Offshore Methane Hydrates in Japan:

Prospects, Challenges and the Law

Deepwater Drilling Vessel 'Chikyu' (Photo Courtesy JAMSTEC).

Working Paper, September 2019

CONSTANTINOS YIALLOURIDES

ROY ANDREW PARTAIN

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List of Acronyms

AIST	National Institute of Advanced Industrial Technology
CLCS	Commission on the Limits of the Continental Shelf
EDCC	Environmental Dispute Coordination Commission
EEZ	Exclusive Economic Zone
EI	Energy Independence
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ENAA	Engineering Advancement Association of Japan
ESF	Energy Self-Sufficiency
GEA	Global Energy Assessment
IEA	International Energy Agency
IIASA	Applied Systems Analysis
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
JMHEP	Japan Methane Hydrate Exploitation Programme
JOGMEC	Japan Oil, Gas and Metals National Corporation
LNG	Liquified Natural Gas
METI	Ministry of Economy, Trade and Industry
MH21	Research Consortium, Research Consortium for Methane Hydrates
NM	Nautical Miles
NRA	Nuclear Regulation Authority
SFFS	Self-Developed Fossil Fuel Supply
Tcf	Trillion Cubic Feet
Tcm	Trillion Cubic Meters
UNCCD	United Nations Convention to Combat Desertification
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
US EIA	United States Energy Information Administration

Executive Summary

This report provides a background to the science and engineering of Japan's offshore methane hydrates, on the place of the natural gas produced from those hydrates in Japan's overall energy policies, and how Japan might best legally prepare for the onset of natural gas production from those offshore hydrate assets.

Chapter One provides a non-technical introduction to the field of offshore methane hydrates. Methane hydrates are essentially a natural gas reserve trapped within icy water fields; methane hydrates reserves can be found onshore in cold areas but are far more abundantly found offshore at sufficient depth under layers of mud. The methane produced from hydrates is chemically and functionally equivalent to the natural gas already utilized in Japan for energy supplies, chemical feedstocks, and for home cooking and heating. Thus, the finding that Japan has a large domestic supply of natural gas from its offshore methane hydrate reservoirs could be transformative for Japan's energy policies and its opportunities for economic growth.

Methane hydrates will require less drilling to access than conventional offshore natural gas, as the methane hydrates lay under mud layers, whereas conventional natural gas lays miles under rock and mud. But the consequence of the shallow hydrate deposits is that they are less geologically protected; the mud layers are more readily disturbed and injurable than the geological traps of conventional natural gas, so there are new risks to consider. Primarily, the risks will be those of venting and leaking methane from the bottom of the sea; secondarily weakened mudbeds could collapse in subsea landslides that could in turn cause tsunami to hit nearby coastal communities. Novel technologies and precautionary strategies will need to be developed to ensure safe production of the offshore methane hydrates.

Chapter Two explores the drivers, causes, and effects of Japan's multiple energy policies. Both historical and recent energy challenges are reviewed, from Japan's traditional comparative lack of fossil fuel resources, to challenges of supporting industrial growth during the oil shocks of the 1970s, to the hopes of reducing carbon emissions, under the United Nations Framework Convention on Climate Change (UNFCCC), by relying on nuclear power, to the recent policy frustrations created in the aftermath of the 2011 Great East Japan Earthquake and Fukushima Daiichi nuclear accident. It is very clear that Japan would greatly benefit from securing a domestic supply of energy. As offshore methane hydrates are precisely that, a large domestic supply of natural gas, the Japanese Government's plans to support the development of this novel natural resource is found to be a robust policy response to the opportunity.

Chapter Three explores the existing legal frameworks that would apply to commercial operations from offshore methane hydrates. We place Japan in control of its natural resources, as soundly supported under international law. A variety of other legal enactments are reviewed, evidencing that Japan does have a reliable legal system in place for the development of offshore minerals.

In the Final Remarks, a concern is raised that the licensing and liability frameworks contemplate more conventional forms of mining, such as conventional crude oil, and may need complementary new frameworks to more robustly address the opportunities and challenges unique to offshore methane hydrate extraction and production activities. We recommend further study on this opportunity for legal frameworks to support Japan's new energy opportunities.

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About this study

On 19 March 2013, the world changed. On that day, Japan became the first-ever country to announce successful continuous-flow production of methane gas from a solid methane hydrate layer located under the seabed, establishing the technical feasibility of this new energy resource and of its novel extraction technology.[1] 'Japan could finally have an energy source to call its own', announced the Japan Oil, Gas and Metals National Corporation (JOGMEC), the state-run company which leads methane hydrates extraction in Japan.[2] This breakthrough experiment, conducted from the drilling ship *Chikyu* in the Nankai Trough about 100 miles east of Osaka, was the world's first methane hydrate production test in deep waters.[3]

According to current estimates, the amount of natural gas located in global methane hydrates reserves 'is believed to greatly exceed the volume of known conventional natural gas reserves', making it a potential game-changer for countries with limited conventional energy resources like Japan.[4] Given this abundance of methane hydrate in both permafrost and sub-seabed sediments, scientists in Japan have begun looking to methane hydrates as a prospective new source of natural gas for energy production. However, the extraction of methane hydrates from the seabed raises questions about various risks and hazards to the environment, including the potential of submarine mudslides and tsunami.[5] Many of such risks and hazards are not present with the production of traditional natural gas.[6] The regulatory schemes that would

[1] On Japan's accomplishments in the field of methane hydrates, see Ai Oyama and Stephen M Masutani, 'A Review of the Methane Hydrate Program in Japan' (2017) 10 Energies 1–13.

[2] Hiroko Tabuchi, 'An Energy Coup for Japan: "Flammable Ice"' (*The New York Times*, 12 March 2013) <https://www.nytimes.com/2013/03/13/business/global/japan-says-it-is-first-to-tap-methane-hydrate-deposit.html>.

[3] Ibid.

[4] Timothy S Collett and Gabriel D Ginsburg, 'Gas Hydrates in the Messoyakha Gas Field of the West Siberian Basin – A Re-Examination of the Geologic Evidence' (1998) 8(1) International Journal of Offshore and Polar Engineering 96.

[5] The exact properties of undersea hydrates and how they might affect the environment are still poorly understood, see Tabuchi (n 2); Ben Lefebvre, 'Critics Warn of Environmental Hazards of Extracting Methane Hydrate' (*Wall Street Journal* 29 July 2013) <https://www.wsj.com/articles/SB10001424127887323664204578610370550437906>; Rudy Rogers, *Offshore Gas Hydrates: Origins, Development, and Production* (Elsevier 2015) 1–2; Roy A Partain, 'The Application of Civil Liability for the Risks of Offshore Methane Hydrates', (2015) 26 Fordham Environmental Law Review 225, 234.

[6] Roy A Partain, *Environmental Hazards from Methane Hydrate Operations* (Wolters Kluwer 2017) 3, 57–92.

eventually govern extraction of natural gas from methane hydrate within Japan's 200 nautical miles (nm) continental shelf and beyond may not be robust enough to prevent or mitigate these risks.

This study examines the potential prospects and benefits stemming from the commercial development of offshore methane hydrates in Japan and ascertains whether existing legal frameworks are sufficiently robust to address the foreseeable environmental risks posed by methane hydrate exploration and exploitation operations in Japan.

The study seeks to investigate and address the following questions:

- How do methane hydrates fit within Japan's established energy policy?
- How does Japan's existing legal framework regulate methane hydrates?
- Would the existing legal framework in offshore methane hydrates be adequate to address the environmental risks associated with Japan's offshore methane hydrate resources and what regulatory changes would be required?

METHODOLOGY AND STRUCTURE

In addressing the above questions, the study takes an interdisciplinary methodological approach with technical, commercial and public policy perspectives applied to the examination of methane hydrate regulation within Japan's 200 nm exclusive economic zone (EEZ) and continental shelf.

The overall approach of this study is based on a combination of literature review and consultation with legal experts to better understand the legal framework governing mining operations in Japan. The literature review has focused on primary legal sources and available scientific literature, including past research carried out by the members of the research team, such as Partain's monograph 'Environmental Hazards from Offshore Methane Hydrate Operations: Civil Liability and Regulations for Efficient Governance', which served as a starting basis for the present study.

This study is structured as follows.

Following this introduction, the first part of the study provides a non-technical introduction to the scientific, engineering and commercial characteristics of offshore methane hydrates. It also provides an informative primer to the geology and extraction process for methane hydrates whilst contrasting it with conventional hydrocarbon extraction. This will also serve to highlight some of potential 'new risks' associated with methane hydrate extraction compared to conventional oil and gas.

In the second part, the study presents the potential benefits in light of Japan's pressing energy challenges.

The third part of the study examines existing Japanese laws and international conventions to determine which might be applicable to activities engaging offshore methane hydrates in Japan. The domestic petroleum and maritime laws of Japan are presented and analysed in order to determine whether there are adequate mechanisms in place to address environmental risks and hazards associated with offshore methane hydrates.

The fourth, and final, part of the study provides some recommendations as to how to update the existing legal frameworks to accommodate the onset of offshore methane hydrates development in Japan and beyond.

1

Non-Technical Introduction to Methane Hydrates

1.1 INTRODUCTION

Methane hydrates are not a novel type of resource. In fact, they were first reported by Humphrey Davies in 1811 and have been a functional part of chemistry for over two centuries.[7] For several decades, methane hydrates were classified mainly as an 'industrial hazard' which had the potential to block deep-water oil and gas pipelines.[8] Accordingly, research concentrated almost exclusively on preventing gas hydrate formation in pipelines and associated oil and gas infrastructure.

As for their potential role as an energy resource, it was not until 1964 that the first methane hydrate gas field was discovered within the Russian Messoyakha gas fields, located in the West Siberian Basin; the production results at Messoyakha proved that extraction difficulties facing methane hydrates could be overcome and made clear the geologic significance of methane hydrate deposits as a potentially feasible energy source.[9]

The discovery of methane hydrates coincided with the global energy crisis of the 1970s, prompting rapid expansion in methane hydrate research and development programs across jurisdictions.[10] The first international conference on methane hydrate extraction, as an energy resource, was held in 1991 and the first offshore methane hydrate well was drilled in 1999.[11] At the Mallik site in the Canadian Arctic, a full-scale thermal production test was completed in 2002, and gas hydrate production was tested in 2007

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7 Rogers (n 5) 1–2; Partain (n 6) 10.

8 Ibid.

9 Yuri Makogon, 'Hydrates of Natural Gas' (*Geoexplorers Associates*, 1978) (W. Cieslewicz tr.) <https://pdfs.semanticscholar.org/42be/1c46e47a42940d3710414d8167dbf8ec1808.pdf>; Collett and Ginsburg (n 4).

10 Makogon, ibid; George J Moridis and others, 'Toward Production from Gas Hydrates: Current Status, Assessment of Resources, and Simulation-Based Evaluation of Technology and Potential' (2009) 12(05) SPE Reservoir Evaluation and Engineering 745, 748–52.

11 Partain (n 6) 10.

and 2008. The first continuously flowing methane hydrate production well was tested only in 2013 by JOGMEC in the Eastern Nakkai Trough, within Japan's EEZ.[12] Thus, while hydrates are not a recent discovery, it is not until very recent times that their potential as an energy resource was properly identified.

Progressively, technological innovations and rapid advances and improvements in seafloor and seabed data acquisition (e.g. 2-D and 3-D seismic survey systems), offshore coring, drilling and logging techniques (providing ground-truth information on the location of seabed resources) have greatly facilitated the detection of large quantities of technically recoverable methane hydrate deposits around the globe.[13]

A number of studies conducted during the past 30 years have reported large volumes of methane hydrates in worldwide locations pointing to their 'truly vast natural gas hydrate potential', creating new hopes of fuel independence and economic growth especially for coastal States long depended on imported fossil fuels.[14] While global estimates for total gas in place have a very wide range, as the resource and its extraction techniques become better understood with time, volume estimates have become more precise.[15]

[12] For a timeline of important methane hydrate-related events, see Rogers (n 5) 1–2.

[13] Note that early geophysical studies simply identified methane hydrates in situ with no attention paid to either technical recoverability or commerciality of the resource; see Michael D Max and Arthur H Johnson, *Exploration and Production of Oceanic Natural Gas Hydrate: Critical Factors for Commercialization* (Springer 2016) 61; Rogers (n 5) 1–2; Partain n 6) 1, 9. On marine technological advances in the period between 1982 and 2016, see João Camargo and others, 'Marine Geohazards: A Bibliometric-Based Review' (2010) 9(2) Geosciences 1, 23–24.

[14] Arthur H Johnson, 'Global Resource Potential of Gas Hydrate – A New Calculation' (2011) 11(2) Fire in the Ice, Methane Hydrate Newsletter, US Department of Energy 1–4 <https://www.netl.doe.gov/sites/default/files/publication/MHNews-2011-12.pdf>; see also A Trofimuk, N Cherskii, and V Tsaryov, 'The Role of Continental Glaciation and Hydrate Formation on Petroleum Occurrence' in R F Meyer (ed) *The Future Supply of Nature-made Petroleum and Gas* (1st edn, Pergamon 1977) 919–26; R F Meyer, 'Speculations on Oil and Gas Resources in Small Fields and Unconventional Deposits' in R F Meyer and J C Olson (eds) *Long-Term Energy Resources* (Pitman 1981) 49–72; Kärg Kama, 'Resource-Making Controversies: Knowledge, Anticipatory Politics and Economization of Unconventional Fossil Fuels' (2019) Progress in Human Geography 1, 4 <https://doi.org/10.1177/0309132519829223>; Gordon J MacDonald, 'The Future of Methane as an Energy Resource' (1990) 15 Annual Review of Energy 53–83; Keith A Kvenvolden, 'Methane Hydrate – A Major Reservoir of Carbon in the Shallow Geosphere?' (1988) 71 Chemical Geology 41–45.

[15] Max and Johnson, (n 13) 61.

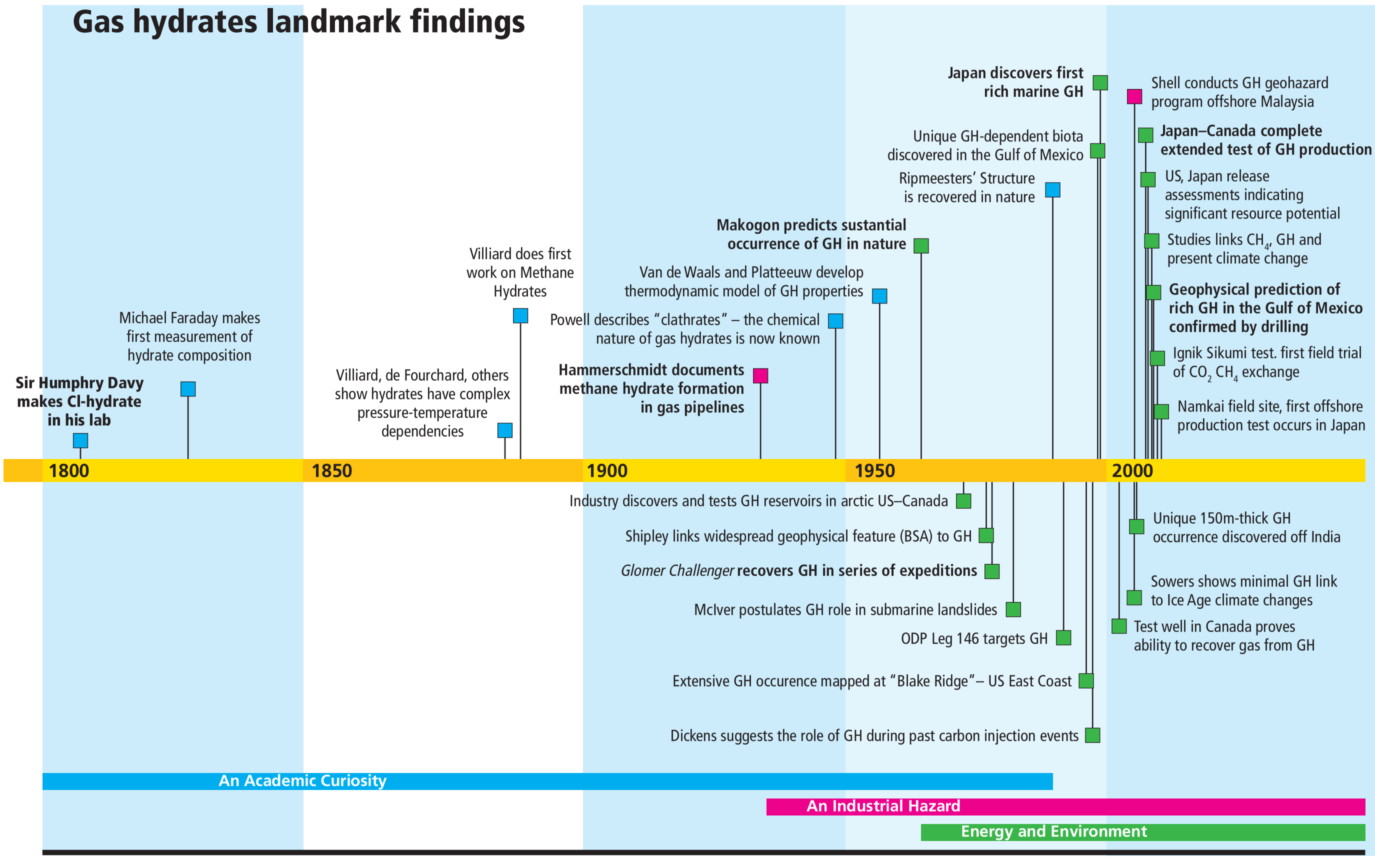

Figure 1 *Methane hydrates landmark findings*   Source: 'Frozen Heat – A Global Outlook on Methane Gas Hydrates'

1.2 GLOBAL METHANE HYDRATE RESOURCES

A report undertaken by the International Institute for Applied Systems Analysis (IIASA) as part of the Global Energy Assessment (GEA) provides the latest, comprehensive assessment of methane hydrate resources globally. It covers every coastal margin on Earth over 18 regions, along with Polar Regions and employs a 'petroleum systems approach': methane hydrate formations are excluded from the assessment if they do not meet the critical parameters for their classification as technically and economically extractable (so called 'high-grade' methane hydrate deposits).[16] This places this evaluation of methane hydrates into a potential 'reserves' estimate, due to the commercial feasibility requirements, instead of the geological reservoir estimates more commonly reported in studies on methane hydrates.

