COASTAL
Collaborative Land-Sea Integration Platform

Deliverable D18
Coastal-Rural Generic Scenarios and Transition Pathways

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COASTAL: Collaborative Land and Sea Integration Platform - Co-creating evidence-based business roadmaps and policy solutions for enhancing coastal-rural collaboration and synergies in Europe focusing on economic growth, spatial planning and environmental protection. Project timeframe: 01/05/2018 - 30/04/2022

Partnership:

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ABBREVIATIONS

ASC	Aquaculture Stewardship Council
BAU	Business As usual
BSAP	Baltic Sea Action Plan
BRICS	Brazil, Russia, India and China (OECD acronym)
BWN	Building With Nature
BWM	Ballast Water Management
CAP	Common Agricultural Policy
CCMT	Climate Change Mitigation Technologies
CCS	Carbon Capture and Storage
DAU	Dynamics as Usual
DG AGI	Directorate-General for Agriculture and Rural Development
DG-EMPL	Directorate-General for Employment, Social Affairs and Inclusion
DG-ENER	Directorate-General for Energy
DG ENV	Directorate General for Environment
DG-GROW	Directorate-General for Internal Market, Industry, Entrepreneurship, and SMEs
DG MARE	Directorate-General for Maritime Affairs and Fisheries
DG REGIO	Directorate-General for Regional Policy and Urban Affairs
EIP-AGRI	European Innovation Partnership for Agricultural productivity and Sustainability
ENRD	EU Network for Rural Development
ETC	Energy Transition Commission

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ETS	Emissions Trading System
EU	European
EWEA	European Wind Energy Association
FAO	The Food and Agriculture Organization
FEEM	Fondazione Eni Enrico Mattei
FOLU	Food and Land Use Coalition
GDP	Gross Domestic Product
GEA	Global Energy Assessment
GHG	Greenhouse Gas
GSG	Global Scenario Group
GW	Gigawatt
HELCOM	Helsinki Commission
ICZM	Integrated Coastal Zone Management
IIASA	International Institute for Applied Systems Analysis
IOBE	Foundation for Economics and Industrial Research
IPCC	Intergovernmental Panel on Climate Change
IUCN	Union for Conservation of Nature and Natural Resources
JTM	Just Transition Mechanism
LEM	Local Energy market
LNG	Liquid Natural Gas
LPG	Liquefied Petroleum Gas
M	Month
MA	Multi-Actor
MAL	Multi-Actor Lab
MPA	Marine Protected Area
MS	Milestone

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MSFD	Marine Strategy Framework Directive
MSP	Marine Spatial Planning
MWH	Megawatt
NGO	Non-Governmental organisation
OECD	Organisation for Economic Co-operation and Development
RCP	Representative Concentration Pathways
RD	Rural Development
R&D	Research and development
RES	Renewable Energy Sources
SAB	Scientific Advisory Board
SCP	Social Consumption and Production
SD	System Dynamics
SDe	Sustainable Development
SDG	Sustainable Development Goal
SRES	IPCC Special Report on Emissions Scenarios
SSP	Shared Socio Economic Pathways
TM	Transition Management
UNEP	UN Environment Programme
WFD	Water Framework Directive
WP	Work Package
WTE	Waste-to-Energy

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SUMMARY

Objective

D18 is the output of the work conducted as part as task 5.2. The report presents a critical analysis of scenarios and transition pathways (TP) with relevance for coastal-rural synergy following the initial inventory conducted during task 5.1 (Deliverable D17), and generic coastal-rural scenarios and transitions pathways developed by Work Package 5 (Milestone 4).

The objective of the deliverable is to propose a set of sustainable scenarios and transition pathways for coastal-rural areas following an initial critical analysis of currently available scenarios and transition pathways which highlight a gap in the literature when it comes to scenarios and transition pathways applicable to coastal-rural areas

Rationale

The report first present the methodology (section2) undertake in task 5.2 which started by establishing a common understanding of concepts used between partners within the project, then the section present the Transition Management approach follow to develop sustainable coastal-rural scenarios and transition pathways.

