

# ACTNOW

## What-If Scenarios

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# Table Of Contents

<b>1. What are What-If Scenarios?</b>	<b>3</b>
<b>2. What-If Scenarios and PESTLE</b>	<b>4</b>
<b>SSP5 – World Markets</b>	<b>6</b>
<b>SSP3 – Regional Rivalry</b>	<b>6</b>
<b>SSP1 – Sustainability</b>	<b>7</b>
<b>SSP4 – Inequality</b>	<b>7</b>
<b>3. Drivers of Marine Ecosystem Change</b>	<b>8</b>
<b>4. Narratives for the What-If Scenarios</b>	<b>9</b>
<b>5. Questions for Stakeholders</b>	<b>11</b>
<b>6. References</b>	<b>12</b>



# 1

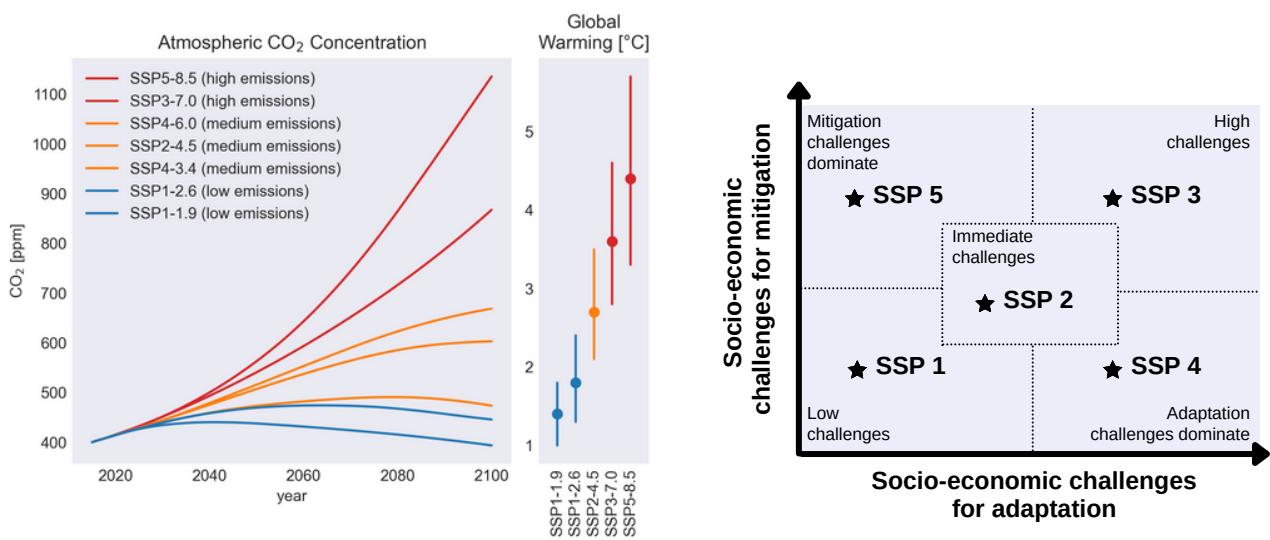
## What are What-If Scenarios?

Scenarios are an essential tool in catalysing a variety of possible futures into an organized overview of likely pathways.

Scenarios can help guide strategy and are created in sets of plausible and coherent alternatives. Scenarios can help define the scope for adaptation by characterising the responses of various stakeholder groups (policymakers, conservationists, business owners, and the general public) under each future scenario.<sup>3</sup> In principle, scenarios may be predictive (outlining how a system may change in the future based on predefined conditions), normative (describing different pathways via which a specific target or desired outcome may be achieved) or exploratory (describing the future evolution of the system based on different, contrasting assumptions of underlying conditions).

The Intergovernmental Panel on Climate Change (IPCC) has developed two types of complimentary scenarios. The first describes how the concentration of CO<sub>2</sub> and other greenhouse gasses may rise or fall in the future, so-called Representative Concentration Pathways (RCPs). The second are Shared Socio-economic Pathways (SSPs), which describe how future changes in society (population growth, gross domestic product, international cooperation, etc.) can influence how easy it is for countries to enact climate adaptation or climate mitigation policies. The SSPs (social-economic, geo-political) and RCPs (amounts of global warming) were designed to be used together and, although not specifically matched, some RCP-SSP combinations are more likely to happen than others.<sup>3,4</sup> The figures below illustrate the RCPs with their mean temperature changes until the year 2100 (left) as well as the SSPs with different socio-economic challenges for climate change mitigation and adaptation (right).<sup>5,6</sup>

**What-if scenarios** fall into the category of exploratory scenarios. They describe the evolution of a set of relevant parameters under a variety of assumptions on how society (at global or local scales) will change in the future.



