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# Governance challenges of marine renewable energy developments in the U.S. – Creating the enabling conditions for successful project development

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ABSTRACT

Increasingly, marine renewable energy developments are viewed as an opportunity to meet climate change obligations, with the added benefit of powering the economy and the creation of jobs. Technical, economic and engineering challenges co-exist with governance challenges in the development of large-scale marine renewable energy projects. This paper addresses the question, if the prerequisites for sustainable project development are evident in selected case studies. It also asks what lessons can be learned from current practice in the context of energy governance at the local level. The authors argue that these lessons can be central enablers to support decision makers in future programmes, to better understand how to build the enabling conditions for programme implementation towards renewable energy at higher spatial scales of governance, importantly the national level. The study builds on a multiple stakeholder approach involving interviews and group discussions with key individuals from industry, government and civil society in emerging pilot programmes along the East Coast of the United States (U.S.). New policy windows were opening at the time of the analysis and ambitious development was underway by a range of actors who are driving progress in the sector and positioning the area to become a major provider of blue energy.

## 1. Introduction

Increasingly, marine renewable energy resources and ocean technologies are viewed as an opportunity to meet climate change obligations by developing a low-carbon supply of energy with the added benefit of powering the economy and providing the necessary conditions for the creation of jobs [1]. The International Energy Agency (IEA) [2] and Loorbach & Rotmans [3] highlight the value of large marine renewable energy developments as a central ingredient for the global energy transition. Energy transitions form part of a wider discussion on the potential for transforming human-technological interactions to achieve sustainable patterns of production and consumption [4].

The Intergovernmental Panel on Climate Change (IPCC) emphasise technological obstacles to marine renewables. Some of them are fundamental, particularly for wave and tidal [5]. Due to uncertainties around the commercial availability of wave and tidal energy at attractive investment costs, developments globally are still at R&D, pilot and demonstration stage. Whereas these technologies are at a nascent stage, offshore wind technology in some parts of the world, particularly in countries in Europe (Denmark, the UK and Germany), are deployed on a large commercial scale [5]. However, increasingly both the onshore and offshore wind sector are challenged to find technical solutions (e.g. around energy transmission) and to overcome institutional barriers. Institutional barriers are most importantly consenting regime issues, high costs of developments and public acceptance relating primarily to visual intrusion [5,6]. In terms of public acceptance, experiences of community opposition from Scotland and other countries emphasised that previous assumptions that marine renewable energy is "out of sight, out of mind" can be questioned [7]. The studies highlighted that local context referring to indigenous and local communities' rights and ownership matter, as these can strongly affect local perceptions of different marine technologies, whether it be visible from land or not. Given that in the meantime some countries have experienced getting large marine renewable energy developments off the

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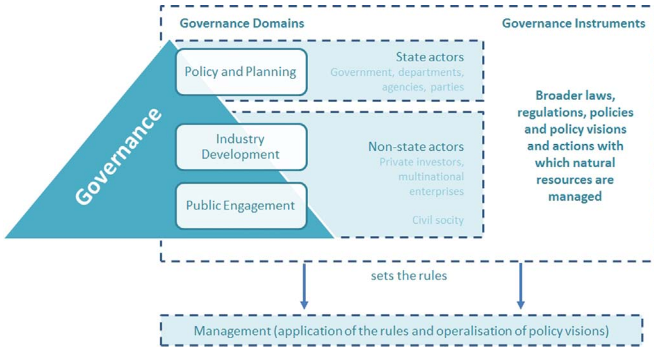



**Fig. 1.** Governance understanding as a basis towards setting up of rules for the management of human activities.

ground and into the sea, the international context for learning for countries with similar ambitions is of crucial importance.

In order to learn from country experiences, this paper sets out to show that governance issues are one of the main challenges of transitioning towards sustainable energy futures, with an enlarged share of marine renewable energy sources. Based on an assessment of the enabling conditions for programme implementation at the project level, the authors of this article draw general conclusions for the national level. Referring to UNESCO [8] and Folke et al. [9], they define governance as encompassing broader laws, regulations, policies and actions with which natural resources are managed. Management on the other hand is concerned with the application of these rules and operationalisation of policy visions. Van Tatenhove & Jan [10] focus on governance of marine use activities and dynamics within a framework of coalitions of state and non-state actors. Thus, governance sets the stage within which management occurs [11]. Even if technical, engineering challenges, laws and regulation exist, these co-exist with governance challenges at various levels, which relate to 'policy and planning', 'industry development' or 'public engagement'. Fig. 1 highlights the theoretical understanding of governance based on the authors referenced above. In addition, the figure highlights the governance domains and the instruments setting the rules for the management of human activities.

The authors of this article define the governance domains established above as the category system for the assessment. In this paper, they focus on governance challenges from the perspective of each one of the governance domains. *Firstly*, they ask if the prerequisites for sustainable project development are given in selected case studies. The *second* question addresses, what lessons can be learned from current practices in the context of energy governance at the local level. The authors argue that these lessons can be central enablers to support decision makers in future programmes to better understand how to build the enabling conditions for programme implementation towards renewable energy at higher spatial scales of governance, importantly the national level.

These questions are based on the concept of nested systems of governance at multiple scales [12]. The assumption is that decision makers and managers can address some issues more effectively at one level, and less effectively at another. Therefore, decision-making must recognize conditions at least at the next higher level in the governance system. The study builds on the work by Olsen et al. [12] and its governance baseline approach. This approach forms part of an 'orders of outcome analysis' framework presented in the context of Integrated Coastal Management (ICM). It is based on the analysis of governance response to ecosystem change and features the collection of selected case studies and profiles of stakeholders in current governance systems, namely from industry, governments and civil society as a core component of the framework (including understanding of power dimensions, decision-contexts around key issues that matter to residents and other key stakeholders). Marine renewable energy developments will involve multiple stakeholders within and outside coastal communities. Social science research needs to explore the context for each of these perspectives. From a science perspective, comparative studies can provide an opportunity to aggregate results from individual cases to higher level. From the perspective of decision makers, these studies can support a framework for learning and transferring of knowledge across scales [13].

