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Scenario-Building for Marine Spatial Planning

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1   Introduction

The use of scenarios in strategic (terrestrial) spatial planning has been widely accepted for a number of years (ESPON 2007; Haughton et al. 2010). A range of scenario-building techniques has also been applied within marine management in order to support decision-making (Van Hoof et al. 2014; Lukic et al. 2018). Scenario-building is now attracting some attention within the specific context of marine/maritime spatial planning (MSP) too. This chapter explores the extent to which scenario-building is starting to be introduced and presents a scenario-building exercise carried out in relation to a transboundary MSP exercise for the Celtic Seas region. This example of scenario-building takes previous practice as its starting point but aims to produce a narrative that focuses more directly on two of the most critical issues for MSP in transboundary spaces—namely evolving patterns of spatial development in the marine area and the need for increased cooperation between MSP authorities.

Scenario-building is one of a set of terms being used to suggest a future-oriented, strategic dimension to planning; visions, forecasts, strategies, prospective road maps and action plans also suggest forward-looking tools to support plan-making. For simplicity, in this chapter, we focus on the notion of scenarios. The concept has its origins in military strategy and business plan-

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ning (Lindgren and Bandhold 2009) but has been adopted within public administration. Whilst there is no single definition of a scenario, one useful definition from the Intergovernmental Panel on Climate Change (2001) states:

> A scenario is a coherent, internally consistent and plausible description of a possible future state of the world. It is not a forecast; rather, each scenario is one alternative image of how the future can unfold.

Therefore, any process that examines a scenario or scenarios involves the creation of alternative images of the future and evaluating them against some kind of goal or set of values. In doing so, the purpose of using scenarios is inextricably linked to the question of *what do we want to know about the future?* At a general level, van Hoof et al. (2014) suggest that scenarios "can contribute to policy decision making by identifying and anticipating developments (desirable and undesirable) and information gaps and inconsistencies" that help to focus attention on causal processes and decision points that can be used in making better strategies.

2   Existing Scenario-Building Practice

The United Nations Educational, Scientific and Cultural Organization (UNESCO) MSP guide (Ehler and Douvere 2009) suggests that an MSP process should include the consideration of alternative spatial scenarios, of which one should be selected as the goal of the plan. Indeed, there are a number of existing examples of scenario-building within the context of coastal and marine planning and management. These have been partly experimental in nature, related to pilot projects, but also include some official processes. A frequently quoted example is that of the Belgian GAUFRE project (Maes et al. 2005). This was a research project that developed a visionary approach for the marine environment, applying certain land-use planning concepts and methodologies.

Here, we present more detailed examples from the UK, France and the wider Celtic Seas region. Firstly, in 2004, the UK's Department for the Environment, Food and Rural Affairs commissioned a study on Alternative Futures for Marine Ecosystems (AFMEC), (Pinnegar et al. 2006). This aimed to create a set of scenarios for use in strategic planning over a 20–30-year time frame. This resulted in a four-quadrant, two axes *possibility space*, which helped to define four scenarios. The two axes were the driving forces of the scenarios: societal values (from individual to community) along the horizontal axis, and

distribution of power (autonomy to interdependence) along the vertical axis. Incorporating other key parameters, such as gross domestic product (GDP), demographic change and water consumption, it was then possible to build narratives related to the four separate quadrants of the possibility space. These narratives were given summary names: World Markets, Global Commons, Fortress Britain and Local Stewardship. The scenarios were then applied to a range of activity domains such as climate, fisheries and aggregates to demonstrate how possible trends may play out.

Secondly, within the UK's English marine planning process, there are key stages where future uses of the sea are being considered. In the initial plan preparation phase, these include "identifying issues" and "gathering evidence". In these two stages, the Marine Management Organisation (MMO) in conjunction with stakeholders gathered information about the plan area. In the "options development" stage, the MMO considered different ways of achieving the plan objectives and vision. Options were compared to a *business as usual* scenario, which considered how the marine area might develop in the absence of a MSP. Scenarios were again incorporated into the "plan policy development" stage. The MMO commissioned research to review past trends and current drivers and develop future projections for selected industry sectors active in the plan areas (MMO 2017). The scenarios used in this exercise were developed as part of the Celtic Seas Partnership's Future Trends project (described later) and consisted of *Business as Usual*, *Nature @ Work* (maximising ecosystem services) and *Local Stewardship* (local decision-making and differentiation) scenarios. Changes in activity for each sector were mapped and plotted according to the most appropriate unit of activity (e.g. MW of energy generated, Gross Value Added (GVA), freight tonnage). Potential trade-offs between sectors and the environment were identified in each of the marine plan areas.

