do not constitute a one-to-one substitute for the light and medium-sour grades primarily coming out of the Middle East – the very grades that many Asian refineries are precisely configured to process.[510] In addition to logistical limitations, this means that it will likely be a slow process for Asian refineries to reconfigure on their own accord to enable processing of US tight oil. As already mentioned, Marsden Point would similarly face obstacles switching to an even lighter crude diet.[511] Some commentators have also noted the increasing difficulty of US producers to market the generally very light-

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[506] Although other countries have shale reserves, they may not be as economically viable to extract. A combination of upstream factors in addition to the characteristics of the fields themselves could impact the economic viability of a shale play. Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 14.
[507] Ibid., 23.
[508] Ibid., 10.
[509] IEA, *World Energy Outlook 2019*, 64.
[510] Light and medium sour grades account for over 70% of the oil that Japan and Korea's refineries process. China and India also have substantial appetites for these grades but process a slightly more diverse range of oil grades: ibid., 168-69.
[511] Personal communication with Refining New Zealand.

sweet tight crude overseas, given its comparatively lower yield of the middle distillates for which there is more of a demand globally.[512]

Despite the limitations above, the US shale oil boom has nevertheless resulted in another large exporter emerging on the market, presenting consumer countries with a potential large source of petroleum from a politically stable free-market economy with which to diversify their supply. Tight oil production has a comparatively short investment and production cycle, which the IEA claims provides somewhat of a safety net for global markets in the event of supply-demand imbalances.[513] Given the expected shorter lead-times of shale oil production compared to conventional projects, new unconventional production may also make global production more flexible in responding to disruption. It is however unclear how rapidly tight oil production could respond to a significant disruption;[514] at present, tight oil production increases in the US are constrained by infrastructure limitations.[515] While the US could theoretically meet a large proportion of any Middle East supply shortfall given its ability to ramp up tight oil production relatively quickly, this would also cause significant short-term issues given the aforementioned differences in crude characteristics.[516] Furthermore, Asian refiners' ability to switch to tight oil feedstock would lag significantly behind any supply increase, and doing so would also have major impacts on product mix and yield, adding additional costs and affecting the economics of refining operations.

Regardless of how much more flexible tight oil production is to traditional sources, making additional oil available to the global market may be seen as improving global oil security overall. Nevertheless, it does not appear that US tight oil production alone will resolve or the Asia-Pacific region's or New Zealand's dependency on Gulf oil supplies.

Traditional Exporters and Conventional Production

The NPS indicates the majority of conventional production increases are expected to come from current OPEC members. More specifically, production growth is expected to come from

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[512] Bill Barnes, "US Tight Oil: Too Light, Too Sweet," *Petroleum Economist*, 24 November 2017, https://www.petroleum-economist.com/articles/markets/outlook/2017/us-tight-oil-too-light-too-sweet ; Tom DiChristopher, "Shale Oil Has a Refining Problem, and Morgan Stanley Thinks Investors Can Profit," *CNBC*, 17 April 2018, https://www.cnbc.com/2018/04/17/shale-oil-has-a-refining-problem-and-morgan-stanley-smells-opportunity.html.
[513] Gould and Kim, "The World Can't Afford to Relax About Oil Security."
[514] R. L. Kleinberg et al., "Tight Oil Market Dynamics: Benchmarks, Breakeven Points, and Inelasticities," *Energy Economics* 70 (2018): 77.
[515] IEA, *World Energy Outlook 2018*, 134.
[516] IEA, *World Energy Outlook 2019*, 168-69.

Middle East members, with minimal cumulative export growth from members outside of this region. To the extent that this proves to be the case, global oil security will depend even more on stability within these Middle East producer countries, and the availability of spare capacity within the region. The oil consumption levels within OPEC member countries is also relevant here. Growing consumption in traditional exporter regions could have security implications. Overland highlights that many OPEC countries have rapidly growing populations, and as a result the export capacity of some OPEC members is dwindling as more product is consumed domestically.[517] The IEA expects that growing domestic demand within the Middle East will limit the region's ability to meet the growing demand of other countries.[518]

The anticipated market changes highlighted above may also have implications for the oil industries and economies of traditional exporters. The IEA notes that some traditional producers and exporters are facing an increased pressure on their oil revenues as the dynamics of the oil market change. Significant growth in tight oil production poses a serious challenge to many of the world's producers as oil incomes are squeezed, especially those heavily reliant upon oil and gas revenues.[519] This pressure on petroleum revenues may be compounded as OPEC reduces market share making market management efforts more difficult to achieve.[520] The anticipated slowing of demand growth and ultimate decline casts further doubt on future revenues. As the 2019 WEO states: "[Traditional producers] face the prospect of a world where markets for their ample oil resources are not guaranteed, and where reduced income from hydrocarbons hampers their ability to maintain upstream spending and constrains the investments necessary to diversify their economies."[521] It further notes that a shortfall in upstream spending arising from reduced revenues would result in considerably tighter markets and therefore markedly higher prices for oil.[522] It could also result in short-term supply interruptions ballooning into prolonged outages.[523] Ultimately, such an under-investment situation could result in increased risk of volatility and disruptions.[524] Therefore, oil security

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[517] Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 10.
[518] IEA, *Energy Security in ASEAN+6*, 9.
[519] IEA, *World Energy Outlook 2019*, 160.
[520] Ibid., 24.
[521] Ibid., 130.
[522] Ibid., 69.
[523] Ibid., 172.
[524] Ibid., 36.

could be harmed if the revenues of traditional producers are reduced and insufficient investment in production occurs.

7.5.3 Oil Transport

In the IEA's NPS, the volume of oil transiting Indian Ocean SLOCs will further increase, in part due to the aforementioned growth in energy flows to Asia. This is in line with the view widely shared by experts that these SLOCs will continue to grow in economic and strategic importance. Increased trade flows will result in more pressure on chokepoints within these SLOCs; oil transiting through the Strait of Hormuz is expected to remain at substantial levels, while oil transiting the Strait of Malacca is expected to increase markedly.[525] Any impediment to shipments through either chokepoint could significantly tighten markets,[526] and will therefore remain a risk to New Zealand's security of oil supply. The IEA warns that growing trade volumes and increasing geopolitical risk relating to key chokepoints means that policymakers must continue to be vigilant regarding oil security, and that emergency oil stocks will remain vital to respond to disruptions.[527] Direct shipments from the Atlantic Basin to New Zealand could avoid these chokepoints altogether, but as previously noted shipping distance and duration is longer from this region. This increase in delivery timeframes inherently limits flexibility when handling transport emergencies and therefore raises additional oil security challenges for New Zealand and other net-importers in the region.[528]

7.5.4 IEA Effectiveness

The continuing trend of a growing proportion of demand moving from developed to developing countries may also have implications for New Zealand's mix of oil security policy instruments. The stagnation and anticipated decline in developed countries' oil demand will mean an eventual reduction in vulnerability to supply disruption. However, this will also mean that the group's relationships with suppliers and the efficacy of international energy institutions like the IEA that have been structured around industrialised western economies may be negatively impacted, particularly as consumption grows concurrently in other regions.

Assuming that IEA membership remains the same, the proportion of global oil demand that OECD members constitute will decrease, and the IEA's ability to stabilise the market will

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[525] Ibid., 130.
[526] Ibid.
[527] Ibid.
[528] IEA, *Energy Security in ASEAN+6*, 9.

decline accordingly. In fact, the IEA's current cumulative stockholding is expected to halve to around 11% of total global demand by 2040.[529] Transparency in the oil market has also been highlighted as a possible issue. Market coordination mechanisms may become more difficult to implement, as oil consumption continues to grow within countries whose energy data is unavailable or unreliable. [530]

7.5.5 State Responses

Although some of these energy mega-trends are fairly straightforward to discern, it is less clear how countries will respond to these changes in the oil markets. The anticipated impact on New Zealand's oil security is therefore uncertain as the policy choices of other states will be a large determinant. While such questions are not pursued in-depth here, two uncertainties that could impact New Zealand's oil security environment are of note.

The first uncertainty relates to the continued stability of relations between producer and consumers states. For example, it is unclear how the US might respond to becoming a net-exporter, both in regard to its willingness to coordinate with other oil exporters on oil prices[531] and whether this will ultimately affect the country's engagement in the Middle East.[532] In contrast, while the US may disengage from the Middle East, Asia's anticipated demand growth is expected to continue to drive major importers in the region into closer political and economic ties with the Middle East and other exporting regions.[533] However, there is related uncertainty regarding the interactions of large consumers in the Asia-Pacific region, who as mentioned earlier have a history of competing to secure supply. The heightened level of import dependency may result in increased competition between these large consumer states, or alternatively force cooperation between them to ensure stable and secure supplies. Similarly, there is significant disagreement among experts regarding the trajectory of events in the Indian

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[529] Ibid., 24.
[530] International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 21.
[531] For a discussion on this question, see Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 10.
[532] For a discussion on this question, see International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 18; Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 9.
[533] International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 20.

Ocean, and whether this trajectory arcs toward cooperation or competition between the major regional players.[534]

Another uncertainty relates to the trajectory of the large oil exporters that New Zealand relies upon. As the gap between production and domestic consumption shrinks within OPEC countries, they will become increasingly vulnerable to loss of income from reduced export prices as a greater share of oil revenues are required to maintain domestic subsidies.[535] If sustained downward pressure on prices forces subsidy cuts, these cuts could lead to political instability and possibly regime change in OPEC countries.[536] Instability within major oil producers would threaten oil flows, negatively impacting New Zealand and other consumer states. Conversely, some observers posit such a change might provide some benefit to regional security. Non-democratic oil-fuelled states like Iraq, Iran, Russia and Libya have a history of being involved in interstate conflict over recent decades. Overland suggests the reduced oil revenues for authoritarian countries might result in less capacity for interstate conflict in the world,[537] which may provide some benefit to security within the region and for oil production.