This study applies the principles of the Olsen et al. [12] framework for analysing the governance dimension of energy in a range of marine renewable energy initiatives along the Northeast Coast of the United States (U.S.). The study team engaged with individuals from selected case studies in the States of Maine, Rhode Island and Maryland involved in the process of programme implementation within interviews and group discussions. In addition to the U.S. analysis, the paper provides high-level views on consenting solutions towards marine renewable energy transitions from Denmark and the United Kingdom (UK).

## 2. Background

The work is part of a larger study, looking at case study material from Europe, including Ireland and Denmark [14]. The U.S. as an example was chosen for three reasons: *First*, significant work was underway in pilot testing to leverage vast wind energy resources for potential electricity generation. *Second,* new policy windows were opening at the time of the analysis and *third*, ambitious development was underway by a range of actors who are driving progress in the sector at pilot scale and positioning the area to become a major provider of green and blue energy [15–17]. While onshore wind became the most important new renewable energy technology in the U.S. in 2006, leaving behind geothermal and solar energy, offshore wind has been a topic of much debate and controversy in the coastal zone [18–20].

As an example, the offshore wind farm Cape Wind in Massachusetts engendered the difficulties in U.S. consenting of marine energy developments and wide spread public opposition [21,22]. Opposition with a number of litigations was based principally on visual intrusion and on cost grounds. Applications for permits first emerged in 2001. Developers initially looked for the construction of the first offshore wind farm in the U.S., consisting of 130 × 3.6-MW turbines with a capacity of 468-MW powering more than 220,000 homes [17]. However, no turbine planned in this project has been installed by the time of writing. In 2015, the U.S. Departments of the Interior (DOI) and Energy (DOE) enforced policy changes by issuing leases and funding for demonstration projects. This together with promising externalities in market conditions unlocked potential for the completion of the first wind farm in U.S. offshore waters in August 2016 and 23 projects in various development stages. Energy experts expect that the 30-MW Block Island Wind Farm will power homes on the island and onshore. In December 2016, the company Statoil won an offshore licence off the coast of New York at a cost of $42.5 mi US [23]. The company views the U.S. East Coast as a key emerging market for offshore wind, bottom fixed and floating. The lease comprises an area that could potentially yield more than 1-GW of offshore wind.

The authors of this article carried out a comparative analysis of governance dynamics and priorities at the *federal government level* related to marine renewable energy developments and emerging pilot programmes in this field at the *state* and *local level*. This has been undertaken to understand the decision-making power at various scales and interconnections across different stakeholders. The study put only limited emphasis on technological aspects of energy sources, such as device development and grid connection, and economic conditions, such as the efficiency and security of the supply.

## 3. Material and method

The research method in support of this study was designed to

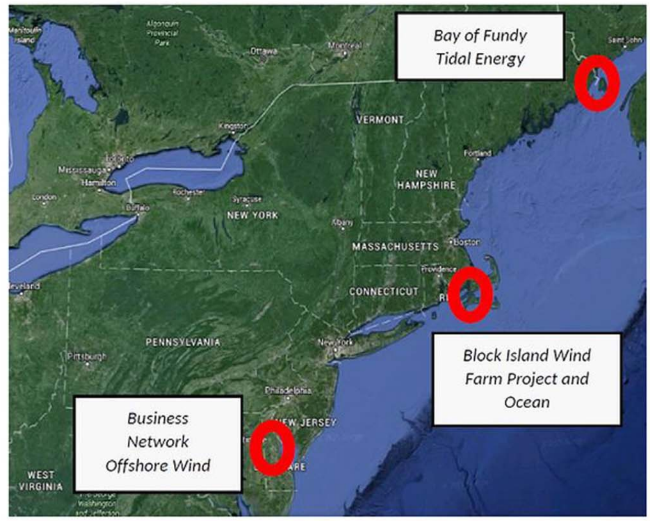
| Case study | Lead partners | Status | Location |
|---|---|---|---|
| (1) Bay of Fundy Tidal Energy Project, Maine | Industry-led by a Small and medium-sized enterprise (SME) | completed |  |
| (2) Business Network Offshore Wind, Maryland | Industry-cluster and policy-led | ongoing | |
| (3) Block Island Wind Farm Project and Ocean Management Plan, Rhode Island | Policy, academic and plan-led | completed | |



**Fig. 2.** Case study profiles highlighting lead partners, status and locations.

provide insights on the interplay between the local level and higher levels of governance, by adopting a multiscale and multiple stakeholder approach. At the *state or local level* three case studies were identified to reflect the different stages of development in site-specific marine renewable projects (two completed, one ongoing) relating to one of the three governance challenges (policy and planning, industry development, public engagement). The only example not related to offshore wind energy developments is on tidal energy. Even if technology systems pertain to very different issues, the example was analysed in detail. This is because it provides a different perspective on overcoming some the issues related to community opposition (e.g. due to the absence of visual intrusion of technology). Selection criteria in general pertained to a variety of preconditions for effective and sustained implementation of planned programmes. An important selection criterion of the cases was their potential for scaling up meaningful lessons from an energy transition perspective to the national level. Fig. 2 summarises the case studies by highlighting the lead partners in each case, the status and the case study locations.

In order to highlight challenges and opportunities of marine renewable energy developments, in total twenty-four semi-structured confidential interviews with forty-four experts and stakeholders were conducted during a three-week period in March 2015. The identification of stakeholders mainly followed a targeted and snowball sampling [24]. To draw from a variety of perspectives, the project team balanced the selection by involving stakeholders from all governance domains (government, industry and civil society) and academia and research. Participants were also selected given their power to influence decisions at the respective levels. Table 1 highlights the number of interviews and interviewees relative to the profiles of the interviewees.