Thirdly, in France, the North Atlantic-Western Channel Façade is piloting the implementation and monitoring of strategic planning for maritime space and coastal areas (*façades*). A guide to the process by which it will be produced was recently published (Ministère de l'Environnement, de l'Énergie et de la Mer 2017 and Direction Interrégionale de la Mer Nord Atlantique-Manche Ouest (DIRM-NAMO) 2017). In the first stage, the existing conditions of the *façades* and emerging issues and risks will be identified. This will be followed by the definition of a Vision for 2030, priority objectives for the *façades* and the selection of indicators to measure progress against the objectives. In defining the Vision for 2030, a scenarios method will be adopted that builds in different socio-economic, institutional and environmental factors to develop contrasting pathways and visions and enables different points of view and actors to be brought together for collective reflection.

Finally, the Celtic Seas Partnership's Future Trends work examined the future of the Celtic Seas region, with reference to what this means for the achievement of good environmental status (GES) and the need for an integrated, ecosystem-based approach to marine management (ABPmer and ICF International 2016). The period considered was approximately 20 years from 2016 and covered 10 maritime sectors including conservation. In this project a set of three scenarios was used to project and map spatial development and highlight potential opportunities and spatial conflicts that may need to be resolved through cooperation.

It is also worthwhile to note that within the context of the European Union's framework for MSP, Directive 2014/89/EU (the MSP Directive, EC 2014) does not directly refer to scenarios, but Article 4(5) states:

> Member States shall have due regard to the particularities of the marine regions, relevant *existing and future activities and uses* [emphasis added] and their impacts on the environment, as well as to natural resources, and shall also take into account land-sea interactions.

In addition to this, maritime spatial plans should "identify the spatial and temporal distribution of relevant existing and future activities and uses in their marine waters" (Art. 8) to support the sustainable development and growth of the maritime sector. In so doing, Member States should take into consideration relevant interactions of activities and uses, such as aquaculture areas, fishing areas, installations and infrastructures for energy, transport routes and so on. Hence the need to take into account future uses and activities across a range of sectors may provide for the consideration of alternative options or scenarios. Furthermore, where maritime spatial plans are likely to have significant effects on the environment, they are subject to Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (the SEA Directive, EC 2001). This requires that in thinking about policy responses, "reasonable alternatives taking into account the objectives and geographical scope of the plan" should be considered, thereby ensuring plan-making authorities explore differing futures in some way.

3   Developing a Typology of Scenarios

These examples of scenario-building for marine management illustrate different ways of thinking about the future and the different types of scenario that may be used to answer questions about pathways for development. Borjeson

et al. (2006) provide a simple distinction between scenario types based on the principal questions that a user may want to pose about the future:

- What will happen?
- What can happen?
- How can a specific target be reached?

Normative scenarios address the question "how can a specific target be reached?" and are most frequently used when a desired end state is known, with the user wanting to determine how that state can be reached by working backwards. Back casting from an end state can help to identify incremental steps that should be taken to achieve the desired goal. Back casting can also identify the factors that may prevent achievement of the end goal.

Predictive scenarios attempt to answer the question of "what will happen?" In this case, information about the past and present is projected forward to a future point to see what the situation might be, that is, changes are determined by forecasting. For example, predictions of coastal erosion around the UK coast have been used to develop Shoreline Management Plans that respond to potential risks over 20-, 50- and 100-year periods.

Exploratory scenarios consider "what can happen?" given a set of plausible futures. They are often used to understand developments over a longer time horizon or more strategic issues (Borjeson et al. 2006, 727). An example of this is a project which aimed to strengthen the preparedness and adaptive capacity of communities within the Hudson River watershed in the face of climate change (Roberts 2014). Here four scenarios (Procrastination Blues, Stagflation Rules, Nature be Damned! and Give Rivers Room!) were used to determine the consequences of different paths of action and the likelihood that different response options would be taken up under each scenario.

The pathways explored by each of the three types of scenario are illustrated in Fig. 14.1. Visualising scenarios in this way, normative scenarios may be seen as *inward bound* as they work backwards to see how a desired future might grow from the present. In contrast, predictive and exploratory scenarios might be described as *outward bound* as they extrapolate trends into the future or ask "what if?" or "what can happen? questions to arrive at a range of possibilities.

There are instances when different types of scenario (exploratory, normative etc.) can be used in conjunction with each other. For example, in the Water Scenarios for Europe and for Neighbouring Countries (SCENES) project, exploratory scenarios for freshwater management were first developed to provide a specific "end point" that set a socio-economic and institutional

Normative
How can a specific target be reached?

Predictive
What will happen?
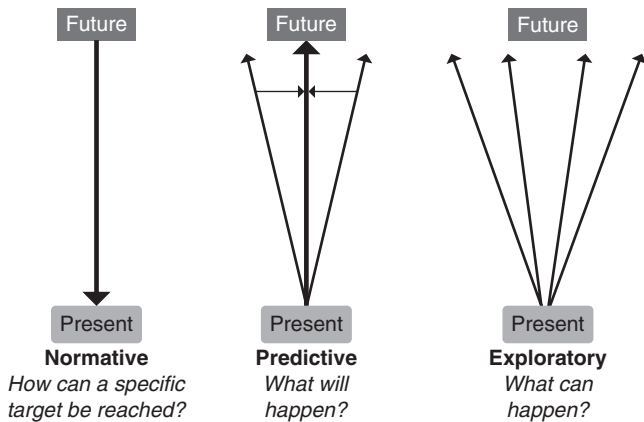
Exploratory
What can happen?