A critical factor in the identification of 'high-grade' methane hydrate deposits was the lithology (rock type) of the host sediment. Methane hydrates located in high-porosity, high-permeability sediments such as sands and gravels, have much greater prospects for being commercially exploited with existing technologies than methane hydrates located in fine-grained sedimentary rocks such as shales and sandstones.[17]

The report concludes that the mid-range ('median') estimate of technically recoverable methane hydrates situated in high-grade, sand-based reservoirs of continental margins stands in excess of 43 tcf (about 122 trillion cubic meters (tcm)) and ranging up to a maximum of 217 tcm.[18] This is about only a fraction of 5 per cent of the total average estimate for gas hydrate in-place resources globally.[19] Nevertheless, as Max and Johnson suggest, global methane hydrate resources are so vast that even if a very small fraction of the resource is commercialised (i.e. produced at cost and profit margins that would allow it to compete with other gas resources), 'the resulting production would be significant on a world scale'.[20] Indeed, considering that, as a

[16] The report includes reservoir rocks with adequate porosity and permeability to allow rates of production that are high enough to ensure a reasonable economic return, see International Institute for Applied Systems Analysis, *Global Energy Assessment (GEA) – Toward a Sustainable Future* (Cambridge University Press 2012) 455.

[17] Ibid.

[18] Arthur H Johnson, 'Global Resource Potential of Gas Hydrate – A New Calculation' in *Proceedings of the 7th International Conference on Gas Hydrates (ICGH)* (United Kingdom, 17–21 July 2011) 309; see also International Institute for Applied Systems Analysis, ibid 455–58.

[19] Y C Beaudoin and others (eds), *Frozen Heat: A UNEP Global Outlook on Methane Gas Hydrates* (United Nations Environment Programme 2014) 20; '[O]nly a fraction of the methane sequestered in global gas hydrate deposits is likely to be concentrated enough and accessible enough to ever be considered a potential target for energy resource studies', US Geological Survey, 'Gas Hydrates – Primer' (19 March 2019) <www.usgs.gov/centers/whcmsc/science/gas-hydrates-primer?qt-science_center_objects=0#qt-science_center_objects>.

[20] Max and Johnson, (n 13) 65.

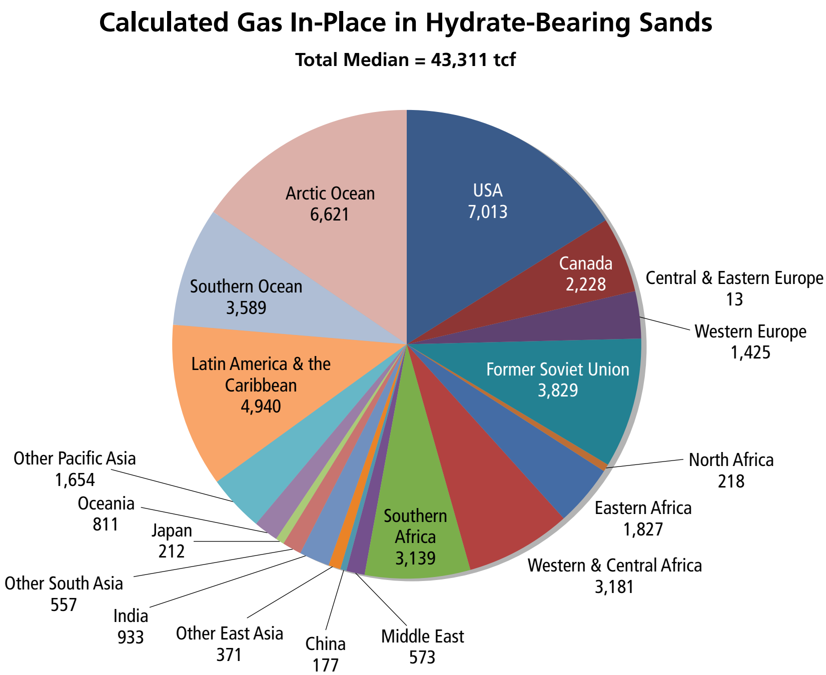

Figure 2 *Sand-Based Methane Hydrates Global Volume Estimates in Tcf*

Source: Arthur H Johnson, 'Global Resource Potential of Gas Hydrate – a New Calculation'

comparison, technically recoverable conventional natural gas reserves are presently estimated as 187 tcm, methane hydrates could shape the global energy picture in the years to come, loosely doubling the commercial reserves of available methane or natural gas.[21]

To help place these numbers into perspective, as can be seen in **Figure 2** above, Japan, which is the focus of the present study, ranks in the report's Top-15 countries with technically recoverable methane hydrate resources. As an energy importer, Japan ranks first in liquified natural gas (LNG), second in coal, and third in crude oil.

Japan's conventional natural gas consumption is steadily increasing while its proven conventional natural gas reserves have declined from 1.4 tcf (about

[21] Renat Shakirov and Anatoly Obzhirov, 'Western Pacific Gas Hydrate Belt' in *Proceedings of the 7th International Conference on Gas Hydrates (ICGH)* (United Kingdom, 17–21 July, 2011) 2034.

0.48 tcm) in 2007 to 0.7 tcf (about 0.020 tcm) as of January 2017.[22] In comparison, reports estimate modest reserves of technically producible methane hydrates offshore Japan (50.4 tcm in the Nankai Trough alone).[23] This is particularly important for an energy-hungry country such as Japan: its methane hydrates assets will contribute to Japan's existing energy mix, thus adding to its energy security, and may well be served as a 'transition fuel' from coal to low carbon alternatives, considering that natural gas from methane has a significantly lower carbon footprint than coal when used for electricity generation.[24]

1.3 WHAT ARE METHANE HYDRATES?

Methane hydrates[25] are one of the major naturally-occurring fossil fuel resources from which natural gas may be produced and are composed of volumes of methane and fresh water that condense into a solid both in sediments below seafloors (usually deeper than 500 metres) and in permafrost soils.[26] Commonly manifesting the appearance of slushy ice, the methane molecules are trapped within cage-like structures within a water-ice framework.[27] Methane hydrates carry the general chemical form of M_n (H^2O), whereby M represents the inner molecule around which the water lattice forms.[28]

Offshore methane hydrates are formed when methane seeps from the earth into subsea mud deposits; the chemical reaction that follows extracts both salt from the oceanic brines and strips out natural gas liquids, leaving only pure freshwater and clean methane gas in hydrates.[29] For example, $1m^3$ of methane hydrate could involve approximately $160–170m^3$ of methane gas and $0.8m^3$ of water – although the exact amount varies depending on conditions of temperature and pressure of measuring environment.[30] Thus, if you find methane hydrates, you have both fresh water and pure natural gas with no salt and no contaminants.

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[22] Energy Information Administration, 'Country Analysis Brief: Japan' (2 February 2017) 8.

[23] METI, 'Strategic Energy Plan' (July 2018) 34 <https://www.enecho.meti.go.jp/en/category/others/basic_plan/5th/pdf/strategic_energy_plan.pdf>.

[24] Max and Johnson, (n 13) 65–66.

[25] Other synonymous terms are gas hydrates, natural gas hydrates and clathrate hydrates.

[26] In the present study, the term methane hydrate is used as a general term to denote 'a clathrate or hydrate of methane-rich natural gas of any composition or crystal structure', see Max and Johnson, (n 13) 47.

[27] Research Consortium for Methane Hydrate Resources in Japan, 'What is methane hydrate?' (1 September 2010) <https://www.mh21japan.gr.jp/english/mh21-1/01-2/>; US Geological Survey, (n 19).

[28] Partain (n 6) 11.

[29] MacDonald, (n 14) 53, 59.

[30] Rogers (n 5) 1–2; Partain (n 6) 3.

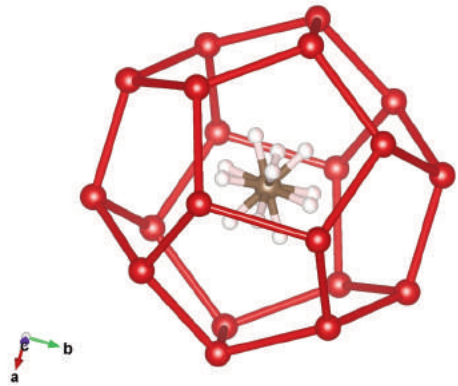

Figure 3 *Methane Hydrate Molecule*

Source: Research Consortium for Methane Hydrate Resources in Japan

Natural gas from hydrates is typically the same type of gas used by consumers for cooking, heating, and increasingly as a transport fuel; and industrially as a fuel for power plants and as an industrial feedstock for the petrochemical industry.[31]

This chemical simplicity makes methane hydrates attractive to countries for three simple reasons. First, as mentioned above, methane is an easy and ready to use fuel that is 'the cleanest and most environmentally friendly' of all fossil fuel options such as coal or crude oil. Second, extraction of methane from hydrates produces a large volume of potable water fit for multiple purposes.[33] Third, the co-production of water and methane enables the production of hydrogen, which is a green fuel source as its combustion leaves only energy and water.[34]

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31 MacDonald, (n 14) 53, 62.

32 Max and Johnson, (n 13) 65–66.

33 Roy A Partain, 'Delivering Energy to the Drylands: Obligations Under the UN Convention to Combat Desertification(UNCCD) to Provide Energy, Water, and More' in Raphael J Heffron and Gavin Little (eds) *Delivering Energy Law and Policy in the EU and the US* (Edinburgh University Press 2015) 1–4 <https://ssrn.com/abstract=2583288>.

34 Ryunosuke Kikuchi, 'Analysis of Availability and Accessibility of Hydrogen Production: An Approach to a Sustainable Energy System Using Methane Hydrate Resources' (2005) 6 Environment, Development and Sustainability 453–471. Further, any carbon dioxide produced from the production of hydrogen fuel could either be vented far from coastal communities or re-injected back into the hydrate formation to enhance additional hydrate recovery extraction, see Partain (n 6) 11.

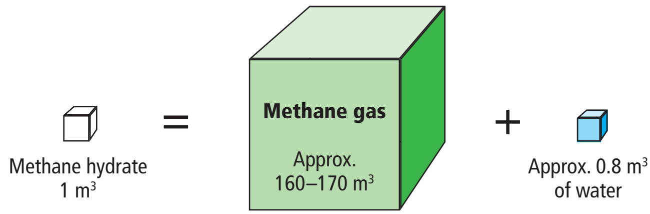

Figure 4 *Methane Gas and Water*

Source: Research Consortium for Methane Hydrate Resources in Japan

Given the abundance of methane hydrates and the need to maintain a low carbon ratio, scientists in Japan have begun exploring not only how to combust the produced natural gas from methane hydrates to produce electricity but also how the greenhouse gas emissions can be re-injected back within the hydrate reservoir system. Such a system could enable the production of carbon-neutral electrical power. Additionally, in a hydrogen fuel era, the freshwater can be converted to steam to use in generating hydrogen from the natural gas co-produced with the water. Thus, freshwater can be produced from offshore methane hydrates with co-production of natural gas; electrical power, hydrogen fuel, and carbon capture and storage can be implemented alongside the production activities.

1.4 OFFSHORE METHANE HYDRATE LIFECYCLE

Production research and development studies suggest that natural gas could be explored, exploited, and produced using techniques that are already employed by the hydrocarbon industry.[35] Conventional oil and gas activities have a recognised lifecycle which includes four phases:

a) Exploration (to determine whether oil and gas may be present);
b) Appraisal and Development (to determine whether oil and gas is commercially exploitable and, if so, plan for production);
c) Production (oil and gas are commercially produced) and finally;

[35] Beaudoin and (n 19) 22.

d) Decommissioning (to safely shut-down wells, remove installations and prevent future emissions from wells).[36]

1.4.1 Exploration

In conventional oil and gas settings, exploration is the application of geophysical surveying methods in the search for potential hydrocarbon-bearing accumulations. The progressive advancement of exploration techniques, such as those concerning seismic acquisition and processing, has improved geologists' understanding of the geological characteristics of the seabed and subsoil and increased the efficiency of exploration. Seismic surveys are amongst the most widely used techniques applied to methane hydrate geophysical exploration to enable the mapping of the broad subsurface structure and to detect the likelihood of methane hydrate-bearing formations, prior to the drilling of the initial exploration wells.[37] Moreover, similar to conventional oil and gas, the exploration phase of methane hydrates requires a small number of wells to be drilled within an identified target to confirm the actual occurrence of methane hydrates.

1.4.2 Appraisal and Development

The appraisal phase shifts the emphasis from data collection and analysis to determine the presence of methane hydrates (i.e. the objective of the exploration phase) to delineating the extent of the oil and gas deposit and determining the commerciality of the resource. This typically requires more seismic surveys to be conducted, further wells to be drilled and logged to delineate the field, with additional data collected and analysed to reduce the uncertainty in the description of the hydrocarbon reservoir, and to provide information with which to take a commercial decision on whether or not to develop the field. To appraise the commerciality of a methane hydrate field several wells need to drilled and tested; production and early safety reports

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[36] It should be noted that the term 'decommissioning' is often used in the literature interchangeably with the term 'abandonment', see B Hamzah, 'International Rules on Decommissioning of Offshore Installations: Some Observations' (2003) 27 Marine Policy 339–48; Zhiguo Gao, 'Current Issues of International Law on Offshore Abandonment, with Special Reference to the United Kingdom' (1997) 28 Ocean Development and International Law 59–78. While both terms tend to refer to the process of removing (partly or fully) and disposing disused offshore oil and gas assets, the industry generally tends to avoid the term 'abandonment' as 'it conveys the wrong image of what is involved', see John Paterson, 'Decommissioning of Offshore Oil and Gas Installations' in Greg Gordon, John Paterson, and Emre Usenmez (eds) *UK Oil and Gas Law: Current Practice & Emerging Trends* (3rd edn, Edinburgh University Press 2018) 235.

[37] W A Ashcroft, *A Petroleum Geologist's Guide to Seismic Reflection* (Wiley-Blackwell 2011) 3.

during the appraisal and development phase are critical to decisions on how and whether to shift to the production phase.

Exploration drilling for methane hydrates can be carried out at great depths, in excess of 10,000m, where the chance of finding traditional oil is negligible because of oil's thermodynamic instability at high temperatures.[38] The shift from exploration and appraisal drilling to actual production is the most critical one, since it brings with it a different set of new and less well understood environmental impacts, requiring comprehensive risk assessment and response as appropriate.[39] It is during the drilling phase that most of the actual hazards are present: drilling induces methane hydrate disassociation which could weaken sediment integrity deterioration, which in turn opens up the possibly for a host of onward hazards, such as methane leakage from the seafloor around the production well, around any re-injection wells, or from seafloor subsidence and submarine landslides.[40]

Once methane hydrate formations have been identified through exploration, there are four principal methods for recovering natural gas from methane hydrate deposits:

i. thermal stimulation;
ii. depressurization;
iii. the use of chemical injection; and
iv. gas-exchange method.[41]

The thermal stimulation of a methane hydrate deposit requires the injection of thermal energy into the rock in order to raise the local temperature to induce hydrate to dissociation and releasing of natural gas.

In depressurization, the pressure in the deposit is lowered until the phase boundary is crossed causing dissociation of the hydrate.[42] The free gas would then flow up the well, to be collected at the surface using conventional equipment.

In 2012, an advanced production test programme involving carbon dioxide injection and pressure draw-down was completed in Alaska and in early

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[38] MacDonald, (n 14) 53, 54.

[39] Nao Arata and others, 'Environmental Impact Assessment Studies on Japan's Methane Hydrate R&D Program' in *Proceedings of the 7th International Conference on Gas Hydrates (ICGH)* (United Kingdom, 17–21 July 2011) 214–219.

[40] Partain (n 6) 62; Kvenvolden (n 14) 41, 47; Beaudoin and others (n 19) 23.

[41] Zhenyuan Yin and Praveen Linga, 'Methane Hydrates: A Future Clean Energy Resource' (2019) Chinese Journal of Chemical Engineering 1, 8–9 <https://doi.org/10.1016/j.cjche.2019.01.005>; See also Benjian Song and others, 'Seafloor Subsidence Response and Submarine Slope Stability Evaluation in Response to Hydrate Dissociation' (2019) Journal of Natural Gas Science and Engineering 1, 2 <https://doi.org/10.1016/j.jngse.2019.02.009>.

[42] MacDonald, (n 14) 53, 66.