The **interview** structure was according to a set of open-ended questions. Central, generic questions pertained to whether consenting regimes were in place to support marine renewable developments, if processes were to engage with local communities, if governance frameworks added to traditional forms of policy and planning, and if planning towards marine renewable developments and targets were clearly formulated? The authors developed the questions to examine whether the enabling conditions for a successful project were in place. Olsen et al. [12] suggest that all four of the **enabling conditions** outlined below are essential pre-requisites to sustainable project development:

1. A core group of well informed and supportive stakeholder groups support the program,
2. Sufficient initial capacity is present within responsible institutions to implement policies and action plans,
3. Governmental commitment is in place to provide necessary authorities and financial resources required to implement a program,
4. Adoption of unambiguous goals are in place against which program efforts can be measured.

An **expert-led approach** via a focus group discussion was applied at the national level. The aims were to identify perceptions of issues around the current governance framework for energy purposes, both terrestrial and at sea. The focus group meeting was held at the

**Table 1**
Profiles of interviewees and their role in industry, government or civil society.

| Governnace domain | Profile of interviewees | Number of interviews | Number of interviewees |
|---|---|---|---|
| Industry | Industry leaders in the marine renewable energy sector | 3 | 6 |
| Government | Senior officials from federal and state governments, connected agencies and a global funding agency | 3 | 12 |
| Civil society | Practitioners from NGOs engaged in public engagement | 5 | 6 |
| | Practitioners at the science-policy interface engaged in public engagement | 3 | 3 |
| | Members of an opposition group | 1 | 5 |
| Academia and research | Scientific peers (involved in marine energy projects or with a background in technology, energy, climate science or marine policy) | 9 | 12 |
| Total number | | **24** | **44** |

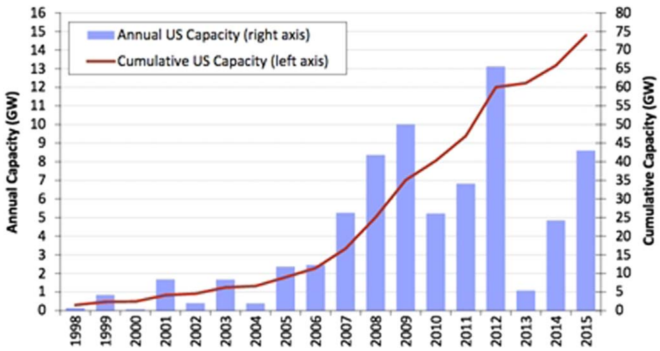



**Fig. 3.** Annual and cumulative capacity in U.S. wind power capacity [27].
Ref: [29] Wiser, R. & M. Bolinger, 2016. 2015 Wind Technologies Market Report. Lawrence Berkeley National Laboratory (LBNL), Berkeley.

headquarters of the National Oceanic and Atmospheric Administration (NOAA) (subordinated authority to the U.S. Department of Commerce) in Washington D.C. on 20th March 2015 and involved a group of ten senior officials and staff of the authority. The study team selected interviewees based on their expertise and their ability to provide insights into perceived issues at the federal level as the authority has a remit in multiple energy sectors. Qualitative data was acquired through a moderated discussion and analysed using tape- and note-based analysis. In the following section, the results and focus on the context and related issues for energy governance at the national level arising from both a desk based context piece (Sections 4.1 and 4.1.1) and insights from the focus group and interviews (Sections 4.1.2, 4.1.3 and 4.1.4) are presented. International examples provide a desk-based review on European country examples for marine renewable energy consenting (Section 4.2). Section 5 then outlines the details of the local level case studies. Sections 6 and 7 build on the comparative case studies and discuss and draw conclusions in light of the governance domains established in the sections above.

## 4. Results

### *4.1. Context for energy governance at the national level*

The U.S. energy portfolio is dominated by the use of largely non-renewable energy resources. The rise of domestic production of oil and shale gas between 2008 and 2014 supported the resurgence of oil and gas production [25]. Whilst renewables in U.S. energy consumption accounted for only 10% of the overall consumption, non-renewable energy and nuclear electric power accounted for 89%. Whilst the traditional energy sources hydroelectric power, wood and biofuels accounted for 71%, wind energy accounted for only 18% of the entire renewable energy portfolio. Investments in renewable energy developments in the U.S. are second largest globally ($38.3bn US in 2014, 7% increase year previous, after China with $83.3bn US, 33% year previous) [26]. However, developments of national importance in the marine environment are lagging [27]. Despite the strong annual growth of land-based wind developments and the potential for offshore developments, the wind energy market provided only 5.6% of total electricity generation in 2015 [28]. The U.S. lag behind European countries such as Denmark which achieves up to 40%, and Portugal, Ireland and Spain which achieve up to 20–30% of electricity supply from renewable energy resources.

There was a high degree of consensus amongst those interviewed that this was partly because the renewable energy portfolio has not been priority of government administrations. Rather, the country, as the world biggest producer and second biggest exporter of oil and the biggest producer of natural gas [25], still strongly relies on the use of finite energy resources. In terms of the enabling conditions, several of those interviewed mentioned major obstacles towards an energy transition. These obstacles were a lack of formal commitment, and sufficient capacity by congress to stimulate developments and a lack of clarity and coherence in energy planning. The powerful role of congress in steering tax policies and the complex regime for energy planning are highlighted in the following sections. With regard to renewables, both terrestrial and in the marine environment, interviewees highlighted three key issues for the slow pace of development at the federal level:

– Dependence on the federal tax policy and investor uncertainties (Section 4.1.1),
– Lack of clarity and coherence in regulation and planning of energy at the federal level (Section 4.1.2),
– Lack of a nested system for energy governance and overlapping jurisdiction between states and the federal level (Section 4.1.3).