Fig. 14.1 Types of scenario

context for water management. Then a back casting (normative) method was used to identify interim objectives, policy actions and strategies to achieve this vision (Kok et al. 2011).

4   Principles of Scenarios

Based on these examples and wider literature, a set of principles for developing scenarios for use in MSP can be outlined. These are:

1. *Scenario-building should be participatory:* Scenarios should be created with stakeholder input, either in the creation of the initial narrative, defining focus/scope, or in checking plausibility and potential outcomes (Herry and Winder 2015).
2. *An appropriate time frame should be adopted:* this may vary depending on the nature of driving forces. This should be at least 5 years where change happens quickly but up to 50 years where change may be more slow or uncertain; at least 10 years is typical (Pinnegar et al. 2006, 16).
3. *Plurality is required:* two to four scenarios are considered to be the optimal number for exploring a range of potential futures.
4. *The scenarios developed should have plausibility:* whilst scenarios are not intended to be accurate forecasts of the future, they should be constructed in such a way that users can see the scenarios as possible futures.
5. *Scenarios should have internal consistency:* the building blocks (or drivers) that are used to create each scenario should be joined together in an explainable and logical manner (Haines-Young et al. 2011; Van Hoof et al. 2014).

6. ***Scenarios should have resonance with their users:*** the scenarios produced should have sufficiently distinct narratives for users to understand the varying conditions and drivers to be considered. They should tell a story that is convincing. Dramatic or extreme scenarios, using memorable names, are helpful in this instance (Joint Research Commission 2008).

5   Scenarios for the Celtic Seas

A scenario-building exercise was carried out as part of a transboundary MSP project that sought to understand possible future patterns of spatial development in the Celtic Seas region and what this might mean for transboundary cooperation on MSP (see McGowan et al. 2018; and www.simcelt.eu). This region incorporates national waters from France, Ireland and the UK and involves seven administrations with MSP responsibilities.

The development of scenarios in this exercise followed a four-stage process:

- Background material on key maritime sectors was collected and used to produce a set of sectoral Briefing Notes. These covered policies and MSP processes in relation to the specific sector and identified a series of drivers (political, economic, technological, etc.) that may be critical to the future development of each sector across the Celtic Seas.
- Based on previous examples of scenario development, a *possibility space* was developed as a framework to shape four distinct scenarios. This was shaped around two axes, representing two dimensions of particular importance to transboundary cooperation.
- The drivers for change identified in the Briefing Notes were mapped on to the new possibility space in order to create more in-depth narratives or *pen pictures* for each scenario.
- The scenarios were tested by stakeholders in a workshop setting, where they considered different sectoral trajectories for growth, what this might mean for integration and identified key issues where transboundary working would become more important.

5.1   Chosen Sectors

The sectors included in this exercise were deliberately limited to a small number due to the time-limited nature of the project and to make it possible to examine each sector in depth. They were selected using two criteria:

- The sector has a distinct transnational dimension, in terms of movement across transnational space or fixed patterns of spatial development (or structures) that span national borders or
- The sector is known to have growing spatial demands, that is, it is an expanding sector that must be taken into account in the development of maritime spatial plans

The sectors chosen were:

- Cables and Pipelines
- Ports and Shipping
- Offshore Wind Energy
- Wave and Tidal Energy
- Aquaculture

5.2   The Development of Scenarios: The Possibility Space

Following previous examples of scenario development, the scenarios were developed using the four-quadrant or *possibility space* approach with two main variables used to construct the horizontal and vertical axes. The axes represented to key dimensions, as follows.

Footprint: Spatial Diffusion Versus Efficiency (Horizontal Axis)

Changing spatial footprint was represented by a continuum from spatial diffusion to spatial efficiency. Whereas previous scenario exercises have tended to use environmental concerns or green approaches against economic development as a proxy for changing spatial footprint, this approach recognised how the activities of many new maritime sectors are shaped by technological advances and the drive to decarbonise the economy, providing *greener* or more sustainable patterns of development, for example, energy generation from offshore wind turbines or cleaner, more fuel-efficient ship design. Given the different stages of economic growth that can be attributed to different maritime sectors, some activities can be expected to expand in terms of spatial distribution (e.g. the development of new offshore wind farms) and/or resource use (e.g. more intensive aquaculture). Conversely, other maritime sectors could be expected to decrease their spatial footprint (e.g. when oil and gas fields are exhausted and rigs are decommissioned).

In this case, **spatial diffusion** is used to describe a situation where different marine users or sectors:

- take up the maximum amount of marine space that is available to them;
- use that space exclusively (i.e. do not coexist or co-locate with other marine users); and
- use marine resources both expansively and most intensively to maximise exploitation of the marine resource available to them.