2013, Japan conducted the first production test, using depressurization in the Eastern Nakkai Trough off Japan's South-Eastern coast.[43] In 2017, China utilised the depressurisation method to extract hydrates in the Shenhu area of the South China Sea.[44]

Most current models assume that a combination of techniques may be required for the economic extraction of methane hydrates from deep-sea locations.[45]

1.4.3 Production

The production stage commences with the first commercial quantities of methane hydrates flowing through the wellhead. This marks the turning point from a cash flow perspective, since from this point onwards revenues are generated and can be used to pay back the prior investments, or may be made available for new projects.

Generally, production will not begin unless initial safety testing and production flow tests have been fully completed within the development stage. These tests are usually based on the expected production profile which depends strongly on the mechanisms utilised to sever, extract, and lift the methane from the deposits. The production profile will determine the facilities required and the number and phasing (vertical or horizontal) of wells to be drilled.

The period of production will normally last for decades and will generally continue to include new in-field drilling (e.g. to enhance production flow) and extensions to existing equipment. Thus, once the initial phase production is underway, excepting for new in-field drilling operations, risks will be of similar type and variance for each day of operation.

1.4.4 Decommissioning

Decommissioning refers to the stage of the methane hydrate lifecycle where offshore installations and structures, at the end of their production life (i.e. when final production volumes are extracted and transported) need to be dismantled, removed (whether wholly or partly), disposed of, or re-used, in a socially responsible and environmentally sound way.[46]

Technically speaking, there are two key stages to methane hydrate decommissioning: an early active stage of closing and stabilising the field and a

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[43] MacDonald, ibid 53, 68.

[44] Song and others, (n 41) 1, 2.

[45] Yin and Linga, (n 41) 1, 8–9; Partain (n 6) 37; Moridis and others, (n 10) 745, 757–759.

[46] Paterson, 'Decommissioning of Offshore Oil and Gas Installations' in Gordon, Paterson, and Usenmez (n 36) 235.

subsequent stage of securing and monitoring the field. With respect to procedures to stabilize the deposits and reserves, a variety of chemicals may be injected into the deposit level. Thereafter, wells would be plugged to ensure minimum communication between the well systems and the surface above the production zones.

The latter stage of decommissioning could potentially last decades; it is unclear when it would be possible to declare a depleted methane hydrate field stable and safe so as to not require additional monitoring.

1.5 POTENTIAL 'NEW RISKS'

Considering that high-grade, sand-based methane hydrate resources could be extracted and developed using techniques already employed by the oil and gas industry, the assumption is that most environmental considerations related to natural gas production from methane hydrate would apply to those of conventional oil and gas projects.[47] However, ongoing studies suggest that the commercial development of methane hydrates contains a 'mixture of risks', some of which are 'unique' to methane hydrates.[48] Thus, despite employing largely the same extraction techniques as traditional oil and gas, the potential risks arising from methane hydrate extraction and development could significantly differ. This significant difference arises from the vastly different geology containing offshore methane hydrates. As Partain explains:

> Methane hydrates are located not under geologically deep cap rocks, but instead they lay under mud beds at the bottom of the sea. And those mud beds are not laying flat, but are sloped, and thus at risk of slipping. As methane is extracted from the hydrates beneath those mud beds, there are several ways for the muddy containment system to fail, enabling methane to escape uncontrolled. That venting could be either cataclysmic and release massive volumes of methane immediately or be persistent leaks that slowly emit methane into the water column. Both forms of emissions lead to a variety of risks and hazards.
>
> What is unique to methane hydrates is the placement of methane hydrates under subsea muds and the hydrates' lack of a geological cap rock to secure them in place; this stands in stark contrast to conventional oil and gas deposits that are found deep in the earth under cap rocks […] The greatest unique environmental problem facing the extraction of methane from

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[47] Beaudoin and others (n 19) 23.
[48] For a full account, see Partain (n 6) 57–87.

hydrates would appear to be the uncontrolled release of methane once the hydrates are disturbed.[49]

Previous studies indicate that there are known environmental risks associated with methane hydrate extraction that include marine geohazards, such as seabed subsidence, submarine landslides (which in turn could trigger tsunami) and destruction of marine ecosystems on the seabed (e.g. if large amounts of methane escape the sediment and dissolved into the benthic waters).[50] As Moridis and others explain:

> [B]ecause the proximity of [methane hydrate deposits] to the ocean floor and the large compressibility of marine sediments can compromise the stability of structures such as platforms with catastrophic economic and safety consequences, and even more so along the continental slope, where underconsolidated and possibly overpressured zones developed during hydrate dissociation can trigger submarine landslides.[51]
>
> These risks and geohazards are in addition to less well understood but nonetheless plausible risks to the environment, such as the potential for global warming if, following a large-scale uncontrolled methane hydrate dissociation, methane is released into the atmosphere.[52]

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[49] Partain, ibid.

[50] Marine geohazards are 'disasters induced by natural processes or human activity'; they include 'any feature or process that could harm, endanger, or affect seafloor facilities' and have the 'potential to develop into seafloor failure events, which cause losses of life or damage to health, environment or field installations', see Camargo and others, (n 13) 1; See Jian-liang Ye, 'Preliminary Results of Environmental Monitoring of the Natural Gas Hydrate Production Test in the South China Sea' (2018) 2 China Geology 202–203; Itsuka Yabe and Hideo Kobayashi, 'Environmental Risk Analysis of Methane Hydrate Development' in *Proceedings of the 7th International Conference on Gas Hydrates (ICGH)* (United Kingdom, 17–21 July 2011) 206–213; Joo Yong Lee and others, 'The Seafloor Deformation and Well Bore Stability Monitoring During Gas Production in Unconsolidated Reservoirs' (World Congress on Advances in Structural Engineering and Mechanics, South Korea, 8–12 September 2013) 703–707; Yin and Linga, (n 41) 1, 16. On the relationship between submarine landslides and methane hydrates, see Xuemin Wu and others, 'Submarine Landslides and their Distribution in the Gas Hydrate Area on the North Slope of the South China Sea' (2018) 11(12) Energies 3481–3499; M F Nixon and J L H Grozic, 'Submarine Slope Failure due to Gas Hydrate Dissociation: A Preliminary Quantification' (2007) 44(3) Canadian Geotechnical Journal 314–325.

[51] Moridis and others, (n 10) 745, 764; see also Imen Chatti and others, 'Benefits and Drawbacks of Clathrate Hydrates: A Review of their Areas of Interest' (2005) 46 Energy Conversion and Management 1333–1343.

[52] Of increasing interest to scientists is the broader impact of methane hydrates on the climate system, particularly the response of methane hydrate occurrences to sea level change and atmospheric and ocean warming, see Beaudoin and others (n 19) 23; Partain (n 6) 67–69.

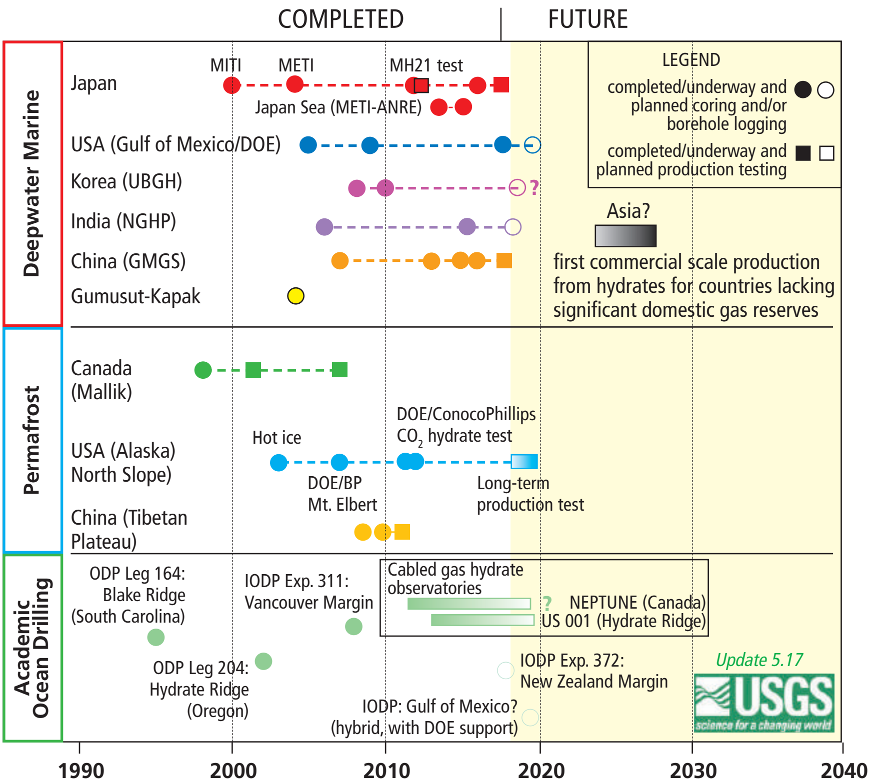

Figure 5 *Methane Hydrate Drilling Activities Around the World*

Source: Carolyn Ruppel, US Geological Survey (2019)

A recent study, conducted as part of the Japanese Research Consortium for Methane Hydrate Resources (MH21) which currently operates offshore production tests from methane hydrate deposits, notes that while methane hydrate production tests showed minimal short-term impacts on the environment before, during and after the field production tests in the Eastern Nankai Trough, it is difficult to understand the long-term cumulative risks posed by methane hydrate extraction.[53] The study suggests that in view of the 'unprecedented' character of methane hydrates, 'comprehensive marine environmental surveys' based on 'proactive predictions' on the effects of

[53] Arata and others, (n 39) 214–219; see also Yabe and Kobayashi, (n 50) 206, 207–208: 'The testing period is short (one week one month). Therefore, these risks might be small in the first offshore production well.'

methane hydrate dissociation and 'the risks of possible consequences such as tsunami that may be generated by slides' must be applied.[54] Considering the current state of knowledge in this field, 'significant scientific gaps exist' which cannot be comprehensibly addressed by short-term field monitoring.[55] Rigorous environmental monitoring systems are currently being developed across jurisdictions to systematically understand the precise short-term and long-term hazards associated with commercial methane hydrate extraction.[56] Early impact monitoring studies indicate that there are 'certain limiting parameters for operational safety' and some methane hydrate fields are likely to be safer and more stable than other fields 'with more readily foreseeable harms and hazards'.[57]

In all, despite the existence of environmental risks and increased scientific uncertainty as to the extremity of such risks, ongoing methane hydrate research and development programmes, in Japan and beyond, are likely to dramatically accelerate methane hydrate commercialisation for wide-scale methane hydrate production in the years to come.[58] **[see Figure 5]** There is, thus, a critical need to ascertain, prior to the onset of methane hydrate commercial development in Japan, whether robust regulatory mechanisms are in place for preventing for preventing major accidents in methane hydrate operations offshore Japan and for limiting the consequences of such accidents.

54 Arata and others, ibid 214–219.

55 Yin and Linga, (n 41) 1, 10.

56 See, for instance, the innovative 'four-in-one' monitoring system developed by China to monitor environmental conditions in the seafloor, the sea water, the borehole environment and the near-sea surface atmosphere during methane hydrate production, Ye, (n 50) 202–203; Jin-fa Li and others, 'The First Offshore Natural Gas Hydrate Production Test in South China Sea' (2018) 1 China Geology 5–12.

57 Partain (n 6) 64, 79–80.

58 Max and Johnson, (n 13) 65–66.

2

Japan's Pressing Energy Challenges and Methane Hydrates

2.1 Introduction

Many readers would rightfully recognise that Japan enjoys a vibrant industrial economy, has long been one of the world's largest economies and is a recognised leader in energy technologies and, thus, readers might assume that Japan has solved its energy problems.

This is far from being the case.

Japan has faced enormous energy challenges ever since the onset of the first oil crisis in 1973, and major supply shocks were felt recently from the energy shortfalls in the aftermath of the 2011 Great East Japan Earthquake, its resultant tsunami and the subsequent multi-year nuclear stand-down resulting from the Fukushima Daiichi nuclear accident.[59] Japan's energy policymakers must navigate between a *Scylla* of almost no domestic energy resources and a *Charybdis* of bad energy options, such as carbonaceous and polluting coal, expensive LNG imports, and risky uranium-fuelled nuclear power plants. Cutting through that Gordian knot of energy policy risks, offshore methane hydrates have the potential to offer to Japan a new domestic resource, a lower-carbon and locally-abundant energy resource.

This section reviews the key policy materials (law, regulations and programmes) that guide and inform Japan's national energy policy in providing an overview of the current energy environment in Japan, particularly from the viewpoint of energy supply and demand and the role of methane

[59] Security of energy supply has always been critical to Japan, according to the International Energy Agency, *Energy Policies of IEA Countries: Japan* (2016 IEA Review) 9. On the consequences of the Fukushima nuclear accident for Japan's energy security, see Vlado Vivoda, 'Japan's Energy Security Predicament Post-Fukushima' (2012) 46 Energy Policy 135–143; Junko Edahiro, 'Japan's Strategic Energy Plan under Review after 2011 Nuclear Disaster' Japan For Sustainability Newsletter No114 (February 2012) <https://www.japanfs.org/en/news/archives/news_id031723.html>; Masatsugu Hayashi and Larry Hughes, 'The Policy Responses to the Fukushima Nuclear Accident and Their Effect on Japanese Energy Security' (2013) 59 Energy Policy 86–101.

hydrates within Japan's overall energy policy. Energy policy materials reviewed for this purpose include but are not limited to the following:

Basic Act on Energy Policy: This Act, which came to be known as Japan's 'Energy Constitution', was adopted and enforced in 2002.[60] Its stated objective is:

> To promote measures on energy supply and demand on a long-term, comprehensive and systematic basis by laying down the basic policy and clarifying the responsibilities of the State and local public entities with respect to measures on energy supply and demand and by prescribing matters that form the basis of measures on energy supply and demand, thereby contributing to the preservation of the local and global environment and to the sustainable development of the Japanese and global economy and society.[61]

The Act establishes three basic goals of energy:

i. Energy security;
ii. Adaptability to the environment; and
iii. Utilisation of market mechanisms.[62]

Whilst the Act itself does not provide any specific energy policies, its principal function is to set a systematic and comprehensive energy policy planning structure.[63] The Act requires the Government of Japan to prepare a Basic Energy Plan (also known as Strategic Energy Plan) 'in order to promote measures on energy supply and demand on a long-term, comprehensive and systematic basis'.[64] The Government of Japan is expected to revise the Basic Energy Plan at least every three years or as necessary in light of changing circumstances or ineffective energy strategies.[65]

Basic (Strategic) Energy Plan: This policy document formulated by Japan's Ministry of Economy, Trade and Industry (METI), presents the basic direction of Japan's energy policy under the Basic Act on Energy Policy (2002). The first Basic Energy Plan was adopted in 2003 and was revised successively in March 2007, July 2010 and April 2014.[66] The 2014 version

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60 John S Duffield and Brian Woodall, 'Japan's New Basic Energy Plan' (2011) 39(6) Energy Policy 3741, 3742–43.

61 Art 1, Basic Act on Energy Policy (Act No 71 of 2002) <http://www.japaneselawtranslation.go.jp/law/detail/?vm=04&id=123&re=02>.

62 Arts 2–4, ibid.

63 Duffield and Woodall, (n 60) 3741, 3741–42.

64 Art 12, Basic Act on Energy Policy (n 61).

65 Art 12(5), ibid.

66 See International Energy Agency, (n 59).

was prepared in response to renewed concerns about Japan's security of energy supply due to the 2011 earthquake, the subsequent tsunami and the Fukushima Daiichi nuclear accident.[67]

Recognising that Japan's energy supply structure is 'vulnerable', the 2014 Strategic Energy Plan set the basic viewpoint of Japan's new national energy policy stipulating four fundamental policy goals (labelled as 'Three E's + Safety'):

i. **E**nergy Security (i.e. ensuring stable energy supply);
ii. **E**conomic Efficiency (i.e. enhancing the efficiency of energy consumption);
iii. **E**nvironmental Suitability (i.e. ensuring environmental protection);[68] and
iv. Reflecting on the Fukushima disaster, the fundamental condition of **S**afety was added to Japan's overall energy policy.[69]

In July 2018, METI released a revised Strategic Energy Plan to form the basis for the orientation of Japan's new energy policy towards 2030 and further towards 2050, considering the changes in energy environments inside and outside Japan. The new plan includes 'technologies related to energy where intensive measures should be taken for their research and development in order to promote measures on energy supply and demand on a long-term, comprehensive and systematic basis, and measures that should be taken in connection with such technologies'.[71]

Long-Term Supply and Demand Outlook: This document is produced by METI to present the structure of the Japanese Government's desired long-term energy supply and demand policy in keeping with the key policy objectives concerning energy security, economic efficiency, environmental suitability and safety.[72] The latest Outlook was published in 2015 and describes pathways to satisfy the 'Three E's + S' goals in a balanced way. On the balance of nuclear energy and other energy resources (such as LNG-powered energy and renewable energy sources), the new Outlook envisages a reduced role for the former and increased use of the latter.[73]

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[67] Edahiro, (n 59).
[68] METI, 3rd Strategic Energy Plan (April 2014).
[69] Ken Koyama, 'Inside Japan's Long-Term Energy Policy' Institute of Energy Economics, Japan (IEEJ) (September 2015) <https://eneken.ieej.or.jp/data/6291.pdf>.
[70] METI, 'Strategic Energy Plan' (July 2018).
[71] Art 12, (n 61).
[72] Koyama, (n 69).
[73] METI, 'Long-Term Energy Supply and Demand Outlook' (July 2015) 4–7.