Scenarios of emissions of CO<sub>2</sub> and corresponding differences in global mean surface temperature (left) linked to differences in the effectiveness of implementing climate mitigation and adaptation (right). Source: IPCC AR6 WG1 report.<sup>7</sup>



## 2 What-If Scenarios and PESTLE

**We use what-if scenarios to explore the cumulative impact of multiple drivers on marine biodiversity and ecosystem services.**

ACTNOW uses What-If scenarios to explore how multiple drivers impacting marine biodiversity and ecosystem functions and services may change in the future. In this first step, this glossy card introduces the overarching narratives of four scenarios of change based on the SSP<sup>8,9</sup> and RCP<sup>10</sup> framework used in the Sixth IPCC Assessment Report. This framework is widely used and enables us to compare the results of ACTNOW and other projects examining climate change impacts on marine and other habitats and systems, fostering uptake by the scientific community as well as policy- and decision-makers. The four narratives encompass a wide range of socioeconomic futures (see next page) and are associated with three qualitative levels of greenhouse gas emissions (high, medium, low) compatible with the underlying differences in the SSPs.

PESTLE is an acronym for six dimensions acting on a specific problem (Political, Economic, Societal, Technological, Legal, Environmental). Originally developed to conceptualise how external factors affect a business or company,<sup>11</sup> this approach has been successfully adopted by previous EU projects<sup>12,13</sup> to design future scenarios for marine habitats and sectors. The ACTNOW What-if scenarios are based on mapping PESTLE elements within each of these four, general narratives. PESTLE allows us to consider key dimensions that define future levels of multiple, interacting drivers of marine biodiversity and ecosystems (see p5).







# The PESTLE Approach

**PESTLE is an abbreviation for Political, Economic, Social, Technological, Legal and Environmental.**

PESTLE is a way to look at all the potential factors that may influence planned actions. Although PESTLE analysis stems from the business community, it has been previously applied to explore future scenarios for EU aquaculture and fisheries in the CERES project.<sup>13</sup> To help guide stakeholders in providing more detailed, region-specific information for each PESTLE element, the following illustrates general questions to ask when building contrasting scenarios for better understanding the multiple drivers that change our marine ecosystems.



## Political

How do future **policies** affect the management of marine ecosystems and their exposure to external drivers?



## Economic

What do the pathways of **economic development** imply for the different sets of drivers?



## Societal

How do **societal and cultural elements** determine the way we see the marine environment and use marine resources, and how do they contribute to the acceptance of management policies?



## Technological

How does **technology development** alter the energy grid, the efficiency of exploitation of natural resources and the levels of pollution and contamination?



## Legal

What will the **regulatory framework** look like in the different future narratives and how will this affect the different sets of drivers of change?



## Environmental

How are **environmental conditions** likely to evolve under the contrasting narratives?



# The Four What-If Scenarios

## How society tackles climate adaptation and mitigation in three plausible scenarios.

The What-If Scenarios presented in this glossy card provide a simple, consistent framework of pathways of future evolution of marine ecosystem pressures and drivers. After explaining the four scenarios, a next step is to “regionalize” these scenarios with information from stakeholders within ACTNOW Case Studies (see section 5). ACTNOW will use these regionalized scenarios for ecological modeling (of single-species, food-webs or full ecosystems), performing risk assessments, and presenting its solutions. These four What-if scenarios will allow us to not only compare outcomes across broad European regions but also to provide targeted analyses and solutions for specific regions and contexts.

### World Markets (SSP5)

#### High challenges to mitigation, low challenges to adaptation

The world places increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development of human capital as the path to sustainable development. Global markets are increasingly integrated. There are strong investments in health, education, and institutions to enhance human and social capital. At the same time, the push for economic and social development is coupled with exploitation of abundant fossil fuel resources and the adoption of resource and energy intensive lifestyles. These factors lead to rapid growth of the global economy, while global population peaks and declines in the 21<sup>st</sup> century. Local environmental problems such as air pollution are successfully managed. There is faith in the ability to effectively manage social and ecological systems, including by geo-engineering if necessary.