Section 3 is a critical analysis of positive and Business as usual scenarios at a global and EU level, and scenarios at a national level of COASTAL case studies, completed by a critical analysis of transition pathways per sector relevant to coastal-rural areas (agriculture, energy, tourism, maritime activities).

Section 4 is the core of the deliverable, it presents the 3 scenarios (“Naturally Better”, “Stronger Together”, “What Goes Around Comes Around”) and 13 transitions pathways (one sectoral TP per scenario) developed in WP5 for sustainable coastal-rural areas based on cross-sectoral collaborations and synergies.

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1. INTRODUCTION

This deliverable is developed as an output of work carried out under Work Package 5 – Scenarios and Transition Pathways. The two main objectives of the WP are:

- to develop qualitative and quantitative information on the uncertainties affecting the outcomes of business and policy solutions (interacting with WP3)
- to provide independent information on the potential transition patterns, which can be compared with the simulated dynamics (interacting with WP4)

Understanding the role of uncertain exogenous drivers, key system parameters and structural changes of the system is crucial for developing robust business and policy strategies and developing solutions which maximize the resilience of the system.

WP5 is organized around four work tasks:

5.1 Literature inventory of scenarios and transition pathways

5.2 Generic Scenarios & Transition Pathways

5.3 Application to the case studies

5.4 Robustness Analysis

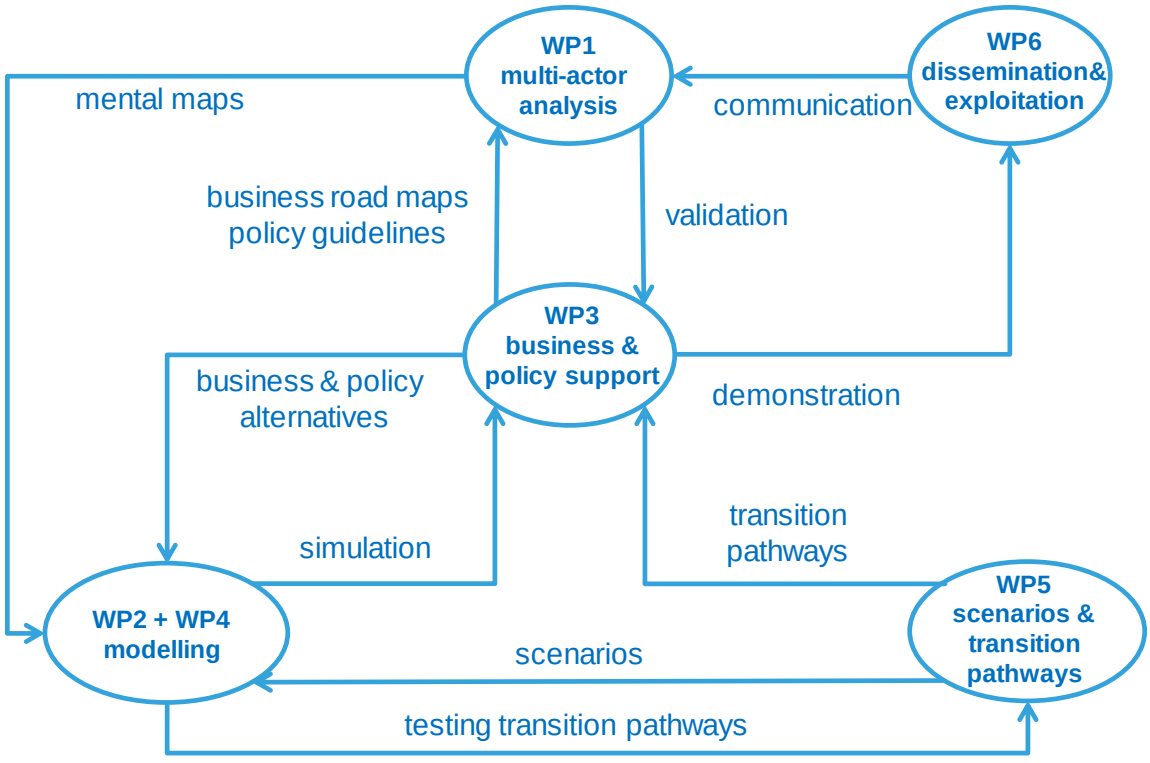

Figure 1 Workflow for the COASTAL project.