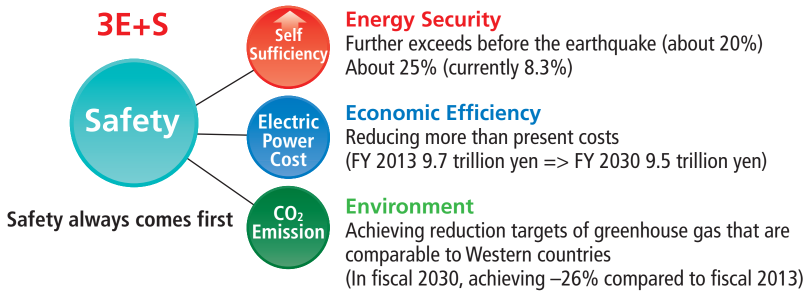

Figure 6 *Basic Energy Policy of Japan (Es+S)*

Source: METI

Annual Report on Energy (Energy White Paper): This is a report produced by METI and submitted to the Diet annually, pursuant to Article 11 of the Basic Act on Energy Policy.[74] It is intended to provide the Government with an outline of the measures taken during the previous fiscal year concerning energy supply and demand, and the ongoing state of Japan's energy security. The latest 2018 edition of the Energy White Paper presents some key changes surrounding the energy security environment in Japan (including, among others, progress made towards diversifying Japan's current energy mix, global crude oil price trends, and the state of restoration of nuclear power production in Japan) and concludes that '[e]nergy security has worsened in Japan due largely to the inactivation of nuclear energy plans'.[75]

2.2 ENERGY SECURITY

Japan enjoys the world's third largest economy in terms of nominal gross domestic product and is amongst the top five largest energy consumers globally, despite continuous and progressive efforts for energy efficiency and conservation measures.[76] Such an industrial economy requires fuel and energy.

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74 Previous editions of the Annual Report on Energy (Energy White Paper) are available here: <https://www.enecho.meti.go.jp/en/category/whitepaper/>.

75 METI, Agency for Natural Resources and Energy: 'Energy White Paper 2018 (Outline)' <https://www.meti.go.jp/english/press/2018/pdf/0608_001a.pdf>.

76 Nick Butler, 'Japan is Nervous about its Energy Security' (*Financial Times*, 9 July 2018) <https://www.ft.com/content/66c37158-801a-11e8-bc55-50daf11b720d>.

Japan's domestic energy resources are limited, so it relies almost exclusively on imported fossil fuels to meet its domestic energy needs.[77] Japan remains the world's largest importer of liquefied natural gas (LNG) and ranks in the top four countries for the highest coal imports, and has a high level of net imports of petroleum and other liquids.[78] The Government of Japan has repeatedly stated that excessive reliance on overseas energy supplies makes Japan's energy structure fundamentally 'vulnerable' to energy supply disruptions (e.g. if some of the trade routes required to bring energy supplies to Japan through Asia were to be disrupted due to regional maritime and territorial conflicts).[79] Indeed, a major issue for Japan's energy security relates to transport of energy by sea, specifically the physical safety of shipping oil from the Persian Gulf to East Asia. Not only is Japan importing almost 90 per cent of its oil from the Middle East but, in addition, most of it passes through risky shipping channels such as the Strait of Hormuz.[80] Inter-state tensions between Iraq and other states pose increased risks to shipping through the Strait of Hormuz and frequent big typhoons in the Malay Strait can require LNG from Australia or Indonesia to take longer routes to Japan.[81]

The challenges associated with Japan's excessive reliance on energy imports are exacerbated by the fact that energy-hungry countries in the Asia-Pacific region, such as South Korea, India and China, are also competing to secure long-term oil and gas supply contracts with suppliers in the Middle East and other regions.[82] Japanese companies are 'often failing to outbid Chinese national oil companies who are backed by deep pockets of their home government'.[83] Furthermore, Japan's close security alliance with the United States often results in Japan's aligning with the US on sanctions

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[77] The energy self-sufficiency of Japan in 2015 was 7.4 per cent, according to data released by the Hovenement of Japan, Ministry of Economy, Trade and Industry (METI); see METI, 'Japan's Energy: 20 Questions to Understand the Current Energy Situation' https://www.enecho.meti.go.jp/en/category/brochures/pdf/japan_energy_2017.pdf.

[78] Energy Information Administration, (n 22) 1–12; see also BP Statistical Review of World Energy (June 2016) 3 www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2016/bp-statistical-review-of-world-energy-2016-full-report.pdf.

[79] METI, 'Strategic Energy Plan' (July 2018) 6; see also, Butler, (n 76).

[80] Personal Communication with Professor Nakatani (31 Aug 2019).

[81] See Reuters Graphics, 'Tensions rise in the world's most strategic oil chokepoint' (19 July 2019) <https://graphics.reuters.com/MIDEAST-ATTACKS-HORMUZ/0100B0B50N3/index.html>; Yoichiro Sato, 'Japan's 'trilemma' in the Strait of Hormuz' (*The Japan Times*, 17 July 2019) <https://www.japantimes.co.jp/opinion/2019/07/17/commentary/world-commentary/japans-trilemma-strait-hormuz/#.XXZdiJNKiqQ>.

[82] Vlado Vivoda, (n 59) 135, 136–137.

[83] Ibid; see also METI, 'Strategic Energy Plan' (July 2018) at 18, recognising that 'the country always faces the risk of supply instability against the background of the limits of its negotiating power in resource procurement and the effects of changes in the situations of resource-supplying countries and sea lanes'.

measures against certain oil exporters, limiting Japan's energy supply options.[84]

Japan pledged in 2009 to address its overall energy self-sufficiency ratio[85] by increasing the country's nuclear power contribution to electricity generation from 30 to 50 per cent.[86] However, this goal was challenged in 2011 by a 9.0 magnitude earthquake that struck off the eastern coast of Japan, triggering a tsunami and causing serious damage at the Fukushima-Daiichi nuclear reactor.[87] The damage to Japan's energy infrastructure resulted in an immediate shutdown of about 10 gigawatts (GW) of nuclear electric generating capacity.[88] The plants that were not immediately damaged were gradually shut down as a result of scheduled maintenance and lack of government approvals to return to operation.[89] For nearly two years, between mid-2013 and mid-2015, Japan suspended nuclear power generation for the first time in more than 40 years. Five and a half years on only three of Japan's 54 nuclear reactors were in operation.[90] This policy of nuclear caution created an energy supply gap of around 30 per cent.[91] In a reverse of its 2009

[84] In 2010, Japanese oil company INPEX, which was to be a major developer of Iran's Azadegan oil field, abandoned its stake in the project facing the prospect of being denied access to United States' financial institutions, see Vivoda, ibid.

[85] The Energy Self-Sufficiency (ESF) Ratio is the percentage of Japan's primary energy supply, which is produced domestically (nuclear, renewable energy and fossil fuels). The Self-Developed Fossil Fuel Supply (SFFS) ratio is the percentage of imported coal, oil and natural gas, which is produced by Japanese companies operating overseas. The Energy Independence (EI) ratio is the percentage of Japan's primary energy supply, which consists of either energy produced domestically or imported fossil fuels, which are produced by Japanese companies; it can be calculated as follows: EI = ESF + SFFS (100% – ESF), see Duffield and Woodall, (n 60) 3741, 3743.

[86] International Energy Agency, (n 59) 9, 31. For an overview of the energy policy objectives stipulated in Japan's 3rd Strategic (Basic) Energy Plan, see Duffield and Woodall, ibid 3741–49; Edahiro, (n 59).

[87] International Energy Agency, (n 59) 9, 31.

[88] Vlado Vivoda (ed) *Energy Security in Japan: Challenges After Fukushima* (Ashgate 2014) 5. According to the World Nuclear Association, after the Fukushima accident, only 17 out of Japan's 50 remaining nuclear power reactors were in operation, World Nuclear Association, 'Nuclear Power in Japan' <www.world-nuclear.org/information-library/country-profiles/countries-g-n/japan-nuclear-power.aspx>.

[89] In addition to Nuclear Regulation Authority (NRA) approval, the restart of Japan's nuclear reactors requires the approval of the central government and the consent of local governments or prefectures where the power plants are located, see US Energy Information Administration, 'Today in Energy: Five and a Half Years After Fukushima, 3 of Japan's 54 Nuclear Reactors Are Operating' (13 September 2016) <https://www.eia.gov/todayinenergy/detail.php?id=27912>.

[90] Ibid.

[91] Whilst the share of nuclear energy in total primary energy supply (TPES) fell from 15 per cent to zero, the share of natural gas increased from 17.3 per cent in 2010 to 23.3 per cent in 2015, that of coal from 23.1 per cent to 27.5 per cent, and that of oil from 40.6 per cent to 42.9 per cent, International Energy Agency, (n 59) 9, 18.

commitments, Japan was forced to replace the significant loss of nuclear power largely with at-that-time expensive fossil fuels (i.e. LNG, oil and, from 2013, coal) which resulted in higher government debt levels and even higher dependence on energy imports from foreign countries such as Saudi Arabia, the United Arab Emirates and Australia.[92]

2.3 ELECTRICITY COSTS

As nuclear generation was shut down following the incident at the Fukushima-Daiichi nuclear plant, the composition of fuel used for Japan's power generation efforts shifted back to fossil fuels, particularly LNG and coal, which became the primary substitutes for nuclear power in Japan's electricity portfolio.[93] With this increasing reliance on fossil fuel imports, electricity prices in Japan rose sharply.[94] High electricity prices adversely impact on Japan's competitiveness, in particular in the manufacturing sector.[95] As of August 2019, electricity prices remain substantially high and will likely remain higher in comparison to the other G-20 economies such as Germany, France, the United States and the United Kingdom.

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[92] Dependence on imported fossil-fuels rose from 80 per cent in 2010 to 94 per cent in 2014; According to US EIA, Japan spent about USD 270 billion for fossil fuel imports in the three years following the Fukushima accident, see Energy Information Administration, (n 22); This has contributed significantly to Japan's record trade deficit of JPY 2.5 trillion (about USD 31.78 billion) in the first half of 2012, see World Nuclear Association, (n 88); see also, METI, 'Strategic Energy Plan' (April 2014) at 5 and METI, Agency for Natural Resources and Energy: 'Energy White Paper 2015' (July 2015) (Outline) at 9 <https://ewb-c.infocreate.co.jp/ewbc/_pt_pdf.html?&id=0.6872112628503704&siteId=003_meti#!lang=en&file=https%3A%2F%2Fwww.meti.go.jp%2Fenglish%2Freport%2Fdownloadfiles%2F2015_outline.pdf>.

[93] Energy Information Administration, (n 22) 13; Energy Information Administration, 'Japan's Electricity Prices Rising or Stable Despite Recent Fuel Cost Changes' (13 September 2016) <https://www.eia.gov/todayinenergy/detail.php?id=27872>.

[94] Following the Fukushima accident, electricity companies passed on the rising costs due to fuel imports to consumers which resulted in higher tariffs with around a 25 per cent increase for households and 40 per cent for industry by the end of 2014, International Energy Agency, (n 59) 32; METI, 'Energy White Paper 2015' (n 92).

[95] According to METI, increases in electricity prices have caused adverse effects on small and medium-sized enterprises resulting in personnel cuts and production transfer to overseas locations due to deteriorating profitability for domestic business, see METI, 'Strategic Energy Plan' (April 2014) 10–11.

2.4 Greenhouse Gas Emissions

Historically, Japan has preferred nuclear electricity as a means of enhancing its energy security while simultaneously enabling Japan to reduce its greenhouse gas emissions.[96] However, following the 2011 nuclear crisis the increased use of fossil fuels in power supplies drove annual greenhouse gas emissions from power generation up by more than 110 million tonnes (Mt), an increase of more than 20 per cent from 2010 to 2013 and further up by 11.8 per cent in 2014, according to IEA data.[97] By fuel types, the largest contributors of greenhouse emissions in Japan are coal (39.1 per cent), oil (38.2 per cent) and natural gas (21.9 per cent).[98]

While Japan's 2015 'Long-Term Energy Supply and Demand Outlook to 2030'[99] envisaged the progressive restart of nuclear power plants as the most cost-effective and environmentally sound way to cover the energy shortfall, this was met with significant implementation costs ranging from USD 700 million to USD 1 billion per nuclear power unit and several judicial rulings which have hindered a wide number of approved restarts.[100]

Whilst that initial surge in restarts has now subsided, as 19 nuclear stations have come back on stream, it remains unclear to what extent nuclear power production will eventually be restored and the exact timeline of any

[96] Energy Information Administration, (n 22) 17–18;

[97] International Energy Agency, (n 59) 21–22; METI announced that since the Great East Japan Earthquake, the amount of greenhouse gas emissions in Japan reached 1.4 billion tons in 2013 and although it started to decline after 2014, 1,307 million tons was still emitted in 2016, see METI, 'Japan's Energy' (n 77) 5.

[98] International Energy Agency, ibid 27–28; see also Takamitsu Sawa, 'The Future Shape of Japan's Energy Policy' (*The Japan Times*, 12 July 2018) <https://www.japantimes.co.jp/opinion/2018/07/12/commentary/japan-commentary/future-shape-japans-energy-policy/#.XLgAlJMzaqQ>.

[99] Prepared subsequently to the adoption of the 4th Strategic Energy Plan in 2014; International Energy Agency, ibid 23; Japan aims to reduce greenhouse emissions by 80 per cent by 2050, see METI, 'Strategic Energy Plan' (July 2018) 108.

[100] Vivoda, (n 88) 5; Two reactors were restarted in April 2016 and several others are still in the process of approval, World Nuclear Association, (n 88); Opposition to reactor restarts has been primarily related to public concerns about seismic risks, the efficacy of existing regulations, and evacuation plans in the event of an accident, see Energy Information Administration, (n 89); Bungate writes that ['t]he stigma of nuclear power runs deep' and local communities have successfully campaigned to block the restarting or construction of new reactors, see Peter Bungate, 'Plotting Japan's Energy Future' (*The Diplomat*, 12 July 2018) <https://thediplomat.com/2018/07/plotting-japans-energy-future/>; Mari Saito and Sophie Knight, 'Thousands in Japan Anti-Nuclear Protest Two Years After Fukushima' (*Reuters*, 10 March 2013) <https://www.reuters.com/article/us-japan-protest/thousands-in-japan-anti-nuclear-protest-two-years-after-fukushima-idUSBRE92903Y20130310>.

approved restarts. If nuclear power generation falls short of the 20–22 per cent target for 2030, under Japan's long-term energy outlook, that outcome would make it extremely challenging, if not impossible, to fill the current energy gap with renewable energy sources alone.[101] Failing to meet the 20–22 per cent share of nuclear power in electricity supply in 2030 will result in increased generating costs and, in the case of coal and oil use, increased greenhouse gas emissions, hence, complicating Japan's emission reduction targets for 2030.[102]

In overview, Japan is currently faced with serious energy challenges and urgently needs a solution. As amply explained by Vivoda:

> If we are to define energy security as the availability of energy at all times in various forms, in sufficient quantities and at affordable prices, without unacceptable or irreversible impact on the economy and the environment (UNDP, 2004), Japan is facing a serious predicament and a dilemma regarding the direction of its future energy policy. As a consequence of 3/11, the Japanese people are paying more for energy, the supply of which is less secure. Moreover, the higher cost of the energy mix, which is heavier on the fossil fuel side, has an adverse effect on both the economy and the environment.[103]

That being the case, Japan has pledged to drastically improve its overall energy self-sufficiency ratio (8 per cent in 2016) to about 40 per cent by, *inter alia*, increasing its self-developed oil and natural gas supply ratio (27 per cent in 2016) to 40 per cent in 2030; thereby strengthening the country's energy security.[104] **[see Figures 7 and 8]**

New energy technologies that have the potential to promote and secure a stable supply of domestically-produced energy for Japan, such as offshore methane hydrates, will be key to enabling Japan's overall energy policy to reduce dependence on overseas energy imports and also as a next-generation 'clean energy resource' as the country shifts away from high-carbon-intensive fuels such as coal and oil.[105]

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101 International Energy Agency, (n 59) 9; METI, 'Strategic Energy Plan' (April 2018) 4–5.

102 Japan's greenhouse gas emission reduction targets for 2030 can be found here: <https://www.mofa.go.jp/ic/ch/page1we_000104.html>.

103 Vivoda, (n 59) 135, 137.

104 METI, 'Strategic Energy Plan' (July 2018) 4, 6–7, 14, 31 and 35–36.

105 METI, Agency for Natural Resources and Energy: 'Energy White Paper 2016' (May 2016) (Outline) 15 <https://www.meti.go.jp/english/report/downloadfiles/2017_outline.pdf>; METI, 'Energy White Paper 2015' (n 92); METI, 'Strategic Energy Plan' (April 2014) 20; METI, 'Strategic Energy Plan' (July 2018) 6, 35–36, 108–111.