7.6 Summary

Assuming current trends continue, oil will almost certainly remain a vital energy source for the world and New Zealand to 2040 and beyond. This will be characterised by increased global oil and gas consumption, greater importing of the resources, and concentration of supplies in a few countries. Oil's share within the global energy mix may decrease, but is unlikely to be replaced by alternative fuels to any large extent over this timeframe. Moreover, it is possible that New Zealand's oil demand may become even more inelastic as oil consumption is reduced first within the sectors in which it is easiest to do so. New Zealand and others in the Asia-region are anticipated to become more heavily dependent upon Middle East exporters for oil supply. While other sources from the Atlantic Basin will begin to constitute a greater proportion of oil supply to the region, this will take time as refineries adapt to new feedstocks. Moreover, these sources will come into play at the same time as exports decline in other supplying regions,

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[534] Sweijs et al. conduct an extensive literature review on this topic: Sweijs et al., *The Maritime Future of the Indian Ocean,* 7,36.
[535] Overland, "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas," 10.
[536] Ibid. Conversely, lower oil prices could reduce the difference between the import price and domestic subsidised price, but Overland concludes this would probably be insufficient to solve this problem for subsidising states.
[537] Ibid., 12.

including Africa and Southeast Asia. Anticipated trends, including increasing tight oil production growth and decreasing demand growth, may introduce even more challenges for ensuring stable global oil supplies. How other states – particularly large ones – respond to these changes will also influence the extent to which New Zealand's oil security is positively or negatively affected, and in turn will have implications for the effectiveness of New Zealand's current approach to maintaining oil security. The forecast changes in global oil markets are unlikely to make New Zealand's current oil security concerns less relevant to any meaningful extent. Assuming no change to New Zealand's mix of oil security policy instruments, its dependence on certain countries and transport routes appears set to continue and even has the potential to intensify. Consequently, security of supply will remain a vital objective for New Zealand over the 2040 timeframe, with the efficacy of its oil security policymaking conditional upon comprehensive analysis of petroleum markets and mega-trends over long time horizons.

8 Geopolitical Storylines and Policy Options

8.1 Introduction

This study has so far established the ways that New Zealand's oil supply chain could be vulnerable to adverse geopolitical events, and what policies have correspondingly been chosen to maintain security of supply. It has also established that anticipated changes within the oil and energy spheres to 2040 are unlikely to minimise this vulnerability, and certain risks might even intensify within the region. Establishing the relevance and significance of one further variable is central to this study: whether changes in the geopolitical environment can affect the risk profile of oil supply and the effectiveness of security of supply policy instruments, and thus is a variable that should be considered within oil security assessments and policymaking.

This chapter uses the two qualitative external scenario storylines introduced in Chapter 2 to examine the role of geopolitical uncertainty in oil security. Following Van der Linde et al.'s *Study of Energy Supply Security and Geopolitics*,[538] the storylines and the general findings on risk and policy instrument effectiveness within them are discussed here, and subsequently applied to the New Zealand context in Chapter 9. The storylines are considered here as occupying either end of a theoretical geopolitical contextual continuum. The first storyline, *Markets and Institutions*, sees an intensification of globalisation and cooperation within international political and economic institutions. The second storyline, *Regions and Empires*, sees the world divided into integrated political and economic blocs with satellite regions, competing for markets and resources. These storylines do not imply that every state will behave in the same way. Rather, they provide an explanation of general state behaviour within different geopolitical contexts.

8.1.1 Storyline 1: Markets and Institutions

The core assumption of the *Markets and Institutions* (M&I) storyline is a multilateral system governs international relations, even if one state is dominant.[539] The international liberal order and globalisation intensifies in M&I. States cooperate in international economic and political institutions to drive wide-scale economic development under balanced market forces. The flow

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[538] As noted in Chapter 2, this study uses the findings from the WEC's 'Hard Rock' scenario to update Van der Linde et al.'s Regions and Empires storyline to a minor extent. Areas where the storyline and general findings have been updated with elements taken from the 'Hard Rock' scenario will be highlighted.
[539] Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 535; Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 95.

of capital, goods and people continue to grow as markets liberalise further, facilitated by regional free-trade organisations and strong economic institutions including the World Trade Organisation (WTO), International Monetary Fund (IMF), IEA and OPEC.

States across the globe are economically and politically integrated, and markets and institutions effectively operate in a multilateral world. Collective pressure for good governance, including financial institutions, results in more sound and stable government around the world. Economic, social and environmental stress is abated somewhat by international institutions and economic and political treaties. Religious, ideological and political conflicts continue to take place at the international, national or regional level. However, global and regional institutions such as the UN and the EU are able to cope with most of these and the global security environment overall remains stable.

8.1.2 Storyline 2: Regions and Empires

The *Regions and Empires* (R&E) storyline envisages significant changes in the make-up of the international political and economic system. In contrast with the core assumptions of M&I, R&E describes a world that has broken up into rival political and economic spheres of influence. The absence of effective global markets for strategic goods leads to the creation of bilateral supply arrangements and treaties, reinforcing the formulation of more or less integrated blocs with satellite regions and exclusive backyards. The international oil market becomes more regionalised, although there is the possibility of trade flows between some blocs. Oil and gas exporting nations that are part of an empire principally trade within that bloc, with minimal flows going elsewhere.[540] Some countries move toward having the state play a stronger role in the domestic energy market – a few re-nationalise their energy infrastructure and companies.[541]

Countries use whatever capabilities and endowments they have at hand to achieve energy security, which becomes a greater policy priority over environmental concerns.[542] Global powers act fast to reduce reliance on imports from outside of their sphere of influence, and those without secure fuel reserves of their own attempt to avoid dependence on it where

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[540] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 91-95; Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 535-6.
[541] World Energy Council, *World Energy Scenarios 2019*, 49.
[542] Ibid., 47.

possible through alternative technologies.[543] Rivals use their political, economic and military power to compete for markets and scarce resources, including oil.[544]

The international system and associated agreements are weakened, with organisations like the UN, EU, WTO, OPEC and IEA lacking political legitimacy as a result of countries either refusing to participate or trying to dominate within them.[545] The decline of the multilateral system and increased competition leads to a rebirth in tensions within areas like the South China Sea and the Middle East, including the Persian Gulf.[546]

Nations and regions are divided on the basis of ideology, religion and political arguments.[547] National and international security concerns, including economic, social and environmental security, hinder international economic integration, restricting the flow of capital, goods and people. Lack of collective interests in existing international organisations may eventually lead to dominant states undertaking military interventions to secure their supplies. Conflicts over natural resources are more likely to emerge in this scenario.

8.1.3 Storylines in the Present Context

As has been noted, there is growing evidence to suggest the world is moving from a period of relative geopolitical stability towards a new phase of geopolitical uncertainty. It is therefore difficult to discern which storyline the world will more closely resemble in the future. While an in-depth discussion of possible trends within the geopolitical environment is beyond the scope of this study, it is nevertheless important to acknowledge that the multilateral rules-based order appears to be under increasing strain in recent years. Challenges to freedom of navigation principles within areas like the South China Sea; rising tensions between world powers including the US and China; and growing nationalism and a seeming retreat from institutional multilateralism within some countries – most notably the US and the UK – are just some of the changes within the geopolitical environment that suggest a future more closely resembling R&E is a distinct possibility.

Van der Linde et al. considered that instability in the Middle East would be possible under both

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[543] Ibid., 49.
[544] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 91-95; Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 535-6.
[545] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 91-95.
[546] World Energy Council, *World Energy Scenarios 2019*, 47.
[547] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 91-95; Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 535-6.

storylines, as the risk of disruption to supplies was present at the time of publication and not sometime in the future. However, they do note that the risk of instability would become somewhat lower in M&I.[548] Acknowledging recent events within the region, including those having directly interrupted the region's oil supply chain, this assumption is also adopted here.

8.2 Storylines and Supply Disruptions

As described in Chapter 3, the ways that oil supply may be disrupted can be broadly categorised into two types: sudden disruptions; and, supply gaps that emerge slowly over time.[549] Van der Linde et al.'s findings regarding the likelihood of these two types of disruption occurring within each storyline, and how their impact differs, is examined next.[550]

8.2.1 Sudden Disruptions

Markets and Institutions

In M&I, a disruption of oil flows from whatever capacity is available is certainly possible.[551] Given supply arrangements are through markets, a disruption will result in market reactions and reallocations through price. Prices therefore increase to reflect the scarcity of the oil or products involved in the disruption. The IEP and other emergency schemes may be required to reduce the impact of oil supply shocks through alleviation of temporary shortfalls. Emergency responses are likely to be implemented in coordination with OPEC in instances where disruptions are not where the organisation's spare capacity is located. Higher prices reward producers for their ability to provide oil to the world market. Eventually, there may be a collective decision, or less likely a unilateral action to regain access to blocked production capacity via military means.

Regions and Empires

Under R&E, a sudden disruption is also very much possible.[552] This has the potential to cause significant distress in global oil supply depending on the region(s) and scale involved, due to

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[548] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 122-27.
[549] Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 538.
[550] As noted in chapter 2, this study uses the findings from the WEC's 'Hard Rock' scenario to update the Van der Linde et al.'s Regions and Empires storyline to a minor extent. Areas where the storyline and general findings have been updated with elements taken from the 'Hard Rock' scenario will be highlighted.
[551] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 101-02; Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 538.
[552] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 101; Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 538.

the lack of surplus production and transport capacity that would allow for the rescheduling of deliveries. Countries or regions particularly dependent on supplies from one exporting region or country such as the Persian Gulf can face severe impacts if they cannot find supplies from other sources. The price mechanism's coordinative effect is weakened due to prices mainly being set within bilateral contracts; rigid bilateral trade structures may make oil trade flows inflexible to meet required adjustments.

With the absence of a market and prevalence of bilateral agreements, there are significant difficulties in implementing the IEA's IEP due to the conflicting interests of the countries involved. The unreliability of this collective system - and others like the EU emergency schemes - means countries must hold relatively larger strategic oil stocks as the collective schemes cannot be relied upon to effectively come into action. In the event that a major OPEC supplier suffers a large disruption, a lack of agreement between OPEC suppliers renders the organisation's ability to manage production less effective. As a result, generally higher crude and product prices are induced. Disruptions may eventually invite military intervention to ensure access to oil production capacity.