### Regional Rivalry (SSP3)

#### High challenges to mitigation and adaptation

A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues. Policies shift over time to become increasingly oriented toward national and regional security issues. Countries focus on achieving energy and food security goals within their own regions at the expense of broader-based development. Investments in education and technological development decline. Economic development is slow, consumption is material-intensive, and inequalities persist or worsen over time. Population growth is low in industrialized and high in developing countries. A low international priority for addressing environmental concerns leads to strong environmental degradation in some regions.



**More details:** [www.actnow-project.eu/scenarios](http://www.actnow-project.eu/scenarios)



## Sustainability (SSP1)

### Low challenges to mitigation and adaptation

The world shifts gradually, but pervasively, toward a more sustainable path, emphasizing more inclusive development that respects perceived environmental boundaries. Management of the global commons slowly improves, educational and health investments accelerate the demographic transition, and the emphasis on economic growth shifts toward broader aspects of human well-being. Driven by an increasing commitment to achieving development goals, inequality is reduced both across and within countries. Consumption is oriented toward low material growth and lower resource and energy intensity.



## Inequality (SSP4)

### Low challenges to mitigation, high challenges to adaptation

Highly unequal investments in human capital, combined with increasing disparities in economic opportunity and political power, lead to increasing social inequality and stratification. The gap widens between an inter-nationally-connected society that contributes to knowledge- and capital-intensive sectors of the global economy, and a fragmented collection of lower-income, poorly educated societies that work in a labour intensive, low-tech economy. Social cohesion degrades and conflict and unrest become increasingly common. Technology development is high in the high-tech economy and sectors. The globally connected energy sector diversifies, with investments in both carbon-intensive fuels such as coal and unconventional oil, but also low-carbon energy sources. Environmental policies focus on local issues in middle and high income areas.



**More details:** [www.actnow-project.eu/scenarios](http://www.actnow-project.eu/scenarios)

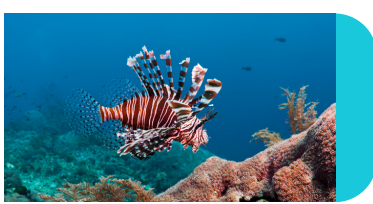


# Drivers of Marine Ecosystem Change

How society tackles climate adaptation and mitigation in three plausible scenarios.

ACTNOW applies approaches to enable transformative changes in society for marine biodiversity and ecosystems recovery. These approaches are tested and implemented with environmental managers for broad application (e.g. to support policies, improve governance, involve businesses) with the aim that all indirect drivers of biodiversity loss are addressed and that 'do no harm' biodiversity policies become a mainstream part of all sectors. Our research will demonstrate the importance of consistent policies across political borders by highlighting connectivity in drivers of change in biodiversity and their impacts across large spatial scales.

Our project focuses on the following drivers of change in biodiversity, ecosystem function and ecosystem services:



### Biotic

- Invasive Alien Species (IAS)
- Harmful Algal Blooms (HABs)
- Overgrazing



### Climate Change

- Warming
- Acidification
- Sea Level Rise
- Changes in coastal water salinity



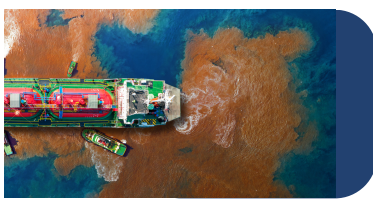
### Environment

- Artificial Light At Night (ALAN)
- Habitat Loss / Protection / Restoration
- Sedimentation
- Shipping / Windfarms