#### *4.1.1. Dependence on the federal tax policy and investor uncertainties*

Key enabling conditions for the stimulation of investments in emerging renewable energy developments relate to federal tax policy and financial incentives. Fig. 3 shows the annual and cumulative capacity of land-based wind energy. From 2007–2009, 2010–2012, and from 2013 to 2015 the sector grew strongly due to the federal wind Production Tax Credit (PTC). Significant growth years are followed by lacklustre years immediately thereafter (2010, 2013) [29].

Wiser & Bolinger [29] highlight that this pattern evolved mainly due to the federal tax policy. The scheme includes a termination of the PTC after three years and requires renewal by congress. As highlighted through discussions, the congress often not extended the PTC until shortly before the subsequent fiscal year, leaving investors with uncertainty about the renewal period and conditions. This led to large capacity additions during the years in which the PTC was set to expire. Central federal approaches to taxation, steered by congressional decisions, caused favourable terms in the short-term, but at the same time created uncertainty over a longer period. In December 2015, congress voted to extend the PTC for five years. This is expected to drive substantial additional capacity in the near term.

Continuing uncertainties relate to a lack of formal commitment and insufficient capacity of congress to provide favourable market conditions. At the same time, annual growth trends were influenced positively by favourable market externalities in land-based wind developments. These are improved costs and performance, corporate demand for wind energy and state driven tax policies, namely the Renewable Energy Portfolio Standard (RPS) and the Mandatory Green Power Option (MGPO). Here tax policies are used to achieve policy objectives towards a state's renewable energy portfolio [30]. As opposed to the PTC, interview partners emphasised that particularly the state RPS, which requires utilities to acquire a certain share of their electricity supply from renewable energy sources, became a promising market-based policy instrument to overcome some of the uncertainties arising from PTC termination. This is because the RPS required utilities to acquire a certain share of their electricity supply from renewable energy sources.

#### *4.1.2. Lack of clarity and coherence in the regulation and planning of energy at the federal level*

The focus group discussion with senior federal level officials, yielded insights into the current framework for energy consenting with a focus on comparative views of both land-based and offshore oil and gas, and marine renewables, particularly offshore wind. Federal decisions towards the consenting of marine renewables have been influenced significantly by experiences from the oil and gas consenting regime, which dates back over 50 years [31].

The consenting system for energy development both terrestrial and at sea is based on a complex multi-level (federal, state, local) and multi-agency regime for licensing of energy infrastructure. The 2005 Energy Policy Act (EPAct) is the overriding regulatory authority at the federal level. With regard to developments in the marine environment, the

EPAct authorizes the Bureau of Ocean Energy Management (BOEM) to issue leases, assessments and right of way to allow for renewable and non-renewable energy developments (oil and gas leasing) on the Outer Continental Shelf (OSC). In 2009 new regulations (Final Renewable Energy Framework) provided oversight responsibility of offshore renewable energy activities to BOEM.

In order to highlight the complex conditions for licensing, practical terms of the consenting process and lead responsibilities for large offshore developments arising from the focus group discussion will be highlighted. Developers that seek to explore offshore oil or gas need to contact BOEM under the DOI first. The bureau has a consolidated review for oil and gas developments beyond the three sea mile jurisdiction. In order to ensure federal consistency, a state agency needs to review the project before granting the final lease. After this is granted, a developer needs authorisation for the exploration plan and the development and production plan from the Bureau of Safety and Environmental Enforcement within the DOI. By contrast, in terms of a marine renewable energy development in federal waters beyond three nautical miles, BOEM has the overarching authority, does the leasing and has the right of way for the tracks and the transmission lines.

The state needs to become involved to review the application of an energy project (State Review). Once a development generates energy that needs to be transmitted to the national grid, the developer needs to get an authorisation by the Federal Energy Regulatory Commission (FERC). If the project is being developed within the three sea miles with adjacent mainland connection across state waters, a development will exclude BOEM and fall under state jurisdiction. Table 2 provides a comparative analysis for the different responsibilities in energy regulation for offshore oil and gas explorations and marine renewable energy projects. It further lists the responsible authorities for land-based energy regulation.

The table highlights the wide array of authorities having a central responsibility in energy consenting. Interviewees suggested that lead organisations are often independent of each other, which has created delays, led to economic uncertainty and hindered progress in the sector. Issues appear to be the lack of formal commitment at the federal level and a nested system for energy governance (providing integration between policy implementation, regulation and stakeholder engagement). Other issues are overlapping jurisdiction between states and the federal level both at sea and on land, and shifting lead responsibilities for consenting that address the siting, exploration, development, refinement and sale of energy infrastructure.

**Table 2**
Comparative analysis of energy regulation and responsibilities in land-based and offshore oil and gas and marine renewable energy governance.

| Energy source | Lead consenting responsibility |
|---|---|
| **Land-based oil and gas** | U.S. Department of the Interior (DOI)<br>Bureau of Land Management (under DOI)<br>Office of Indian Energy and Economic Development<br>Surface Mining Reclamation and Enforcement (under DOI)<br>Office of Drinking Water (under the Environmental Protection Agency)<br>Surface Transportation Board (under the U.S. Department of Transportation (DOT))<br>Federal Energy Regulatory Commission (FERC) |
| **Offshore oil and gas** | Bureau of Ocean Energy Management (BOEM) (under the DOI)<br>State Reviews – Lease, exploration plan, development and production plan<br>Bureau of Safety and Environmental Enforcement within the DOI |
| **Marine renewable energy** | BOEM<br>State Reviews<br>FERC (for transmission)<br>In State Waters FERC (no BOEM authorisation is needed) |

*4.1.3. Lack of a nested system for energy governance and overlapping jurisdiction between states and the federal level*

The previous section highlighted BOEM as an institution, which has oversight responsibility for both renewable and non-renewable energy related decisions in the marine environment. Interviewees unanimously agreed that BOEM has succeeded in speeding up consenting of projects to some extent, however institutional integration across diverse stakeholders in the process of implementing energy projects is still lacking. Interviewees highlighted that public engagement was not envisaged to be carried locally with or within coastal communities. Rather BOEM works with interested and affected federal, state, local and tribal governments through intergovernmental renewable energy task forces. Task forces have been established within thirteen coastal states to date and have been established amongst others to improve stakeholder engagement. However, interview partners anonymously agreed that vertical integration particularly down to the local public level and vice versa is still lacking.