8.2.2 Slowly Emerging Supply Gaps

Markets and Institutions

A slowly emerging supply gap as a result of a poor investment climate is unlikely to occur under M&I.[553] Past spare capacity shortfalls suggest that the international institutions IEA, OPEC and IEF have not been fully effective and that a market-based approach has yet to be implemented in some parts of the international system, but "…once all producing countries have adopted a market-based approach such inefficiencies disappear."[554] Global markets remain liquid and react efficiently to changes in supply and demand through shifts in futures prices, which in turn leads to the reallocation of supplies and investment into new production and transport capacity. The IEA and EU market schemes and a number of commercial agents continue a system of information sharing. Governments and industry work together to establish effective procedures for planning, emergency schemes and environmental purposes.

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[553] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 102-04; Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 538-39.
[554] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 102.

There is the possibility that religious or ideological unrest in local areas reduces the appetite for investment. These circumstances gradually develop, and the market reacts to scarcity through efficient shifts in prices, which in turn supports investment in production and transport capacity in other unaffected areas.

Regions and Empires

Slowly emerging supply gaps as a result of poor investment in various producer economies is possible under R&E.[555] A poor investment climate for production or transport facilities in certain regions or countries could result in slowly emerging supply gaps. The poor investment climate could be caused by general political or economic instability or motivated by religious and ideological choices of groups within the producing region. Either alternative supplies will have to be utilised to fill the gap, or the shortage will drive up prices curbing demand in the long term. Should a large exporter like Saudi Arabia decide to turn away from the market after a radical regime change, other suppliers would have little hope of filling the supply gap, and OPEC would be rendered ineffective at market regulation.

A reduction in production or transport capacity may result in increased competition between consumers and suppliers trying to bilaterally secure exclusive investment and supply contracts. This may result in increased involvement of NOCs and consumer states in the oil market, politicising the market further and reinforcing the problem. The increased prevalence of bilateral trade structures may hinder the flexibility of trade flows. IEA and also OPEC will find it progressively difficult to calibrate oil market management schemes, information systems and strategic stocks.

International conflict may develop over the exclusive relationships between oil producers and the several regions and empires and their related NOCs. In addition, there will be unilateral attempts to open up alternative areas for exploration and production,[556] or there may be a greater push to develop other energy resources for security rather than environmental considerations.[557]

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[555] Ibid., 102-03; Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 538.
[556] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 102-03; Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 538.
[557] World Energy Council, *World Energy Scenarios 2019*, 47.

8.3 Storylines and Security of Oil Supply Objectives

The relevance and effectiveness of various policy instruments varies under each storyline. This

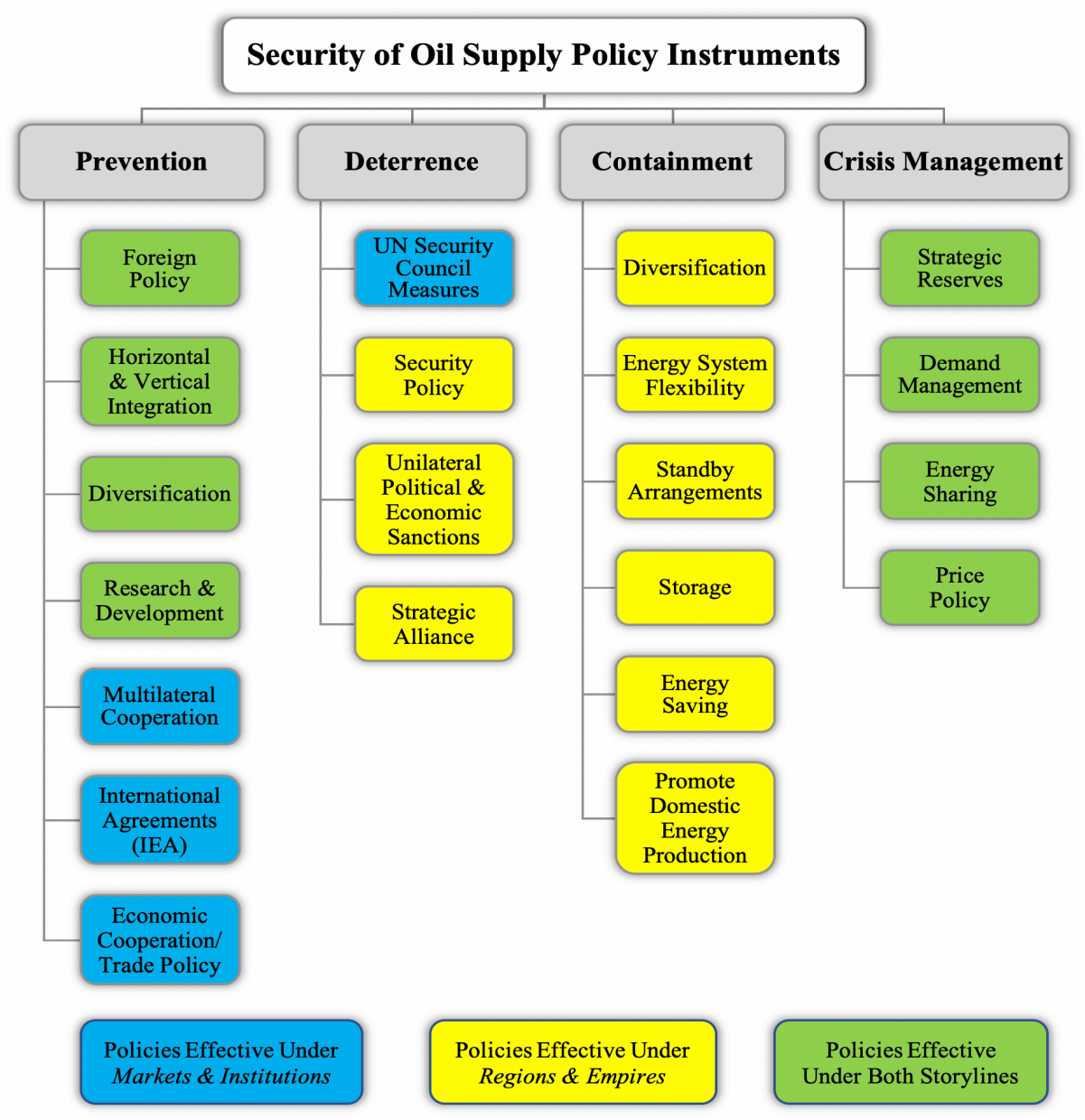

Figure 10: Security of Oil Supply Analytical Framework

is discussed below using the analytical framework introduced in Chapter 2 and reintroduced in Figure 10. In the different storylines, the four security of oil supply objectives of *prevention, deterrence, containment and crisis management* are unlikely to be achieved in the same manner. For example, prevention policy instruments structured on international cooperation are likely to function in M&I but unlikely to do so in R&E. The policy avenues that would be open or closed within the storylines according to Van der Linde et al. are examined below,

including which instruments are likely to be used by other states and how these choices might affect the security of supply of other nations.

8.3.1 Prevention

Prevention policy instruments seek to create a political environment where there are fewer grounds for oil supply disruptions.

There are higher quality prevention instruments available in the M&I storyline, because governance of the international political and economic system is dependent on stronger international institutions and international cooperation in general.[558]

The market is given more space within the political and economic climate of M&I. Any mismatches in supply and demand are largely addressed by the market. Import dependency is less of a strategic issue as oil is made available through the market, strongly supported by multilateral cooperation through institutions such as the IEA and IEF, and others like the World Bank an IMF. These institutions facilitate the development of policy that supports and protects the value of investors' assets.

Within other spheres, the UN Security Council (UNSC) could intervene in regional conflicts through the use of sanctions or other mechanisms, thereby reducing the risk of failing state power in producing nations. Strategic national interests are softened by the growing number of strong international governance structures. The strength and coherence of these institutions overall is expected to increase in M&I.

Significantly higher levels of coordination between large consumer and producer countries advanced through economic cooperation and trade policy would also necessarily appear within M&I. All producers have open access to FDI and to sell their supplies on trade and consumer markets. This reduces the likelihood of producing regions falling into turmoil. Security of delivery rather than security of supply becomes the concern relating to import dependency, but policy measures remain in place to respond to operational, technical or market failures. A minimum price for oil may be utilised to minimise the impact of market fluctuations and limit investment uncertainty.

In R&E, bilateral political and economic cooperation and strategic alliances dominate, rather than market forces. Foreign policy is used with security of supply issues in mind, and regions

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[558] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 114-19.

and empires strategically serve their domestic interests by pursuing trade agreements that are bilateral in nature. Distrust among nations is a prominent feature, and international institutions are likely weakened. It is probable the Middle East is contested among large consumer states, resulting in an intensification of regional conflicts. R&E sees horizontal and vertical integration of NOCs as a key strategy to access and secure resources. Competition between consumer countries for scarce resources is unlikely alleviate conflict, resulting in a high chance of strategically important producing countries or regions falling into turmoil.

Consequently, the current international oil market becomes more state-governed in R&E. TNOCs and NOCs, supported by their respective countries, compete to secure access to strategic resources and help to establish spheres of influence in the regions. Trade in oil becomes more structured within regions and between allies. The oil industry is not coordinated by the market but by long-term contracts and bilateral agreements. Long-term supply contracts strengthen producer-consumer relations and support further investment in oil and gas production.

Reducing import dependency is key to reducing vulnerability in R&E. Domestic production of any available petroleum sources will be promoted by states for security of supply reasons, rather than solely environmental ones. Energy technology research and development to reduce import dependency through energy diversification or increase energy system flexibility will be supported for the same reasons.

In M&I, instruments that aim to establish good multilateral relations fit well. In R&E however, these instruments are limited in both scope and use. Market participants are encouraged to invest in supply security as it aligns with economic interests, resulting in more efficient solutions than arrangements made by states or international institutions. In R&E, governments will need to set terms of security of supply more actively where there is increased politicisation of markets.

8.3.2 Deterrence

Deterrence policy instruments seek to prevent or deter producer states from disrupting oil supplies for political reasons.

Deterrence is less relevant within M&I than within R&E.[559] In M&I, the UNSC is a competent and effective deterrence option, implementing interventions such as sanctions and peacekeeping efforts where needed. Other multilateral institutions like OPEC also have established and credible frameworks for dealing with economic conflict resolution.