Spatial efficiency, on the other hand, occurs when users or sectors:

- take up a smaller amount of marine space;
- use the same space—coexisting or co-locating with other compatible activities;
- use limited resources or use marine resources in a more sustainable manner.

Cooperation: Autonomy Versus Cooperation (Vertical Axis)

This axis reflected the degree of cooperation that takes place between MSP authorities. At the bottom end of the scale, *autonomy* refers to minimal levels of cooperation between authorities (at national or international scales) and the maintenance of "hard" boundaries around a given entity's maritime space. At the opposite end of the vertical axis, *cooperation* refers to strong relationships between planning authorities that span national borders, more permeable boundaries (whilst respecting national sovereignty) and a recognition of shared responsibility for maritime regions. This may manifest itself in the development of regional cooperation, new models of governance, ecosystem-based management or more integrated forms of planning (van Tatenhove 2013).

The Possibility Space

By combining the two axes, a possibility space is created containing four quadrants or possible outcomes (scenarios), depending on different combinations of footprint and cooperation (Fig. 14.2). This allows the development of more detailed scenarios. In the top left-hand quadrant, Scenario 1 represents a situation where cooperation may be high between authorities and patterns of development also show high levels of spatial diffusion. Moving to the right,
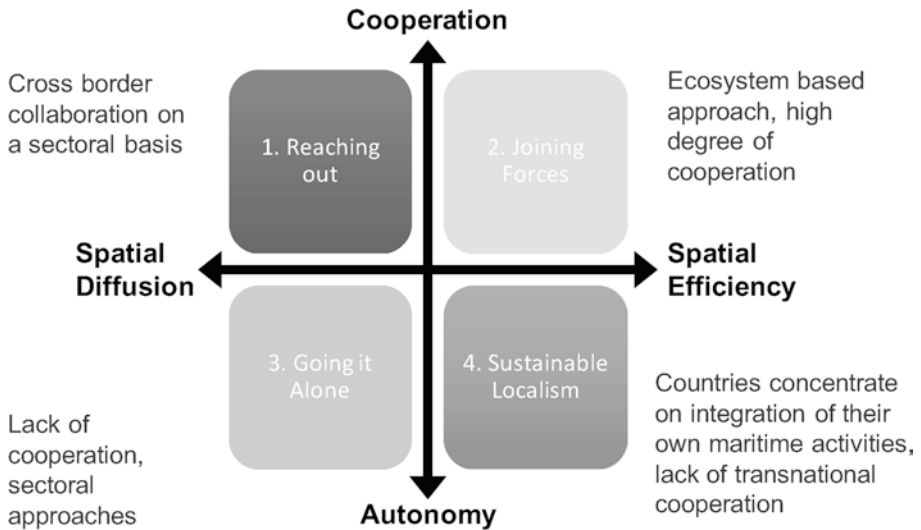
Fig. 14.2   The SIMCelt possibility space

Scenario 2 also displays high levels of cooperation but a high level of spatial efficiency. In certain circumstances this may be considered the *ideal* scenario as it represents the greatest level of cooperation between authorities and most efficient use of marine resources. In contrast, the bottom left-hand quadrant (Scenario 3) represents a situation of little cooperation and high levels of spatial diffusion, inferring uncoordinated and expansive resource use. Finally, Scenario 4 (bottom right-hand quadrant) refers to a situation of little transboundary cooperation but more efficient resource use within individual jurisdictions. Full descriptions for each scenario are given in Fig. 14.4.

5.3   Mapping Drivers onto the Possibility Space

Having defined the four different scenarios, the next step was to develop a storyline for each scenario. This was expressed in a set of four *pen pictures*. To do this:

1. The drivers for change identified in the Briefing Notes were collated in a table for each sector, with additional columns for spatial efficiency, increasing cooperation and justification,
2. For each driver or planning issue, a judgement was made whether it would lead to increasing or decreasing spatial efficiency and increasing or decreasing levels of cooperation between authorities. The results of this were recorded in a table (see example in Fig. 14.3) with justification.

Sector: Aquaculture		Spatial Efficiency	Cooperation	Justification
A8	National ambitions to increase aquaculture production	-	+	Will require some expansion of sites, but also increased stakeholder engagement
A21	Development of integrated multi-trophic aquaculture (IMTA), or polyculture, where different species such as shellfish, seaweed and fish are cultivated together to enable the recycling of nutrients through the food chain	+	=	Positive impacts in terms of spatial efficiency. May not require transboundary cooperation
Sector: Offshore Wind Energy				
O24	Increasing size and generation capacity of wind turbines	+	-/=	Possibility to concentrate higher output in smaller areas.
Sector: Ports and Shipping				
P5	Reduction of CO_2 emissions and pollution by shipping	=	+	Enforcement may require cooperation between authorities
P8	Continued development of the TEN-T network	=/+	++	Concentration of shipping traffic through key routes to enable accessibility of all regions

KEY			
++	High increase	=	Neutral
+	Some increase	-/=	Neutral – tending to decrease
=/+	Neutral-tending to increase	-	Decreasing

Fig. 14.3 Example of mapping cooperation and spatial impacts

3. Except where the resultant impact for each driver was judged to be neutral, the driver was mapped onto the possibility space.

