Comparative Analysis of Offshore Wind Policy between East Asian Nations: Which Policy Factors Influence Successful Offshore Wind Development?

de Putter, Anthonus

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Anthonus Aart de Putter
s1529145

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Thesis supervisor: Saori Shibata

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Abbreviations

ANRE – Agency for Natural Resources and Energy

CPA – Comparative Policy Analysis

DV – Dependent Variable

EA – Energy Act

EIA – Environmental Impact Assessment

EIS – Environmental Impact Statement

EPA – Environmental Protection Administration

GWEC – Global Wind Energy Council

IEA – International Energy Agency

IMF – International Monetary Fund

IPP – Independent Power Producers

IV – Independent Variable

MSSD – Most Similar Research Design

NIMBY- Not In My Backyard

OWP – Offshore Wind Power

PPS – Planning, Permitting and Siting

PV – Photovoltaic

REDA – Renewable Energy Development Act

RES – Renewable Energy Sources

1. Introduction

1.1 Research problem

Tackling climate change is arguably the most important problem of our time. The potential for disruption and devastation on a global scale has given rise to a scientific debate on potential avenues to tackle the problem. The international scientific consensus which emerged is lowering fossil fuel consumption can only be achieved by increasing introduction of renewable energy technologies. It has also become increasingly clear that rapid, far-reaching and unprecedented change is needed to stave off a global climate crisis (IPCC 2018).

The introduction of renewable energy sources (RES) into the energy mix has proven to pose a unique policy problem. The reason for this slow response has been attributed to numerous factors, such as difficulty in communicating the urgency of the problem, economic viability of renewable energies, vested interests of greenhouse gasses emitters and mobilizing support for climate policies (Moser and Dilling 2004, Richardson 2011). Support for climate change policies and the awareness of the urgency of the problem have gained attention in the last decade through activists' actions and the increasing scientific and political attention for the issue. The economics of the renewable energy transition and opposition from vested interests has nonetheless remained a large part of the problem (Moe 2016).

The emergence of offshore wind power (OWP) in the last decade as a cost-effective renewable energy source presents a promising potential for the renewable energy transition in many countries (IRENA 2019, 42, Adelaja, et al. 2012, 192). Whereas onshore renewable energy solutions are often burdened by having to compete for land-use with other interests, whether agricultural, residential or ecological, OWP has the potential to solve these issues due to its location. Widespread adoption has been mostly limited to Europe due to early development and investment being concentrated in this region, combined with favorable siting locations This is starting to change as OWP has been making strides over the last decade in aspects of technological advancement, reliability and most importantly cost-effectiveness (IEA-RETD 2017, 3). The advances in floating OWP have made the technology a promising candidate for increased deployment in Asia and the Americas as these regions are often burdened with deep offshore waters, unsuitable for fixed-foundation OWP. Despite the relative maturity of the technology, the East Asian nations of Japan, South Korea and Taiwan have relatively low levels of OWP development, whereas the implementation of OWP in China has risen tremendously in the last decade (GWEC 2020).

1.2 Research objective and research question

This thesis aims to build on previous efforts attempting to explain the slow development of OWP in Japan, Taiwan and South Korea by examining the differences in policies between these nations and examining to what extent these differences have influenced the outcomes of OWP development.

The use of comparative policy analysis (CPA) is well-suited to explain differences in variables and outcomes across countries (Geva-May, Hoffman and Muhleisen 2018, 24). The goal of CPA is to find a variable that leads to a certain outcome and then to examine whether there are ways of formulating and executing policy in different countries that could lead to more desirable outcomes. More desirable outcomes are necessary to increase the development of OWP.

This thesis examines the role of policy in the development of the offshore wind sector in the different countries by posing the research question and two sub-questions:

Research question:

What can a MSSD comparative analysis of the Japan, Taiwan and South Korea teach us about how policy variables influence offshore wind development?

Sub-questions:

To what extent have policies impacted the development of the offshore wind sector in Japan, Taiwan and South Korea?

What are differences in policies between Japan, Taiwan and South Korea?

The first sub-question focuses on within-case analysis to provide a better understanding of the role of policy in each of the countries under examination. The second sub-question aims to compare the differences in policies and development outcomes in the countries. These questions will be answered by testing several hypotheses on the role of policy and comparing the outcomes of the sub-questions in a cross-country comparative policy analysis in order to arrive at conclusions that inform the development of OWP.

1.3 Academic and societal relevance

Academic relevance

The field of policy science was pioneered by the seminal work of Lasswell (1971) from where it expanded to encompass a variety of methods and theoretical frameworks. Of particular note for this thesis is the comparative policy analysis, first introduced by Lijphart (1971) which, through increasing diversity and complexity of available methods, has grown into many different forms of research designs (Peters and Fontaine 2020). The CPA literature encompasses policy areas from healthcare to education and from criminal justice to globalization (Geva-May, C. and Muhleisen 2020, 376).
The body of scientific literature regarding RES development and policies is immense, arising during the late 90's from an already flourishing field of policy analysis. CPA research designs have increasingly been applied to the policy problems surrounding RES development. These comparisons have ranged from broad subjects, like a comparison of RE sector growth between countries (Dent 2013) to specific research aimed at finding which political, social or economic environmental factors

are most conducive to RE investments (Schmid and Bornemann 2019). Often these comparative studies aim to examine a specific policy instrument, such as a comparison of market integration policies (Klessmann, Nabe and Burges 2008) or financial incentives (Mabee, Mannion and Carpenter 2012), but more generalized studies have been published as well (Zhang, et al. 2011, Chen, Kim and Yamaguchi 2014).

Within the RES literature, the OWP fields’ evolution can be roughly divided into three routes: the OWP and policy route, the environmental and societal impacts route and the wind farm selection and installation route (Hsieh, et al. 2018). The OWP and policy route focuses mostly on case studies of countries or sites, such as Söderholm and Pettersson’s (2011) overview of offshore wind policy in Sweden or O’Keeffe and Hagett’s (2012) case study into the barriers facing the success of the Firth of Forth offshore wind farm. Other case studies focused on the implementation of policy and its role on the development of OWP capacity (Toke 2011, Verhees, et al. 2015).

The literature pertaining to OWP policy issues started with a focus on Europe, as the technology first reached maturity there. Consequently, the literature often focused on Europe and examinations of the region have continued to account for the lion-share of the research (Hsieh, et al. 2018, 2), since Europe’s offshore wind market constitutes about 75% of total global OWP installations (GWEC 2020). This emphasis on Europe means that other regions were neglected in the literature, a trend that has only begun to reverse in the last decade (Peters, et al. 2020, 5). There has been an increased emphasis on the role of Asia in the OWP policy field, due to the large amount of OWP resources, relative lack of interest in RES development and large demand for power. The East Asian nations, due to their relative wealth yet comparatively low levels of RES investment, were often the focus of governance studies in the literature (Li and Xu 2019, Kao and Pearre 2017, Chien 2020, Park and Kim 2019).

The combination of CPA research designs and the subject of OWP policies has created a thriving field of study. At first, these comparative studies focused on European countries (Mani and Dhingra 2013, O'Hanlon and Cummins 2020, Asia Sustainable and Alternative Energy Program 2010). Gradually other regions such as Asia, Africa and Latin America were given more attention, often using difficulties in OWP implementation in the European market as lessons for the implementation of OWP in these regions (Mani and Dhingra 2013). There is a lack of studies comparing the OWP policies of countries within their own regions. This research hopes to contribute to the literature regarding CPA studies of OWP policies by addressing the gap of comparative OWP policy studies within the East Asian region. OWP policy comparison studies can provide valuable information on what effects policy variables and their implementation have on the development of OWP capacity in the East Asian region.