The majority of interviewees referred to the Cape Wind project (mentioned in Section 1) as an example, which illustrates the difficulties in U.S. consenting of marine energy developments and in finding solutions to strong objections mostly driven by visual intrusion. In contrast, the example of Rhode Island's Ocean Special Area Management Plan (Ocean SAMP) was offered repeatedly as an example of successful programme implementation because it reconciled issues such as a fragmented approach to decision-making and overlapping jurisdictions. SAMPs are highlighted in the 1972 Federal Coastal Zone Management Act (as amended through Pub. L. No. 109-58, the Energy Policy Act of 2005) [32], as an overarching framework at the federal level that seeks to harmonise overlapping interests in water use decisions. The Ocean SAMP is the first of its kind in the marine environment. It was formally adopted in 2011 by the state government and the responsible federal government authority. It covers a 3800 $km^2$ and falls under both federal and state jurisdictions. The main driver for the development of the plan was Governor Donald L. Cacieri. In 2006, he mandated the provision of 15% of the state's electrical power by offshore wind resources by 2020. The mandate further included the construction of a wind farm off the coast of Rhode Island. The central authority for coastal resources management took up the mandate by proposing the creation of the Ocean SAMP [11,33,34]. In 2016, the process fundamentally enabled the successful construction of the Block Island Wind Farm, a first major step towards the energy transition in the U.S.

The examples highlight that *first*, a central state authority set out the goal to implement a SAMP that finally led to the development of an offshore wind farm off the coast of Rhode Island. *Second*, longstanding partners from the state government and academia with sufficient capacity for programme implementation gathered in a multiple stakeholder collaboration. *Third*, state and state academic funds were allocated to create a management plan that allowed the integration of the project into a wider marine spatial plan. *Fourth*, project partners aligned the process of implementation and the review of progress to very precise and timely project deadlines. Senior officials from academia and government agreed that the Ocean SAMP served as a regulatory, planning and adaptive management tool for marine use and agreed that the process proved to be effective in addressing emerging energy use conflicts. Section 5.3 discusses the plan from a local level perspective and emphasises the designation of a “Renewable Energy Zone” as a mechanism to prevent conflicting interests in water use decisions.

*4.1.4. Emerging lessons from state-level perspectives*

Interviewees concluded that uncertainties created by government decisions, multiple responsibilities and most importantly fragmentation are the most significant issues in marine renewable energy governance at the federal level. Whilst developers are ambitious and prove to have a high degree of pioneering mentality, larger energy transitions towards a larger share of renewable energy resources driven by the federal government (administration, congress, senate) are lagging behind. Interviewees agreed that a nested system is needed to provide economic certainty and to allow bottom-up energy transitions to unfold. A disconnect between federal level power dynamics and politics, and priorities at lower levels, such as the state and the local level were mentioned as one of the key challenges for progress. Examples at the state and local level such as the implementation of the Ocean SAMP and the development of the Block Island Wind Farm show that despite policy dynamics at the federal level, nested decision-making can create the enabling conditions to drive individual projects and progress of the sector forward. The following section presents broader perspectives and highlights high-level views on solutions towards marine renewable energy transitions from Denmark and the United Kingdom (UK).

### 4.2. Experiences from Europe

In terms of learning from best practice, the Danish approach offers potential insights in consideration of issues of ‘Lack of clarity and coherence in regulation and planning of energy’ and a ‘Lack of a nested system for energy governance and overlapping jurisdiction’. In 2016, The World Bank [35] ranked Denmark as first in renewable energy performance. This was due to ambitious policy goals as well as streamlined consenting processes. Today over 40% of the country's electricity demand are provided by renewable energy sources, particularly on- and offshore wind. The plan is to provide 100% of the Denmark's energy demand from renewable energy sources. The country has a single streamlined process for all marine renewable energy developments. Only Denmark, Italy and the Netherlands have such a single permit system [36]. Three licenses are required, one to carry out preliminary investigations, one to establish the marine renewable energy project and one for power generation. The regime is based on a tailor-made process, not built on existing regimes, for example for oil and gas sector. The Danish Environmental Agency (DEA) is the single ‘one-stop-shop’ authority for developers to manage often-opposing interests in the marine environment. It conducts hearings with other regulatory authorities and relevant local municipalities at pre-establishment phase of a project to address major concerns [6]. Municipality emphasis is on energy cooperatives that provide estimates of potential benefits of more localised and distributed patterns of energy generation [see 37,38].

Another example with successful consenting practice is the streamlined process for consenting of marine renewable energy developments in the UK. The potential for marine renewables in Scotland in particular is significant with already 398-MW installed tidal energy capacity and targets to provide 100% of gross energy consumption to be generated from renewables by 2020 [39]. The target to meet 50% renewable electricity was exceeded in 2015. A central point and single ‘one-stop-shop’ for marine renewable energy consenting is Marine Scotland. The authority administers the complete licensing process from screening and scoping consultations, the delivery of a Marine Licence and the final decision by the minister. Licensing procedures in the rest of the UK are conducted according to a similar approach [40]. Wright [41] highlights strength and weaknesses of the process. Stakeholders particularly emphasised early strategic engagement by Marine Scotland as a central improvement of procedural processes. The author emphasises that the system still needs cross-departmental integration and strong continued government commitment, which worked well so far. Whether a ‘one-stop-shop’ can be replicated in other large-scale developments within Scotland or other jurisdictions remains uncertain. This is because such framework needs to cope with a range of emerging issues surrounding energy developments in the marine environment.