5.4 Developing Storylines

Mapping Impacts on to the Possibility Space

Having identified the likely impacts on sectoral drivers and planning issues across all the sectors in the Briefing Notes, these were mapped on to the possibility space in order to create storylines for each scenario, as follows:

1. Each driver/issue was numbered (e.g. O1, O2 for offshore wind, C1, C2 for conservation).
2. The possibility space was further divided up into 7 × 7 grid squares for each quadrant.
3. Based on the likely impacts of each driver/issue in the table, a decision was made about where this would fit within the possibility space using the two axes as a guide. For example, where spatial efficiency was seen to be increasing, a marker was placed on the right-hand side (Scenario 2 or 4), or if it was decreasing on the left (Scenario 1 or 3).
4. Level of cooperation was then considered. If this was reckoned to be increasing, the marker would be moved towards the top half (Scenario 1 or

2), or if decreasing in the bottom half (Scenarios 3 and 4). For moderate or low changes, markers would be placed closer to the centre of the corresponding axes, and for extreme changes markers would be further out.

5. This process was repeated with each driver until they had all been placed within the possibility space. Multiple markers were allowed in each grid square (Fig. 14.4).
6. The drivers in each quadrant were then assembled into a pen picture with illustrative examples of how different sectors may develop up to the year 2050.
7. Each scenario was given a title that conveys its main characteristics (Fig. 14.5).

Cooperation (top axis) · Autonomy (bottom axis) · Spatial Diffusion (left axis) · Spatial Efficiency (right axis)

							C9		C2			
	O4					T20, P5			P8, C8	C1		A6
O5				O1, T17	O26, A23	A18, P4	O30, A3			O10	O22	
			O2, T14	O20b	A8	O19, T12	A1a, P16	P29	A2			
		O6, O17	A5	O20a, T8	T19, A20	O20c	O8	A14		T18	O16, C5	C6
	T22		A11	O20e, T4	O18	T13, C7	P31	T6, P11	P21		C3, T3	T5
					A10	A9	P22		P6	O24, T7	A21	C4
			A12		P26	A19	C10	P12	A17			
	T1, T10											
	T2											

Fig. 14.4 Mapping individual drivers onto the possibility space

Scenario 1. Reaching Out

Key features: Cross border collaboration on a sectoral basis

International and national climate change targets and pollution controls are key drivers of change.

These lead to countries making greater efforts to deploy **marine renewables** in coastal areas and further offshore. More areas are zoned for the primary purpose of renewable energy growth both in coastal areas and further out to sea, creating competition for space between energy interests and other sea users such as aquaculture and shipping and increasing cumulative impacts. Transnational energy infrastructure is put in place to support the distribution of green energy.

Sharing of **information** within sectors is seen as a way to increase coordination, e.g. E-navigation, maritime service portfolios and development of the Common Information Sharing Environment for shipping.

Within the **shipping** sector international agreements on pollution are also key drivers of change, with more Emission Control Areas being designated and a much greater number of ships using LNG fuels. The seasonal opening of Arctic sea routes takes place but is dependent on high levels of international cooperation to maintain safety and security. Motorways of the Sea continue to develop along key routes and into more remote areas to connect with Arctic routes and growing renewable energy zones.

Ambitions for **aquaculture** production remain high across Celtic Seas countries as consumer demand for aquaculture product increases. As aquaculture moves further offshore this creates greater competition with other sea users. Climate change impacts such as increases in sea water temperature and increasing storminess also make large-scale production more challenging.

Increased sharing of data regarding **MPA** designations and collaboration on environmental monitoring takes place, e.g. using satellite data and autonomous vehicles to monitor marine habitats and species movements.

Scenario 2. Joining Forces

Key features: Ecosystem based approach, high degree of governmental cooperation

This scenario affords the highest level of protection to the **marine environment**, with regards to international requirements such as CBD and MSFD. Countries cooperate on decisions about new MPAs, including some in international waters. At the national level, there is greater clarity and direction in the way that MPAs are designated and managed.

Tight environmental constraints mean that countries think more strategically about the location of maritime activities and there is a strong drive towards **colocation** of marine renewables with activities such as coastal defences, tourism, fisheries and aquaculture.

International **shipping** activity continues to increase, with larger ships being used to take advantage of economies of scale. In EU Member State waters, reduced customs formalities increase the efficiency and volume of goods moved through ports. Upgrades to port facilities and connectivity to ports hinterlands are implemented to take advantage of both international and local shipping movements. In areas where multiple marine users are active, protection of navigational safety is considered a priority.

Aquaculture growth is managed through the allocation of space in maritime spatial plans. Continued financial support from the EU and other institutions helps to deliver new operations that use innovative methods such as multi-use platforms shared with offshore wave energy and monitoring stations.