### Extractive Uses

- Fishing / Overfishing
- Aquaculture
- Sand and Gravel
- Oil, Nature Gas











### Pollution

- Contaminants (PCBs, PAHs, TNTs)
- Eutrophication





# 4 Narratives for the ACTNOW What-If Scenarios

Element	 <b>World Markets (SSP5)</b>	 <b>Regional Rivalry (SSP3)</b>
 <b>P</b>	<p>High economic growth and <b>unrestricted use of fossil fuels</b>. Policies centre on <b>free markets</b> and human capital. International collaboration for economic development; environment protection not important. Few <b>limits on natural resource</b> use. Environmental issues tightly connected to economic benefits.</p>	<p><b>National interest and security</b> are main objectives. National governments dictate an agenda of <b>weak and uneven international collaboration</b>. Institutions show <b>little regard for global commons</b> and environmental issues. High levels of exploitation and little care for natural spaces result in habitat loss.</p>
 <b>E</b>	<p><b>Strongly globalised</b> and connected economy fosters high growth with <b>reduced inequalities</b> especially across countries. <b>Unrestricted use</b> of the available resources with consequence of strongly increased <b>pressure of extractive uses</b>. International trade and economic growth lead to increased shipping traffic with implications for connected matters such as IASs.</p>	<p>A <b>de-globalised economy</b> that is centralised around <b>national security</b> with highly restricted international trade leads to <b>low economic growth</b> and high inequalities across countries. Economic issues are prioritized over environmental ones which leads to <b>unmanaged exploitation of the global commons</b>.</p>
 <b>S</b>	<p>Highly <b>educated, cohesive, participative society</b> oriented towards economic growth. Population growth rate low and well managed, Social and gender equity high. Social <b>preference is materialistic</b> with high consumption. Increased use of natural resources. <b>Little regard to environmental issues</b>. Urbanisation and significant increase in related pressures.</p>	<p>Conflicts exist an <b>uneven society</b> with little cohesion and participation; large <b>gender disparity</b>. Focus on security and national identity. <b>Low priorities for education or environmental values</b> (if not connected to traditional culture). Population growth poorly managed and very high in less developed countries. Increased resource use resulting in <b>loss of healthy habitats</b>.</p>
 <b>T</b>	<p>Rapid <b>technology development/transfer</b>. Efficient exploitation of natural resources causes <b>mixed impacts on natural environment</b> (e.g. high exploitation of target fish species, but reduced by-catch). Energy sector focused on <b>fossil fuel resources</b>. Alternative energy sources not actively pursued. High carbon/energy use increase climate change impacts.</p>	<p>Low levels of international cooperation and political focus. <b>Slow development/transfer</b> of technology. Shift towards domestically available energy sources. <b>Demands for energy (incl. fossil fuels) are high</b> where these are locally available. <b>Inefficient resource extraction</b> and the absence of other technologies that might limit environmental impacts.</p>
 <b>L</b>	<p>There is essentially <b>no regulation on the use of fossil fuel</b> resources. Regulations on the use of natural resources and spaces are limited, particularly when they would interfere with economic interests. Regulations are put into place when they underpin economic benefit (e.g. tourism) to society.</p>	<p>There are <b>few if any regulations</b> on the use of natural resources. International treaties and agreements on nature conservation are abandoned, leading to <b>high levels of pollution and habitat degradation</b>.</p>
 <b>E</b>	<p>Limited focus on environmental issues leads to <b>high pressures on the natural system</b>. Where issues arise, these are <b>addressed locally</b> with engineered approaches. Exploitation of natural resources is maximised to support economic growth. The absence of constraints on fossil fuel use leads to <b>high GHG emissions</b> and continued, rapid climate change.</p>	<p>There is <b>serious degradation of the natural environment</b>. Low technological development and restricted trade lead to <b>inefficient and high use of natural resources</b>. The reliance on local (domestic) energy sources promotes unconventional use of fossil fuel resources causing <b>high GHG emissions</b> and continued, rapid climate change.</p>



## Sustainability (SSP1)



## Inequality (SSP4)

Policy focus shifts from economic benefit to **sustainable development** creating an environment of international collaboration towards sustainability goals. This shift is facilitated by **efficient institutions** at national and international levels. **Reduced pressures on the ecosystem** at local level and carefully managed use of natural resources.

Policies oriented towards **benefits of political/economic elites**. Little attention for vulnerable parts of society. Well-connected upper class establishes effective national and international **networks mostly focused on self-interest**. Uneven picture of well-managed and protected environments. Disregard for social and environmental issues in areas not benefitting governing elite.

Economy in support of sustainable development built on **regional production**. **Connected markets** and international trade. **Reduced inequalities** within and across countries; medium to high growth combined with **efficient use of the available resources**. Valuing of natural resources and services leads to **protection of natural habitats** and balance of ecological/economic interests.