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1.1. Aims and Objectives

The main objective of the deliverable is to describe the generic scenarios and transition pathways with relevance for coastal-rural synergy. The deliverable is the output of work conducted under Task 5.2 and Task 1.3, in analysing the scenarios and transition pathways catalogued in Task 5.1 developing generic scenarios and transition pathways for costal-rural development. To this end the lead partners for WP3 and WP5 have worked in close collaboration with the MALs in order to produce this deliverable.

The deliverable incorporates Milestone 4 (Generic Scenarios and Transition Pathways), which presents a draft of the developed available generic scenarios and transition pathways. This second deliverable of WP5 builds on an overview of the current relevant scenarios and transition pathways available at international, EU, regional, and case study level with relevance for both coastal and rural development, in order to develop a set of generic scenarios and transition pathways which reflect the context of the COASTAL project.

It analyses existing scenarios and transition pathways collated as part of D17 (Literature Inventory of Scenarios and Transition Pathways), before proceeding to outline the methodology adopted to develop these generic scenarios and transition pathways. The deliverable goes on to present the developed generic scenarios and transition pathways, as well as outline the first steps towards the implementation of Task 5.3 which involves the downscaling of the generic scenarios and transition pathways to case study level.

Partners who have contributed to the development of this deliverable include: ICRE8, GRBR, VITO, INRAE, HCMR, SU, CSIC, NIMRD, ICEADR.

1.1.1. Relationship with other deliverables

The deliverable presented in this document is related to the following deliverables:

- D03 – Sectoral Analysis of Coastal and Rural Development
- D06 – Model and Data Inventory
- D17 – Literature inventory of scenarios and transition pathways
- D19 – Application of Scenarios and Transition Pathways to the Case Studies

This deliverable builds on the work of D17, analysing the existing scenarios and transition pathways, as well as D03, utilising the key drivers identified by the MALs to define the scope of the scenarios and structure the relevant quantitative descriptors. Likewise, relevant data, variables and indictors identified within D06 also informed the selection of the quantitative descriptors of each scenario. Finally, this deliverable forms the basis upon which D19 will be developed within Task 5.3.

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2. METHODOLOGY

> *"We will move to a low-carbon world because nature will force us, or because policy will guide us. If we wait until nature forces us, the cost will be astronomical."*
>
> **– Christiana Figueres**
> **(Convener of Mission 2020.**
> **Executive secretary of the UNFCCC from 2010 – 2016**
> **Director of the Paris Agreement of 2015 – Exponential Roadmap)**

The main aim of the COASTAL project is grounded in gaining a sound understanding of the dynamics within coastal-rural systems in order to trigger sustainable change. This systems innovation approach is underpinned by driving a fundamental shift in the way society functions and meets needs such as transportation, communication, housing and feeding. These large scale-transformations seek to embed new paradigms within societal structures through patterns of actions (Boelie et. al, 2004; Boelie and Wieczorek, 2005; Competentiecentrum Transities, 2009).

The scenarios and transition pathways constructed within this deliverable have been developed in the underlying context of climate change and the need of driving our society toward zero-net carbon emissions. Therefor the latest EU directives on **Circular Economy** (EU action plan for the Circular Economy[1]), Plastic (European Strategy for Plastics in a Circular Economy[2] and the Single-Use Plastics Directive3) and Energy (The Renewable Energy Directive[4]), have been taken into account for the development of generic coastal-rural scenarios and transition pathways, as well as the **European Green Deal**[5] which gives to coastal-rural areas unique business opportunities and potential solutions to on-going environmental issues in the run for a decarbonize economy by 2050.

[1] EU COM/2015/0614

[2] EU COM/2018/028

[3] Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment.