As well as developing colocation with aquaculture, fisheries and environmental monitoring, **renewable energy** continues to grow in two main areas. **Offshore wind** energy moves further out to sea, as technology for deeper waters (including floating platforms) becomes more viable both technologically and financially. A limited number of **tidal lagoons** are built, primarily for energy generation, but also supporting new leisure and tourism activities.

Scenario 3. Going It Alone

Key features: Minimal cooperation, expanding sectoral approaches

Under this scenario, countries work independently to pursue their own **Blue Growth** targets, expanding and maximising exploitation of their maritime resources across marine territories. Coordination and cooperation on MSP is minimal. Competition within maritime sectors becomes fiercer, leading to distinct winners and losers, for example bigger **ports** using economies of scale and their connectivity to capture more shipping trade compared to smaller ports.

Efforts to protect the **marine environment** are limited as countries seek greater levels of economic exploitation, e.g. using waters more intensively for aquaculture, fishing and producing energy.

In terms of **aquaculture**, increasing demand for farmed products and the need to combat impacts of climate change such as increased seawater temperatures lead to the use of genetically modified alternatives to fishmeal, and GM species that grow faster.

To ensure security of energy supplies, existing sources of hydrocarbons continue to be extracted whilst new sources are explored. **Offshore wind, wave and tidal energy** continue to expand, with devices deployed in coastal waters and further offshore. Large tidal lagoons and barrages are built where these do not interfere with key navigational routes, resulting in some loss of habitats.

Scenario 4. Sustainable Localism

Key features: Countries concentrate on developing their own maritime activities but there is a lack of transnational cooperation.

Under this scenario economic growth in traditional industries is slow but there is accelerated growth in green and high-tech sectors. Smart **specialisation** within the maritime sector helps regions to develop unique strengths and capacities. New technologies also help to integrate different sectors using the same space as shared platforms, monitoring systems and less polluting ways of doing things are found.

Conservation and environmental objectives focus on the reinforcement of existing management and regulation measures. Where new MPAs are considered for designation, there is a strong emphasis on additional socioeconomic benefits that can be provided through designation.

To use space more effectively, the **aquaculture** sector adopts a polyculture approach and multi-trophic species. High quality, niche aquaculture products with greater added value and traceability throughout supply chains are developed for local markets.

Diversification occurs within the **port** sector due to the slow growth of international trade, for example specialised shipbuilding services and innovations in logistics through greater use of IT and real-time tracking. Facilities servicing the offshore energy industries are adopted by some ports to compensate for the decrease in international cargos. In other ports, **short sea shipping** experiences a modest increase for specialised cargos such as liquid bulk.

Wave and tidal energy is increasingly favoured over offshore wind as technologies improve and both small and large-scale projects become more financially viable. Tidal lagoons are built in locations for the dual purposes of energy generation and protecting areas vulnerable to flood risk.

Fig. 14.5 The four scenarios

5.5   Stakeholder Preferences

The four scenarios were tested in a workshop with 35 participants representing the different administrations of the Celtic Seas, consultants, researchers, ecologists, planers and industry representatives from the energy, fisheries and shipping sectors. Interactive sessions were used to explore the scenarios. Participants were organised into groups representing the key sectors involved. They then explored, firstly, *sectoral ambitions* up to 2050. Secondly, they considered *sectoral interactions*, looking at other sectors' ambitions for 2050 and

what this might mean in terms of potential competition for space or new synergies that might arise. Thirdly, significant cross-border MSP issues were identified and discussed with a view to *promoting cross-border cooperation.*

5.6   Sectoral Ambitions

In the first session, participants were asked to consider where their sector would be by the year 2050 in terms of the degree of transboundary cooperation that might take place and whether the sector would increase its spatial efficiency. Their views were recorded on the possibility space (Fig. 14.6). For all sectors, there was an aspiration to move towards greater spatial efficiency:

- For conservation, some permitted activities may develop within Marine Protected Areas (MPAs), but this may be on an ad hoc basis
- For offshore wind energy, location would be influenced by potential supergrids and interconnectors