Societal relevance

OWP is absolutely essential to achieve the energy transition towards a sustainable economy and society. The impacts of climate change can only be mitigated through the use of RES. However, all forms of RES have societal, environmental and economic issues. OWP is one of the most promising forms of RES potential, as it can ensure security of supply, system quality and affordable overall costs (especially in the future) with smaller environmental, social and economic impacts compared to other RES. Issues of NIMBY-ism and land-use are especially relevant to the countries under examination in this thesis, as they are densely populated and have little suitable land to build onshore RES capacity. Furthermore, all of them are in large part reliant for energy security on energy imports, which shackles their economic progress to carbon-heavy fuels and makes them vulnerable to disruptions in the supply of these energy imports. Offshore wind is well positioned to serve as an antidote to these concerns, providing energy security and affordable energy without many of the downsides of onshore RES capacity. Increased investment in OWP development holds the potential of creating a large new production and maintenance industry, including job creation and competences that can be leveraged for more economic potential in the future. On the political front, agreed targets in multilateral treaties such as the Kyoto, Copenhagen and Paris Agreements can be achieved, leading to increased international standing and public support for climate change mitigation efforts.

In summary, issues of policy are important for the smooth introduction of renewable technologies, especially technologically difficult RES such as offshore wind (ESMAP 2019). A better understanding of the policy variables and their importance in the introduction of OWP capacity is important to ensure efficient siting and installation of this important part of these countries' RES strategies.

1.4 Reading guide

The thesis is divided into nine chapters. After this introductory chapter, a literature review follows that introduces the relevant concepts and provides context for the research, as well as defines the terms used in the thesis. The third chapter discusses the methodology, method and contains the justification for the choice of data sources. The fourth chapter explains the conceptualization and operationalization of the variables under examination and it will provide the hypotheses that the thesis will test. The fifth, sixth and seventh chapters concern the three country studies. The eight chapter consists of the cross-country analysis and its results and the ninth chapter is the conclusion.

2. Literature review

2.1 Development

In the academic literature, OWP development has received a lot of attention and the associated field has grown in the last two decades. The terms used to denote installed and future capacity of OWP vary. Terms in use are ‘adoption’ (Burke, et al. 2019), ‘uptake’ (Mukonza and Nhamo 2018), ‘dissemination’ (Jonkman and Matha 2011), ‘deployment’ (Sinclair, et al. 2018), ‘diffusion’ (Doblinger and Soppe 2013), ‘implementation’ (Pedro Varela-Vázquez et al. 2019), ‘utilization’ and ‘use’ (Houghton, Bell and Doquet 2016). Although these terms are often used interchangeably, there are differences in definition, both in terms of scope and time. This thesis will use the term ‘development’. The definition of the verb “to develop” relevant to this research is stated in the Cambridge Dictionary; both as “to invent something or bring something into existence” and “to start to happen or exist”. The definition thus includes both those projects that are already brought into existence as well as those projects that are in the planning or building process. This is important, as this research aims to incorporate current as well as near-future planned OWP capacity.

2.2 Factors influencing development

The factors influencing OWP development are myriad according to the literature. Many of these are case-specific and therefore need not be investigated in this thesis. There are however still a number of factors that affect the development of OWP that are regarded as universal variables. The following sections will discuss these factors and the literature that has been produced regarding their influences on development of OWP.

2.2.1 Wind resources

It may seem obvious, but no review of variables impacting OWP development is complete without discussing the necessity of useable wind sources. The literature underwrites the importance of useable offshore wind resources in the development process of OWP capacity. The evaluation of wind resources has attracted a lot of attention in the literature, with many different statistical, spatial and marine analyses and computer modeling studies as a consequence. Nevertheless the usability of offshore wind resources is not a sufficient predictor of OWP development (Toke 2011, Gosens 2017, Keivanpour, Ramudhin and Ait Kadi 2017). Besides, one only needs to observe the many unharnessed offshore wind resources in the world to come to the same conclusion.

2.2.2 Planning, permitting and siting model

The OWP policy field debates the importance and influence of planning, permitting and siting (PPS) procedures at length. Snyder and Kaiser (2009) find the EU’s regulatory framework has “almost certainly sped up development”. They describe EU’s regulatory model as encouraging the development of an offshore wind energy industry, both through first-come first-served application processes, but also via simple PPS procedures. Similarly, Bohn and Lant (2009) examine three different PPS models and find that simplicity is most beneficial to development. Petterson et al. (2010) find that national-level decision making leads to less uncertainties and quicker siting procedures than local-level decision making. Söderholm and Pettersen (2011) follow this up with an analysis of Sweden’s wind power policy, where they conclude that clarity of policy and simplicity of process are favorable for OWP development.

2.2.3 Policy

The literature on RES policy concerns itself with the effectiveness of policy instruments on the development of RES. Debate over which policy instruments are most effective in increasing RES development is ongoing (Delmas and Montes-Sancho 2011). The issue with this debate is that the effectiveness of these policy instruments is often heavily dependent on the context into which they are implemented. That does not mean that selection of policy instruments doesn’t offer important suggestions for why OWP development varies across countries. These policy instruments can be categorized into financial- and target-based instruments, which will be discussed further (Berasalli, Menanteau and El-Methni 2020).

2.2.3.1 Financial incentive policies

The main financial policy instruments consist of the Feed-in-Tariff (FiT) and tax incentives. Research provides evidence that tax incentives are not sufficient to incentivize RE deployment (Berasalli, Menanteau en El-Methni 2020). The principal financial incentive policy instrument remains the FiT, which is “a policy mechanism developed for the support of renewable energy technologies, through the award of a certain payment per kWh for electricity produced by a renewable resource and fed into the grid” (Kaldellis 2012). The debate regarding FiTs focuses on FiTs effect on the development of OWP and how to effectively implement the policy to ensure that developers are willing to invest in OWP, since the FiT provides a guarantee that they will see a return on their investments (Mabee, Mannion and Carpenter 2012).

The FiT is often placed opposite target-based policy instruments and the debate revolves around which of the two provides the most beneficial effect on OWP development. Evidence suggest that more financially equilibrated countries, such as those under examination in this thesis benefit more from the use of FiT than of quota-based policy instruments (Costa, Ghorbani en Eslamizadeh 2020).

2.2.3.1 Quantity incentive policies

Renewable Portfolio Standards (RPS) are quota-based policy instruments aimed at creating demand for RES, thus stimulating development. Also called renewable energy targets or renewable electricity standards, all of them operate on the basis that electric utilities are mandated to purchase a certain amount of renewable energy per designated period of time. If these targets are not achieved, penalties for noncompliance can be applied. There is some debate about the efficacy of RPS policies vs. FiT policies which provides some evidence that RPS is less effective in high-GDP countries and that it comes with a risk of excessive use of low-quality renewables, which excludes OWP (Johnstone, Haščič en Popp 2010).

2.2.4 Electricity market type

The literature debating the importance of electricity market type on RES development is divided into one side that points out the increases in RES development in liberalized electricity markets and another side that argues that these increases are not necessarily due to liberalization and that liberalization, in fact, has a negative influence on RES development.

Studies that argue that liberalization increases opportunities for RES development, since liberalization leads to more efficient resource utilization and allocation, increased competition and private participation, which allows RES to compete on a level playing field (Munksgaard and Morthorst 2008). Supporting evidence has shown dramatic increases in the deployment of RES in liberalized electricity markets (Agora Energiewende 2019, 38). Others argue that liberalization is detrimental to RES development and that it hinders successful commercialization due to RES characteristics of high capital costs, initial transaction costs and the intermittent nature, making RES unable to compete with traditional energy sources in a liberalized market (Nalan, Murat and Nuri 2009, Aflaki and Netessine 2012). All things considered, the evidence in developed countries points to liberalization as being beneficial to RES deployment (Ferguson-Martin and Hill 2011, Nicolli and Vona 2019).