Streamlined consenting, such as in Denmark and the UK, can facilitate the successful implementation of energy transitions. The examples emphasise that clear mandates for regulators (‘one-stop-shop’ approaches) and a nested system of governance at multiple scales can help to overcome some the issues highlighted in the examples presented. Finally, yet importantly, government commitment and support at the highest policy level can be a key factor for energy transitions. In this section, the authors of this article set out to show that nested decision-making, such as in the development of the Block Island wind farm, and streamlined consenting, such as in countries like Denmark and the UK, can be key factor of success. These conditions can be enabling factors to drive individual projects and progress of the sector forward. Against this background, the authors took a closer look at lower scales. The following section presents local level insights by examining experiences from three selected case studies in the marine renewable energy domain along the Northeast Coast of the U.S. at different development stages and with different lead responsibilities.

## 5. Selected case studies - Lessons on the energy transition in the U.S

The following section identifies enabling factors for a successful implementation of marine renewable energy programmes to identify general prerequisites for sustainable project development. Insights stem from case studies in different development stages (two completed and one ongoing) and different partners (one industry-led, one industry cluster-led, and one policy- and plan-led).

### 5.1. Local Maine based company sets up tidal energy arrays in the Bay of Fundy and provides local benefits (completed)

The Bay of Fundy has the highest mean spring tidal range in the world (~14.5 m) and is thus one of the most promising places worldwide for the generation of tidal power but commercial resources remain untapped. Due to the absence of visual intrusion, this type of technology is perceived to overcome some the issues related to strong objections, e.g. in comparison to offshore wind. However, the context of indigenous and local communities can affect local perceptions differently [7]. The development company constructed a pilot turbine for a tidal energy converter in Northeast Gulf of Maine. In 2012, the company successfully deployed a 30 ft demonstration device in the wider Bay of Fundy area. It was the first array of its kind in the Americas feeding power into the national grid. The company is now planning to test new designs and to expand developments to full commercial scale.

The example emphasised the necessary connection of the developer and the public and the developer's knowledge of public engagement. An intense dialogue between the company and the community, and access to highly experienced local contractors were central enablers of the successful implementation for the Bay of Fundy. Two senior executives of the development company informed about the process of implementation from an industry perspective. Separately, scientific peers, following the process as part of a review of stakeholder engagement, informed about the implementation process from an academic perspective. Interviewees agreed that the company engaged with the local public well before deploying the pilot device. Scientific peers further confirmed that the developer built the relationship with the community on trust and communication was transparent. The company set out a roadmap for community engagement and used it as part of a project implementation plan. The process aimed at unlocking win-win situations and maintaining a constant flow of information. First, the developer presented project plans in the community and asked stakeholders to come forward with priorities and ideas. The developer presented ideas on which technical support the company might contribute to achieve those visions. Afterwards the developer evaluated if power generated from the project can be used to benefit the community, e.g. by providing energy to adjacent towns and townlands creating local employment. The developer envisaged and presented the prospect of providing regional economic benefits. The developer made recourse to local contractors for predevelopment and construction. Well-prepared, trained staff provided the necessary technical support. Interviewees highlighted the employment of local contractors as a major precondition to gain trust in the community and acceptance of the project.

Senior executives summarized their experiences of engaging in the community by highlighting two pre-conditions for the successful implementation of the program, which are, *first*, developer's know-how of community engagement, and *second*, the provision of local benefits. By considering the local characteristics of the place and communicating with the community intensively, the community felt informed and supported the project. In terms of technology, tidal energy arrays are not without limitations. Although technology experts see huge potential in harnessing hydrokinetic power due to its force and fare more predictability than most other renewable energy sources, interview partners highlighted the following challenges: Intermittence of the resource, limits to energy yield at low or high tide, and power generating time of 75 percent across the arrays. However, the intermittence of hydrokinetic powers remains a challenge, the issues are less challenging for tidal than for wind energy [42]. Thus, the further roll out of such projects into the future is somewhat uncertain.

### 5.2. *State policies and industry stakeholders support the enabling conditions for offshore wind developments in the State of Maryland (ongoing)*

The potential for vast wind resources off the coast of Maryland has been identified by NOAA and others [20,31]. Firestone et al. [43] estimated that to meet Maryland's RPS (18% of the state's electricity supply by renewable energy sources by 2022) entirely by offshore wind energy resources would require the installation of 3,900-MW (using 5-MW arrays). Given the available space for wind farms, considering technological requirements, the state has the potential to install almost 60,000-MW capacity of offshore wind farms.

The case unveiled one major issue in governance, which was government inertia that created uncertainties. In 2013, Maryland's State Governor Martin O'Malley signed the Offshore Wind Energy Act [44]. This framework aimed to unlock the potential in the market, and to enhance the pace of development in the sector. The goal was to provide up to $1.7bn US as a development fund for 20 years to encourage the development of up to 500-MW of offshore wind capacity. Central ingredients of the bill were the Offshore Wind Renewable Energy Credit (OREC) and the business development fund. The OREC was a funding scheme, which supported pre-development of a roughly 200-MW offshore wind project off Maryland's coast. In 2016, site investigations for the project were undertaken.

In the aftermath of the establishment of the development fund, a business network for the promotion of offshore wind in Maryland was founded. Interviewees highlighted two key interventions by the state government to influence initial market conditions: *First*, in 2013 the signing of the Offshore Wind Energy Act [44] showed that the state government was committing to offshore renewable developments, which influenced sectoral confidence positively. *Second*, in early 2016 state government support shrank, when Governor Larry Hogan vetoed the Clean Energy Jobs Act (SB 921/HB 1106) [45], a bill to ensure that Maryland produces 25% of its electricity from renewable energy sources by 2020. This created mixed messages and inertia as the bill had already passed the General Assembly 2016 legislative session. Interviewees highlighted that the initial government support was essential to provide the preconditions for developments in the sector whilst mixed messages and a lack of consistent commitment in recent years was creating uncertainty for developers.