[4] DIRECTIVE (EU) 2018/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 on the promotion of the use of energy from renewable sources.

[5] European Commission, A European Green Deal: Striving to be the first climate-neutral continent, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

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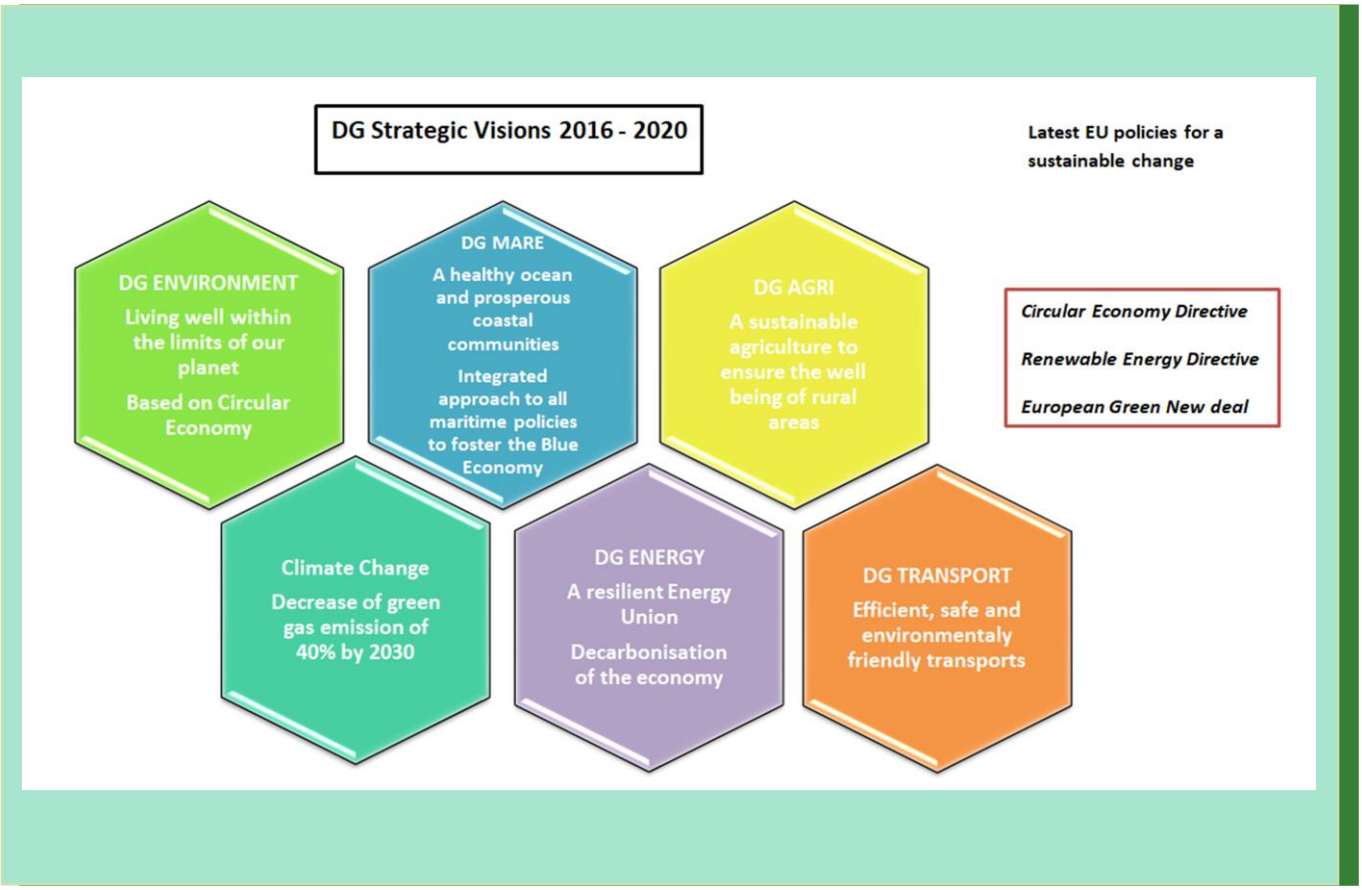