2.2.5 Social acceptance

Social acceptance of OWP constitutes both general RES acceptance as well as OWP specific acceptance. The body of literature on social acceptance of RES encompasses many different studies, from local opposition issues (NIMBYs) to research on levels of acceptance in the general population (Fast 2013). Social acceptance can greatly impact development of RES through opposition movements and political influence. Some important conclusions from these studies are as follows: NIMBY issues are often related to a lack of participation by the public in the PPS process (Fast 2013), increased accessibility of information regarding RES development is linked with increased acceptance of RES technologies, levels of trust in the government is directly associated with acceptance of RES developments and cost-benefit analyses are most influential to public acceptance (Segreto, et al. 2020). OWP specific social acceptance also addresses issues of perceived fairness (Firestone, et al. 2012), lack of information on tangible benefits and relationships between developers, outsiders and locals (Hagett 2011). The literature also focuses more specifically on impacts to economic, commercial or aesthetic losses associated with OWP development (Teisl, et al. 2015).

3. Methodology

3.1 Most Similar Systems Design

The Most Similar Systems Design (MSSD) is a commonly used methodology in comparative policy research (Anckar 2006, 390-391). When using MSSD, the goal is to test the effect of an independent variable on a dependent variable, whilst keeping other variables constant and therefore increasing the legitimacy of the influence of the independent variable on the dependent variable. As Della Porta (2008) states, *"by means of such a strategy 'many variables are "parametrized": if we have more or less the same degree of economic development, similar culture and the like, we can consider these characteristics as constant and check for the influence of other factors'. If the most-similar systems design is conceived of in the latter form, most comparative studies confined to specific geographic settings could be said to implicitly apply a most-similar systems design."*

MSSD aims to test theories and is better suited to small-N studies with less than 8 cases where it uses the variable-oriented approach whilst still allowing for complexity that is difficult to reduce to simple data in a data set, as quantitative research would approach it (Anckar 2020, 42-43).

The MSSD methodology is well suited, as this thesis aims to answer the deductive question of "what is the causal relationship between the independent variable of policy on the dependent variable of OWP development".

3.2 Internal validity and method

Since this paper intends to test a causal relationship between a dependent variable (OWP development levels) and independent variables (OWP policies), safeguarding internal validity is of utmost importance (Lewis-Beck, Bryman and Liao 2004, 503-504). Since the research method has an extensive impact on the internal validity, let us first introduce this thesis' method of document analysis.

Document analysis was chosen as the method of analysis, as it is a very efficient and effective way of gathering available data, as documents are practical resources that are easily accessible, reliable and stable (Bowen 2009, 31). It is especially effective at providing a broad coverage of data in both content and timespan, a quality well-suited to a comparative analysis covering a broad range of policies. Document analysis is often combined with ethnographic research methods such as interviews and questionnaires to fill in gaps in the available literature (Bowen 2009, 31), however due to travel restrictions this method could not be employed, therefore document analysis is the sole method employed in this thesis. This need not be detrimental, as policy documents, laws, studies and interviews in media are readily and abundantly available online, allowing the thesis to largely infer the results a potential ethnographic research study would have provided.

To combat threats to the internal validity of the research, parameters for the analysis were constructed. Firstly, the document analysis is limited in scope to documents relevant during the time span of 2017-

present. Secondly, as stated above, document analysis mitigates issues of subjectivity and selection bias, as all relevant documents are analyzed. The thesis was also written using a self-conscious research design and with continuous self-reflection of potential biases and predispositions.

3.3 Case selection criteria and reasoning

The methodology of MSSD is utilized in this thesis, meaning that the selection of case is made on the basis of similarity across multiple dimensions, making it best suited for outcome-oriented explanatory studies. To that effect, the East Asian countries of Japan, Taiwan and South Korea were chosen due to the similarity in several key areas. The decision to select these countries was made in order to control for as many institutional, social, cultural, environmental, political and economic factors as possible. The most important difference according to Chen et al. (2014) is the significant variance in government policy of Japan, South Korea and Taiwan regarding renewable energy. Therefore the OWP policies (and other policies indirectly impacting OWP development) are assumed as the independent variable to explain the dependent variable. The dependent variable in this research is the current and near-future level of development of OWP.

3.4 Data sources

Data used in the analysis were collected from official government sources, such as the relevant ministries, sub-ministries and local governments, international and local interest groups, commercial reports and academic publications. Statistical data was gathered from the Japanese Ministry for Economy, Trade and Industry and Ministry of Environment, the South Korean Ministry of Trade, Industry and Energy and Ministry of Environment, the Taiwanese Ministry of Economic Affairs and the Ministry of Environment, as well as additional data from the International Energy Agency and Global Wind Energy Council and national interest groups.

3.5 Within-case analysis

In order to conduct the within-case analysis, the process-tracing method is used. Process tracing is a qualitative research method described by George and Bennett as an attempt to “identify the intervening causal process – the casual chain and causal mechanism – between an independent variable (or variables) and the outcome of the dependent variable” (2005, 206). A variant called explaining-outcome process-tracing is applied: explaining-outcome process-tracing investigates the available evidence to work backwards from a known outcome to uncover the causal mechanism(s) that produced the outcome (Beach and Pedersen 2011, 22). Through the combination of explaining-outcome process tracing in the within-case analyses with a MSSD methodology, the issue of “correlation is not causation” in small-N comparative studies is largely assuaged.

3.6 Cross-country analysis

After conducting three within-case analyses a cross-country analysis follows. In this analysis, we compare the findings, looking for insights into the explanations for causal processes. To do this, we use congruence analysis. Congruence analysis is used to assess whether and to what extent the data reflects the theory (Grandis 2013). Wauters and Beach state that the aim of congruence analysis is “to compare the strength of the evidence for different theoretical explanations of the outcome Y (2018, 288).”

3.7 Limitations

There are too many potentially relevant variables that influence the development of OWP to include all of them in this thesis, an issue that is often called the ‘too many variables, too few cases’ problem (Lijphart 1971, 686). This is partly mitigated through the thesis’ deductive research design, where a set of hypotheses is tested and other explanatory variables can be disregarded as they are irrelevant to the testing of the hypotheses (Ebbinghaus 2005, 143).

This issue is also partly mitigated through case-selection, but even then the selection of cases is made through a deliberate choice based on a theory-driven comparative method, informed by historical and political processes. This choice is made on the basis of the MSSD theory, namely that the cases selected need to be as similar as possible in as many variables as possible.

4. Operationalization

4.1 Irrelevant variables

The MSSD methodology was chosen in order to rule out as many non-relevant variables by means of similarity among the selected cases. These variables are addressed here. Firstly, all three countries have a democratic form of government with a consensus-based decision making process and high levels of bureaucracy (Fukuyama 2011, 39-41, Berman 2017, 6-8). According to the IMF's World Economic Outlook Database, their GDP in both nominal and PPP corrected terms are comparable, ranging from $32.123 in Taiwan to $42.928 in Japan and GDP (PPP corrected) ranges from $44.585 in Japan to $59.398 in Taiwan. Japan, South Korea and Taiwan occupy the places 25, 28 and 31 respectively on the list of per capita nominal GDP and places 27, 25 and 12 in per capita GDP (PPP corrected) for countries and dependencies (International Monetary Fund 2021). They all share a high population/land ratio and scarcity of traditional natural energy resources, making them dependent on the import of foreign energy resources (Kuznets 1988, 35). They also share the natural environment including the dangers of typhoons, earthquakes and tsunamis as well as deep oceans off their shores.

Levels of public acceptance of renewables are often measured by asking citizens' willingness-to-pay electricity surcharges for renewable power generation. Outcomes of studies in all three countries suggest a similar level of willingness-to-pay for the introduction of renewable energy technologies into the energy mix (Lin, et al. 2013, Lee en Heo 2016, Nakano, Tomio en Morikawa 2018). In other research that utilizes questionnaires (Fraser 2020), quantitative modeling (Kung, Zhang en Chang 2017) and social structure analyses (E. Park 2021), the outcomes suggest a similar low-to-medium level of social acceptance in all three countries. Opposition to OWP often originates from fishery associations and the levels of acceptance and their inclusion in the policy processes is also at equal levels throughout all cases (Kularathna, et al. 2019, Shiau and Chuen-Yu 2016, Lee and Park 2020).