Under R&E, security policies of states play a larger role. The ability to intervene within core producing countries will depend on the military strength of an aggressor, and the level of deterrence that the producer country has or is able to arrange through strategic alliance with a competing empire. Political and economic instability could therefore be commonplace in producer states or regions that have not been brought under a large power's sphere of influence.

Another deterrence policy instrument could be the unilateral use of political and economic sanctions. The effectiveness of sanctions would be governed by the degree to which a producer's need for security of demand is asymmetrically higher than the consumer's need for security of supply. The strength of this approach would therefore depend on countries' levels of import dependence.

8.3.3 Containment

Containment policy instruments seek to reduce the impact of an oil supply disruption on a country's national security and the economy.

Containment policy instruments are less effective in M&I than R&E, as market forces effectively coordinate supply and demand.[560] In R&E however, these instruments are highly important as they can reduce supply disruption impacts. Governments would likely need to take an active role for most of these instruments to be implemented, for example by encouraging energy system flexibility through the use of different fuels or technologies. The government could also enter into standby arrangements with producer countries, although such options would likely be limited to the alliances within the country's respective empire. Market relations are only moderately important in R&E.

8.3.4 Crisis Management

Crisis management policy instruments seek to mitigate harm during an oil supply disruption.

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[559] Ibid., 119-20.
[560] Ibid., 120-21.

Crisis management approaches stay essentially the same between storylines; both using security of supply instruments like strategic reserves, demand management and pricing controls.[561] However, where M&I would see stockholding implemented under the umbrella of the IEA or similar organisation, in R&E countries would establish strategic reserves individually or within their empire. Generally, the greater the participation, and the greater the consensus on policy objectives and when they are to be used, the more effective and easier it will be to employ these instruments. The lack of collective strength of the IEA arrangement within R&E may therefore require importing countries to increase their stockholding to account for reduced effectiveness. Conversely, coherence would likely improve under M&I given the lesser politicisation and polarisation between market participants.

8.4 Summary

Security of oil supply unfolds in the geopolitical environment of the day. Geopolitical environments are in a constant state of flux, such that policymaking in the present may not deliver an optimal mix of policy instruments for different geopolitical environments in the future. Imagining and exploring different geopolitical contexts over long time horizons can inform more adaptive policy mixes. Future possible geopolitical environments can be conceived as lying somewhere on a continuum between two extremes of *Markets and Institutions*, and *Regions and Empires*. The former foresees an intensification of globalisation and cooperation within international political and economic institutions, while the latter foresees a polar opposite world divided into integrated political and economic blocs competing for markets and resources. Supply disruptions are a feature of both futures, but differ in their likelihood, impact on oil security and the form they take. This difference results from varying degrees of multilateralism; stability of institutions; information sharing and credibility; the level of trust between nations supporting collective action and international agreements; investment climate; and economic and technical flexibility of energy systems.[562] Achieving the four security of oil supply objectives of prevention, deterrence, containment and crisis management necessarily demands a different mix of policy instruments according to the geopolitical environment that unfolds. The efficacy of security of oil supply policymaking is,

[561] Ibid., 121-22.
[562] Ibid., 107.

along with the veracity of assessments, also a function of the degree to which geopolitical uncertainty over long time horizons is factored in.

9 Discussion

9.1 Implications of Storylines

The storylines in the previous chapter clearly demonstrate that the geopolitical environment is an important determinant of New Zealand's security of supply and the effectiveness of associated security policies. Unsurprisingly, the geopolitical environment can influence the risk of a disruption within New Zealand's oil supply chain occurring. Some risks to New Zealand's supply, notably disruptions to production from the Middle East, are likely to persist over the next 20 years regardless of the geopolitical environment. However, exposure to other disruptions appears more likely in some geopolitical environments than others, particularly disruptions within the midstream sector and slowly emerging supply gaps from a poor investment climate. Thus, changes within the geopolitical environment can not only alter the exposure to potentially disruptive geopolitical events, but the type of disruptions likely to be experienced.

The connection between the strength of market mechanisms and geopolitical risk is also of note. The storylines show it is likely that the ability of related markets to effectively manage supply disruptions is negatively correlated with this disruption risk; a more competitive geopolitical environment would likely increase the risk of disruptive events, and at the same time decrease the power of market mechanisms to respond and reallocate scarce supply as countries pursue non-market means to maintain oil security. Investment can still occur in the upstream sector within a competitive geopolitical environment, but the storylines would suggest it is more likely to be in the form of exclusive supply contracts, dislocated from the market. The likelihood of disruptive events, the form they take, and the capability of related markets to respond to them can all be impacted by changes within the geopolitical environment, and each concurrently in ways that can make the task of maintaining security easier or more challenging. Following from this, the more competitive the geopolitical environment, the more relevant the structure of a country's oil supply chain becomes for security of supply.

The storylines also demonstrate that the impact on disruption risks inevitably results in impacts on policy instrument effectiveness, as does the level of cooperation or competition among consumer countries. As a result, certain policies are more appropriate in some geopolitical contexts than others, and this is directly relevant for New Zealand's current security policy settings. Most notably, the storylines suggest that the IEA's IEP would become a less effective policy instrument if multilateral approaches weaken, with the IEA perhaps insufficient on its

own to maintain New Zealand's oil security at a desirable level in such an environment. Similarly, New Zealand's ticket-based approach to stockholding obligations may be less appropriate in such an environment because of weakened market allocation mechanisms, and less certainty that IEA members will meet their stock transfer obligations in a crisis. In this regard, New Zealand's approach to oil security is more closely aligned with a world resembling Markets and Institutions – or a comparatively stable and cooperative geopolitical environment – rather than a geopolitical environment more closely resembling Regions and Empires.

9.1.1 Impact on Current Security Assessments & Policymaking

The findings above have notable implications for New Zealand's approach to assessments of its security of oil supply. As has been explained, the framework of New Zealand's current assessments is predicated on two notions: that the market is highly capable of reallocating supply and thus dispersing the impact of a disruption among market participants; and, that the IEP is an effective tool to mitigate the effects of a supply shortfall and ensuring that the burden of a shortfall is shared equitably among member states. However, this study has found these notions to be somewhat of an oversimplification.

In addition, the storylines show that geopolitical context can have a strong influence on the strength of the market and the IEA agreement. More specifically, the responses of states to the geopolitical environment can influence the size and strength of the oil market and the effectiveness of IEA membership as an insurance policy, thus influencing the level of supply security provided. The effectiveness of energy security policy instruments and approaches thus not only depends on international oil market dynamics and New Zealand's domestic energy supply and demand, but also the geopolitical context. As Correlje & Van der Linde conclude, "…energy policymaking cannot be seen in isolation from what goes on in the international system."[563] This study therefore finds that the utility of New Zealand's current assessments and policymaking are limited in their efficacy by not accounting for geopolitical uncertainty over the long-term.

The above has important implications for New Zealand's long-term oil security. The storylines approach demonstrates that changes within the geopolitical environment have the potential to markedly change New Zealand's oil security calculus, particularly when considered alongside other supply chain and market-related variables identified throughout this research. The limited

[563] Correlje and Van der Linde, "Energy Supply Security and Geopolitics: A European Perspective," 533.

examination or absence of these variables within current security of supply assessments means that considerations of present and future oil security may differ markedly from what would otherwise be the case.

9.2 Improving Oil Security Assessments

Effective policymaking requires accurate and relevant information being available to governments. Given the current limitations of existing assessments identified above, there are a number of ways that New Zealand's oil security assessments could be changed to improve the information provided to New Zealand policymakers. The improvements discussed below relate to the general understanding established within this study that the current level of oil security and the effectiveness of the existing policy mix can be affected by changes in the external supply chain and geopolitical environment.

9.2.1 Allowing for Complexity

Oil supply chain realities

New Zealand's oil security assessments should frame their external disruption scenarios upon the actual structure of the country's supply chain and its sector dependencies, rather than global supply disruption estimates. This could, for example, include a scenario where transit through the strait of Malacca is disrupted. These scenarios should not only account for the expected scale of the disruption, but the anticipated capability of the market to respond to varying disruptions given upstream, midstream and downstream constraints identified in this research, including the expected impact on product suppliers. Similarly, the expected time delays for New Zealand to receive emergency supplies from unaffected IEA members should also be accounted for. This will provide a more accurate measure of risk and risk preparedness.

Furthermore, New Zealand's oil security cannot be determined in isolation. Assessments should also account for the disruption vulnerability of other states that source their oil supply from the same countries and regions. A country's level of import dependence, diversification and stockholding will affect each country's ability to provide relief to New Zealand during a disruption. This will also affect the level of supply shortfall in the region over the short-term, and by extension the level of stress placed on nearby unaffected sources while a disruption is being resolved.

Implementation of such improvements could be enhanced with further research of the supply chain. Australia is currently developing comprehensive supply chain modelling and

information sharing requirements for market participants to improve responses to disruptions;[564] New Zealand should do the same. Modelling should include establishing what economically viable alternative sources of crude are available should current sources be disrupted, taking account of New Zealand's refinery blending and product volume requirements. Where possible, this could also include examining supplier flexibility for the overseas refineries from which New Zealand sources refined product. Having accurate information regarding the supply chain not only allows for more effective responses to disruption, but also allows for a more accurate determination of supply vulnerability. This is confirmed by New Zealand's existing security assessments that note better knowledge of the country's ability to second-source in the event of a disruption of supply from regular sources would be beneficial for this reason.[565]

Market realities

This study has found that market conditions can impact oil security, in addition to the state and structure of New Zealand's supply chain specifically. A more accurate assessment should account for levels of tightness, concentration and flexibility within associated upstream, midstream and downstream markets, and the extent that supply is being traded through open market channels. These factors may become more relevant should concerns about peak demand lead to investment within these sectors falling to insufficient levels.

Geopolitical Realities

It is clear that the geopolitical environment can affect the level of disruption risk, and the effectiveness of various policy instruments and mix thereof. This variable therefore needs to be accounted for within existing assessments. Global geopolitical trends are relevant for determining security, as are specific situations within areas like the South China Sea and Persian Gulf that are directly relevant for New Zealand's supply chain. Part of this approach should not only include identifying what geopolitical events are occurring within supplier regions, but also being aware of the approach large consumer countries are taking to secure supplies, particularly those dependent on the same supply sources as New Zealand.