Figure 2: EU visions and policies (relevant to COASTAL) for a sustainable change

2.1. Establishing a common understanding

As with all multi-disciplinary endeavours, establishing a common understanding and lexicon amongst project partners was a crucial first step. The deliverable builds on work and findings of D17, by examining and analysing the core concepts of the deliverable, i.e. 'scenarios' and 'transition pathways'. Following feedback on D17, it became apparent that it was necessary for project partners to have access to a concise guide, which would break down these concepts in a simple and easily digestible manner. As such, the team developed a glossary of key WP5 terms (Appendix 1), including examples in order to facilitate understanding amongst partners and lay the groundwork for the activities to come within Task 5.2 (in particular interaction with the MALs). The following sections outline the established definitions presented within the glossary.

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2.1.1. Future Narrative

This is a qualitative storyline which captures a vision of the **Future** of their coastal areas, based on the principle of **Sustainable Land-Sea Synergies.** Sometimes referred to as a **'scenario plot'** (Maak, 2001), it should portray a visionary image of the case study areas in a future where the various sectors work together to enhance sustainable land-sea synergies. In so doing, the Future Narrative should explore the state of key drivers in the context of the envisioned future, building a storyline around them (Volkery et. al., 2008; Foran et al., 2013). The Future Narrative should convey the potential to inspire participants, as well as mobilise individuals outside the process (Roorda et. al., 2012). In the context of the COASTAL project, Future Narratives will be developed both by WP5 researchers and the MALs, and form the **qualitative element of the Scenarios**.

Example 1:
Storyline of a Sustainable Future focusing on the theme of Energy – H2020 GLOBAQUA Project (Source: Rault et al., 2018)

Energy Investments in environmental technologies, together with the phase-out of subsidies for fossil fuels and with lower taxation, make renewable energies more attractive. Fossil fuels are used less and less, reducing also the CO2 emissions compared to the present. As a result of the overall trend to reduce energy and resource use, the resource and energy efficiency increases. This leads to an overall decrease in energy demand.

Example 2:
Vision for Aberdeen City in 2050 – Interreg MUSIC Project (Source: Frantzeskaki, 2012)

In 2050, Aberdeen City provides a high quality of life for all that live in the City. Aberdeen's city centre is a vibrant and attractive place. Aberdeen's City Centre Development Framework quarters have been realised with the city centre designed for people. Flagship projects and ventures will bring more visitors to the city, alongside this Aberdeen's granite heritage and distinctive aesthetic is celebrated. Heritage, arts, culture and leisure sites within the city centre are easily accessible and connected to an integrated public transport system. Aberdeen's has affordable and well-designed housing, in collections of urban villages where communities flourish, services are provided, and there is local economic growth and attractive neighbourhoods. Aberdeen is a tourist destination and offers a wide range of heritage, sport and leisure activities. Aberdeen City is the tourist gateway for visitors to access the Cairngorms National Park and the River Dee.

2.1.2. Quantitative Descriptors

These refer to a set of **quantitative measures** which outline the **parameter settings** of a given scenario. The descriptors are a list of environmental and socio-economic indicators, such as population, GDP per capita, unemployment, urbanization, percentage use of fossil fuels, percentage use of renewables etc., which drive the system. The Quantitative Descriptors **quantify the main themes of the Future Narrative** and reflect the identified drivers (Rault et al., 2018). In the context of the COASTAL project, Quantitative Descriptors constitute the **quantitative element of the scenarios**, and will be developed within WP5 in collaboration with WP2 and WP4 partners, to ensure that they correlate with model variables to be explored by these WPs.