Economic environment of **globally connected elites** with moderate levels of international trade produces low to medium growth with **high levels of inequality** particularly within countries. **Use of resources is efficient** but there is uneven availability of resources to the population. Natural habitats are protected where they are of interest to governing elite but sacrificed for economic interests elsewhere.

Highly **educated, cohesive and participative** society is oriented towards the **sustainability goals** creating low (and well managed) population growth rate. This leads to **low levels of material consumption** and high social and gender equity. **Environmental stewardship** is highly valued as it contributes more to personal well-being and health compared to purely economic incentives and status.

**Society split** between elite class with high education, consumption, and access to health care, and lower class with much less opportunity. **Social equity is low** with gender inequality. Social cohesion and participation low, on average, and stratified. Environmental issues valued but only where these have direct impact on quality of life for governing elite. Urbanisation increases creating more **pressures on coastal habitats**.

**Rapid technology development** and transfer away from fossil fuel-based consumption and energy grids efficiently using **renewable sources**. This generates low requirements for carbon resources and energy. In general, developments target **efficient and low resource extractions** and aim to **reduce environmental impacts** causing reduced marine eutrophication and other forms of pollution.

High-tech economies and sectors promote **fast technology advancement** in some sectors, but **low progress elsewhere** and very limited transfer of the benefits across society leading to a generally **mixed impact of technological development** on ecosystem pressures. The energy sector moves gradually away from fossil fuels, **towards efficient renewables** leading to low or medium carbon and energy usage.

Strong **internationally coordinated regulations** are implemented on the use of natural resources and the impacts of humans on natural spaces. Environmental **trade-offs are carefully managed** where conflicting interests arise (e.g. renewable energy infrastructure that may threaten essential marine habitats).

Highly regulated legal frameworks exist in mid to high income societies, while the exploitation of natural resources is largely unmanaged elsewhere. This causes **mixed and variable management of marine habitats** resulting in **highly polluted and degraded areas** in some places and strongly protected areas in others.

The overall focus on sustainability goals generally **improves environmental conditions**. Increased efficiency of extraction of natural resources, decreased demand and rapid transfer/uptake of **best practice relieves pressure** on the natural system. The shift away from fossil fuels results in **low GHG emissions** and reduced climate change impacts.

Environmental conditions improve for high to mid income areas but degrade elsewhere. The **efficiency of extraction of natural resources is high for large-scale industrial enterprises**, but low otherwise. Gradual development towards renewable energies leads to, on average, **medium GHG emissions** and moderate amounts of climate change.



# 5 Questions for Stakeholders

**ACTNOW engages with stakeholders to regionalise the generic What-If Scenarios in the context of the different Case Studies.**

These are suggestions for questions that may be raised with stakeholders in support of the regionalization of the Storylines and What-If Scenarios:

### Drivers of Marine Ecosystem Change (see p. 8)

- Can you rank the drivers on a scale from 0 (irrelevant) to 4 (highly relevant)?
- Are there any drivers missing that are important in your case (please rank these on the same scale)?

### Policy & Regulations

- What are the main drivers driving policy in your region?
- Which drivers are subject to regulations in your area and is regulation effective?
- What drivers are not regulated by legislations and norms?
- How is regulation likely to evolve under the different narratives?

### Mitigation, Adaptation & Development

- Which measures of adaptation and mitigation are supported by high social acceptance? Which are more difficult to implement due to low acceptance?
- Which developments are likely to benefit most from advances in technology in the different narratives?
- What are the most likely conflicts of interest between economic interest and sustainable development? Where may synergies be found?





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## What is ACTNOW?

ACTNOW - Advancing understanding of Cumulative Impacts on European marine biodiversity, ecosystem functions and services for human wellbeing is an EU-funded research project that provides regulators and decision-makers the knowledge and fit-for-purpose tools they need to combat biodiversity loss in coastal and marine habitats threatened by climate change (CC) interacting with other local and regional drivers.

We are conducting our research and cooperating with marine and MPA managers in Case Study Regions across Europe. Our goal is to deliver concrete scientific support to regulators charged with implementing adaptation and mitigation measures, sustainably expand the blue economy and provide nationally determined contributions to the United Nations Framework Convention on Climate Change (UNFCCC).

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