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[564] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*.
[565] NZIER, *New Zealand Oil Security Assessment Update*, 7.

9.2.2 Time Horizons

Finally, security assessments should examine over longer time horizons. Long-term assessments allow for forecasts of risk given anticipated changes in the above factors, including in the energy markets, the geopolitical environment and New Zealand's oil supply chain. In addition, the use of long-term forecasting also allows for policy instruments with long implementation times to be assessed as possible responses, thereby introducing a more diverse range of policy options for the government to consider. This allows for development of a more coherent strategy for maintaining long-term energy security. Such an approach is not unheard of within New Zealand policymaking; accounting for geopolitical realities and longer time horizons have been part of the nation's oil security assessments in the past.[566] As the WEF concludes, "…the world has moved into a new and unsettling geopolitical phase… assessing and mitigating risks… will require careful horizon scanning and crisis anticipation by both state and non-state actors."[567]

9.3 Policy Responses for Long-term Security

As already noted, policymakers must balance energy security objectives with other - sometimes conflicting - objectives when determining an appropriate energy policy mix. Determining this mix is beyond the scope of this study. However, the findings of this research suggest that new policy options warrant consideration.

As long as New Zealand remains dependent upon external supply, no mix of policy instruments is capable of eliminating geopolitical risk to supply entirely. As BEC notes, the country's domestic economy will continue to be exposed to changes in the international oil market as long as it continues to participate within it.[568] Moreover, New Zealand is too small to pursue certain security improving policies. Barton concludes that many of the country's energy security issues will exist no matter what legal provisions or policy mix is in place, as oil imports are largely out of the control of a small country.[569] Pathways to improve flexibility of oil consumption are also likely to remain limited given the few fuel alternatives available for use in the nation's current vehicle fleet. However, this does not mean that other policy instruments

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[566] G F Preddey, *Fast-Track Self-Sufficiency: An Alternative Energy Plan* (Wellington: Commission for the Future, 1980).
[567] World Economic Forum, *The Global Risks Report 2018*, 7.
[568] BusinessNZ Energy Council, *New Zealand Energy Scenarios: Navigating Energy Futures to 2050*, 31.
[569] Barton, "Reaching the Limits of What the Market Will Provide: Energy Security in New Zealand," 389.

in addition to the ones currently adopted cannot be utilised to improve supply security and manage vulnerabilities.

New Zealand can use a range of other policy instruments to improve oil supply security and minimise the impact of a disruption, particularly when long time horizons are considered. Given the high level of uncertainty regarding the future geopolitical landscape, the New Zealand Government's best strategy is likely to be one that keeps numerous policy instruments viable for adoption if required while working to limit vulnerability to sector disruptions over time. With this in mind, the following section discusses potentially viable policies or strategies that the government should consider implementing to improve oil security or could be implemented should changing circumstances require it.

9.3.1 Retaining & Modifying Existing Policies

IEA

This study has shown that IEA membership does not guarantee oil security, nor is the IEP guaranteed to operate as intended in all circumstances. Other policy instruments may therefore need to be adopted to ensure a satisfactory level of security into the future. Nevertheless, this is not to assert that New Zealand's IEA membership is not highly beneficial to the country's security of supply. As noted earlier, the question of whether New Zealand needs to remain within the IEA to maintain its current level of supply security has been raised in previous assessments. This questioning stems from confidence that effective market allocation of supply will ensure New Zealand benefits from an IEP stock release irrespective of its IEA participation. However, as has been shown, this notion of market allocation is an oversimplification of market and supply chain realities. In a situation where a significant regional disruption occurs or where New Zealand's regular supply lines are disrupted, having IEA members both within and outside the Asia-Pacific that are obligated to directly supply New Zealand would be highly beneficial. Moreover, the IEA remains an important counterbalance to supplier ambitions. The benefits provided by IEA membership and more broadly by the organisation's existence mean that New Zealand should be attempting to strengthen the IEA where possible, not weaken it through the country's departure. New Zealand's best approach to maintaining oil security over the next 20 years will therefore almost certainly involve retaining IEA membership, albeit supplemented with additional security policies where necessary.

Given the change in market dynamics to where many of the largest consumers are not OECD countries, it has been suggested that the IEA should consider expanding its membership qualifications to allow for these large energy trading countries to transition from observer status to fully-fledged signatories of the IEP.[570] For the reasons above, New Zealand should support such actions. By the same token, New Zealand should encourage Australia to meet its IEA stockholding obligations, which it has failed to do for quite some time and by a significant margin;[571] furthermore, that such stocks be held in-country. This is not only to strengthen the institution and its emergency measures, but also because Australia is one of the closest IEA members – both in proximity and relations – that could provide assistance during a disruption to New Zealand's oil supplies. While this research does not examine the broader national security implications of oil supply security, it should also be highlighted that in a more hostile security environment Australia would likely be an important security partner to New Zealand. It is therefore in New Zealand's security interest for Australia to have the necessary oil supplies available to effectively operate economically and militarily.

Strategic Reserves

The WEC notes that stockpiling will become a less popular oil security policy instrument as the energy system decarbonises.[572] It may be tempting to act on the view that oil – and therefore security of supply instruments like strategic reserves – will become less important for New Zealand. However, as has been shown, a secure oil supply will remain vital for the country for at least the time horizon of this study. As long as supply security is a key national objective, strategic reserves will therefore remain an important policy instrument to weather any supply disruptions. Furthermore, the importance of stockholding is likely to become even greater should New Zealand's dependence on Middle East suppliers increase and supplier diversification decline.

Not all stockholdings necessarily provide the same degree of security. Off-shore stock ticket contracts have provided a cheaper alternative than physical stocks to maintain New Zealand's IEA stockholding obligations. However, this approach has some shortcomings to domestically held physical stocks, including that ticket stocks are not immediately available for use, along

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[570] International Security Advisory Board, *Energy and Geopolitics: Challenges and Opportunities*, 21; IEA, *Energy Security in ASEAN+6*, 3.
[571] IEA, "Oil Stocks of IEA Countries."
[572] World Energy Council, *World Energy Trilemma Index 2019* (World Energy Council, 2019), 28, https://trilemma.worldenergy.org/reports/main/2019/2019%20Energy%20Trilemma%20Index.pdf.

with the accompanying uncertainty of whether bilateral commitments to ensure stock delivery to New Zealand will be honoured in all circumstances. The New Zealand government should therefore reconsider its ticket-based approach to meeting its IEA obligations. Strategic reserves in the form of physical stocks held in-country would not only deliver a concrete level of insurance against physical disruption, but also provide the government with more time to determine the severity and length of a disruption, and the viability of options available to respond.[573] Additional stockholding capacity will necessarily require capital and time to create; the government should not wait until such capacity is needed in order to build it.

Another way the security provided by stockholding could be increased is by allowing for the various factors discussed within this study when determining the optimal level of stockholding, rather than simply adopting the IEA 90-day net import stockholding target. Accounting for refining capacity and petroleum grade requirements, the required levels of each oil product, and the viability and transport distances of alternative sources in stockholding calculations would provide a better determination of appropriate stockholding targets. Where necessary, the government should also consider placing minimum stockholding requirements on refined product, similar to the EU.[574]

Finally, over the long-term it can be expected that oil consuming sectors that can easily convert to other energy sources will do so. This will likely result in a more concentrated demand within sectors such as transport that cannot substitute demand or easily reduce it in the short-term. New Zealand might therefore consider adjusting its stockholding mix and volumes to reflect the relative importance of meeting different domestic consumption demands, rather than focusing on generic consolidated consumption quantities alone.

9.3.2 Import Substitution

Increasing domestic production has been highlighted in earlier New Zealand oil security assessments as the main non-storage security of supply policy instrument for improving energy security.[575] It has also at times been promoted by the New Zealand Government as a way to reduce the country's oil import bill.[576] In 2011, the Government claimed there was significant

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[573] Fattouh, *How Secure Are Middle East Oil Supplies?*
[574] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 30-31.
[575] Hale & Twomey and Covec, *Oil Security*, 82, 89.
[576] Ministry of Economic Development, *New Zealand Energy Strategy to 2050* (MED, 2007), 13, http://www.mcguinnessinstitute.org/wp-content/uploads/2016/08/nzenergystrategyto2050.pdf.

potential for further development of petroleum resources within New Zealand that could eventually make the country a net exporter.[577] However, despite establishing regulatory regimes designed to encourage oil exploration,[578] this net exporter scenario now appears unlikely. To the contrary, New Zealand's domestic oil production has declined noticeably since 2011. MBIE states the drivers of this decline in recent years are twofold: firstly, as a result of natural field exhaustion;[579] and secondly, due to the absence of any new major field discoveries.[580]

Furthermore, this decline in oil reserves looks set to continue. International oil companies have decreased their investment in New Zealand's upstream oil sector amid a low oil price environment,[581] resulting in oil exploration and permitting in the country being at historic lows.[582] Beyond the influence of oil price, in general New Zealand's attractiveness to oil exploration companies is somewhat limited by the country's geographical isolation; exploration and mining companies operating in New Zealand must bear the associated costs of getting equipment to and from the country, with seismic vessels and offshore drilling rigs costly to mobilise if not already present within New Zealand.[583] Further reducing the country's attractiveness is geology broadly inconducive to large oil reservoirs.[584] In 2017, the IEA concluded that "…all in all, the production outlook for [New Zealand] is rather limited,"[585] a sentiment echoed within the BEC forecasts examined in this research. Reducing import dependency to any significant extent via promoting domestic production therefore appears not to be a viable policy instrument. Nevertheless, despite the anticipated continuing decline in production, adopting this policy may still represent the best opportunity to achieve oil security objectives. As BEC notes, New Zealand's remaining domestic oil and gas resources may become economically viable to extract in the event of a major conflict in the Middle East.[586]

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[577] Ministry of Economic Development, *New Zealand Energy Strategy 2011-2021*, 3.
[578] IEA, *New Zealand 2017 Review*, 49, 52-54, 59.
[579] Ibid., 18; MBIE, *Energy in New Zealand 2018*, 24. At the end of 2017, proved plus probable oil and condensate remaining reserves stood at approximately 71 million barrels. "Reserves are the estimated total amounts of oil and gas that are able to be recovered from a known petroleum reservoir. Remaining reserves are ultimate recoverable reserves, less production to date."
[580] MBIE, *Energy in New Zealand 2017*, 23; IEA, *New Zealand 2017 Review*, 33.
[581] IEA, *New Zealand 2017 Review*, 18. MBIE, *Energy in New Zealand 2017*, 34.
[582] MBIE, *Energy in New Zealand 2018*, 24.
[583] Barton, "Reaching the Limits of What the Market Will Provide: Energy Security in New Zealand," 378.
[584] Ibid.
[585] IEA, *New Zealand 2017 Review*, 18, 53.
[586] BusinessNZ Energy Council, *New Zealand Energy Scenarios: Navigating Energy Futures to 2050*, 95.