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Example:

Table 1 Table of Descriptors used within H2020 GLOBAQUA Project (Source: Rault et al., 2018)

Sector	Descriptor
Society & economy	Growth per capita
	Unemployment
	Inequality Index
	Urbanisation
Energy	Use of fossil fuel (%)
	Use of renewable resources (%)
Environmental effects	Air quality
	Biodiversity
	Invasive species
	Deforestation
	Soil Degradation
	Water Scarcity
Water management	Technical measures
	Non-technical measures
Agriculture	Irrigated surface area (ha)
	Industrial agriculture
	Organic agriculture
	Meat production
	Use of pesticides
	Area cover with water intensive crops (ha)
	Organic fertilizers
	Mineral fertilizers
	Reuse of manure and by- products
	Abandonment of land
	Crop rotation
	Erosion prevention
	Soil Salinization
Industry	Investment in technology to emission reductions
	Level of emissions
Residential	Water consumption/demand
Tourism & recreation	Mass tourism
	Selected tourism
Policies	Protected areas
	Water quality standards
	Food security
	Desalination for irrigation

2.1.3. Scenario

A **Scenario** is a description of a potential version of the future, which consists of **both qualitative and quantitative elements.** Within the COASTAL project, scenarios are developed within WP5 using qualitative input from both the literature and MALs in the form of **Future Narratives**, as well as quantitative input in the form of **Quantitative Descriptors.**

Example:

Development of Exploratory Policy Scenarios for Agriculture **(Source: van Berkel and Verburg, 2012)**

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Exploratory scenarios for a period of 25 (2030) years in the future were defined to address stakeholders' concern about Common Agricultural Policy reforms. Scenarios that reflect two opposing policy and subsidy options for the case study region were developed:

i. *More balanced, targeted and sustainable support (BTS)*
ii. *Abolishment of market and income support (AMIS).*

*The scenario description (**Future Narrative**) and parameters (**Quantitative Descriptors**) for Scenario 1: More balanced, targeted and sustainable support, are outlined below.*

SCENARIO 1: Balanced, targeted and sustainable support

In this scenario reforms are aimed at balancing the economic, environmental and social dimensions of rural areas for creating or maintaining synergies between these domains (European Commission 2010). Several reforms to the direct payments scheme are proposed that affect the case study in a number of different ways. A basic flat rate subsidy for all famers would be established. This results in less pressure for small farmers and non-expansionists to increase production through farm expansion. However, the basic rate cap also results in decreased income for both milk producers and large farms leading to fewer resources for production expansion (De Bont et al. 2006). A small-farm subsidy leads to a lesser chance that small farms will sell their holdings due to favourable earning possibilities. Compulsory aid for the provision of 'green' public goods results in a decreased probability that landscape elements will be cut in protection zones (habitat directive areas). In these same zones incentives for landscape elements, such as hedgerows and tree lines, will increase planting or restoration of such features. Furthermore, a focus on rural development will increase subsides for rural residents wishing to diversify.

	BTS	
	2005	2030
Total number of farmers	1705	1230
Average farm size (ha)	14	31
Total agricultural area (ha)	45765	45254
Percentage of multifunctional/diversified farmers	31	16
Percentage of rural resident not primarily engaged in Agri.	38	40
Percentage change in the length of Landscape elements		
Semi-natural areas (ha)	5045	5612
Average distance to farthest parcel of land (km)	15	19

2.1.4. Transition Pathway

Transition Pathways describe possible routes from now to the envisioned future. Each pathway revolves around a subtheme and describes intermediate goals, barriers that need to be overcome, actors that are/become important and essential actions/interventions. The transition paths provide insight into what is needed to reach the envisioned future and give direction to the subsequent development of the transition agenda (Roorda et al., 2012; Roorda and Akinsete, 2013). Within the COASTAL project, Transition Pathways can be considered as goal-oriented descriptions for the different transitions towards sustainability, exploiting innovative business and policy solutions aimed at the development of coastal-rural synergy. The Transition Pathways will be developed within WP5 based on the selected

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future **Scenarios**. Input from the MALs in the form of recommendations for action, barriers, drivers and key actors will support the development of the Transition Pathways.