The potential for OWP development is also of a similar high level in all three countries, although there are differences, these don't constitute a relevant variable as current and planned development is at most utilizing 1% of this potential (Song, et al. 2016, Fang 2014, Abudureyimu, et al. 2012).
OWP R&D and industry in all countries lags significantly behind in comparison with European and US efforts, as is reflected in the literature which is dominated by western scholars. Additionally the most influential universities and institutes are located almost exclusively in Europe (Gordon 2020).

4.2 Dependent variable

This thesis will examine the dependent variable (DV) development of OWP through the following indicators:
Indicator 1: Total OWP installed capacity in MWh.
Indicator 2: Annual OWP capacity additions in MWh.

Indicator 3: Total installed OWP capacity per 100 people in Wh.
Indicator 4: OWP penetration of total energy supply in percentages.
Indicator 5: Planned OWP capacity additions until 2030 in GWh.

4.3 Causal explanations

What follows are hypotheses and definitions of ordinal values with which to measure the independent variables (IV).

4.3.1 Planning, permitting and siting process (IV1)

Hypothesis 1: Countries with simple planning, siting and permitting processes have higher levels of offshore wind development

Adapted from Bohn and Lant (2009) but modified due to differences in locations and issues in the political and bureaucratic processes. Instead of a 'standard', 'streamlined' and 'minimal' planning, permitting and siting (PPS) model, this thesis uses the terms cumbersome, standard and simplified. We use characteristics for these that have been adapted from the recommendations for siting policies by Hoagland et al. (2004).
This thesis defines IV1, with the associated characteristics cited above, as the following ordinal values: *0 = cumbersome PPS model, 1 = standard PPS model, 2 = simplified PPS model.*

4.3.2 Financial incentives (IV2)

Hypothesis 2: Countries with higher feed-in tariff rates have higher levels of offshore wind development

The FiT is a policy instrument aimed at accelerating investment in OWP technologies by offering long-term guarantees of grid-access and cost-based purchase prices.
This thesis defines the FiT as IV2, reflecting the ordinal value of the financial incentive, where *0 = low (0-0.10$/kWh), 1 = medium (0.01-0.20$/kWh), 2 = high (0.20-0.40$/kWh).*

4.3.3 Development target (IV3)

Hypothesis 3: Countries with a higher RPS target have higher levels of offshore wind power development

Renewable Portfolio Standard (RPS) is a government policy instrument that requires electric utilities to generate a certain percentage of electricity from renewable sources by a certain date.
In this thesis, we use as indicator of RES development target the percentages of RPS via the ordinal values *0 = no/voluntary quota, 1 = low target of 1-9% RPS, 2 = medium target of 10-19% RPS, 3 = high quota of 20+% RPS*

4.3.4 Electricity market type (IV4)

Hypothesis 4: Countries with a more liberalized electricity market have higher levels of offshore wind power development

The European Bank for Reconstruction and Development (EBRD) (2014) has developed a classification system for liberalized electricity markets, ranging from 0 to 4. This categorization is used as the definition of our ordinal values.

Thus, this thesis defines these ordinal values as *0 = fully monopolized, 1 = largely monopolized, 2 = partially liberalized, 3 = fully liberalized*

5. Japan

5.1 Background and development

Japan has an OWP potential of around 600GW, using both fixed-bottom as well as floating turbine designs (JWPA 2012). Traditionally, Japan has focused on nuclear energy as a “clean energy” source, but due to the Fukushima Daiichi nuclear power plant disaster the government has shifted their attention to renewable energies. A lack of space onshore means that other renewables including onshore wind are constrained in their ability to provide the significant amount of renewable energy needed to achieve Japan’s ambitious targets for CO_2 neutrality in 2050. Furthermore, the costs associated with the current energy imports of coal, gas and oil and the associated issues for energy security accelerates the need for alternative energy sources. OWP holds the potential to serve as a solution to some of these problems and to become an important part of the energy mix.

To understand the current position that OWP occupies in Japan’s energy mix, we should first examine the numbers. Current total OWP installed capacity is 58.6MWh, with annual OWP capacity additions constituting 5MWh/per year from 2017 to 2020 (GWEC 2020). This converts to a total installed OWP capacity per 100 people of 46.3Wh per 100 people and OWP penetration of the total generation capacity is 1.2023×10^{-5}%. In comparison, OWP constituted about 0.3% of total global electricity supply in 2019 (Global Wind Energy Council 2020). Japan’s development can thus be said to be straggling in comparison to other developed nations and its immediate neighbors, who possess higher levels of OWP development in all relevant indicators. Recently Japan has increased its efforts to develop OWP resources; the government has ambitious plans to develop 10GW of OWP capacity by 2030 (Okutsu and Shibata 2021). Overall, Japan’s level of OWP development is low, but there are indicator of a brighter future for OWP development.

5.2 Planning, permitting and siting process

The Act on Promoting the Utilization of Sea Areas for the Development of Maritime Renewable Energy Power Generation Facilities (The National Diet 2018) went into effect in 2019 and aims to increase the development of OWP. This law outlines a selection process for so-called “promotion zones”, which aim to remove problems such as local opposition, adverse environmental impacts and potential legal conflicts. These areas also provide an area with suitable natural conditions and suitable ports for OWP facilities (Hogan Lovells 2020). The designation process is expected to take approximately 10 months and is undertaken by the Ministry for Economy, Trade and Industry (METI) and the Ministry for Land, Infrastructure and Tourism (MLIT). Afterwards a public auction is held to select developers. Developers need to meet requirements, such as:

1) Passing an assessment, where the operator is ranked on its ability to: develop a project that is beneficial to local economies and to co-ordinate with local stakeholders and finance, own, operate and maintain the project. Relevant experience and track-record on other (domestic) OWP projects will be

taken into consideration.
2) Research the OWP potential to provide total output figures with a ±20% deviation.
3) Ensure suitable port infrastructure.
4) Provide a technical and financial plan for decommissioning activities.
The time period to provide these documents and have the assessment issued is six months (Hogan Lovells 2020).

During the permitting process, OWP developers need to undertake an Environmental Impact Assessment (EIA) as outlined in the Environmental Impact Assessment Act. Japan's EIA process is the strictest in the world; it takes at minimum 4 years (METI 2016) and almost all relevant data needs to be gathered by the operator itself (REI 2021). Schumacher (2019) determines there are 28 procedural steps for completing the EIA. The permitting process includes different requirements laid out in a variety of laws, such as the EIA law (The National Diet 1997), the Factory Location Act (The National Diet 1959), the National Land Use Planning Act (The National Diet 1974) etc. The introduction of the new law does not preclude these requirements, meaning that throughout the application, planning and permitting process a large amount of permits and permissions are required, from local and national regulators to sub-local committees. The involvement of several ministries, such as the METI, the MLIT and the Ministry of Environment and other local and national stakeholders has hindered OWP development. With the introduction of the 2019 Act on Promoting the Utilization of Sea Areas for the Development of Maritime Renewable Energy Power Generation Facilities the process is now nominally presided over by METI, who should be coordinating the communication between these stakeholders. In practice little has changed and developers still need to communicate with the stakeholders to obtain the relevant permits (REI 2021).

It is clear there is no central decision making authority and various legal requirements are dealt with by different authorities. This creates a needlessly complicated and opaque PPS process, with the added detriment of an enormous amount of required documents and permits, which bogs down the process further. Preference for operators with domestic experience can also form a potential barrier to entry for new operators.

We conclude that Japan's PPS model can be defined as a cumbersome PPS model that has stifled development of OWP.

5.3 Financial incentives

Japan started its FiT incentive policy in 2011 (The National Diet) with the intent of stimulating RES development by forcing electric utilities to purchase electricity generated from RES on a fixed-period contract at a fixed price. Until 2016, the FiT rates for solar photovoltaic (PV) and wind were uneven, with solar PV FiT rates higher than wind FiT rates. This caused low investment in wind, as capital costs for wind power are higher than solar PV and fixed prices for solar PV were guaranteed to be higher than wind prices, making wind an unattractive option. This stifled both onshore as well as OWP development, as less wind capacity was added after the introduction of the FiT compared to before (Renewable Energy Institute 2017).