	Self Sufficiency (2000)		Self Sufficiency (2016) * China/India – 2015	Primary Nationally Produced Resources
U.S.	73%	↗	88%	Natural Gas Coal, Petroleum
U.K.	74%	→	67%	Petroleum
Germany	40%	→	37%	Coal
France	52%	→	54%	Nuclear Power
China	98%	↘	84%	Coal
India	80%	↘	65%	Coal
Japan	20%	↘	8%	None

Figure 7 *Japan's Self-Sufficiency Ratio*

Source: METI, 'Japan's Strategic Energy Plan (Outline)' (12 April 2018) <https://www.numo.or.jp/topics/1-1Nakanishi.pdf>

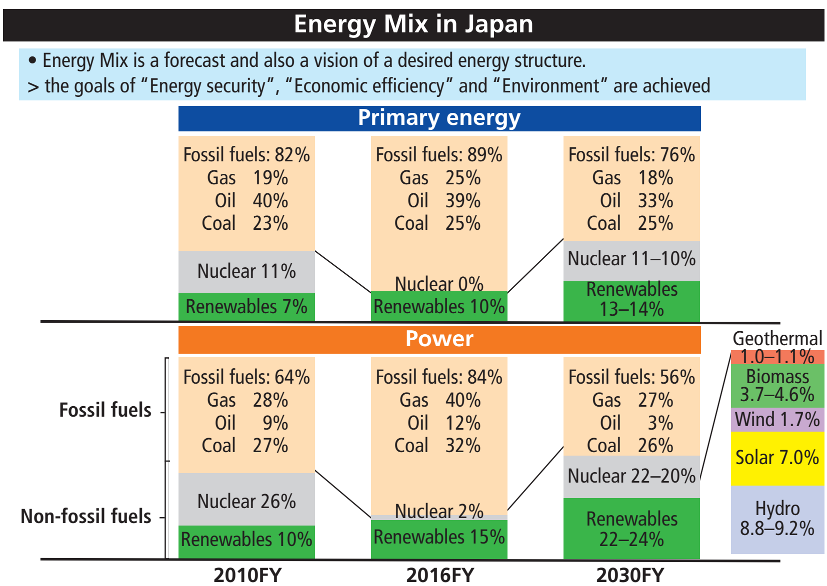

Figure 8 *Energy Mix in Japan*

Source: METI, 'Japan's Strategic Energy Plan (Outline)' (12 April 2018) <https://www.numo.or.jp/topics/1-1Nakanishi.pdf>

2.5 JAPAN'S METHANE HYDRATE RESEARCH PROGRAMME[106]

Japan's geophysical surveys indicate there are at least seven major methane hydrates reservoir systems offshore Japan:

i. the Nankai Trough;
ii. the Hyuga Nada;
iii. the Okushiri Basin;
iv. Offshore of Tokachi-Hikada;
v. Offshore of Abashiri;
vi. the West Tsuguru Basin; and
vii. the east of the Boso Peninsula **[see Figure 9]**.[107]

Estimates suggest that the Nankai Trough alone might contain at least 50.4 tcm of technically producible methane hydrates equivalent to a decade's worth of natural gas consumption in Japan.[108] Japan could well enjoy a century of domestic natural gas resources if Japan were to consume its supply of offshore methane hydrates at its current rate of 4 to 5 tcm per year.[109]

Japan's pressing energy security and climate-change concerns, taken with the promising potentials of its methane hydrate assets, go a long way to explaining why Japan is presently pursuing one of the most advanced research and development methane hydrates programmes in the quest for this abundant energy resource.[110] The Government of Japan established a dedicated national research and development (R&D) programme on methane hydrates in 1993 and has continued to promote research projects in this area since that time.[111] Japan's high expectations for this research programme can be found in the Kyoto Protocol Target Achievement Plan (2005 as revised in

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[106] For a detailed account, see Jorge F Gabitto and Maria Barrufet, *Gas Hydrates Research Programmes: An International Review* (Technical Report, Prairie View A&M University 2009) 1, 14–22; Oyama and Masutani, (n 1) 1-13; Shyi-Min Lu, 'A Global Survey of Gas Hydrate Development and Reserves: Specifically in the Marine Field' (2015) 41 Renewable and Sustainable Energy Reviews 884–899.

[107] Gabitto and Barrufet, ibid.

[108] METI, 'Strategic Energy Plan' (July 2018) 34.

[109] Partain (n 6) 5; Gabitto and Barrufet, (n 106) 1, 11–12.

[110] In 2014, a budget of JPY 12.7 billion (about USD 113 million) was allocated for methane hydrate development projects, International Energy Agency, (n 59) 78; Oyama and Masutani, (n 1) 1, 3; see also Gabitto and Barrufet, ibid.

[111] Research Consortium on Developing Methane Hydrate Resources, 'Japan's Methane Hydrate R&D Program: Phase 1 Comprehensive Report of Research' (August 2008) <http://www.mh21japan.gr.jp/english/wp/wp-content/uploads/ca434ff85adf34a4022f54b2503d86e92.pdf>.

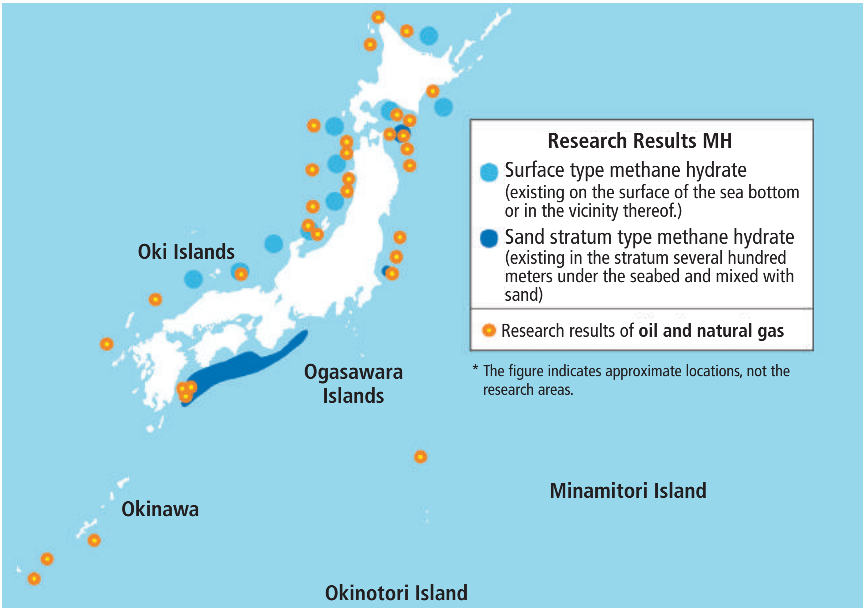

Figure 9: *Methane Hydrates within Japan's EEZ*

Source: METI <https://www.enecho.meti.go.jp/en/category/brochures/pdf/japan_energy_2017.pdf>

2008),[112] the Basic Plan on Ocean Policy (2018)[113] and METI's Strategic Energy Plans of 2014[114] and 2018.[115]

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[112] The Government of Japan will expand role of natural gas in the country's energy mix by promoting the development of technologies related to Gas-to-Liquid (GTL) and Dimethyl ether (DME) which can be produced from natural gas and *methane hydrate* [emphasis added]', see Kyoto Protocol Target Achievement Plan (Formulated 28 April 2005, partially revised 11 July 2006, totally revised 28 March 2008) <https://www.env.go.jp/en/earth/cc/kptap.pdf>.

[113] The establishment of the Basic Act on Ocean Policy in 2007 (hereafter, Ocean Act) was intended to facilitate the development of marine energy and mineral resources, including offshore methane hydrates. The stated purpose of the Ocean Act is to set out the general principles guiding the development and use of Japan's waters and offshore natural resources in harmonisation with the conservation of the marine environment, thus, contributing to the 'sound development' of the economy and society of Japan and improving the stability of the lives of its citizens. In order to promote 'industrial use of the ocean', Japan plans to develop technologies for utilizing methane hydrate with the aim of launching commercialisation projects led by private-sector corporations by the mid-2020s and continue research on recovery and production technologies for shallow methane hydrate, see Art 1, Ocean Act (Act No 33 of 27 April 2007) and Basic Plan on Ocean Policy (April 2013) at 5–6.

[114] METI, 'Strategic Energy Plan' (April 2014) 34–35.

[115] METI, 'Strategic Energy Plan' (July 2018) 35–36.

The Research Consortium for Methane Hydrate Resources in Japan (hereafter, MH21 Research Consortium), established by METI, has led coordination of the development of offshore methane hydrates as a natural gas resource since 2002.[116] The MH21 Research Consortium brings together leading researchers in Japan and provides private and public alignment on research by coordinating the efforts of METI, the Japan Oil, Gas and Metals National Corporation (JOGMEC) and other public and private bodies such as the National Institute of Advanced Industrial Technology (AIST) and the Engineering Advancement Association of Japan (ENAA).[117]

Soon after establishing MH21, in 2004, METI also created the Japan Methane Hydrate Exploitation Programme (JMHEP) to better facilitate methane hydrate research.[118]

The MH21 research programme has been divided into three phases.

- **Phase 1** (FY2001–2008), seismic surveys and explorations were conducted in the eastern Nankai Trough area during which a considerable amount of methane hydrate was confirmed.[119]
- **Phase 2** (FY2009–2015), offshore methane gas production experiments were conducted aiming to develop a technology to extract methane hydrate below the seabed surface.[120] In March 2013 JOGMEC reported that the research vessel Chikyu (a deep-sea drilling vessel owned by the Japan Agency for Marine-Earth Science and Technology) had successfully extracted methane from a deep ocean reserve near the Daini Atsumi Knoll off the coasts of the Atsumi and Shima peninsulas in the Nankai Trough, 80 km (approximately 43 nm) south of central Honshu.[121]
- **Phase 3** started in fiscal year 2016.[122] In June 2017, JOGMEC announced the completion of a second test near the Atsumi/Shima peninsula, reporting preliminary values of produced gas of approximately 35,000 m^3 for the first production well over 12 days and 200,000 m^3 for the second production well over 24 days.[123]

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[116] Oyama and Masutani (n 1).

[117] For the accomplishments of the MH21 Research Consortium from 2011 to Present, see here: <http://www.mh21japan.gr.jp/english/>.

[118] Peter Englezos and Ju Dong Lee, 'Gas Hydrates: A Cleaner Source of Energy and Opportunity for Innovative Technologies' (2005) 22 Korean Journal of Chemical Engineering 671.

[119] Methane Hydrate Resources Development Research Consortium (MH21) (tentative translation from Japanese) <http://www.mh21japan.gr.jp/>.

[120] Ibid.

[121] 'Gas Production from Methane Hydrate Layers Confirmed' in, *JOGMEC News Releases* (12 March 2013) <www.jogmec.go.jp/english/news/release/release0110.html?recommend=1>; METI, 'Strategic Energy Plan' (April 2014) 34.

[122] Methane Hydrate Resources Development Research Consortium (n 119).

[123] Oyama and Masutani, (n 1) 1, 6–7.

Based on the results of the above experiments, commercialisation of production technology is expected to move rapidly to fruition so that a project for commercialisation led by private businesses can be started by the late 2020s.[124]

2.6 Japan's Energy Policy and Methane Hydrates

A constant challenge in Japanese energy policy since before World War II has been energy independence.[125] Reducing the enormous energy procurement costs and changing the structure dependent on overseas energy remains, to date, 'an unchanging requirement' for Japan.[126] In the aftermath of the 2011 Great East Japan Earthquake and Fukushima-Daiichi nuclear accident, the debate surrounding Japan's future energy choices has revived. Energy independence for an energy security immune to overseas factors is – perhaps now more than ever – Japan's most pressing priority subject to the conditions of safety, economic efficiency and environmental sustainability.[127]

Nuclear energy is one option, however, the Fukushima-Daiichi nuclear accident raised strong concerns among the Japanese people over nuclear power and generated 'distrust of and resentment at the government and nuclear operators that promoted the nuclear power policy'.[128] The Government of Japan has recognised that both it and nuclear operators 'fell into the trap of the so-called "myth of safety", resulting in the failure to adequately deal with the severe accident and prevent [the] disaster'.[129] Accordingly, the current energy policy direction of Japan is that 'dependency on nuclear power generation will be lowered to the extent possible by energy saving and introducing renewable energy as well as improving the efficiency of thermal power generation'.[130] However, given the intermittent nature of many renewables, the amount of capacity that must be built to fill every kilowatt of lost electricity, absent nuclear energy, must be several times greater than for other sources, greatly reducing their cost-effectiveness.[131] Moreover, while minor efficiency gains in thermal power generation are theoretically possible, significant increases in energy effi-

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[124] Methane Hydrate Resources Development Research Consortium (n 119).
[125] METI, 'Strategic Energy Plan' (July 2018) 4.
[126] Ibid.
[127] Ibid 17.
[128] METI, 'Strategic Energy Plan' (April 2014) 47.
[129] METI, 'Strategic Energy Plan' (July 2018) 3, 56, 113.
[130] Ibid 23.
[131] 'According to one estimate, even 100 GW of installed photovoltaic capacity, or the equivalent of nearly 40% of current power generating capacity, would meet only 12% of Japan's electricity demand', see Vivoda, (n 59) 135, 140; METI, 'Strategic Energy Plan' (April 2018) 4–5.

ciency in order to significantly reduce reliance on fossil fuels are not feasible in the short or medium term.[132]

With nuclear energy remaining at low levels for the foreseeable future, and the challenges regarding renewables, Japan may well raise its self-sufficiency ratio to levels almost double those before the Great East Japan Earthquake if it can develop domestic marine energy and mineral resources, such as methane hydrates.[133] This idea is consistent with Japan's fundamental energy policy to secure energy resources for the purpose of stably supplying inexpensive fossil fuels to domestic economy, lower dependence on the Middle East, toughen its domestic energy supply network and diversify its fuel energy mix.[134] Moreover, from the viewpoint of global warming countermeasures, natural gas from methane hydrates emits the least amount of carbon among Japan's fossil fuel options and methane has a high efficiency as a heat source, so its use is expected to dramatically increase being the most preferable 'mid-term alternative energy option' as Japan moves towards a zero-emissions era.[135]

[132] Vivoda, ibid; 'Most of the easy savings in industry have already been exploited', see Duffield and Woodall, (n 60) 3741, 3742–43. Of course, any discussion on energy efficiency goals requires a discussion on Jevons' Paradox, that energy efficient technologies do not result in surplus energy supply, that instead it results in increased demand for energy, which could frustrate Japan's energy goals. See Roy A Partain, 'Gored by a Cornucopia: The Risk of Green Paradoxes from Laws and Policies that Incentivize Competitive Energy Innovations' (2015) 3 LSU Journal of Energy Law and Resources 433, 474 and 478; see also Roy A Partain, 'Climate Change, Green Paradox Models, and International Trade Laws' in Panagiotis Delimatsis (ed) *Research Handbook on Climate Change and Trade Law* (Edward Elgar 2016) 312–314, for a discussion on both Jevons' Paradox and the more recent Khazzoom–Brookes postulate on energy efficiency.

[133] The Government of Japan considers the commercial development of methane hydrates as a technologically feasible technology aimed at strengthening the energy supply and demand structure of Japan, see METI, 'Strategic Energy Plan' (July 2018) 108–110; METI, 'Strategic Energy Plan' (April 2014) 34–35; Oyama and Masutani, (n 1) 1, 7–8.

[134] METI, (n 73) 10–11.

[135] METI, 'Strategic Energy Plan' (July 2018) 24–25; '[N]atural gas is a bridge to convert the high-carbon-intensive fossil fuel energy into the zero-emission energy, because methane is a hydrocarbon with the lowest carbon intensity', see Lu, (n 106) 884, 885–896.

3

Legal Framework for Offshore Methane Hydrates in Japan

3.1 INTRODUCTION

One of the main objectives of any national legal framework for mining operations is to provide the basic legal and regulatory context to better coordinate those operations with the diverse needs of society to promote social harmony. It is important for the relevant authorities to clearly establish the principal rules governing the operations, to set standards of conduct for mining operations within the areas falling under the national jurisdiction of the state concerned and to define the principal administrative rules for investment activity for those mining projects, for both domestic and foreign investors.[136] To ensure harmony across generations and to ensure future enjoyment of all of Japan's resources, the legal framework for mining operations must provide for clear and comprehensive rules aimed at preserving and protecting the natural environment where mining operations are carried out.[137]

This part presents a collection of domestic Japanese laws that would be expected to become applicable to the extraction of offshore methane hydrates within Japan's EEZ and continental shelf. This includes a brief outline of the relevant provisions of the United Nations Convention on the Law of the Sea (UNCLOS) as incorporated within Japan's domestic legislation, followed by a discussion of Japan's basic ocean policy objectives as far as methane hydrates are concerned and, finally, a composite overview of Japan's basic mining regime.

3.2 SOVEREIGN RIGHTS IN OFFSHORE METHANE HYDRATES

In accordance with UNCLOS, Japan exercises sovereign rights within its EEZ

[136] Bernard Taverne, *Petroleum, Industry and Governments* (Springer 1999) Ch 5.

[137] William T Onorato, 'Legislative Frameworks Used to Foster Petroleum Development' (1995) World Bank Policy Research Working Paper 1420, <http://documents.worldbank.org/curated/en/761771468765623659/pdf/multi-page.pdf>.

and on its continental shelf for the purposes of exploring and exploiting, conserving and managing its natural resources, both living and non-living.[138]

The maritime jurisdictional areas of Japan are divided into three zones, in conformity with UNCLOS:

- Territorial Sea: extending seaward from the coastal baselines (meaning the low-water mark) up to 12 nm;[139]
- EEZ: extending seaward from the coastal baselines up to 200 nm;[140]

Figure 10 *Maritime Zones of Japan*

Source: Based on Japanese Coast Guard materials. Credit: AKIYAMA Masahiro[141]

[138] The rights and duties of coastal states over their EEZ and continental shelf are set out in Arts 55–57 and 77 of UNCLOS. Other parts of UNCLOS set out more detailed rules regulating the way in which these rights may be exercised so as not, for example, to intrude on the rights of other states in relation to navigation of vessels. See also *South China Sea Arbitration (Republic of Philippines v The People's Republic of China)* (Award of 12 July 2016) paras 240–245.