By considering the history of their own network, interviewees realized the value of a continued knowledge exchange and learning from developed renewable energy markets in Europe. Site visits were run routinely to places in Denmark, Germany and the UK (2015, 2016, 2017). This allied to topics like grid connection, transmission or the consenting process. Interviewees and observers from outside the project saw efforts to share this knowledge amongst network partners by supporting a constant flow and exchange of information as a precondition to gain trust between stakeholders along the supply chain. Interviewees further highlighted Public Private Partnership (PPP) initiatives and mutual learning experiences with international partners and from other sectors as useful means of fostering knowledge transfer. Interviewees agreed that given uncertainties at the federal level, this type of commitment by network partners is essential in creating the enabling conditions for larger energy developments.

### 5.3. *Government policies and allocated funding for a special area management plan led to the first offshore wind farm in U.S. waters (completed)*

The process of designating a “Renewable Energy Zone” in Rhode Island State waters as a key aspect of the plan-led approach deserves special emphasis. This is because it was used as an effective mechanism to engage with diverse stakeholders, create certainty for developers and prevent conflict in water use decisions. In this case state governmental resource planners and developers of the Block Island Wind Farm used the framework for the implementation of a Special Area Management Plan (SAMP) to create the legal basis for a marine spatial plan that covered an even wider area than the area of the then Block Island Farm itself. This process therefore created a much wider outcome than initially anticipated. As discussed in Section 4.1.3, initially it laid the foundation for the construction of the first offshore wind farm in the U.S. and second the adoption of the Ocean SAMP. The framework aimed at engaging with diverse stakeholders to produce insights on the marine use priorities of these stakeholders. Informal and formal mechanisms such as educational stakeholder group meetings, media outreach, and the establishment of a technical advisory committee were used to identify common grounds across all stakeholders. The open discussion finally led to the designation of a “Renewable Energy Zone” and an appropriate wind energy site off the Block Island coast in state waters [34].

Interviewees from the state government and academia agreed that the process created certainty for developers. In 2014, construction on the site began. However, they confirmed that the process was not without its challenges. At the federal level, conflicts arose due to delays in the impact assessment process as well as planning for single topics in state waters, which fall under the responsibility of federal authorities like BOEM, such as defense, navigation and interstate commerce. Interviewees emphasised that institutional capacity and leadership to implement towards a special area management plan created the enabling conditions for the successful implementation of the programme. Critical success factors identified by the interviewees in the process were *first* institutional capacity, expressed by the initial appeal by the state government and the allocation of state and state academic funds for programme implementation, and *second* meaningful coordination of the implementation, expressed by the leadership commitments by key individuals with responsible oversight. Interviewees highlighted vulnerabilities around over reliance upon a few key individuals. Therefore, a management team shared responsibilities across multiple leaders with different skills and experiences. A management team was formed, represented by government's central authority for coastal resources management and academia. In general, decisions took the local context of places and communities into account.

## 6. Discussion

In this study, the authors looked at governance challenges of marine renewable energy developments from the perspective of industry and government and with impacts on civil society. They asked what lessons can be learned from current practices in the context of energy governance at various levels in order to understand how to build the enabling conditions for moving towards a supply of energy with an enlarged share of marine renewable energy resources. Case study examples do not claim to be representative, as each country and regional context is different. An analysis of examples with similar issues must focus on the local context and the perceptions of the people hosting marine renewable energy infrastructure in their region. However, building on comparative case studies and interaction with multiple stakeholders at various scales, the authors discuss prerequisites for successful developments along the governance domains established and the transferability of the lessons in the following.

### 6.1. Prerequisites for successful developments

At the *federal level,* the authors observed a substantial governance problem for pushing marine energy. Failures in **policy and planning** weigh strongly in this context. Three key factors are apparent for the slow pace of marine renewables and sustainable energy transitions: The first issue is the adherence to short termism in federal tax policy and investor uncertainties created by congressional politics and decisions. The second probably most prominent is the existence of unclear and incoherent regulation for marine energy developments. The third underlying issue is a lack of a nested system for energy governance and overlapping jurisdiction between states and the *federal level*. Technological obstacles, such as device development, the security of energy supply and grid connection, are fundamental and to be solved but in this study these issues were not explored in detail. The assessment of the enabling conditions revealed that sufficient initial capacity within responsible government institutions at the *federal level* exist to provide financial resources that provided initial impetus for progress in the marine renewable sector. BOEM has oversight responsibility for both renewable and non-renewable energy related decisions in the marine environment, which provides structure. On one hand, both measures signal government commitment. However, the regular termination of funding and mixed messages at the highest levels creates uncertainty, which can halt progress in the sector. Investors are left with a feeling that policy support shrinks. The study also showed that convoluted and unclear consenting regimes for energy in the marine environment can also create uncertainty and deter developments. Industry can help to overcome issues to some extent. It can provide necessary integration through knowledge exchange with diverse stakeholders along the supply chain and a constant flow of information. However, unless the government is committed to creating the enabling conditions, sustainable energy transitions are unlikely to emerge.

The three case studies highlighted lessons from the *state and local level*. Case study 1 (Section 5.1) revealed two key factors for success: The first was the developer's knowledge of **community engagement** as a central pillar of the company's development strategy. The second factor was the provision of local benefits. Case study 2 (section 5.2) laid out government inertia as a major problem hindering progression towards marine renewable energy developments that again can be identified as a government failure at the *federal level*. Case study 3 (section 5.3) highlighted the allocation of state and academic funds and a combination of a multiple stakeholder approach (policy-, academic- and plan-led) as key enabling conditions for a successful **industry development** and project implementation, despite various issues identified at the *federal level* . The example from Rhode Island unveiled strengths and weaknesses of an integrated framework and marine spatial plan (Ocean SAMP). Here, new coalitions, partnerships and networks evolved in various areas relevant to the energy field that enabled the management of energy transitions at small scales. The process revealed that despite strong objections, which figure strongly in the U.S., the government designated an area for marine renewable energy developments, which finally led to a significant development. The assessment of the enabling conditions revealed that a core group of well-informed and supportive stakeholder groups were key to support the program. This was not least achieved by the collaboration of experienced staff from state government and academia, with relevant facilitation and negotiation skills. In addition, sufficient initial capacity within responsible government institutions at the state level existed that helped to support progress in the sector.