9.3.3 Reducing Oil Dependence

Diversifying away from consumption of imported oil to more secure alternative domestic energy sources could lead to significant improvements in national energy security. Reducing oil dependence is also likely to be a more viable approach over the long-term compared to import substitution, given the abundance of alternative domestic renewable and non-renewable energy sources at the country's disposal, and because transitioning to renewable energy sources also supports other government objectives including reduction of domestic greenhouse emissions.[587] The current *New Zealand Energy Strategy* already has reducing oil dependence through promotion of diverse energy sources as a key objective,[588] and the New Zealand Government and others have also pointed to alternative fuels use in the transport sector as a method to improve energy security.[589]

Reducing oil dependence can be bolstered by government policies but constitutes an expensive undertaking that would take time to implement. Significantly, for the transport sector to transition from oil dependence would require an alternative energy source that can either be used within existing combustion engines, or in the case of electricity require new vehicles entirely. In 2016, the New Zealand Government adopted an EV programme which targets the doubling of the EV fleet every year to reach around 64,000 vehicles by the end of 2021.[590] While the Government has encouraged EV uptake to some extent,[591] it should be noted that very few policies apart from the Emissions Trading Scheme (ETS) have been implemented to

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[587] Other options such as liquid fuels from New Zealand's abundant lignite deposits have been examined by the government in the past but would have to overcome political and economic obstacles to be viable. See: Martin Garrood and Tony Clemens, *Liquid Fuels from Lignite* (CRL Energy, 2007), https://www.mbie.govt.nz/assets/8fb7b2c240/liquid-fuels-from-lignite.pdf.

[588] This includes the *The New Zealand Energy Strategy*, the *New Zealand Energy Efficiency and Conservation Strategy* and the *New Zealand Transport Strategy*. These strategies are intended to reduce New Zealand's reliance on oil over time. Ministry of Economic Development, *New Zealand Energy Strategy 2011-2021*; MBIE, *New Zealand Energy Efficiency and Conservation Strategy 2017 - 2022* (MBIE, 2017), https://www.mbie.govt.nz/assets/346278aab2/nzeecs-2017-2022.pdf; Ministry of Transport, *The New Zealand Transport Strategy* (Ministry of Transport, 2008), https://www.transport.govt.nz/assets/Import/Documents/fe435c0ddf/NZTS2008.pdf.

[589] See for instance: Ministry of Transport, *The New Zealand Transport Strategy*, 25; Ministry of Economic Development, *New Zealand Energy Strategy 2011-2021*, 19; BusinessNZ Energy Council, *New Zealand Energy Scenarios: Navigating Energy Futures to 2050*, 95.

[590] Ministry of Transport, "Electric Vehicles," updated 9 June, 2020, https://www.transport.govt.nz/multi-modal/climatechange/electric-vehicles/.

[591] New Zealand Productivity Commission, *Low Emissions Economy: Final Report* (New Zealand Productivity Commission, 2018), ii, https://www.productivity.govt.nz/assets/Documents/4e01d69a83/Productivity-Commission_Low-emissions-economy_Final-Report.pdf. Ministry of Transport, "Electric Vehicles." This promotion of EV adoption has been primarily to meet emissions reduction objectives rather than to promote energy security.

support this strategy.[592] If the Government wished to further increase the pace of this transition to meet energy security or other objectives, it would likely require additional and aggressive policies to be implemented. The IEA notes that carbon price is unlikely to drive energy sector transformation on its own, including within transport.[593] Additionally, the New Zealand Government may also need to provide additional support to the domestic energy industry in order to meet the energy requirements of this transformation. The country's state-owned electricity transmission company, Transpower, notes that in a scenario where significant electrification of industrial and transport sectors takes place, the electricity requirements of New Zealand would be expected to almost double by 2040, requiring significant investment in the generation sector.[594]

New Zealand's oil dependence relative to other friendly nations is also of note here. The country needs to keep pace with global trends in energy technology and alternative fuel adaptation to maintain reliable energy supply, particularly in transport, otherwise risk finding itself left behind with potentially more limited oil supply.[595] At the same time, however, it must be noted that security of supply risks are also present for alternative energy sources. The New Zealand electricity sector has highlighted a number of issues and uncertainties that will need to be addressed should renewable electricity become a larger proportion of the country's energy mix. Some of these risks include: intermittent generation from renewables and related energy storage issues; vulnerability to adverse hydrological conditions and potential for climate change to affect renewable generation capacities;[596] and cyber-vulnerabilities of infrastructure.[597] Furthermore, unlike many countries, New Zealand's geographical isolation precludes it from connecting to the electricity grids of other countries. The security of the

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[592] IEA, *New Zealand 2017 Review*, 14.
[593] Ibid.
[594] Transpower, *Te Mauri Hiko - Energy Futures: White Paper 2018* (Transpower, 2018), 20, https://www.transpower.co.nz/sites/default/files/publications/resources/TP%20Energy%20Futures%20-%20Te%20Mauri%20Hiko%2011%20June%2718.pdf.
[595] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 4. A similar warning was given within this research in regard to Australia's oil dependence.
[596] Transpower, *Te Mauri Hiko - Energy Futures: White Paper 2018*, 16; BusinessNZ Energy Council, *New Zealand Energy Scenarios: Navigating Energy Futures to 2050*, 23; New Zealand Productivity Commission, *Low Emissions Economy: Final Report*, 99.
[597] Meghan O'Sullivan, Indra Overland, and David Sandalow, *The Geopolitics of Renewable Energy*, HKS Working Paper No. RWP17-027 (Columbia University Center on Global Energy Policy, 2017), 23, https://energypolicy.columbia.edu/sites/default/files/CGEPTheGeopoliticsOfRenewables.pdf.

domestic grid is therefore vital as the country cannot procure electricity supply from abroad in the event of an energy crisis.[598]

There may also be geopolitical risks relating to renewable energy technologies. Certain rare earth elements are widely used within renewable energy technologies, and the processing and reserves of some of these critical materials are concentrated within only a few countries.[599] Trying to rush electrification of New Zealand's energy sector without accounting for these risks would not only be economically costly but may also undermine rather than bolster New Zealand's energy security. In the same regard, the New Zealand government should not make its energy strategy entirely reliant on technology advancements within the renewable electricity sector. Technological uncertainty in the renewable energy sector is significantly higher than in the oil sector because it involves several separate types of energy source, energy generation, transportation and storage.[600]

New Zealand's best option to maintain energy security may therefore be to hedge its bets and not rely solely on one energy type or technology to meet its future energy needs. As BEC remarks on New Zealand's energy future: "…we cannot afford for policy to be based on a single 'pathway' – as soon as a narrow set of choices and technologies is relied on, we immediately lose our resilience to different futures… The policy which supports [New Zealand's energy] targets needs to strike a balance between being grounded in today's known technology, while not being heavily reliant on assumptions about future advances."[601] It should also be noted that while New Zealand is not capable of deciding the future global energy mix, it is not restricted to simply being a bystander to alternative fuel development. New Zealand could therefore support improvement in its oil security through diversification via alternative fuels technology development.

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[598] Transpower, *Te Mauri Hiko - Energy Futures: White Paper 2018*, 4.
[599] World Energy Council, *World Energy Issues Monitor 2019*, IEA (World Energy Council, 2019), 7, https://www.worldenergy.org/assets/downloads/1.-World-Energy-Issues-Monitor-2019-Interactive-Full-Report.pdf; O'Sullivan, Overland, and Sandalow, *The Geopolitics of Renewable Energy*, v.
[600] O'Sullivan, Overland, and Sandalow, *The Geopolitics of Renewable Energy*, 33.
[601] BusinessNZ Energy Council, *BEC 2050: A Deep Dive into 2030 Energy Targets for New Zealand*, BusinessNZ Energy Council (BusinessNZ Energy Council, 2016), 8, https://www.bec.org.nz/__data/assets/pdf_file/0020/119009/A-deep-dive-into-2030-energy-targets-for-New-Zealand.pdf.

9.3.4 Diversification of Oil Supply

In the more immediate term, encouraging greater diversification of suppliers could be a viable option to improve New Zealand's oil security, particularly if dependency on certain suppliers grows even further or if dependence on certain transport routes becomes a greater concern. The New Zealand government could enact subsidies to incentivise supply from other sources. However, as Korea has learnt, the success of this approach is conditional upon the capabilities of domestic refining infrastructure.[602] Where increasing diversification of supply sources is not viable, New Zealand's domestic stockholding levels should adjust in response to the country's concentrated supplier base.

It is worth noting the importance of domestic refining capacity and capability in relation to supply diversification and to New Zealand's oil security in general. Domestic refining capacity allows for reduced dependence on other states for supply of refined product, but also improves flexibility by allowing the country to meet demand from crude supplies. A decline in domestic refining capabilities and increased reliance on overseas refining would therefore limit supplier options and potentially concentrate supply or transport routes. A reduction in domestic refining would also limit crisis management options given that crude oil accounts for a large portion of the country's IEP strategic stockholding.[603]

It is noteworthy that in Australia three refineries have closed in the past 10 years due to competition from larger more efficient refineries in Asia, leaving only four refineries remaining;[604] New Zealand's sole refinery is facing the same challenges to its competitiveness.[605] Should domestic refining become commercially unviable, the New Zealand Government could implement policies that ensure continued domestic refining capacity in order to maintain oil security. The range of oil crudes that domestic refining can process also influences diversification options. Should the Government choose to support supplier diversification initiatives, implementing policies that incentivise or improve refining flexibility may also be a viable option.