This imbalance was addressed in a 2016 amendment to the law. In 2014, the OWP FiT was set at 36¥/kWh, higher than all other RES (save small-scale biomass at 40¥kWh) [The National Diet 2016]. Whereas the FiT for other RES is now getting lowered by the year, floating OWP remains at 36¥/kWh. Despite this it is unclear whether this will provide sufficient returns for investors, with some developers claiming that ¥40/kWh will be necessary to kick-start the industry in Japan, due to higher base costs and a lack of suitable infrastructure and offshore experience in Japan (Carbon Trust 2014).

Regardless, Japan's FiT policy has the highest government mandated fixed prices for OWP in the world and we should expect OWP development to be rising quickly since its introduction. While OWP development has increased since the introduction of the FiT in 2014, the rate at which OWP development has progressed is slow, with annual OWP capacity addition progressing at a sluggish pace of 5MWh/per year. The government has introduced a new Feed-in-Premium (FIP) regime with the Partial Revision Act, where operators receive a premium on top of the FiT. This aims to encourage operators to develop OWP activities whilst ensuring return on investment and although it is a promising financial policy instrument for future development (Linklaters 2021), we conclude that Japan's FiT policy has not been sufficient to drive OWP development.

5.4 Quantity incentives

The government of Japan implemented a RPS scheme in 2003 which ran until the end of 2011. This was then replaced by the FiT policy. During the years the RPS scheme was active, onshore wind energy (OWP was not mature) grew at an impressive pace (Asano 2009). After the introduction of the FiT scheme, wind energy and OWP development ground to a halt until the revised FiT law in 2016. Although the government has continued to set goals for the development of OWP and RES in general, these goals are not enshrined in national law. Additionally, these goals often included nuclear energy, as they were aimed at reducing greenhouse gasses reductions. At the 2009 Copenhagen Climate Summit, for instance, Japan stated its ambition to reduce GHG by 25% in 2025, but this goal was not realized and has since been criticized as unrealistic (Hughes 2009). Since then the targets on RES development have remained stagnant between 2014 and 2020 with a low RES target of 20-24% of electricity generation in 2030.

Since 2011, there has not been any quota-based incentive for the development of OWP. Specific government ambition on OWP in Japan has remained depressed until 2020. In that year the government announced promotion plans for future installations that aim to achieve 10GWh in 2030, which is an increase of almost 20x the current total installed capacity (METI 2020, GWEC 2019). We can conclude on the basis of this information that the absence of any sort of quantity incentive like RPS in Japan has negatively impacted the development of OWP.

5.5 Electricity market status

Historically, Japan’s electricity sector was dominated by several regional electric power companies. Presently, they supply about 88% of Japan's total electricity consumption, while the rest is generated by wholesale electric utilities, as well as by private generators (Jones and Kim 2013). Despite these statistics, in 2012 the Japanese government implemented the Basic Policy on Electricity Reform, which aimed at reforming the electricity market to liberalize the market, increase competition and improve transmission networks. According to the METI’s Agency of Natural Resources and Energy (ANRE) (2016) , Japan’s electricity market achieved full liberalization in 2016, with an amendment to the Electricity Business Act [The National Diet 2016]. This phase of the electricity system reform completely modified and restructured the regulatory system governing electricity businesses. Then on 1 April 2020, the government implemented the amended Electricity Business Act (The National Diet 2020), which required the unbundling of the transmission and distribution business from the power generation and retail business. On 1 April 2022, distribution service is slated to be added to the three categories by the amendment to the EBA. Following this, Japan’s electricity market should truly be fully liberalized.

Having said that, when we look at the current level of competition, Japan’s electricity market has the characteristics of an unbundled non-monopolized electricity sector with a small amount of private sector involvement. Although there is an independent regulator, the share of private sector involvement is still minimal and for many types of electric utility companies it is required to obtain approval from METI. There are efforts to introduce more private investment in the electricity market, but previously government-managed regional power companies still dominate the market. Path-dependence may prevent significant head-way for private companies into the market, but the market is ostensibly liberalized and should provide opportunities for investment for newcomers in the future. The majority of OWP generated electricity is generated by independent power producers, which implies that a more liberalized electricity market gives more opportunities to develop OWP (JEPIC 2020, 60).

We conclude that Japan’s ostensibly liberalized, largely monopolized electricity market has been unable to provide the necessary competitive environment suitable for OWP development.

5.6 Conclusion

This within-case analysis sought explanations for Japan’s sluggish development of OWP capacity. We assessed the IVs by comparing the results of the DV indicators to our hypotheses and attempted to locate causal mechanisms that could explain the changes in the DV.

The findings so far are summarized as follows:

Independent variable	**Assessment of findings**	**Preliminary conclusion**
IV1:Planning, permitting & siting model	Consistent with expectations, a cumbersome PPS model has stifled OWP development and investment	Confirm
IV2: Financial incentives	Against expectations, a high FiT has not increased development levels	Disconfirm
IV3: Quantity incentives	Consistent with expectations, the lack of RPS policy combined with low target-setting has failed to drive market demand	Confirm
IV4: Electricity market type	Consistent with expectations, a largely monopolized electricity market has formed a barrier to entry for OWP developers	Confirm

Table 1. Summary of findings from Japan

6. Taiwan

6.1 Background and deployment

Taiwan’s OWP potential is one of the largest in the world, due to the high wind speeds caused by its position next to the Taiwan Strait, which may explain the total OWP installed capacity in 2020, which was 128MWh; relatively large compared to its neighbors. Taiwan’s track record regarding RES development has been poor, although government initiatives aimed at promoting renewable energy development since the late 1990s did exist. Despite these initiatives Taiwan’s energy mix has long been characterized as reliant on imported fossil-fuel resources. Although previous administrations made efforts to develop RES through the use of government policies, the Tsai administration was the first to push for increased investment and development of OWP capacity (T. Ferry 2017). This policy is reflected in annual OWP capacity additions, of 30MW/per year from 2017 to 2020 (GWEC 2020). The total installed OWP capacity per 100 people is also impressive at 543Wh/per 100 people, overshadowing that of all countries under examination by a factor of 2 or higher. The OWP penetration of total generation capacity 9.825×10^{-5}% and future planned OWP capacity is estimated at 15GWh in 2030 (MOEABOE 2020). We conclude that Taiwan’s OWP development level is high and poised for faster growth in the future.

6.2 Planning, permitting and siting process

The main laws that govern Taiwan’s OWP development regulatory framework are the Electricity Act (EA) (The Executive Yuan 2019) and the Renewable Energy Development Act (REDA) (The Executive Yuan 2019). The EA allows OWP operators to sell electricity and the public to choose RE sourced electricity over traditional electricity sources and the REDA provides funds for OWP development through the Renewable Energy Fund, includes legislation on FiT rates and outlines the obligations and requirements of OWP operators. An overview of other relevant legislation is provided in figure 1.