[139] Art 2, UNCLOS.

[140] Art 55, UNCLOS.

[141] Note that the legal status of Takeshima Islands (known as Dok Do in Korean) is the subject of a territorial dispute between Japan and Korea. The present report neither endorses nor supports either side of the dispute. For a discussion on the Takeshima/Dok Do islands issue, see

- Continental Shelf: extending seaward from the coastal baselines up to 200 nm or further to the edge of the continental margin.[142] **[see Figure 10]**

Japan enacted its first Territorial Sea Law in 1977 pursuant to which it declared a 12 nm territorial sea measured from its coastal baselines, including the coastal baselines of its islands.[143] In 1996, Japan promulgated domestic legislation setting out the breadth of its EEZ and continental shelf.[144] Article 1(2) of the Japanese EEZ and Continental Shelf Law provides for an EEZ extending to 200 nm from the nearest point on the baseline of Japan. Likewise, for its continental shelf, Article 2(1) provides that the continental shelf extends to 200 nm from the nearest point on the baseline of Japan.[145] According to Article 2(2), Japan's entitlement to a continental shelf is 'in accordance with Article 76 of the UN Convention on the Law of the Sea', more specifically the second criterion stipulated in Article 76(1), which is based on a distance of 200 nm from the baselines from which the breadth of the territorial sea is measured. In April 2012, Japan's offshore jurisdiction was conferred an additional area of continental shelf beyond 200 nm, totaling approximately 310,000 km^2, as a result of a successful submission to the UN Commission on the Limits of the Continental Shelf (CLCS) pursuant to Article 77 of UNCLOS.[146]

Japan's EEZ and Continental Shelf Law provides a domestic legal framework to enforce the relevant provisions under UNCLOS that Japan exercises sovereign rights over its EEZ and continental shelf for the purposes of 'exploring and exploiting, conserving and managing the natural resources,

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Seokwoo Lee, 'Dok Do/Takeshima Islands from a Korean Perspective' Max Planck Encyclopedia of Public International Law (Online Version, 2014) <https://opil.ouplaw.com/view/10.1093/law:epil/9780199231690/law-9780199231690-e2123>; see also Raul (Pete) Pedrozo, 'International Law and Japan's Territorial Disputes' (2017) 1(2) Japan Review 26.

142 Art 76(1), UNCLOS.

143 Territorial Sea Law 1977 (JPN) (as amended by 1996 Territorial Sea and Continuous Zone Law) reproduced in Zou Keyuan, *Law of the Sea in East Asia: Issues and Prospects* (Routledge 2005) 86–87; the 1996 Territorial Sea and Contiguous Zone Law, which was enacted shortly after the ratification of UNCLOS by Japan, added to the existing legislative structure the straight baselines system and the contiguous zone, in conformity with UNCLOS provisions; see also Yutaka Kawasaki and Vivian L Forbes, 'Japan's Ratification of UN Law of the Sea Convention and Its New Legislation on the Law of the Sea' IBRU Boundary & Security Bulletin (1996) 93–97, <https://www.dur.ac.uk/ibru/publications/view/?id=102>.

144 Exclusive Economic Zone and Continental Shelf Law 1996 (JPN) <http://extwprlegs1.fao.org/docs/pdf/jap13392.pdf>; for a discussion, see Kawasaki and Forbes, ibid 92, 97.

145 Art 2, Exclusive Economic Zone and Continental Shelf Law 1996 (JPN).

146 On the submission by Japan in November 2008 and the recommendation of the Commission on the Limits of the Continental Shelf (CLCS), see <http://www.un.org/Depts/los/clcs_new/submissions_files/submission_jpn.htm>.

the establishment, construction, operation and use of artificial islands, installations and structures and the protection and preservation of the marine environment'.[147] The laws and regulations of Japan also apply to offshore drilling and marine scientific research, including research that is directly or indirectly related to the discovery of seabed resources, including exploration for offshore methane hydrate resources.[148]

3.3 OCEAN POLICY AND METHANE HYDRATES

As previously discussed in this research, ensuring a stable supply of petroleum, natural gas and other energy resources is a top priority in Japan's energy policy agenda. While the prospects of developing such capacity from onshore resources appear challenging; in the maritime zones surrounding Japan, researchers have already discovered potential alternative solutions, such as methane hydrates and seabed sediments that contain hydrocarbons and other useful minerals (such as polymetallic sulphides and rare metals such as cobalt and nickel).[149] Japan's marine industries are expected to achieve further growth by promoting those innovations that will provide Japan with new industrial possibilities and pathways to energy security. In order to better facilitate development of its marine energy and mineral resources, Japan has taken considerable measures such as the revision of the Mining Act in 2011[150] (discussed later in this part) and the establishment of the Basic Act on Ocean Policy in 2007 (hereafter, Ocean Act).[151]

The Ocean Act sets out the general principles guiding the development and use of Japan's waters and offshore natural resources in harmonisation with the conservation of the marine environment, thus, contributing to the 'sound development' of the economy and society of Japan and improving the stability of the lives of its citizens.[152] The Ocean Act mandates a rather utilitarian approach to marine environmental conservation by connecting ocean development and biodiversity to the economic prosperity and affluence of the citizens of Japan.[153] This approach is linked to Japan's environment law which provides that 'environmental conservation shall be conducted appropriately to ensure that the present and future generations of human beings

[147] Art 1(1), Exclusive Economic Zone and Continental Shelf Law 1996 (JPN).
[148] Art 1(1)–(4), ibid.
[149] METI, 'Strategic Energy Plan' (July 2018) 26–27.
[150] Act No 289 of 20 December 1950 as amended by Act No 84 of 2011 (promulgated 22 July 2011, entered into force 21 January 2012) <http://www.japaneselawtranslation.go.jp/law/detail/?id=2441&vm=04&re=02> (hereafter, Mining Act).
[151] Ocean Act (n 113).
[152] Art 1, ibid.
[153] Art 2, ibid.

can enjoy the blessings of a healthy and productive environment and that the environment as the foundation of human survival can be preserved into the future'.[154]

The Ocean Act stipulates the state's duty to facilitate the development and use of petroleum, inflammable natural gas and other mineral resources, 'in order to promote the positive development and use of the oceans'.[155] For this reason, the Ocean Act emphasises that the government of Japan must support and promote the role of 'Ocean Industries' (i.e. industries bearing on the development, use and conservation of the oceans) and recognises that these industries form the basis of Japan's sound economic development and social prosperity.[156] This means that Japan as state and METI as the competent authority cum Ministry have legal duties to promote the development and use of methane hydrates, given that methane hydrates could facilitate the 'sound development of Japan's economy'.[157]

Article 16 of the Ocean Act mandates the government of Japan to formulate a basic plan with regard to the oceans (referred to as 'Basic Plan on Ocean Policy'), which is to be reviewed every five years. In response, the Basic Plan on Ocean Policy was published for the first time in 2008 and was revised successively in 2013 and 2018.[158]

The first edition of the Ocean Plan mandated the government of Japan to take all necessary initiatives to steadily promoting full-scale exploration and development projects for offshore energy and mineral resources with a view to realising commercialisation in the medium term.[159] To that end, the Ocean Plan called on the government to invest 'intensively in immediately urgent subjects of exploration and development in the EEZ and continental shelves, i.e. petroleum, natural gas, <u>methane hydrate</u>, and polymetallic sulphides'.[160]

The second edition of the Ocean Plan re-affirms the government's duty to 'elicit the potential of the sea to the maximum extent in order to bring wealth and prosperity' to the country and its people.[161] As one of the key measures to promote the development and use of Japan's marine energy resources, the Plan mentions the intensive promotion and creation of marine industries and the acceleration of surveying for marine energy and mineral resources in collaboration with related government ministries and agencies and private

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154 Art 20, Basic Environmental Law (Law No 91 of 13 November 1993) <www.env.go.jp/en/laws/policy/basic/>.
155 Art 17, Ocean Act, n 113.
156 Art 5, ibid.
157 Arts 10–12, ibid.
158 Basic Plan on Ocean Policy (March 2008), (April 2013) and (March 2018).
159 Ibid (March 2008) at 30–31.
160 Underscoring added, ibid.
161 Basic Plan on Ocean Policy (April 2013), at 2.

companies, *inter alia* through the use of the deep-sea drilling vessel *Chikyu* (used for methane hydrate extraction) and the three-dimensional seismic vessel *Shigen*.[162] It also envisages Japan leading the world in the commercialisation of marine mineral resource development 'by strategically nurturing its related industries and establishing coordination between these industries and existing resource industries'.[163]

As far as methane hydrate development is concerned, the third, most recent, edition of the Japanese Ocean Plan Ocean Plan (2018) re-affirms that Japan should:

a) continue building technologies towards achieving commercialisation of methane hydrates 'of which a considerable amount is foreseen as deposited in Japan's surrounding marine zones, as future energy resources'; and
b) continue conducting the necessary exploration and other research in order to gain an understanding of the amount of reserves of methane hydrate offshore Japan.[164]

In view of the successful methane hydrate production tests by JOGMEC in 2013, the Plan foresees that technological improvements should become sufficiently advanced to enable commercialisation by private firms by 2027.[165]

3.4 BASIC BTRUCTURE OF JAPAN'S MINING REGIME

Japan's national legal framework for mining operations consists of all laws, regulations and rules designed to regulate mining operations carried out within the areas under Japanese jurisdiction (hereafter, mining regime). Broadly speaking, Japan's mining regime can be divided into two categories.

The first category consists of the principal legal instrument governing mining operations, namely, the Mining Act (Act No 289 of 20 December 1950, as amended by Act No 84 of 2011). The Mining Act, discussed further below, comprises 152 detailed provisions as well as a supplementary part which contains associated government regulations and ministerial decrees implementing certain provisions of the Mining Act.

[162] Ibid, at 15.
[163] Ibid, at 45.
[164] Basic Plan on Ocean Policy (March 2018), at 29–30; see also Basic Plan on Ocean Policy (April 2013), at 16.
[165] Ibid (March 2018), at 57; (April 2013), at 45.

The second category includes a number of associated laws and regulations which – although not specifically designed as mining rules, or not originally directed at mining operations, yet because of the nature of their provisions – could affect the conduct of offshore methane hydrate operations in Japan. An example of such law is the Japan Oil, Gas and Metals National Corporation (JOGMEC) Act.[166] The JOGMEC Act provides for the creation of Japan's national oil corporation as a vehicle for the government to promote the exploration for and production of oil, gas and mineral resources.[167] These activities may be undertaken either independently by JOGMEC or in partnership with other parties.[168] The JOGMEC Act stipulates that among the principal duties of JOGMEC is 'to supply the necessary funds for exploration for petroleum and combustible natural gas' (cumulatively referred to as 'petroleum, etc.'), thus contributing to a stable supply at lower prices of fossil fuel.[169] JOGMEC's scope of business operations is quite diverse, covering almost every aspect of the oil-field lifecycle, from exploration through production, transport, and storage.[170] Given that methane hydrates are a form of combustible natural gas, and given the principle duties of JOGMEC under the Act, the binding nature of the JOGMEC Act on methane hydrate extraction activities is well established.

Another good example of law that directly impacts on methane hydrate operations is typified in the Basic Environment Law of 1993.[171] The stated purpose of this Law is to 'comprehensively and systematically promote policies for environmental conservation to ensure healthy and cultured living for both the present and future generations of the nation'.[172] Although most of its provisions serve as non-binding guidelines, the Japanese Environment Law embodies a set of core environmental principles that might guide and inform the conduct of methane hydrate operations in Japan.[173] For example, the Environment Law calls upon the state and individual corporations to take all 'necessary measures' in order to 'anticipatively' prevent interreference with

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166 Act on Japan Oil, Gas and Metals National Corporation (Act No. 94 of 26 July 2002) (as amended by Act No 78 of 16 November 2016) (hereafter, JOGMEC Act) <https://www.jogmec.go.jp/content/300052290.pdf>.

167 International Energy Agency, (n 59) 60.

168 Ibid.

169 Art 3, JOGMEC Act (n 166).

170 Art 11, JOGMEC Act (n 166); 'JOGMEC has been active in supporting oil exploration and development in jurisdictions outside Japan's traditional supply area, the Middle East. As of 2014, JOGMEC has invested around USD 3 billion in 45 companies globally. It has also provided liability guarantees to 13 companies, totalling almost USD 6 billion', International Energy Agency, (n 59) 60.

171 Basic Environmental Law (n 154).

172 Art 1, ibid.

173 For an overview, see Ministry of Environment, 'The Basic Environment Law and Basic Environment Plan' (2018) <https://www.env.go.jp/en/laws/policy/basic_lp.html>.

'environmental conservation'[174] by *inter alia* 'enhancing scientific knowledge'.[175] One of these measures is the requirement to assess and determine the cumulative environmental impacts of large-scale projects and reflect the assessment results in the decision-making, pursuant to the procedures provided in the Environmental Impact Assessment Act of 1997, as amended in 2014.[176]

The Environmental Impact Assessment (EIA) Act imposes an obligation on the central government, local governments and individual corporations (so called as 'project proponents'), to develop an Environmental Impact Statement (EIS) for 'large-scale projects that could have a serious impact on the environment'.[177] EISs require a thorough analysis of the environmental impact of a proposed project, measures for environmental conservation, including details of any environmental impacts that cannot be avoided if the project is carried out and alternative options.[178] To determine whether a project proponent is required to conduct an EIS, an Environmental Impact Assessment (EIA) must be performed.[179] The EIA must be a comprehensive document that contains sufficient evidence and analysis to determine whether or not there will be a serious impact on the environment. If it is determined that there will be a serious impact on the environment, the project is classified as Class-1 and the project proponent must develop an EIS. If, however, the EIA indicates that there will be no serious environmental impacts, the central government may classify the proposed project as Class-2 for which the decision as to whether an EIS is required is made individually on a case-to-case basis, taking into account the opinions of local governments.[180] In other words, all Class-1 projects and Class-2 projects judged to be subject to EIS are subject to the full range of procedures provided in the Environmental Impact Assessment Act.

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174 Environmental conservation is defined in Art 2(2) of the Environment Law (Law No 91 of 1993) as the prevention of phenomena such as 'marine pollution, decrease in wildlife species and others which are caused by human activities and affect the environment of the entire globe or a large part of it, which contributes to the welfare of mankind as well as to the healthy and cultured living of the people'.

175 See Arts 4, 8, 14, 19 and 20, Basic Environmental Law (n 154); for a commentary, see Yumiko Nakanishi, 'Introduction: The Impact of the International and European Union Law Environmental Law on Japanese Basic Environmental Law' in Yumiko Nakanishi (ed), *Contemporary Issues in Environmental Law: The EU and Japan* (Springer 2016) 1–13.

176 Environmental Impact Assessment Act (Act No 81 of 13 June 1997, as amended by Act No 51 of 2014) (JPN) (hereafter, EIA Act); see also Ministry of Environment, 'Environmental Impact Assessment in Japan' (May 2012).

177 Art 1, EIA Act.

178 Art 14, EIA Act (n 176).

179 Ibid.

180 Art 4, ibid.

While offshore methane hydrate operations are not explicitly listed as Class-1 projects in the Environmental Impact Assessment Act, the EIA process has widely been held to apply to each individual stage of methane hydrate operations under the MH21 R&D programme, from initial exploration studies to early production testing.[181] As part of this program, the MH21 EIA team, including representatives from JOGMEC as the project's proponent, has conducted environmental risk analysis and investigated countermeasures against anticipated risks, developed field test environmental impact measurement technology and environmental impact assessments tailored to the specific conditions of the planned offshore production tests, in order to develop a comprehensive environmental assessment and optimal environmental approaches for future methane hydrate development.[182]

Since methane hydrate extraction and production are novel technologies, the principal challenge for the MH21 EIA team is to determine the necessary actions to be taken for safeguarding the status of the environment against future risks when the actions concerned are taken based on mere predictions, namely, in accordance with environmental conditions which will appear in the future when continuous commercial production of methane hydrates have commenced.[183]

3.5 MINING ACT

The Mining Act is the principal legislation governing mining operations in Japan, including methane hydrate exploration and exploitation.[184] The present section analyses the main features of the Mining Act with a particular focus on the following matters: 1. Right to extract and ownership of extracted offshore methane hydrates; 2. Licensing system for allocating mining rights to domestic and foreign mining corporations; 3. Pollution prevention mechanisms and civil liability and compensation claims for damages caused by the prospecting, exploration for, or extraction of, offshore methane hydrates.