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[602] Charles Lee, "South Korea Refiners Say Incentives to Diversify Crude Import Sources Too Low," *S&P Global Platts*, 16 July 2014, https://www.spglobal.com/platts/en/market-insights/latest-news/oil/071614-south-korea-refiners-say-incentives-to-diversify-crude-import-sources-too-low; Keun Wook Paik, "South Korean Oil Refineries Hit Hard by Iran Sanctions," (East Asia Forum, 13 September 2019). https://www.eastasiaforum.org/2019/09/13/south-korean-oil-refineries-hit-hard-by-iran-sanctions/.
[603] Van der Linde et al., *Study on Energy Supply Security and Geopolitics*, 113.
[604] Australian Department of the Environment and Energy, *Liquid Fuel Security Review: Interim Report*, 4.
[605] Hale & Twomey, *Independent Review of the Refining NZ Processing Agreement*, 7.

9.3.5 Strategic Transportation Capacity

Creating emergency tanker capacity via creation of a state-owned or controlled fleet is another diversification policy that may be viable, though whether this approach would provide sufficient benefit in most circumstances relative to the cost required to implement it is less clear. For New Zealand to acquire a merchant navy or establish a fleet of nationally-owned tankers would likely require significant government involvement to implement, although there is precedent for this with the establishment in 1973 of the Shipping Corporation of New Zealand.[606] Given the current effectiveness and efficiency of the international tanker market, such a policy would likely be unjustifiable unless the country's security environment were to change significantly, or where the tanker market became markedly tighter or less effective at capacity allocation to the point where security of supply was threatened by lack of tanker availability.

9.3.6 Foreign & Security Policy

As importing countries like New Zealand source a greater share of their demand from a decreasing pool of suppliers, it is likely that foreign policy will be an important policy instrument for maintaining oil security over the long-term. In line with this consideration, the IEA recommends that Asia-Pacific countries collectively develop long-term strategic ties with large energy exporters in the Middle East as a means to support energy security.[607] Consistent with this observation, the New Zealand Government should continue to cultivate its relationship with Gulf Cooperation Council (GCC).[608]

Barton argues that New Zealand's size and power precludes it from developing bilateral special oil security relationships with suppliers like those pursued by larger states; furthermore, the country's policy approach favours free trade over such special relationships.[609] Consequently, developing special relations with supplier countries is an approach that is unlikely to be pursued given the current structure of the domestic market and present-day geopolitical context. However, this does not mean that favourable arrangements in exchange for ensuring oil supplies could not be developed if circumstances required it. As Högselius and Kaijser show,

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[606] New Zealand Government, Shipping Corperation of New Zealand Act 1973, (1973).
[607] IEA, *Energy Security in ASEAN+6*, 16.
[608] MFAT, "NZ - Gulf Cooperation Council FTA," accessed 5 May, 2020, https://www.mfat.govt.nz/en/trade/free-trade-agreements/free-trade-agreements-concluded-but-not-in-force/gcc/.
[609] Barton, "Reaching the Limits of What the Market Will Provide: Energy Security in New Zealand," 378.

small states have in the past successfully used bilateral agreements to secure additional oil supplies or diversify their supply base.[610] New Zealand has also successfully used this approach in the past, securing a $150 million oil-for-lamb barter arrangement with Iran in 1982,[611] and establishing an arrangement with Australia to supply New Zealand with oil during the 1973 crisis.[612] Pursuing and maintaining positive relations with current and potential suppliers is therefore likely the best approach for New Zealand to keep policy options available. Bilateral arrangements with consumer countries outside of the IEA scheme may also provide avenues for improving security of supply. For example, Mitchell highlights that Korea and Japan's physical stockholdings well exceed their IEA commitments, and suggests there is potential for bilateral agreements between these two countries and countries like New Zealand to ensure continued supply of refined product in the event of a disruption, provided legislation allowed for it.[613]

Ensuring the security of New Zealand's maritime oil transport routes and the continued supply from refiners in Asia and major crude exporters in the Middle East will remain vital. This is reflected in New Zealand's *Strategic Defence Policy Statement 2018*, which explicitly highlights protection of the nation's critical lines of communication as a key objective.[614] However, New Zealand does not have the military capabilities to unilaterally maintain supply route integrity and must instead rely on larger powers or multilateral initiatives - a reality that is unlikely to change in the future. Nevertheless, this does not mean that New Zealand should solely rely on other more militarily powerful states to maintain security of SLOCs, particularly in times of increased risk to supply.

Determining the extent to which New Zealand needs to participate in security initiatives relevant to maintaining oil security depends on whether New Zealand could ever be excluded from receiving the security benefits (or elements thereof) provided by the security initiatives and interventions of more powerful states. If these benefits are not excludable, New Zealand

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[610] Per Högselius and Arne Kaijser, "Energy Dependence in Historical Perspective: The Geopolitics of Smaller Nations," *Energy Policy* 127 (2019).
[611] US International Trade Commission, *Assessment of the Effects of Barter and Countertrade Transactions on US Industries* (Washington, DC: US International Trade Commission, 1985), 137; Chris Nixon and John Yeabsley, "Overseas Trade Policy," Te Ara - The Encyclopedia of New Zealand, accessed 18 March, 2020, https://teara.govt.nz/en/overseas-trade-policy/print
[612] Matthew McKay, "New Zealand and the Oil Crisis: An Examination of Foreign Policy Reactions" (Master of Arts University of Canterbury, 1975).
[613] Mitchell, *Asia's Oil Supply: Risks and Pragmatic Remedies*, 7.
[614] Ministry of Defence, *Strategic Defence Policy Statement 2018* (MOD, 2018), http://www.nzdf.mil.nz/downloads/pdf/public-docs/2018/strategic-defence-policy-statement-2018.pdf.

could avoid participating in such initiatives provided that other indirect costs of freeriding are tolerable. On the other hand, should some security benefits be excludable, militarily dominant states may not allow New Zealand to freeride on their costly foreign and security policies if it does not contribute. The need to avoid the perception of freeriding is recognised in the *Defence Policy Statement,* which expressly identifies the objectives of maintaining a credible contribution to regional and international peace and security initiatives, and the international rules-based order.[615] The New Zealand government will need to determine the costs and benefits of participation within current and possible security initiatives on an ongoing basis.

New Zealand will require sufficient military capacity to allow meaningful participation in maritime security initiatives. Australia is working to strengthen its maritime forces in response to growing challenges to the security of its long and vulnerable SLOCs.[616] Given that New Zealand faces the same challenges, the current prioritisation of investment in enhanced maritime capabilities and inter-operability with Australia's armed forces is favourable for oil security objectives.[617] Maintaining and improving these capabilities would allow for participation in maritime security initiatives generally, and for unilateral tanker escort capabilities which would provide additional policy options in the event of SLOC disruption.

9.4 Summary

An examination of variables impacted by changes to the geopolitical environment finds that New Zealand's current oil security assessments do not adequately account for geopolitical uncertainty over the long-term. This means that considerations of present and anticipated oil security could be markedly different from what is actually the case, particularly when considered alongside other supply chain and market-related variables identified throughout this study. As a result, current assessment limitations impact both the conclusions regarding what policy instruments and strategies are required to maintain adequate security, and the which of those policies and strategies that are actually available to New Zealand. Applying these findings to New Zealand's current assessment approach reveals a number of ways that the

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[615] Ibid.
[616] Sweijs et al., *The Maritime Future of the Indian Ocean*, 28; Australian Department of Defence, *2016 Defence White Paper* (Canberra: Department of Defence, 2016), https://www.defence.gov.au/WhitePaper/Docs/2016-Defence-White-Paper.pdf.
[617] Ministry of Defence, *Defence Capability Plan 2019* (MOD, 2019), https://www.defence.govt.nz/assets/Uploads/03acb8c6aa/Defence-Capability-Plan-2019.pdf.

efficacy of security of oil supply assessments and policymaking could be improved to enhance the nation's oil security across diverse geopolitical environments.

10 Conclusion

Oil remains one of the most important resources for the operation of New Zealand's economy and society. Having an accurate perception of the country's oil supply security and the effectiveness of security-improving policies is therefore vital. Noting this importance, the aim of this thesis has been to determine whether geopolitical uncertainty over the long-term is appropriately addressed within New Zealand's current oil security assessments and policymaking. It has done so by answering the following research question:

> *How might changes in the geopolitical environment affect the efficacy of New Zealand's current oil security assessments and policies out to 2040?*

Through document analysis and utilising a scenario-based approach, this research has found that New Zealand's current oil security assessments and corresponding policy recommendations do not adequately address geopolitical uncertainty. Furthermore, this research has also identified a number of related variables that are also not adequately addressed.

Current security assessments use a cost-benefit analysis process to determine optimal oil security policy settings and use existing estimates of global supply disruption likelihood and size from the literature to represent New Zealand's external disruption risk in their analysis. These quantitative estimates of present-day disruption probabilities offer a usable metric for assessments to derive average risk to New Zealand's supply over time. However, by relying on present-day global disruption estimates the current assessments do not account for important qualitative variables related to New Zealand's supply chain structure, market dynamics and the geopolitical environment within their analysis. The limitations of such demand estimates become particularly stark in the event of 'black swan' events. Thus, as has been explained, there is a wide range of variables that can have notable impacts on calculations of supply risk and policy effectiveness.