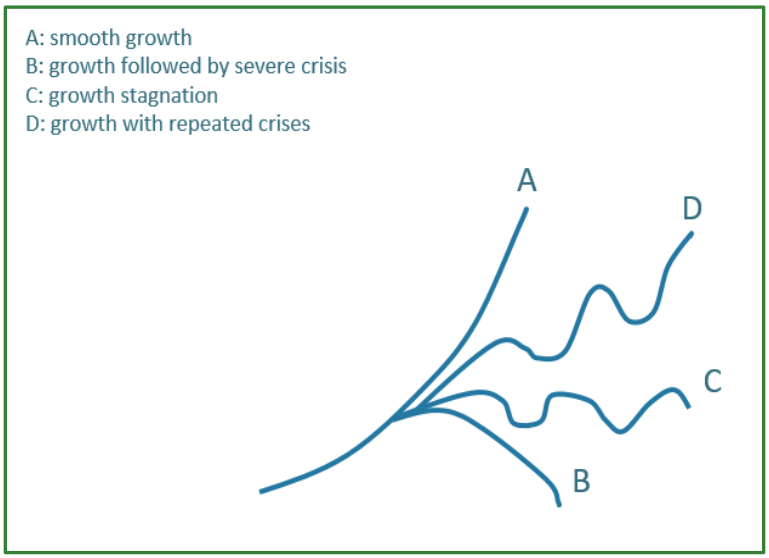

Figure 3: Observed patterns of corporate growth (Source: Sterman, 2000)

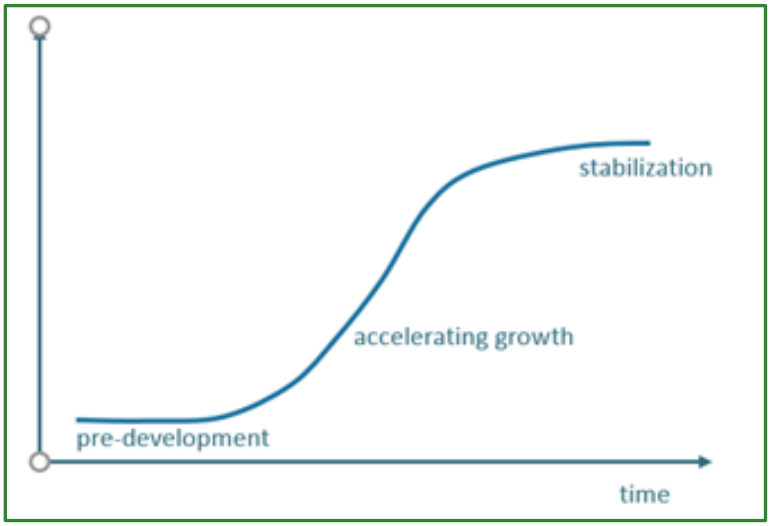

Figure 4: Graphical Representation of a Transition Pathway (Source: Rotman, 2001)