### 6.2. Transferability of state and local level lessons

In terms of the transferability of the lessons, the findings emphasise that a plan-led approach at the *national level* that addresses issues in water use can bring in views from various users in the marine environment and set unambiguous priorities for a future energy mix. A spatial planning process can open windows of opportunity for developers to undertake engagement with communities likely to be impacted by energy developments in the marine environment, and thereby can create the enabling conditions for successful project implementations. Meaningful stakeholder engagement can be an important prerequisite to building credible government decisions in order to build well-informed stakeholder groups that support energy developments. Case studies demonstrated that academia could play an important role by facilitating and undertaking stakeholder engagement, particularly in situations when people are reluctant to engage with developers.

The lessons emphasise that current top down approaches to decision-making at the *federal level* can benefit from integrative frameworks that allow for deliberative and participatory processes that enable decisions to distil down to lower levels. This is because yet favourable decisions based on top-down approaches at the highest level served to halt progress in the sector. Decision-makers should put in place new mechanisms to gain multifaceted views on societal priorities and perceived outcomes of developments. This could help to develop unambiguous priorities for a future energy mix and streamlined processes for consenting, such as those internationally and nationally presented in this paper. A 'one-stop-shop' for the licensing of marine renewable developments may not a one-fits-all solution. This is because this study identified a lack in departmental coordination and government commitment, which both remains major prerequisites for success.

An important thing that needs further scientific attention, is the ability to learn from international examples of best and worst practices, such as the ones touched upon in this paper. Loorbach & Rotmans [3] propose innovative, multidisciplinary, and participative forms of governance, such as transition management, for wider energy transitions. This must include deliberative bottom-up processes to influence governance activities at higher levels in such a way that it leads to accelerated change directed towards sustainability ambitions [46]. This means that in the long term, a dedicated central 'energy transition management team' across government, industry and academia could support integration between the process of policy implementation, regulation and meaningful stakeholder engagement. For federal authorities this could mean a structural realignment towards integrative approaches and intense engagement with multiple stakeholders at multiple levels.

## 7. Conclusions

Transitions towards sustainable energy futures at the *local* and *state level* in the U.S. are underway. Innovative examples of deliberative decision-making are progressing, producing frontrunners and leadership across diverse stakeholders, who are creating the enabling conditions towards successful implementation of transition projects. By applying the governance baseline framework by Olsen et al. [12], to analyse the energy transitions at various scales, the authors found that participative forms of governance could seek stakeholder support and drive progress in the sector, despite weak support at the *federal level*. Getting the renewable energy transition off the ground requires more engaged and predictable initiatives from the federal government. The establishment of an integrating mechanism may help to meet some of the challenges identified. In the Trump administration, it would appear that this is unlikely to happen. However, even if *federal level* politics will be able to delay the process, *state and local level* ambitions and

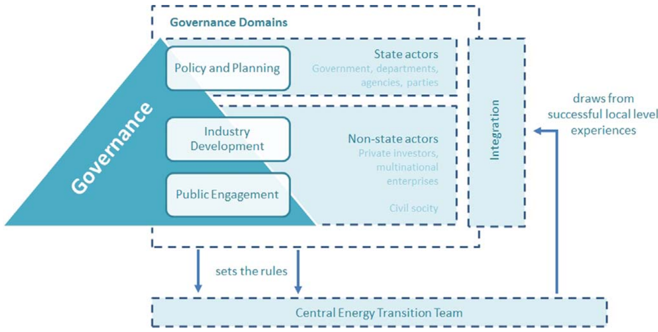



**Fig. 4.** Governance setup towards energy transition based on learning from successful local level experiences.

commitment have already created momentum towards the inevitable transition.

The study supports engagement by leaders at *state and local level* to engage with civil society and provide realistic promises on future costs and benefits of transitions towards marine renewables. In light of the very idea of transition management, which is the building of continuous pressure on the higher political levels of governance through the creation new coalitions, partnerships and networks, this study arguably opens a way to learn from local experiences.

Referring back to the governance understanding established in this paper (Fig. 1, Section 1), the authors of this article suggest the establishment of a central 'energy transition team', that draws from experiences of frontrunners and successful examples at the local level. Fig. 4 highlights the governance understanding and puts a central 'energy transition management team' at the centre of integration and learning from best practices. The task of the institution should not be limited to learn from successful applications locally, nationally and internationally. It should also discover weaknesses in the current interplay of federal and state affairs with an impact on the development of local projects, such as experiences drawn out in this study.

Slow pace of marine renewable energy developments at the *federal* level has been indicated. The authors identified three key issues that need to be addressed to overcome this slow pace: *First*, federal government decisions must address the need for greater certainty amongst investors by creating tax policies that enable long term incentives rather than providing certainty for a short time frame only (from pre-development to construction only). *Second*, the complex multi-level (federal, state, local) and multi-agency regime for licensing of energy infrastructure needs to be replaced by integrated frameworks, such as a wider marine spatial plan with designated areas for marine uses. The study emphasise the opportunity to develop more SAMPs by addressing proper preparatory planning and avoiding marine resource conflicts at development stage. *Third*, a system of formal arrangements for energy governance may be considered to provide integration between policy implementation, regulation and stakeholder engagement.

The future of the U.S. energy transition will depend on the ability and willingness of the *federal state* to address the issues and create momentum of current state level ambitions and support. On the other hand, the region needs to continue facilitated diverse engagement with society that needs to support changes towards more sustainable development.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