In Part I of this study, it has been shown that each segment of the oil supply chain can be exposed to geopolitically induced disruptions, particularly the upstream sector. In line with perceptions of an integrated oil market adopted by current assessments and many theorists, whether a country experiences a disruption as a crisis will largely depend on the global supply shortfall that a disruption creates and the length of time over which it occurs. However, a review of the literature revealed that characteristics of the resource, market functions and global oil supply chain limit the market's ability to allocate supply, at least over intermediate time

periods. As a result, the structure of a country's external supply chain, where a disruption occurs, and what form it takes will also determine the disruption impact experienced by a country. An examination of New Zealand's supply chain shows that the country is no different in this regard, with the greatest challenges to supply security being the risk of a large supply disruption from Middle East producers or a disruption to key oil transport routes that pass through the strait of Hormuz and Strait of Malacca. By failing to account for these other variables and instead using percentages of cumulative global oil market disruption, current assessments oversimplify calculations of risk, potentially leading to incorrect perceptions of New Zealand's level of supply security.

This research has also shown that the limitations of existing assessments impact the perceived effectiveness of oil security policies and the policy options considered. An analysis of the literature reveals that there are a number of oil policies and strategies available to states to maintain or improve security of oil supply, particularly when approaches that take longer time periods to implement are included. These policies can prevent or deter geopolitically induced disruptions or contain and manage the impacts of them. It was also shown that some of the policy choices of other states can impact broader levels of market participation, and thus the strength of the market to allocate scarce supply during a disruption.

Many such policy options are available to New Zealand, and yet the focus of current assessments and policymaking has been solely on the country's IEA membership and meeting the associated stockholding and crisis management obligations. Existing assessments' present-day focus and aforementioned limitations guide their potentially incorrect conclusion that IEA membership is the only policy necessary to maintain New Zealand's security, and that IEA membership is one of the only oil security-improving mechanisms available to the country. Recommendations are also guided by the assumption that IEA emergency response mechanisms – most notably overseas-held stock repatriation – will operate as intended, regardless of context.

Having established the approach of current assessments and shown that potential changes within the geopolitical environment is not a variable that is addressed, Part II of this study aimed to determine whether changes in this variable over the next 20 years could affect risk to supply or policy effectiveness. This study first examined forecasts from leading international and domestic organisations to identify likely changes in domestic and international supply and demand for oil, and then discussed how these changes may impact the risk of disruptions and the effectiveness of security policy options in the future. Findings showed that the importance

of oil in New Zealand's energy mix was almost certainly going to remain high, as was the country's dependence on oil imports. Moreover, anticipated changes to the international oil market were not going to lower the risk of disruption, and in fact may add further challenges to maintaining supply security.

Next, the research examined the potential impacts of a changing geopolitical environment on security of supply using two contrasting future storylines adapted from existing oil security literature. The storylines demonstrated that the geopolitical environment can markedly impact a country's oil security, through altering the likelihood and form of supply chain disruptions, the effectiveness of security policies, and also the strength of related markets to allocate unaffected supply as other states change their oil security policies in response to the geopolitical environment. Failing to account for geopolitical uncertainty within current oil security assessments therefore impedes the accuracy of oil security assessments and the appropriateness of associated policy recommendations.

10.1 Recommendations

With the identified limitations of current assessments in mind, this study has identified a number of ways that New Zealand's oil security assessments could be improved. These recommendations include:

i. Framing their external disruption scenarios upon the actual structure of the country's supply chain and its sector dependencies, rather than global supply disruption estimates;

ii. Modelling for different scales of disruption, and supply line sector and market failure;

iii. Modelling supply chain disruptions to include anticipated delays in receiving unaffected supply from alternate sources, including from IEA members;

iv. Evaluating the vulnerability of other states that share suppliers and supply lines with New Zealand, and their ability to respond to the stock-sharing component of IEP where applicable;

v. Entertaining higher levels of uncertainty with respect to market and IEA emergency response failure under different scenarios;

vi. Maintaining an up-to-date schedule of alternative crude supply sources that meet New Zealand's specifications, and integrating this information into risk assessments;

vii. Evaluating risk of disruption on sector-by-sector basis, accounting for levels of tightness, concentration and flexibility and investment within associated upstream,

midstream and downstream markets, and the extent that supply is being traded through open market channels;

viii. Maintain an ongoing review of geopolitical developments to feed into modelling, adopting an 'adaptive management' approach to oil security planning and policymaking;

ix. Adopting a long time-horizon for policymaking, likely at least 10 years given constraints on energy system transformation.

This study has also highlighted a number of oil security-improving policy instruments and strategies that should be considered if New Zealand's supply security is found to be at an unsatisfactory level. This most notably includes modifying the country's stockholding approach, utilising foreign policy instruments to provide additional options in an emergency, and reducing oil dependence entirely through working to increase the country's adoption of alternative energy technologies.

10.2 Limitations and Opportunities for Further Research

This research entailed a comprehensive examination of relevant and publicly available literature to provide an accurate critique of existing oil security assessments in relation to geopolitical risk and uncertainty. However, as has been noted throughout, there are a number of areas relating to New Zealand's oil security that warrant further examination, or areas where the methods and findings of this research could be applied further.

10.2.1 Expanding Findings

Alternative Supply Information

While this research has discussed New Zealand's current oil supply chain thoroughly, the limitations of this study and existing research leave unexamined in detail the viability of alternative petroleum sources potentially available to New Zealand in the event of a disruption. Further research should therefore be undertaken to determine what crude grades can be utilised within New Zealand's sole refinery, the impact on product output if usable but sub-optimal crude grades are used, and, should refinery reconfiguration be required, the cost and timeframes required to use these grades. This research could also be expanded to encompass the overseas refineries that New Zealand currently relies upon. Doing so would allow for a more accurate determination of New Zealand's oil security.

Improving Scenarios

This research has been limited to the use and examination of two storylines, which somewhat restricts its findings. Other storylines could be developed and integrated into this research to improve understanding of supply security and policy effectiveness. One storyline that could have particular merit would be a situation where demand peaks and declines much sooner, potentially as a result of greater pursuit of emissions reduction initiatives. Such a storyline will allow for a better understanding of what the anticipated decline of global demand will mean for New Zealand's oil security.

There is also opportunity to improve the storylines used within this research to attain a better understanding of risk to New Zealand's oil supply and policy effectiveness within different geopolitical environment. The storylines used in this research were created in the mid-2000s with a focus on EU oil and gas security. The storylines were thus used in this research to derive expected state behaviours that would be witnessed in different geopolitical environments, rather than attributing an action or strategy to any country in particular. Updating these storylines to have a New Zealand focus and outlines of anticipated behaviour of states relevant to New Zealand's oil security would allow for more robust policy recommendations. Supplementing this research with alternative scenario-based approaches, including predictive scenarios, may also be beneficial in this regard.

10.2.2 Expanding Research

A New Oil Security Assessment

Perhaps the most obvious avenue for expanding research would be to undertake a new assessment of New Zealand's oil supply security that adopts in its approach the improvements this research has recommended. Doing so would provide an up-to-date and more robust assessment of New Zealand's oil security, allowing for related policy changes to be made if required.

Non-geopolitical Risks

The specific focus of this research has been geopolitical risk to supply. However, large disruptions can result from other non-geopolitical events, including extreme weather events. The risk to supply posed by such events should also be accounted for in risk assessments for an accurate determination of New Zealand's oil security.

Examining Other Energy Sources

Another focus of this research has been on New Zealand's oil security into the future. However, the security of other energy sources, particularly electricity, are also extremely important. Opportunities for further research could include applying the same strategic approach to other parts of New Zealand's energy system. Findings could then be integrated with this research, allowing for a comprehensive risk assessment of the energy sources the country relies or is expected to rely upon.

Cost-benefit Approach

When determining appropriate recommendations within security assessments, the risk of a disruption needs to be compared against the cost of mitigating that risk. However, it should be noted that the current cost-benefit approach taken in existing assessments is not the only approach available, and there may perhaps be more appropriate means for determining the correct balance between security improving actions and the cost of their implementation.

Were New Zealand to experience a significant disruption to its supply, the impact on the economy and society would likely be significant, going beyond those which can be easily measured monetarily. The cost-benefit ranking approach is used in normal economic management to compare a number of resilience-improving options against other spending options. However, for high impact-low probability (potentially intergenerational) events like a significant oil or product supply shortage, a more risk avoidant approach may be more appropriate. Other means of determining the ideal level of response to low probability-high impact events include the 'minimax regret' approach ("minimise the maximum loss"), which may suggest paying above cost-benefit values to avoid low probability but unacceptable risks.[618] An avenue for further research could be therefore be an examination of whether alternative cost-benefit weightings are more appropriate.

10.3 Final Thoughts

The domestic and global energy system is undergoing profound change, bringing new alternatives to oil within the energy mix. And yet, the issue of maintaining oil security is not disappearing any time soon and will still need to be accounted for within decision making. The

[618] Such an approach is often discussed within the literature on climate change mitigation strategies: Andries F. Hof, Detlef P. van Vuuren, and Michel G. J. den Elzen, "A Quantitative Minimax Regret Approach to Climate Change: Does Discounting Still Matter?," *Ecological Economics* 70, no. 1 (2010).

decisions on which security policies to implement need to be carefully balanced against conflicting policy priorities, just as other decisions regarding other energy policies should account for impacts on energy security. This is also relevant for policies where less consumption of oil is an objective, for instance to meet emission reduction targets. New Zealand must be realistic and pragmatic with policies relating to these other energy goals. Should the government wish to pursue policies that may potentially complicate maintaining oil security, then these policies should also be complemented with policies designed to reduce oil dependence over time - for instance, subsidies for EVs or commitments for infrastructure projects to ensure low cost electricity.

It also needs to be acknowledged that as the energy balance changes, the dynamics of maintaining energy security will change with it. Long-term stability of policy will be necessary so that energy companies have confidence to invest correctly. New Zealand should be cautious sending signals of where it is going if it is unable to get there. The government should only send signals of what it is able to achieve so that the market does not respond in the wrong way and harm energy security inadvertently. Luciani echoes these sentiments; policy indication must not entertain policy objectives that are unlikely to be reached, as oil supply chain participants will respond to announced policies through their investment choices inevitably affecting market dynamics.[619]

Security of oil supply will remain a vital objective for the country for years to come. New Zealand cannot afford to become complacent about its oil security as long as the resource maintains such a vital position in the national energy mix, and the country remains almost totally dependent on the continued flow of oil from outside sources.

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[619] Luciani, *Geopolitical Threats to Oil and the Functioning of the International Oil Market*, 1.

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