Coverage	Legislative Instrument
Wind power generation (general)	• Regulations for Installation and Management of Renewable Energy Generator • Electricity Enterprise Registration Rules • Guidelines for Reservation of Offshore Wind Power Generation Site • Guidelines for Taiwan Power Company's Purchasing of Renewable Energy • Regulation Governing Power Generation Equipment
Subsidies for wind power	• Regulations for Application of Supporting Documents for Tariff Exemption and Instalments of Renewable Energy • Regulations for Rewards of Offshore Wind Power Demonstration Generation Site System
Electricity Transmission	• Guidelines for Distribution of Capacity of Offshore Wind Power Generation Site • Guidelines for Taiwan Power Company's Parallel Renewable Energy on Power Generation
Environmental requirements	• Environmental Impact Assessment Act • Standards for Determining Specific Items and Scope of Environmental Impact Assessments for Development Activities • Environmental Impact Assessment Enforcement Rules • Guideline of Environmental Impact Assessments for Development Activities • Guidelines for Reservation of Offshore Wind Power Generation Site
Building Code Requirement	• Standards for Renewable Energy Facility Installation's Exemption Certificate for Miscellaneous

Fig. 1 Additional legislation for OWP development

The procedures for permitting are as follows:

1) Progress through the EIA process by submitting an Environmental Impact Statement (EIS), which the Environmental Protection Administration (EPA) will review. In cases without adverse ecological impact, the EPA will provide preliminary approval and submits a revised EIS, followed by on-site inspections by the EPA and final EPA approval. The last stage is a public meeting. In cases of adverse ecological impact, the EPA invites interested parties to discuss the EIA report, issues to be addressed and feasible alternatives. The submission of a draft EIA report by the developer follows, taking into account the issues addressed in the previous EPA discussions. Then the on-site inspection and a public meeting are held where feedback is incorporated. If the relevant issues are addressed by the developer the EPA provides final approval on the EIA report. This process generally takes a year to 1½ year (Jones Day 2018).
2) Obtain an Establishment Permit (EP), through the acquisition of consent letters from various authorities. This process includes national and local governmental authorities as well as local fishery associations, the military and financial backers of the project. This process can be difficult and time consuming, although it is guided by the Bureau of Energy (BOE), who will ensure the relevant authorities are contacted. This process can take upwards of 1 year (Hogan Lovells 2020, 136-149).
3) Apply for recognition by the BOE as a RES facility.
4) Enter into a power purchasing agreement with Taipower.
5) Obtain a Construction Permit; this process can be started parallel to the EP process.

6) Obtain an Electricity License.
   Obtaining the licenses after application takes around 3 months on average.

The PPS process is guided from the national level by the BOE, who provides a list of authorities whose consent letters are necessary and provides the relevant data to the EPA and other governmental authorities. The EIA process is streamlined and is completed in a relatively short timeframe, but the EP procedure is needlessly complicated and involves too many authorities. The other steps are straightforward. The focus in the PPS process is on fast implementation of OWP projects (Malik 2019) and this is reflected in the average time from the start of the PPS process until the construction phase, the average time lies between two and a half to three years (Cassingham en Ou 2016). There have been reported delays in project installations, either through local opposition or government in-fighting (T. Ferry 2021) which affect the PPS process negatively.

The PPS model of Taiwan can be characterized as a standard PPS model, with somewhat attuned national and local authorities, a clear coordinating agency, short processing times and an average number of procedural steps. We conclude that the standard PPS model has not affected the development of OWP negatively.

6.3 Financial incentives

Taiwan introduced its' FiT in 2009 when it already had RPS policies in place. During this time, the FiT played second fiddle to the RPS policy and the FiT did not match the goals of the RPS (Wang and Cheng 2012). Since then the FiT has been adapted to better suit the development of OWP, which includes setting high FiT rates of up to 0.23$/kWh in 2018 to 0.17$/kWh in 2020 (Tsai 2021). The height of the FiT is partially driven by additional local content requirements, aimed at increasing the local OWP manufacturing industry. This high FiT is meant to attract international developers such as Ørsted and Yushan Energy to the Taiwanese market (Chien 2020).

Whatever the reason behind the government's decision, the high FiT attracted large international developers and was thus able to increase its development of OWP capacity. It is no surprise then that annual growth in the 2017-2020 period was 30MWh/per year, partially driven through the government's commitment to high FiTs. We can conclude that the FiT policy has increased the development of OWP in Taiwan.

6.4 Quantity incentives

Taiwan has introduced RPS policy on a national level in the REDA of 2019. Before this introduction, Taiwan had an RPS scheme at the local level, aimed at promoting low-carbon cities. Several cities introduced their own RPS schemes, but the results were mixed due to differences in implementation (e.g. a lack of non-compliance fine or a lack of a defined timeline). The newly introduced national RPS is different from traditional forms of RPS, primarily by placing the burden on large electricity consumers instead of electricity utilities. This means that in effect, the RPS policy can be seen as a ‘transformed FiT’, since it incentivizes large electricity consumers to start their own RES producing companies to compensate for their own consumption, rather than buying RECs (Gao, Fan and Chen 2020). Although it can be ascribed as a ‘transformed FiT’, it is still a demand-side incentive.

The lack of a national RPS in Taiwan until 2019 does not seem to have had a detrimental impact on the development of OWP, as annual capacity additions rose to the highest levels yet. The addition of an RPS scheme is expected to further spur on the development of OWP in the future. We can thus conclude that the lack of quantity incentives did not negatively affect OWP development.

6.5 Electricity market status

The ruling Democratic Progressive Party, assuming that state ownership and control of the electricity market is inefficient and increased liberalization will lead to increased efficiency, has emphasized electricity market liberalization since winning the elections in 2016. Electricity market liberalization was attempted in the past, with plans in 1999 to amend the Electricity Act to liberalize the electricity market and privatize Taipower and divide the power industry into segments of generation, transmission and distribution (Wang 2006). These reforms were largely unsuccessful at the time. The latest attempt to reform the electricity market aimed to integrate RES into the market. The Electricity Act amendment in 2017 provides three privileges to RES generators: customers can choose to use only RE sourced electricity, RES generators are allowed to sell directly to end-customers without third-party intervention and are allowed to setup retail electricity companies (Gao, Fan and Liao 2018). These privileges were aimed at increasing RES development, but were ineffective because the “state-owned Taipower maintains a near monopoly because green energy producers have no incentive to sell power for less than the official FiT, while consumers are likely to continue buying Taipower's electricity to secure lower rates and stable supply” (Huang en Chen 2020, 111). This means that effectively, as Chien (2020) states: “Taiwan’s utilities are still in the state’s control”.

Contrary to expectations, Taiwan’s largely monopolized electricity market does not seem to have negatively affected OWP development. This is driven in part by to the governments’ dedication to the development of OWP and its’ control of Taipower, allowing it to mandate Taipower to cooperate with independent power producers on OWP projects (Lu 2016).

6.6 Conclusion

This within-case analysis sought explanations for Taiwan’s expeditious development of OWP capacity. We assessed the IVs by comparing the results of the DV indicators to our hypotheses and attempted to locate causal mechanisms that could explain the changes in the DV.

These are the tentative findings:

Independent variable	**Assessment of findings**	**Preliminary conclusion**
IV1:Planning, permitting & siting model	Consistent with expectations, Taiwan's standard PPS model has not negatively impacted OWP development	Confirm
IV2: Financial incentives	Consistent with expectations, the high FiT has attracted investors and operators, thereby increasing the development of OWP	Confirm
IV3: Quantity incentives	Against expectations, Taiwan's lack of RPS scheme has not negatively impacted OWP development	Disconfirm
IV4: Electricity market type	Against expectations, Taiwan's largely monopolized electricity market does not seem to have hindered OWP development	Disconfirm

Table 2. Summary of findings from Taiwan

7. South Korea

7.1 Background and deployment

South Korean government policies on RES development can be traced back to the 1988 Act on the Promotion of Renewable Energy. Subsequent legislation has been passed to incentivize the development of RES, but the government deemed the subject low priority until the 2011 Fukushima nuclear power plant accident and the subsequent increase of anti-nuclear sentiment. Ambitious RES policy only became a priority in 2017 with the Moon administrations' push for increased RES development and GHG/pollutant reductions (S.-Y. Kim 2021). In the ambitious "Renewable Energy 3020" plan, the government set the goal of 20% renewable energy in the energy mix by 2030. In order to achieve this goal, the government pledges to expand the OWP sector to 12GWh in 2030.

This goal is achievable, as the OWP potential of South Korea is estimated at 33.2GWh and as of 2021, South Korea's total OWP installed capacity is only 140.1MWh. The development is accelerating, as annual OWP capacity additions consist of an additional 23MW/per year from 2017 to 2020 (GWEC 2020). Total installed OWP capacity per 100 people is 270.9Wh/per 100 people and South Korea's OWP penetration rate is $4.3038\text{x}10^{-5}\%$ (Embassy of Denmark in Korea et al. 2021). We conclude that South Korea's OWP development is above average and well positioned to grow at a faster rate in the future.