With regard to levels of cooperation, there was more variation in participants' views and across different sectors. In some cases this may have been due to uncertainties and speculation surrounding the UK's intended exit from the
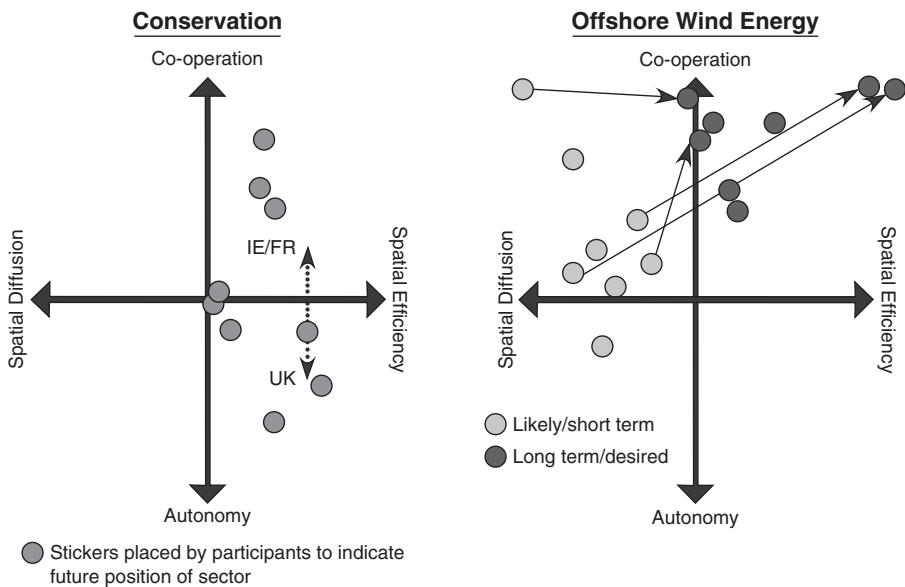
Fig. 14.6 Future directions for selected sectors

European Union and potential implications for existing regulations and mechanisms, such as commitments to the Marine Strategy Framework Directive or the maritime transport space without barriers. Other reasons for changing levels of cooperation included:

- For aquaculture, existing low levels of cooperation expected to continue,
- For conservation, other regional cooperation mechanisms such as OSPAR may facilitate cooperation more than planning authorities,
- For ports and shipping, the need to ensure navigational safety may lead to increased cooperation and
- For wave and tidal energy, large-scale projects such as tidal lagoons can only be successfully implemented with sufficient buy-in from local communities, developers and planners.

5.7   Sectoral Interactions

In the second session, participants were asked to consider the positions taken by other sectors within the possibility space and consider what this would mean for their sector. Some of the key points emerging were:

- *Aquaculture* and *conservation* have a mutual interest in maintaining good water quality.
- The co-location of *aquaculture* and offshore *energy* was identified as a key opportunity; however, some big questions remain about the possibility of co-location as aquaculture areas may not be suitable for energy installations (and *vice versa*). Similarly, it was noted that the case for economic viability and societal benefits has not been made so developers may be unwilling to take risks.
- *Wave energy* appears to offer the greatest opportunities for co-design that can incorporate wider community benefits.
- Co-location between *ports* and *aquaculture* is unlikely to take place, but ports may benefit from the spatial management of aquaculture as they can influence location to protect navigational safety.
- *Ports* may need to evolve in order to keep pace with logistical demands from larger *wave, tidal energy* and *offshore wind* developments.

5.8   Actions to Promote Cross-Border Working

Following the discussions of sectoral interactions, the two top issues from each table were identified by facilitators for elaboration of problems and possible solutions. The issues identified were:

1. Biosecurity and shipping
2. Conservation and offshore wind
3. Co-location of aquaculture and conservation areas
4. Co-location of aquaculture and offshore wind
5. Transnational energy grids and storage facilities
6. Co-location of aquaculture and ocean renewable energy (further offshore)
7. Port diversification
8. Designation of new shipping lanes

Participants then considered these issues in more detail and think of ways they could be addressed by MSP authorities. For each issue, discussion helped to identify the transnational nature of the issue, possible solutions and the resources or mechanisms that would need to be put into place in order to improve the existing situation.

5.9   Outcomes

The scenarios' workshop exercises helped to confirm the predictions that all of the sectors under consideration would continue to grow in terms of their activities over the period up to 2050. With regard to the possibilities of more spatially efficient forms of development, a number of key trends were discerned (Fig. 14.7).

6   Reflections

The use of a four-quadrant or *possibility space* has mirrored the approach to developing scenarios used in other exercises, such as the Millennium Ecosystem Assessment and the AFMEC project (Pinnegar et al. 2006). However, a critical difference in this case was in regards to the two variables used to construct the axes of the possibility space, namely autonomy/cooperation and spatial diffusion/efficiency. The use of these two axes or dimensions, together with the scenario pen pictures, provided for a broad range of possibilities in terms

- Aquaculture may increase spatial efficiency through better integration into marine plans and use of new technologies such as multi-trophic systems; however co-location with other sectors is unlikely to become large scale
- Continuing development of offshore energy infrastructure (cabling), with some cross border interconnectors coming into service
- Designation of MPAs will continue, but management will be more challenging
- Ports and shipping will remain a critical focus for MSP. Diversification of ports and cooperation with other sectors such as offshore wind energy may provide some spatial efficiency
- Offshore wind will continue to have a growing spatial footprint in the Celtic Seas. Some spatial efficiencies may be achieved through technological improvements such as increased generation capacity of turbines
- Upscaling of wave and tidal energy deployment will lead to increased spatial footprint. Additional socio-economic benefits may be gained through co-design and consultation with local communities where they are sited

Fig. 14.7   Key outcomes of the scenarios workshop

of the spatial footprint of future maritime activities and cooperation between planning authorities to be represented. By having contrasting scenarios, this brings into focus the extremes of what might be the most or least desirable futures. For example, the "Joining Forces" scenario represents the ideal in terms of promoting integration between uses, co-location and a high degree of transboundary cooperation in MSP, whilst "Going it Alone" represents the opposite. Use of these extremes also provides for reality checks to occur, as although the ideal situation may be integration or co-location of different maritime activities, there will always be some that require exclusive use of space, such as for navigational safety. Therefore, the scenarios can highlight what may be more feasible within the scope of MSP or specific plans going forward.