3.5.1 Right to extract and ownership of extracted methane hydrates

The Mining Act is founded on the basic rule that ownership of minerals *in*

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[181] Arata and others, (n 39) 214–219.
[182] Ibid.
[183] Ibid.
[184] For a discussion, see Kazuhiro Nakatani, 'Japan's Undersea Resources and Its New Mining Act' in Donald N Zillman, Aileen McHarg, Adrian Bradbrook, and Lila Barrera-Hernandez (eds), *The Law of Energy Underground* (Oxford University Press 2014) 207.

situ is always vested with the State and that private-sector corporations are just acting as the contractor to mine and acquire such minerals.[185] With respect to the type of minerals to which to the Mining Act applies, the Mining Act introduces the concept of 'specified minerals'. Under the Mining Act, 'specified minerals' are those minerals that are 'important for the national economy' and which require 'reasonable development'.[186] According to a Cabinet Order dated 20 December 2011, such minerals include, among others, oil and natural gas and, accordingly, methane hydrates.[187]

The Mining Act provides that only the government has 'the authority to grant the right to mine and acquire minerals that have not yet been mined' without specifically addressing the ownership status of minerals prior to being extracted.[188] Nevertheless, the Mining Act does make it clear that the minerals *in situ* do not belong to the owner of the land but are to be exploited by the holder of a mining right which is granted in the form of a mining extraction licence (discussed in the next section). Such licence confers ownership of the minerals, including oil and combustible natural gas, when these are extracted in accordance with the terms of the licence.[189] 'Extracted' is generally defined to be when the mineral enters the well that has been legitimately drilled by the licensee, although this is not specified in the Mining Act.[190] If someone other than the licensee extracts the mineral, the licensee would still maintain ownership of the extracted mineral.[191] Interestingly, if no licence had been granted in the area, any extracted minerals shall be deemed as ownerless property, according to the Mining Act.[192] This is of

[185] Art 2, Mining Act (n 150).
[186] Art 3 and Art 6-2, ibid.
[187] Cabinet Order to Specify Minerals Referred to in Article 6-2 of the Mining Act (Order No 413 of 26 December 2011); It is interesting to note that with respect to 'specified minerals', the current Mining Act introduces special requirements for granting mining rights – many of which were absent in the preceding Act of 1950. For example, the first-come, first-served (i.e. first-to-file an application) policy for the granting of mining rights has been abolished and a competitive licensing system has been introduced. Further, with regard to an area in which a deposit of a specified mineral is or is likely to be found, the METI may, for reasons associated with the 'promotion of public interest', self-initiate a mining right by designating a 'Specified Mining Zone' and by inviting applicants for the position of a 'Specified Developer'; this must be a 'person highly capable of suitably developing the Specified Mineral in the area' (Art 38, Mining Act); for a discussion, see Nakatani, (n 184) 205.
[188] Art 2, Mining Act (n 150).
[189] Art 8(1), Mining Act (n 150).
[190] Kozuka cites Japan's domestic case-law to the effect that the extracted mineral should be 'sufficiently independent as to be controlled', Souichirou Kozuka, 'Licensing and Regulation of Japan's Offshore Resources' in T Hunter (ed) *Regulation of the Upstream Petroleum Sector* (Edward Elgar 2015) 348.
[191] Art 8(1), Mining Act (n 150).
[192] Art 8(2), ibid.

legal note, for liability does not derive from ownerless property, and in the case of environmental injuries from an unlicensed taking, it might be difficult to assert claims for damages.

3.5.2 Licensing system for mining operations

The mining regime established under the Japanese Mining Act implements a licensing system, regulated according to norms of administrative nature, to allocate mining rights to private or public sector mining companies. By the term 'mining rights', the Mining Act refers to the 'right to mine and acquire' the types of minerals covered by the Mining Act.[193] The Mining Act provides for interested parties to be granted two main types of licence: (i) a licence for prospecting and (ii) a licence for extraction (also referred to as 'digging rights').[194] The granting of a prospecting licence authorises the licensee to conduct search and valuation of mineral resource deposits and to carry out drilling which is not directed at the production of mineral resources. Note that a prospecting licence grants the right to study only the type of mineral resources covered by the licence but not other minerals found or discovered during the period of the licensed prospecting. An extraction licence is required in order for the minerals to be removed from the acreage for commercial sale.

A separate exploration permit must be obtained from the METI when the proposed activity intends to utilise seismic surveys.[195] On this instance, in order for an exploration permit to be issued, the applicant must submit a separate application, indicating the location of the areas intended for exploration and providing specific coordinates for the areas where exploration survey lines are to be drawn, including turning zones and other material points of planning. The applicant must also submit a document indicating that it has no history of being punished as a result of a violation of the Mining Act.[196] In addition, the applicant must satisfy METI of its capacity to properly carry out the envisaged exploration activity without causing any 'extreme adverse effects' to public welfare, public facilities, cultural property, parks, hot spring resources, agriculture, forestry and other related industries and that all necessary measures have been taken in order 'to prevent hazards' in the application

[193] Art 5, ibid.

[194] Art 11, ibid.

[195] Art 100-2 and subsequent, ibid; see also Ordinance for Enforcement of the Mining Act (METI Order No 2 of 27 January 1951) which provides at Art 44-2(1), that the 'seismic survey method prescribed in Article 100-2, paragraph (1) of the Act means the method to artificially produce vibrations to generate seismic waves and detect the reflected waves thereof'.

[196] Art 44-3, Ordinance for Enforcement of the Mining Act (METI Order No 2 of 27 January 1951) in conjunction with Art 100- 3 (ii) (a) (c), Mining Act.

area.[197] Prospecting licences are issued, with respect to oil or combustible natural gas, for a period of up to four years, renewable twice, each time up to two years.[198] Extraction licences and exploration permits have no specified limits.

The Mining Act provides that mining licences shall be deemed as real rights (i.e. rights in real estate or immovable property) and are governed by the laws on real property[199] subject to the restrictions provided in the Mining Act.[200] The licence only becomes effective upon registration with the Mining Registry[201] and is exclusive in the sense that only one mining licence may be granted in the specified zone for the same type of mineral.[202] More than two licences can, however, be established in the same mining zone for minerals that are found in different types of deposits. The Mining Act further stipulates that licence holders may request the merging of adjacent mining areas containing the same type of minerals, hence, treating any straddling deposits as a single unit pursuant to a unitization agreement and exploiting them in an integrated manner.[203]

According to the Mining Act, METI would invite applications through a competitive licensing round and would grant the licence to the applicant with the best capability to carry out the proposed activities in the area which is the subject of the competition.[204] The licensing process works with clear and pre-determined conditions of qualification for the award of a prospecting or exploitation licence. This is a highly positive aspect of the licensing round, as it adopts a single and objective method of pre-evaluation. Current pre-evaluation criteria for the award of prospecting and extraction licences in Japan include the following:

i. the applicant's financial and technical capability to properly carry out the 'reasonable development' of specified minerals in the indicated mining zone;

[197] Art 44-8, Ordinance for Enforcement of the Mining Act (METI Order No 2 of 27 January 1951); Art 100-3, Mining Act (n 150).

[198] Art 18, Mining Act, ibid.

[199] Art 12, ibid.

[200] Art 13, ibid: 'Mining Rights may not be the subject of transfers (except for transfers arising from general succession including inheritance'.

[201] Art 59, ibid.

[202] Art 16(1), ibid.

[203] See Art 50(1), ibid. Unitization can be broadly defined as a special type of joint venture between two or more licensees 'holding exploitation rights with respect to parts of a single, continuous petroleum reservoir that extends beyond the boundaries of their respective exploitation rights', Bernard Taverne, *Co-operative Agreements in the Extractive Petroleum Industry* (Kluwer Law International 1996) 79, 149–154; on the practical benefits of unitization, see Claude Duval and others (eds) *International Petroleum Exploration and Exploitation Agreements: Legal, Economic and Policy Aspects* (2nd edn, Barrows 1996) 204–206.

[204] Art 38(1), Mining Act (n 150).

ii. the applicant's 'social credibility';[205]
iii. the past performance of the applicant (a problem might arise, for example, if the applicant was participant in a previous mining licence that has been revoked or cancelled as a result of a violation of the Mining Act);
iv. the absence of any potential interference or overlap with adjacent mining rights; and
v. the absence of any foreseeable adverse effects on public welfare, health and hygiene, public facilities and cultural property, parks, hot spring resources agriculture, forestry and other related industries.[206]

Therefore, in order to qualify to participate in the competition, the applicant company is required to fulfil the pre-qualification evaluation criteria listed in the Mining Act. In addition, the applicant must satisfy METI of its technical and financial capacity to undertake the proposed activity by offering evidence of the adequacy of financial resources and technical expertise available to it and the likelihood that it will continue to have access to sufficient resources to meet the requirements of the proposed activity together with other commitments previously entered into in other licence areas.

Applicants that satisfy the above conditions would then be evaluated based on the business plan submitted alongside their application.[207] The Mining Act provides that evaluation criteria concerning the content of the business plan are published in the form of guidelines prior to the opening of each licensing round and are established from the standpoint of 'reasonable development of the specified mineral which is the subject of the competition, and of the promotion of public interest'.[208] While evaluation criteria may vary considerably, depending on the type, location and other particulars of the mineral which is subject of the competition, common considerations relate to

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[205] Whilst the definition of 'social credibility' in the Japanese legal system is fairly broad, it is generally understood to encompass criteria such as no links to organised crime, no criminal record, lack of regulatory misdemeanours, complaints and fines, 'New Mining Law for Japan' (Clifford Chance Briefing Note, April 2012) <https://www.cliffordchance.com/briefings/2012/04/new_mining_law_forjapan.html>.

[206] In addition to what is listed in the preceding list of targeted injuries, the METI may restrict licence applications if the mining area of the relevant application is found to be 'extremely unsuitable' in light of domestic and foreign social and economic circumstances and likely to hinder the promotion of public interest, see Art 29(1)(ix), Mining Act (n 150); see also Art 53-1 which states that causing one of the injuries listed in IV and V may result in the licence being revoked or cancelled. Art 53-2 provides that licence holders that had their licenses revoked or cancelled, or their mining sites decreased pursuant to Art 53 may be entitled to compensation. A question might arise in situations where a hydrocarbon field may have become too valuable to provide compensation, and thus frustrate a need to shut-down a risky field or a field that has already caused injury.

[207] 'Evaluation requirements for selecting a Specified Developer', Art 38(4)(vi), ibid.

[208] Art 38(6), ibid.

the applicant's schedule of anticipated exploration, development and production, standards of equipment to be used, the number and general location of each well to be drilled, all environmental and safety standards to be implemented and other pertinent information.[209]

The successful applicant would then be required to prepare an operational plan which conforms to the business plan submitted alongside the application and have it approved by METI.[210] The latter may suggest modifications to the applicant's operational plan with a view to ensuring the optimum development of the specified resources.[211]

The abovementioned evaluation criteria are transparent and apply equally to both foreign and domestic companies and the Japanese state-run company JOGMEC. Thus, when JOGMEC seeks to acquire new blocks for prospecting, exploration and production of petroleum it has to compete with any other national or international companies in accordance with the criteria defined in the relevant bidding process. An exception seems to exist with respect to the issuance of an exploration permit, since, according to Article 100-10 of the Mining Act, government organs 'shall not be required to receive the permission prescribed in Article 100-2 [exploration permit]' but must consult with the METI in advance.[212]

3.5.3 Pollution prevention, liability and compensation claims

The starting point to understanding the response of the Japanese legal system to situations associated with environmental pollution arising from offshore methane hydrate operations is the definition of 'environmental pollution' contained in the Japanese Basic Environment Law. Article 2(3) of this Law provides as follows:

> For the purpose of this law, "environmental pollution" ("Kogai" in Japanese) means, among interference with environmental conservation, air pollution, water pollution…soil contamination, noise, vibration, ground subsidence (excluding subsidence caused from land excavation for mineral exploitation…) and offensive odors affecting an extensive area as a result of business and other human activities, which cause damage to

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[209] 'The person found most capable of developing the Specified Mineral', Arts 40(3) and 40(5), ibid.

[210] Art 63-2, ibid.

[211] Art 100(1), ibid; The content of the applicant's business and operational plan is of strong economic interest to the Japanese government because the property of any information obtained from the work executed by the applicant will be transferred to the government, see Art 100-11, ibid.

[212] Art 100-10, ibid.

> human health or the living environment (including property closely related to human life, as well as fauna and flora closely related to human life and their living environment).[213]

This definition identifies four criteria to legally establish a case of 'environment pollution':

i. its impact must spread over an 'extensive area';
ii. it must be linked to some 'human activity';
iii. it must cause 'damage to human health or the living environment' (including fauna and flora closely related to human life); and
iv. it must fall into one of the typical categories of 'pollution'.

Listed categories include air pollution, water pollution and noise and vibration; all potentially induced by offshore methane hydrate operations. Another listed potential hazard, which is also present with offshore methane hydrate activities, would be offshore ground subsidence cause by seafloor destabilisation, which in turn could induce a wide range of environmental impacts including landslides, destruction of benthic fauna and flora and even tsunami.[214] However, 'ground subsidence caused from land excavation for mineral exploitation' is excluded from environmental pollution per se.

In any case, numerous other hazards likely to lead to environmental pollution are present with the extraction of offshore methane hydrates such as, for example, uncontrolled gas release during drilling operations, well-casing collapse and gas leakage to the surface.[215] A well-documented case of methane hydrate destabilisation resulting in an explosion and leading to the worst offshore oil spill in the history of the United States came during the BP Deepwater Horizon oil disaster in the Gulf of Mexico in 2010.[216] The BP Deepwater Horizon oil disaster, which resulted in approximately 53,000 barrels of crude oil per day leaking into the Gulf of Mexico for 87 days and led to over 100,000 compensation claims being filed in US courts against BP and its contractors, showed that even an accident 80km from shore may well have devastating effects on the environment and the economies of coastal

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[213] Art 2(3), Basic Environment Law.

[214] See Part 2 of this study, 'Non-Technical Introduction to Methane Hydrates'.

[215] Committee to Review the Activities Authorized under the Methane Hydrate Research and Development Act of 2000, *Charting the Future of Methane Hydrate Research in the United States* (National Academies Press 2004) 32, cited in Erin Jackson, 'Fire and Ice: Regulating Methane Hydrate as a Potential New Energy Source' (2015) 29 Journal of Environmental Law and Litigation 611, 629.

[216] Jackson, ibid 629.

communities.[217] However, the events of the BP Deepwater Horizon oil disaster required the presence of crude oil to enable and cause most of those harms, which would not be expected to be found in the Japanese methane hydrate asset areas.

The unique features of methane hydrate exploration and exploitation, including the complicated mix of state and non-state entities involved in the activities, the location of the resource in deep and ultra-deep seabed locations and the wide range of foreseeable environment hazards, raise complicated, novel and even potentially as-of-yet unidentified liability issues.

Considering that the potential for damage may increase during the exploitation phase (i.e. in contrast to the early prospecting and exploration phase), it is crucial to clarify the issue of liability for environmental damage prior to the onset of commercial production of offshore methane hydrates in Japan.

In order to determine what particular pollution prevention mechanisms should be established, the Mining Act requires prospective licensees to include in their applications a description of the mineral deposits for which a licence is sought, including the specific geographical location, geological and structural properties of the resource as well as 'the extent and conditions of mining pollution expected'.[218] Licensees are required to include in their operational plan, both in respect of mining exploration and mining extraction, a detailed description of the measures to be taken in order to prevent uncontrolled pollution incidents and other 'hazards in the application area'.[219] METI may, at its discretion, order licensees to disclose design specifications of mining facilities when it deems necessary to assess the methods utilised and the measures undertaken by licence holders to prevent mining pollution.[220]

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[217] Bio by Deloitte, 'Civil Liability, Financial Security and Compensation Claims for Offshore Oil and Gas Activities in the European Economic Area' (Report Prepared for the European Commission 2014) 64–65.

[218] Art 22, Mining Act (n 150). See also Art 8 of Japan's Mining Safety Act (No 70 of 1949) providing that the holder of a mining right is under a duty to prevent the occurring of hazards, including pollution, from its operation, cited in Kozuka, (n 190) 353. Unlike other pieces of Japanese legislation, no English translation of the Mining Safety Act (No 70 of 1949) has been made available by the Japanese Government; Professor Kozuka considers that the Mining Safety Act is relatively obsolete and contemplates more traditional types of land-based mining (such as gold ore, silver ore, copper ore); its application to offshore methane hydrates is 'not altogether clear' (Communication with Professor Kozuka, 2 Sept 2019).

[219] Art 39(3)(ii) , Mining Act, ibid; Art 44-8, Ordinance for Enforcement of the Mining Act (METI Order No 2 of 27 January 1951); see also Form 20 (No 5) Operational Plan Concerning Digging Rights (Oil, Combustible Natural Gas or Asphalt Mine); Form 20 (No 6) Operational Plan Concerning Prospecting Rights (Oil, Combustible Natural Gas or Asphalt Mine); Form 35 (Application for Permission for Exploration), all requiring the applicant to address issues concerning potential 'operational hazards' occurring from the planned activities.

[220] Art 26, Mining Act, ibid.

The above environmental pollution prevention measures are underpinned by Article 20 of the Basic Environmental Law which provides that 'the State shall take necessary measures to ensure that, when companies are engaged in alteration of land shape, construction of new structures and other similar activities [including, petroleum development], they will conduct in advance, surveys, forecasts or evaluations of the environmental impact of such activities and will give proper consideration to environmental conservation based on the results of them'.[221] As discussed above, the standards of such assessments, including all necessary measures to be taken by companies to prevent pollution, are determined by the licensee (i.e. the 'project proponent') and approved by the central government on a case-by-case basis, in accordance with the provisions of the Environmental Impact Assessment Act.[222] Such environmental pollution prevention measures should be in line with Article 12 of the Mining Safety Act of 1949 which requires licensees to conform to technical standards specified in the METI ordinance. The ordinance on the technical standards for structures used for mining (METI Ordinance No. 97 of 2004) includes technical standards for maritime drilling installations.[223]

Moreover, the important role of the Environmental Dispute Coordination Commission (EDCC) in preventing mining pollution incidents features prominently in Article 15(1) of the Mining Act which provides that the EDCC can designate zones 'not suitable for mining minerals' and may prohibit the creation of mining rights in respect of such areas.[224] There is, thus, an opportunity to prevent development in risky offshore areas, albeit the further particulars of this process receive no clarification in the Mining Act.