7.2 Planning, permitting and siting process

The permitting process begins with obtaining a year's worth of meteorological data, which has to be collected by the developer. To do so, the developer must first obtain a public waters occupancy permit from the Public Waters Management Authority (PWMA). The developer can then apply for an Electricity Business License (EBL) from the Ministry of Trade, Industry and Energy (MOTIE). After issuance, the developer needs to once again apply for a permit at the PWMA to site the turbines. If issued, the developer is granted an occupancy permit of up to 30 years and is expected to formulate a public waters occupancy implementation plan, for which the PWMA needs to give approval (Linklaters 2021).

Additional requirements are: conducting a marine traffic safety examination, commissioning a buried cultural heritage inspection institution to complete a ground inspection and conducting an EIA. If the EIA and other inspections and examinations are deemed sufficient, they must obtain approval for their construction plan from MOTIE, after which the Korea Electrical Safety Corporation inspects the facilities. The onshore facilities require several other permits, such as permits for use of agricultural, forestry and grasslands spaces as well as permits for road use. This process is quite complicated, deals with several different laws, regulations and authorities and contains an enormous number of steps. An overview of additional legislation is provided in figure 2.

National Land Planning and Utilization Act
Public Waters Management and Reclamation Act
Act on the Allocation and Trading of Greenhouse Gas Emissions
Rules on Operation of the Electricity Market
Management and Operation on New and Renewable Energy Mandatory Supply Policy and Fuel Compounding Mandatory Policy
Regulations on Issuance of Authorized Certificate and Trade Market Operation
Transmission/Distribution Regulation
Basic Energy Plan
Basic Plan on Supply and Demand of Electricity
Basic Plan for New and Renewable Energy

Figure 2. Additional legislation in South Korea (Linklaters 2021, 16)

The complexity of the process is also reflected in the length of the process, which historically has taken from 8-11 years to go from permitting to operation.

In 2020, the MOTIE, MOF and MOE issued a “Plan for Offshore Wind Power Generation in Collaboration with Local Residents and the Fishing Industry" aimed at speedy development of OWP projects. This includes permitting and siting streamlining measures and additional government involvement in encouraging stakeholder acceptance, which is expected to transition the PPS model to a standard or even simplified PPS model. At present South Korea’s PPS model constitutes a cumbersome PPS model, which has impacted the development of OWP negatively (Park and Kim 2019).

7.3 Financial incentives

South Korea had a FiT policy from 2001 to 2011, when the policy was replaced by a RPS program due to the heavy financial burden of surging solar PV installations. Since then, South Korea has not had financial incentives, other than access to preferential loans or R&D funds. The FiT policy was reintroduced in 2017’s “Renewable Energy 3020” plan, but is limited to small-scale users and useless for OWP (Park en Koo 2018). When we compare the lack of financial incentives to the growth of OWP development, it is clear that OWP has not suffered from a lack of financial incentives.

7.4 Quantity incentives

South Korea’s RPS program was introduced in 2011, replacing the FiT policy. The current obligation rate is 8% of total generation and is set to rise to 10% in 2023. The government is considering extending and increasing the share until 2030. Companies can either generate RES themselves or purchase Renewable Energy Certificates (RECs) on the electricity market. In the event of non-compliance, power companies must pay a fine upward of 150% of the average REC market price. The

RPS rates are low according to our definition, but high in comparison to South Korea's total RES share of electricity consumption (4.1%) (IEA 2020). The RPS is effective at developing RES, but the effectiveness decreases linearly (Lee en Seo 2019). Park & Koo (2018) argue that a readjustment in the speed of obligation rate is necessary in order to drive OWP development to a higher level. The RPS policy is the largest contributor to RES and OWP deployment in South Korea, which means we can conclude that the RPS program has positively affected OWP development (C. Kim 2021).

7.5 Electricity market status

South Korea's electricity market started as a vertically integrated monopoly of the Korea Electric Power Corporation (KEPCO) (Ahmed en Bhatti 2019). After the economic crisis of 1997, the government set out to reform the electricity market to a more globalized model, which included liberalization and privatization efforts. The plan was to reform the market in 4 stages: 1) the legal separation of KEPCO's generation facilities into newly established companies owned by KEPCO, 2) introduce competition in the generation market from state-owned generation companies, 3) separate the distribution and retail components of KEPCO into state-owned regional companies who will compete on the wholesale market and 4) introduce full retail competition and privatize the previously mentioned state-owned regional companies (Küfeoğlu, Kim en Jin 2019).

This reform process would have led to a liberalized electricity market, but the process was interrupted after the second step was implemented, due to opposition by anti-nuclear activist and labor unions (Sueyoshi, Ryu en Goto 2020). Although the reform did introduce the Korea Power Exchange (KPX) as an independent power system operator, transmission and retail services are still monopolized by KEPCO. Since the end of the reform process efforts were made to partially liberalize the electricity sector, but these were also unsuccessful due to opposition by stakeholders.

We can thus conclude that the Korean electricity market is categorized as a largely monopolized electricity sector with no government subsidies and minimal private sector involvement. The ratio of private to public parties in OWP development, namely 68.8% is developed by private parties and only 13.3% by public parties, leads us to conclude that the monopolized energy market has negatively affected OWP development.

7.6 Conclusion

This within-case analysis sought explanations for Korea's moderate development of OWP capacity. We assessed the IVs by comparing the results of the DV indicators to our hypotheses and attempted to locate causal mechanisms that could explain the changes in the DV.
The findings are summarized below:

Independent variable	Assessment of findings	Preliminary conclusion
IV1:Planning, permitting & siting model	Consistent with expectations, the cumbersome PPS model has negatively affected OWP development	Confirm
IV2: Financial incentives	Against expectations, South Korea's lack of FiT has not hampered OWP development	Disconfirm
IV3: Quantity incentives	Consistent with expectations, the medium-strength RPS policy has been effective in driving OWP development	Confirm
IV4: Electricity market type	Consistent with expectation, the monopolized electricity market has had detrimental effects on the development of OWP	Confirm

Table 3. Summary of findings from South Korea

8. Cross-country analysis

In this cross-country analysis, we will examine the outcomes of the within-case analyses and compare them to look for lessons about the variables that affect OWP development.

8.1 Comparing outcomes

8.1.1. Development

The development of OWP in the three countries follows different trajectories. Where Japan has gradually introduced small amounts of OWP over a period of 8 years, both Taiwan and South Korea have introduced large scale projects in the last few years. This points at building momentum for the development of OWP in Taiwan and South Korea, whereas Japan is proceeding slowly with the development of OWP. This trajectory is reflected in all indicators, from annual capacity additions, to OWP capacity per 100 people and OWP penetration in the total energy supply. Future goals for total installed capacity also reflect the difference between Japan on one side and Taiwan and South Korea on the other. Taiwan and South Korea's goals (15GW and 12GW) for OWP development in 2030 are more ambitious than Japan's (10GW), especially considering the differences in population.