In testing these scenarios with participants, their feedback provided points for reflection.

- The presentation of scenarios including drivers and targets in the scenarios could be adapted to the subnational level at which MSP is taking place in many contexts.
- The definition of a baseline position for each sector on the possibility space was important for context setting and demonstrating the geographic specificities of development for each sector.
- Within larger maritime sectors, there are specific sub-sectors for which the more desirable future may differ quite considerably from the bigger picture. For example, for ports and shipping, cooperation and spatial effi-

ciency may be of less importance to the recreational boating sector as it operates in a different way to the commercial (freight) shipping sector. The example of conservation (as shown in Fig. 14.6) also demonstrates that different scenarios may be preferred or be more likely depending on geographical specificities and country contexts. This demonstrates how although it would be expedient to have one "agreed" scenario to help in the formation of marine spatial plans, there will always be alternative views and potential outcomes that may need to be accommodated in the plan-making and implementation stages.

Although the scenarios were not intended to provide an accurate prediction of the future, the process of scenario-building can promote debate about the direction that plans might take. This can allow for more creativity and opportunities for learning about the potential of MSP to facilitate particular outcomes. Specifically, looking at where each sector may be (or would like to be) in the future can reveal the aspirations of the sector towards cooperation and spatial efficiency. Comparing these aspirations across sectors may then help to show where there are likely to be spatial conflicts as different sectors strive for integration or co-location in limited space, or where sectors may be more resistant to integration and cooperation. For MSP authorities, understanding the direction of travel for different sectors and their aspirations for the future is critical. If this information can be recorded, such as through scenario-building exercises, then plans and policies may be better informed.

7   Conclusions

Within terrestrial settings, there has been significant interest in future-oriented approaches to planning (Albrechts 2004; Haughton et al. 2010; Nadin 2002). This has been mostly at a strategic level of planning, where there is greater scope for considering a range of broad possibilities, reflecting different overall objectives, than may be the case at a more localised, project-specific level of planning. Similar approaches have been adapted to a small extent in marine settings too, as exemplified in this chapter. Arguably, the potential and need for these exploratory approaches is greater in the context of MSP, where planning spaces are geographically vast, the possibilities for human interaction are diverse and priorities for action are far from settled.

Developing alternative scenarios, such as by the method presented here, or engaging in some other future-oriented exercise, can be a productive way of envisaging possible trajectories and shaping preferred lines of travel over the

coming years. It can help those involved in plan making to set out alternatives that higher-level policymakers can consider and stakeholders can deliberate. This may assist in preventing MSP from becoming too narrowly focused on meeting the immediate spatial needs of the most demanding activities and failing to consider broader, long-term objectives and foreclosing opportunities which may become more important with time.

The UNESCO MSP guide (Ehler and Douvere 2009) suggests that identifying alternative spatial scenarios is an integral part of an MSP process. Various decision-making criteria may then lead to the selection of a preferred scenario which then becomes the goal of the subsequent steps of the process, and which the plan aims to deliver. However, it is unlikely that a single, preferred scenario would be easy to agree; differing, competing scenarios may persist, at least in the background, throughout the process. And even if one scenario is formally selected as a goal to be reached, it is unlikely to remain completely fixed but may evolve and be adjusted in the light of realities and changing priorities that come to the fore as plan-making proceeds, not to mention during efforts to implement a plan once completed.

It is perhaps more productive to develop a range of scenarios, through a process such as that outlined earlier, and to allow them to live throughout an MSP process, acting as points of reference as more definitive aspects of planning are carried out. The questions then become, in relation to individual planning decisions: Which of the scenarios does this lead us towards? Is this desirable? Or should we act more in favour of heading towards a different scenario? This is not dissimilar to Hillier's argument for broad visions to be set in the background ("planes of immanence") and more specific plans and projects then to be brought into the foreground ("planes of organisation") (Hillier 2010, 454). One can imagine an oscillation between these two dimensions of planning activity; priorities and criteria of one kind or another for the use of a sea space are shaped by the scenario(s) judged to be preferable, and the scenarios themselves may be revisited in light of the hard facts of establishing those priorities and criteria. The *possibility space* offered by a range of scenarios is thus kept open throughout, so that the MSP process can seek out desirable futures, but remain open to opportunities, so that a clearly defined end point is never quite in view (Boelens and de Roo 2015).

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