The Japanese system of liability is based on negligence or fault, pursuant to the provisions of the Japanese Civil Code (Articles 709 et seq.) and corresponding judicial precedence.[225] The negligence or fault is the wrongful act or omission that breaches the duty owed by the defendant (also known as a tortfeasor or wrongdoer) to avoid the damaging result which she or he had foreseen or should have had foreseen. Under this system, the plaintiff/victim bears the burden of proof that (a) a defendant acted intentionally or negligently; (b) the defendant infringed any right or legally protected interest of others, in other words, the defendant's act was wrongful; (c) damage was

[221] Art 20, Basic Environment Law.
[222] Art 21.1(1), ibid; EIA Act (n 176).
[223] Communication with Professor Nishimoto, 20 Aug 2019.
[224] Art 15(1), Mining Act (n 150).
[225] Eri Osaka, 'Reevaluating the Role of the Tort Liability System in Japan' (2009) 26 Arizona Journal of International and Comparative Law 393; Andrea Ortolani, 'Environmental Damage Remediation in Japan: A Comparative Assessment' in Yumiko Nakanishi (ed), *Contemporary Issues in Environmental Law: The EU and Japan* (Springer 2016) 192.

sustained by the plaintiff; and (d) there was a causal relationship between the defendant's act and the plaintiff's damage.[226]

This system of tort liability could present a major barrier for plaintiffs in cases involving environmental damages where the causation issue is unclear. For instance, if the Japanese law were to require the plaintiff/victim to prove negligence or fault to succeed in a claim from an environmental pollution incident caused by an offshore drilling well explosion, it means that the plaintiff/victim would need to prove that the operator of the mining facility was at fault in its act that caused the explosion. This could be difficult to prove, especially since it would require 'strong' evidence of the nature of the incident and the acts or omissions that caused it. Or, as another potential example, a fishing village might seek to establish legal injury if fishing stocks were reduced by the exploration and exploitation activities, perhaps by gaseous emissions into the ocean that resulted in harm to the fishing stocks. The causal chain of events, and the production of scientifically sustainable evidence for that causal chain, and/or the remoteness of the operators *cum* decision-makers versus the locality of fishermen, may make the identification and evidencing of the necessary causal steps, and the intentional or negligent nature of those steps, difficult to establish.

Due to the difficulty of establishing negligence and causal relationship in situations associated with environmental harm resulting from mining operations under the common rules of tort, the Japanese legal system provides that where environmental harm is caused by the prospecting, exploration for, or extraction of natural resources, a special strict liability regime would be applicable under the Mining Act.[227] In particular, the Mining Act provides for a rule of strict liability for damages caused by, *inter alia*, 'the excavation of land to mine minerals' and the 'discharge of mine water or wastewater'.[228] For these types of damage, the holder of a mining licence for the given area at the time of the occurrence of damage will be liable for the payment of compensation to the person(s) affected, regardless of negligence.[229] Strict liability means that a plaintiff is not required to prove that a defendant acted intentionally or negligently.

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[226] Osaka, ibid 394.

[227] Kozuka, (n 190) 353. Other Japanese laws adopting standards of strict liability for cases of environmental pollution is the Act on Prevention of Air Pollution and the Act on the Prevention of Water Contamination, both potentially applicable to offshore methane hydrate operations, see Air Pollution Control Act (Act No 97 of 10 June 1968, as amended by Act No 5 of 2006); Water Pollution Prevention Act (Act No 138 of 25 December 1970).

[228] Art 109(1), Mining Act (n 150).

[229] The general rules of tort are codified in Chapter 5 of Japan's Civil Code (Act No 89 of 1896) as amended by Act No 78 of 2006 (hereafter, Civil Code); Art 709, Civil Code, 'A person who has *intentionally or negligently* [emphasis added] infringed any right of others…shall be liable to compensate any damages resulting in consequence.'; Under rules of tort, there must 'a causal link (proximity) between the act or omission and the damage', see Kozuka, (n 190) 353.

Furthermore, the Mining Act provides for a rule of joint and several liability for damages caused by the work conducted by licence holders in two or more adjoining mining sites. In such cases, each of the licensees shall have the obligation to jointly and severally compensate for the said damage.[230] This means that each licensee (tortfeasor) is liable for 100 per cent of the damages if, for example, one or more of the other licensees is unable to pay the claim. In such a case, the claimant would recover 100 per cent of the damages should at least one of the licence holders be sufficiently viable financially. Also, in cases where the licence has been transferred *ex post* the occurrence of the damage, the licensee at the time of occurrence of the damage and the subsequent licensee(s) will be jointly and severally liable for that *ex ante* event.[231] Whether the licensee has ever operated under the licence is legally irrelevant, since the special liability for mining-related pollution arises from the simple legal act of holding a licence, not from causing the damage.[232] The special rule of joint and several liability also applies to cases 'where it cannot be established that the damage was caused by the work of one of the holders of mining rights or mining lease rights in two or more mining sites or mining lease sites'.[233]

In the context of methane hydrate operations, a question of liability might arise in situations where a licence holder is producing methane hydrates within a dedicated mining site but the activity causes nearby resources to escape, thus, causing pollution in areas well outside the boundaries of the mining site for which a licence is held. As seen above, under the Mining Act the overall idea of fault is strictly limited to areas within the mining sites covered by a licence, so mining pollution incidents that occur beyond the boundaries of that mining site, and therefore beyond the scope of the licence, might not legally be captured by the special liability regime provided by the Mining Act.[234] This unique consideration may explain why Japan has introduced additional procedures specifically for disputes relating to environmental pollution. Two important laws in that regard are: a. the Act on the Settlement of Environmental Pollution Disputes; and b. the Act on Compensation, etc. of Pollution-related Health Damage.[235]

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[230] Art 109(2), Mining Act (n 150).
[231] Art 109(3)–(4), ibid.
[232] Kozuka, (n 190) 354.
[233] Art 109(2), Mining Act (n 150).
[234] See Art 8(2), ibid, which states that if no licence has been granted in a given area, any extracted minerals shall be deemed as ownerless property.
[235] Act on the Settlement of Environmental Pollution Disputes (Act No 108 of 1 June 1970); Act on Compensation, etc. of Pollution-related Health Damage (Act No 111 of 1973, as amended by Act No 97 of 1987); for a discussion, see Osaka, (n 225) 393.

The Act on the Settlement of Environmental Pollution Disputes establishes a central EDCC at the national level and pollution examination organisations in each prefecture. The EDCC conducts conciliation, mediation and arbitration in relation to serious pollution cases incurring severe injuries, nation-wide pollution cases and inter-prefectural pollution cases. It also conducts the cause-effect adjudication and the damages-responsibility adjudication. The main benefit of using the environmental dispute coordination system is that it is made available at lower costs than formal proceedings in litigation.[236]

The Act on Compensation, etc. of Pollution-related Health Damage creates a system of economic support for the victims of the most severe instances of environmental pollution. The law classifies the areas affected by mass pollution into two categories:[237]

i. 'Class I' areas affected by air pollution, where the population suffered from respiratory diseases; and
ii. 'Class II' areas where a relevant percentage of the population suffered from poisoning, caused by mining activities.

The budget of the program is largely based on the 'polluter-pays principle'. For example, 80 per cent of the financial resources needed to fund the support measures for areas in Class I come from taxes on industries that give rise to the emission events, and the remaining 20 per cent from taxes on fuel-consuming cars.

For relief measures to victims of pollution in Class II cases, the budget comes entirely from the companies held liable for the pollution. The aim of this approach, bluntly stated, is to ensure that, whoever ends up having to foot the bill for environmental pollution incidents related to mining operations, it will not be the Japanese taxpayer, at least beyond the liability that already falls on the taxpayer as a consequence of environmental policies.

To ensure that adequate compensation will be made readily available in case of an environmental pollution incident caused by mining activities, the Mining Act provides the Minister of Energy with the power to order mining licence holders to deposit an amount of money (capital), not exceeding one hundredth (1%) of the value of minerals mined within the previous year in the mining sites concerned as a financial base to call upon if an adverse event occurs.[238] Whether or not the percentage above provides adequate financial security for compensation claims is not altogether clear, however, it is worth

236 Osaka, ibid 399.
237 Ibid 405.
238 Art 117(3), Mining Act (n 150).

noting that environmental risks associated with methane hydrates are not *per se* proportionate to volumes lifted within the previous year.

Another notable feature of the Japanese system concerning liability and compensation mechanisms for environmental damage is that actions can also be filed on the basis of the State Redress Act.[239] Article 1(1) of the Act provides:

> When a public officer who exercises the public authority of the State or of a public entity has, in the course of his/her duties, unlawfully inflicted damage on another person intentionally or negligently, the State or public entity shall assume the responsibility to compensate therefor.[240]

Note that 'intentional' may generally include recklessness, and a Minister who should have known better but permitted or allowed poor behaviour to continue, despite known risks, and which later resulted in harm, could well be ensnared in this rule. Indeed, plaintiffs filing lawsuits against the state in cases of environmental pollution have often grounded their demands in the provisions of this Act based on the argument that the harm they suffered was a result of the state or of local authorities failing to be diligent in their duties, resulting in their negligence to control or regulate hazardous activities.[241] The Japanese judiciary on several occasions has accepted the demands of the plaintiffs and recognised the liability of the state when its inactivity can be defined as 'extremely unreasonable'.[242] In particular, case law has identified four conditions whose presence is necessary for the success of the lawsuit:

i. damage to life or physical integrity;
ii. the damage could have been foreseen (i.e. risks were known);
iii. the damage could have been prevented (i.e. had the state act to prevent it); and
iv. the action of the public authority was indispensable to prevent the damage.[243]

If these four conditions are met, failure of the government (or by local authorities) to act would give rise to liability. One of the first cases of government liability for environmental pollution is the so-called 'case of the recycled plastic in Kochi' of 1974, in which the state, the prefecture and the city of

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239 Emphasis added. State Redress Act (Act No. 125 of 27 October 1947) (JPN) [also referred to as State Compensation Law, see Osaka, (n 225) 399].
240 Underscore added. Art 1(1), State Redress Act.
241 Ortolani, (n 225) 193.
242 Ibid.
243 H Minami and N Okubo, *Kankyoho* (Yuhikaku 2009) 183, cited in Ortolani, ibid 193.

Kochi were held liable for not having made proper provisions for the recycling of plastic at a factory, which polluted the environment and hindered fishing activities in the region.[244] This holding could be seen as analogous to our earlier example of a harmed fishing community, should ministerial agents fail to prevent foreseeable injuries due to methane hydrate mining activities.

3.6 CONCLUSION

This part has provided a composite overview of the domestic laws and regulations that apply, or potentially apply, to the development of offshore methane hydrates in Japan. While this list is by no means exhaustive, the preceding discussion focused principally on the domestic laws and regulations that tend to be more closely associated with traditional offshore mining activities and, consequently, are most likely to have the biggest impact on offshore methane hydrate development operations in Japan.

244 Ibid.

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Final Remarks

The presence of vast quantities of technically recoverable methane hydrates offshore Japan promises great opportunities. Development of offshore methane hydrates in Japan is expected to move rapidly to commercialisation and offshore blocks to be opened for licensing by 2027. While Japan must meet its Paris commitments, it also needs to reflect on the growing body of public mistrust on nuclear energy.[245] Japanese policy makers do not have many options available. There is a pressing need to develop domestic energy sources, both renewable and not, and pressure mounts on those few choices. If indeed presented with a functional technology for commercialisation, Japan may be able to address those challenges and find a pathway to its energy security. It is no coincidence that, in its quest for this abundant and nearby energy resource, Japan has established one of the largest national research and development programmes on methane hydrates in the world. Since its founding in 1993, the research programme has continued to make significant progress, resulting in the experimental successes of 2013 and 2017.

On the other hand, as the extraction of methane hydrates poses significant environmental risks and hazards, many of which are not present within the production of traditional natural gas, the regulatory framework that would eventually govern methane hydrates' commercial production offshore Japan needs to be carefully scrutinised. This study has sought to introduce these opportunities and challenges. It has presented the prospects and benefits of methane hydrates from the standpoint of Japanese national energy policy and the existing domestic laws and regulations that apply, or potentially apply, to the development of offshore methane hydrates in Japan.

[245] In a 2015 poll by the pro-nuclear Japan Atomic Energy Relations Organization, 47.9 percent of respondents said that nuclear energy should be abolished gradually and 14.8 percent said that it should be abolished immediately. Only 10.1 percent said that the use of nuclear energy should be maintained, and a mere 1.7 percent said that it should be increased, see Tatsujiro Suzuki, 'Six Years After Fukushima, Much of Japan has Lost Faith in Nuclear Power' (*The Conversation*, 10 March 2017) <http://theconversation.com/six-years-after-fukushima-much-of-japan-has-lost-faith-in-nuclear-power-73042#targetText=Public%20mistrust&targetText=Only%2010.1%20percent%20said%20that,that%20it%20should%20be%20 increased>.

Japan's domestic legal framework for mining operations serves two basic energy policy objectives. First, to facilitate the timely and efficient development of energy resources in Japan. This involves specifying the type of resources and geographical areas to be developed as a matter of priority – these include methane hydrates within Japan's EEZ and continental shelf. Second, and perhaps most crucially as far as offshore methane hydrates are concerned, to ensure the safety of mining operations by requiring a previous impact assessment of all environmental risks, enforcement of the governing laws and regulations and by establishing remedial measures and compensation procedures for claims arising from damage to the environment.

Japan has enacted legislation that imposes strict liability specifically in respect of claims for damage from environmental pollution resulting from mining operations. As with general tort law, however, the vast majority of this legislation is focused on, and designed for, land-based mining pollution incidents. Indeed, the focus of the Mining Act, especially in respect of risk prevention and liability for compensation, is on damages that occur largely on land rather than the EEZ or the continental shelf: 'Damage caused by the excavation of land', 'destruction of facilities for public use or any facility equivalent to this', 'parks', 'hot spring resources', 'agriculture' and 'forestry'.[246] It is rather unclear what type of liability would apply, for example, to hydrocarbon release incidents occurring beyond the boundaries of the mining site for which a licence is held. In this case, one might assume that aggrieved parties would have to rely solely, or to a large extent, on Japan's civil code and common law for a liability system for claims for compensation from mining pollution, thus, there is a need for the claimant to prove that the defendant was actually at fault. The need to prove fault means that it would be much more challenging for claims for compensation for mining-related damages to succeed.

Moreover, while the Mining Act imposes a rule of strict liability for incidents occurring in a mining site, there is an exception, or at least a defence, for *force majeure*, such as natural disasters and other unforeseeable events.[247] While there is a good argument to be made why a licence holder should not have to pay compensation for damages caused by an oil release incident which could not, allegedly, have been prevented, a major problem might arise when a large scale mining pollution follows as a result of a natural disaster such as an earthquake or a tsunami. As evidenced by the Fukushima Nuclear accident, such risks cannot be excluded and it is not unforeseeable that simi-

[246] Arts 21(1)(ix), 40(1)(v), 53, 100-3(iv), 109(1), Mining Act (n 150).
[247] Art 113, ibid.

lar pollution incidents could also occur from offshore oil and gas operations. Japan's tort law, imposing fault-based liability, may be used to fill the gap, yet it still remains unclear whether Japan's tort law applies to incidents that occur on the EEZ or the continental shelf.

Finally, whilst the Mining Act requires all prospective licensees to demonstrate evidence of financial capability and provide financial security to be called upon if an adverse event occurs, this security, according to the provisions of the Mining Act, does not exceed one hundredth (1%) of the value of minerals mined within the previous year.[248] The magnitude of the likely risks and hazards associated with methane hydrate operations and the scale of costs arising from mining-induced environmental disasters raise the question of whether the specified limit as it stands, is anywhere near sufficient to address a catastrophic incident. It has been a long-standing policy of the Japanese government that, whoever bears the costs of for remediating environmental pollution caused by mining operations, restoring damaged natural resources in the marine environment and compensatory damages for affected persons, it will not be the taxpayer. How the regulator is to ensure the capacity of mining operators to pay for catastrophic risk is not altogether clear.

Areas of further research

Given the breadth and complexity of the subject matter, this study's scope of investigation has been purposely constrained. The present study has focused primarily on the prospects and benefits of methane hydrates for Japan and the Japanese legal framework governing their extraction and commercial exploitation. As a result, the wider international legal ramifications of offshore methane hydrates were not specifically addressed. These global ramifications warrant further examination, including, perhaps, to identify whether the development of commercially feasible technologies for the continuous production of freshwater from offshore methane hydrate assets, as demonstrated by Japan in 2017, may potentially be linked to Sustainable Development Goals (SDGs) particularly those related to energy, access to water and combating of desertification. For example, under the legally-binding United Nations Convention to Combat Desertification (UNCCD)[249] methane hydrate technology could be expanded to states, particularly to developing economies, to help addressing long-term droughts and desertification.[250] Questions concerning liability rules relating to methane hydrate

[248] Art 117(3), ibid.

[249] United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD) (Signed 17 June 1994, entered into force 26 December 1996) 1954 UNTS 3.

[250] Partain, in Heffron and Little (n 33) 1–4.

operations in areas beyond national jurisdiction, namely parts of the ocean that do not form part of any state but are, rather, within the global commons, were also not considered, despite that environmental pollution incidents within Japan's waters might adversely affect the marine environment of other areas beyond national jurisdiction.[251]

[251] For an account, see Centre for International Governance Innovation (CIGI): 'Liability Issues for Deep Seabed Mining Research Series' <https://www.cigionline.org/series/liability-issues-deep-seabed-mining-series>.

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