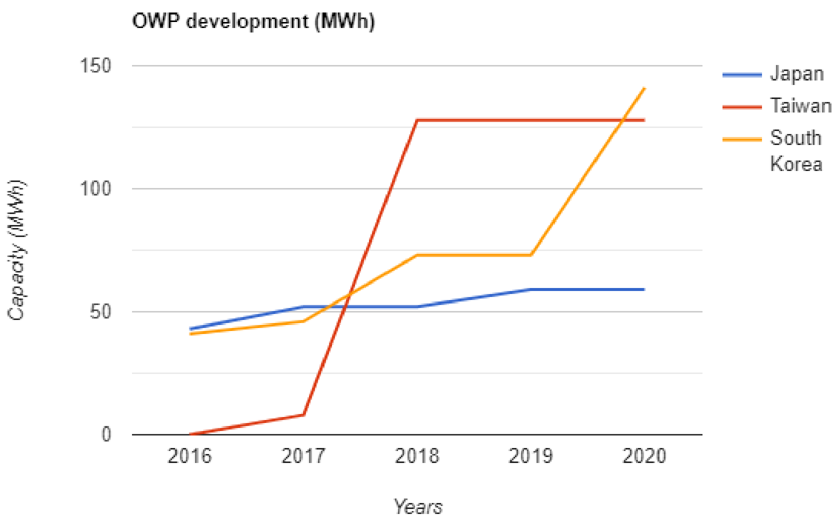

Figure 4. OWP development 2016-2020

8.1.2 Hypothesis 1

Japan and South Korea's cumbersome PPS models have clearly negatively influenced OWP development and the effects of the standard PPS model in Taiwan did not negatively affect OWP development. In Taiwan, we observed that the PPS model aimed for fast installation of OWP projects, which might have benefited OWP development. In both Japan and South Korea the PPS model is both cumbersome and the PPS process is long, leading to uncertainty and high upfront costs for developers. The outcomes of the analyses of PPS models suggests that the PPS model is an important influence on the development of OWP, but besides the level of complexity of the PPS model, the time-to-installation of the PPS model also affects OWP development levels.

We can confirm hypothesis 1 on the basis of our results.

8.1.3 Hypothesis 2

The results of the analysis of financial incentives are contradictory. The high FiT in Japan and Taiwan have had different outcomes and the lack of FiT in South Korea has not hampered OWP development.

The high FiT in Taiwan has driven OWP development, whilst Japan's FiT has failed to do so. In Japan's case, it is likely that the preferential FiT rates for solar PV have impacted the development of OWP, but after this shortcoming was remedied, OWP development has not shown significant improvement. This can be traced to the cumbersome PPS process, which introduces uncertainty, risk and additional costs into an already capital-intensive start-up process for developers. In no other country would developers need a higher FiT than Japan's current rate, as evidenced by Taiwan's FiT success. In Taiwan's case, it is evident that the FiT has driven OWP developers to the market, with an enormous amount of developers interested in the market and willing to bid on projects.

The case of South Korea is an outlier, having no FiT in the time period under examination. The expectation is that the RPS system including RECs drove up the selling price of RE and especially OWP sourced energy due to its high weighting value. Furthermore, these RECs are often sold through fixed-price contracts, thereby decreasing uncertainty and risk and thus functioning somewhat like a FiT.

The outcomes of Japan and South Korea disconfirm hypothesis 2.

8.1.4 Hypothesis 3

The lack of an RPS policy in Japan and Taiwan has once again provided mixed results. Although South Korea had a relatively low RPS target, there is sufficient evidence that it was the leading factor driving the development of OWP in South Korea. It is inconclusive whether Japan's lack of quantity incentives is directly connected to its low OWP development, although it certainly was not conducive to development. More importantly, Taiwan's high OWP development levels are contradictory to the lack of quantity incentives. There is a good chance that Taiwan's high FiT has spurred the development of OWP to such a level that RPS schemes would have been outperformed and therefore unnecessary.

The outcome of Taiwan disconfirms hypothesis 3.

8.1.5 Hypothesis 4

The outcomes of our analysis into the electricity market types are interesting. Japan, possessing the most liberalized electricity market, has the lowest levels of OWP development, whereas Taiwan and South Korea have noticeably higher levels of OWP development but more monopolized electricity markets. An explanation for the lack of OWP development in Japan is the government‘s relative lack of control over the electricity companies compared to Taiwan and South Korea whilst the market is still overwhelmingly monopolized by the regional power companies leaving little opportunity for Independent Power Producers (IPP) to invest into OWP and break into the market. We saw confirmation in South Korea that the monopolized market has influenced OWP development negatively. The explanation for Taiwan's strong performance with a monopolized market is the government's strong developmental bend. The state in Taiwan intervened in OWP development both through the use of policy tools like the FiT, but also through its control of infrastructure such as the monopoly position of Taipower, forcing developers to partner with Taipower. The conclusion is that a liberalized power sector is not sufficient to explain development of OWP.

On the basis of the results of Japan and Taiwan, we can disconfirm hypothesis 4.

8.2 Discussion and conclusions

We found confirmation of Bohn and Lant's (2009) theory that the PPS model influences OWP development in all of the countries under examination. Increased awareness of this issue has caused governments of growing markets to look to European PPS models, which are less complex and more streamlined, decreasing the PPS processing time.

We could not confirm that financial incentives influenced the development of OWP, even though Taiwan's FiT was instrumental in the development of OWP. Japan's lack of development combined with its' high FiT and South Korea's lack of FiT and high performance disconfirmed the theory. Since all countries had high-GDP's, this somewhat takes the wind out of the sails of proponents of FiT who argue that in wealthy developed countries, the FiT is most efficient at increasing RES development (Costa, Ghorbani en Eslamizadeh 2020).

In the quantity incentive results Taiwan is an outlier, sporting strong OWP development and lack of quantity incentives. The literature suggests that quantity incentives are less effective in high-GDP countries and carry risks of excessive use of low-quality renewables, which excludes OWP; a theory that can help explain the results of Taiwan (Johnstone, Haščič and Popp 2010). South Korea, however has increased OWP development, largely based on the RPS policy, providing evidence contrary to this theory.

The electricity market type results of Japan and Taiwan seem to point to an argument in the literature that posits that RES and specifically OWP is not mature and efficient enough to compete with traditional energy sources in a liberalized electricity market. There are often subsidies on traditional energy sources present even in a liberalized market and RES simply cannot compete on costs against these sources (Nalan, Murat and Nuri 2009). South Korea's outcome also seems to support this argument until we look at the sources of OWP generated electricity, which is heavily dominated by

IPP, thereby supporting the argument that liberalized electricity markets increase competition and in turn OWP development (Nicolli and Vona 2019).

Hypothesis	**Conclusion**
H1: PPS model	Confirmed – All findings support the theory
H2: Financial Incentive	Disconfirmed – Japan and Korea don't support the theory
H3: Quantity Incentive	Disconfirmed – Taiwan does not support the theory
H4: Electricity Market	Disconfirmed – Japan and Taiwan don't support the theory

Table 5. Outcomes of hypotheses

9. Conclusion

9.1 Research question, revisited

What can a MSSD comparative analysis of the Japan, Taiwan and South Korea teach us about how policy variables influence offshore wind development?

We answered the question by answering first which policies were different in Japan, Taiwan and South Korea and then by explaining the impact of these policies on their OWP development. We then conducted a cross-case analysis to conclude that PPS models have a noticeable impact on OWP development, but financial and quantity incentives as well as electricity market type are not as important. Where supportive policies in general were stronger, OWP development was higher (Taiwan and South Korea) and where overall policy support was weaker, OWP was lower (Japan).

9.2 Broader implications

Incentive policies

The results of quantity and financial incentives prove that some sort of incentive policy is needed to drive OWP development and that both seem to be suited to the task. The debate regarding which is better suited and to what conditions is likely to continue for the foreseeable future. The important take-away is that incentive policies are necessary drivers for OWP development, because they provide risk mitigation and create demand for a market where large capital costs, difficult environmental conditions and complex technological demands form a large barrier to entry regardless.

Legislation and bureaucracy

The results show that complex legislative and bureaucratic processes from one of the main barriers to entry for OWP developers. Although legislation is needed to protect the environment, the local communities and ensure health and safety, there is a need for governments to form legislation that encompasses all these issues and condenses these different laws and policies into a single legislative document with an accompanying institution or agency to guide developers through these processes in order to further develop OWP. Less bureaucracy in the OWP PPS process is going to be vital if the market is going to reach maturity in the future.

9.3 Future research directions

Due to the limited scope of this thesis, we examined only four variables in three East Asian countries over a four year period. Research on these countries should continue as they are all poised to grow their OWP markets in the coming 10 to 20 years. A comparison between these countries and China is also sure to produce interesting results, as China has made tremendous process in OWP development and a deeper examination of the policies which made this possible can be promising. More attention for the East Asian OWP market has potential for stimulating research and insights that can be applied to the region and globally.

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