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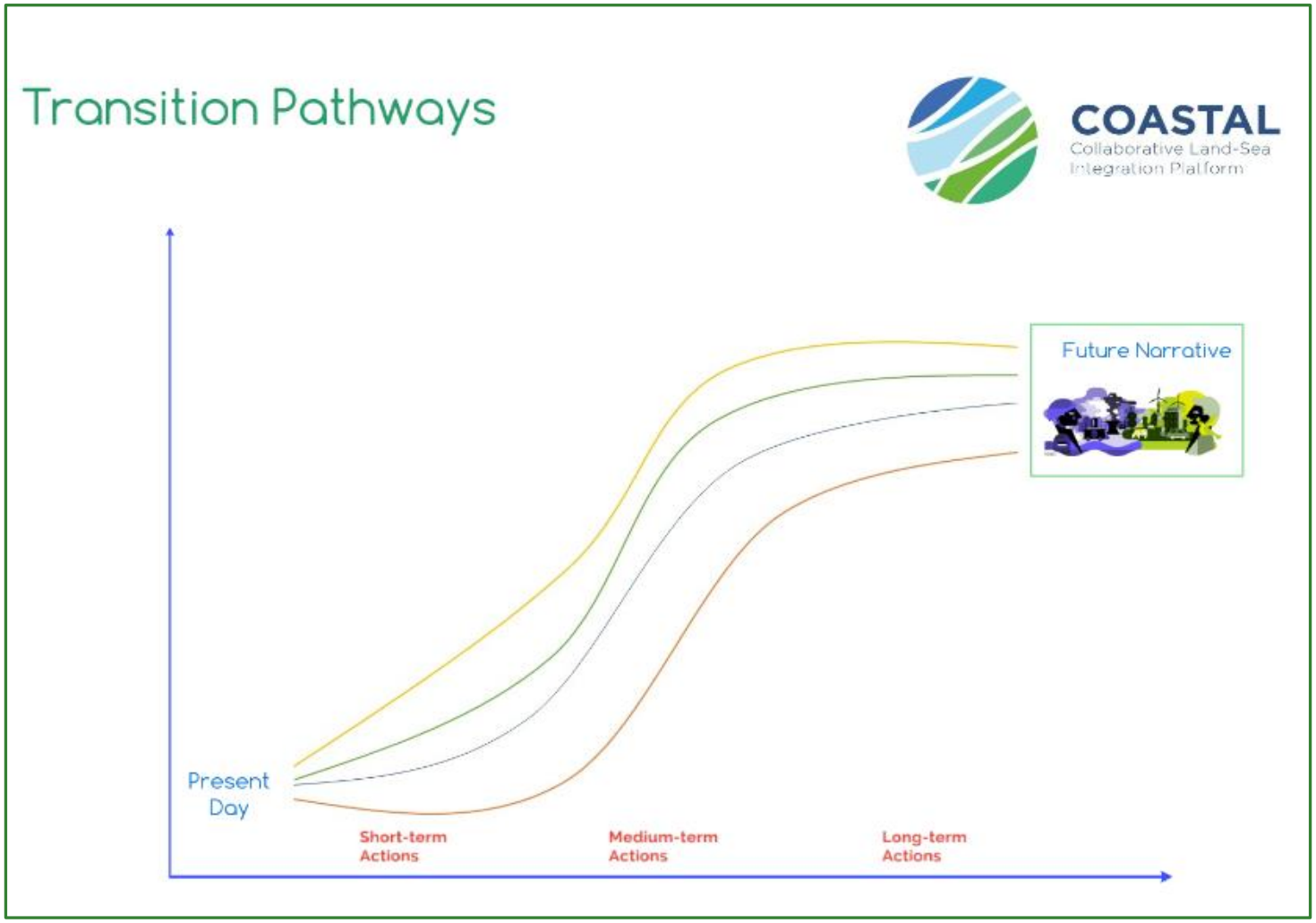

Figure 5: Linking the present and the Future with Transition Pathways (Developed from: Rotman, 2001; Roorda et. al., 2012)

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Examples: Transition Pathways from Interreg MUSIC Project (Source:* Frantzeskaki*, 2012) and EPSRC Realising Transition Pathways Project (Realising Transition Pathways Engine Room, 2015)

i. *From an oil-dependent economy to a diverse economy with a diversity of employment*
ii. *From fragmented working to collaborative public private partnerships*
iii. *Greatly expanded role for civil society in delivering distributed low-carbon generation*

2.2. How do these fit together: Developing a Methodological Framework

A key element of the COASTAL project is collaborating with the MALs in order to co-create fundamental outputs of **WP5** in the form of **Scenarios and Transition Pathways**, which will eventually feed into the development of '**Roadmaps and Guidelines**' for business and policy within **WP3**. In order to achieve this, the WP5 team worked with MAL participants to develop specifically the **Qualitative** elements of these Scenarios and Transition Pathways using a process called '**Backcasting'** (not to be confused with 'hindcasting[6]'). Unlike conventional means of planning for the future such as '**Forecasting'**, Backcasting guides the development process from an envisioned future; retracing required steps and actions back to the present day. As Such, Backcasting is a method to collectively create pathways to an envisioned future, taking the future as starting point and going step-by-step back in time.

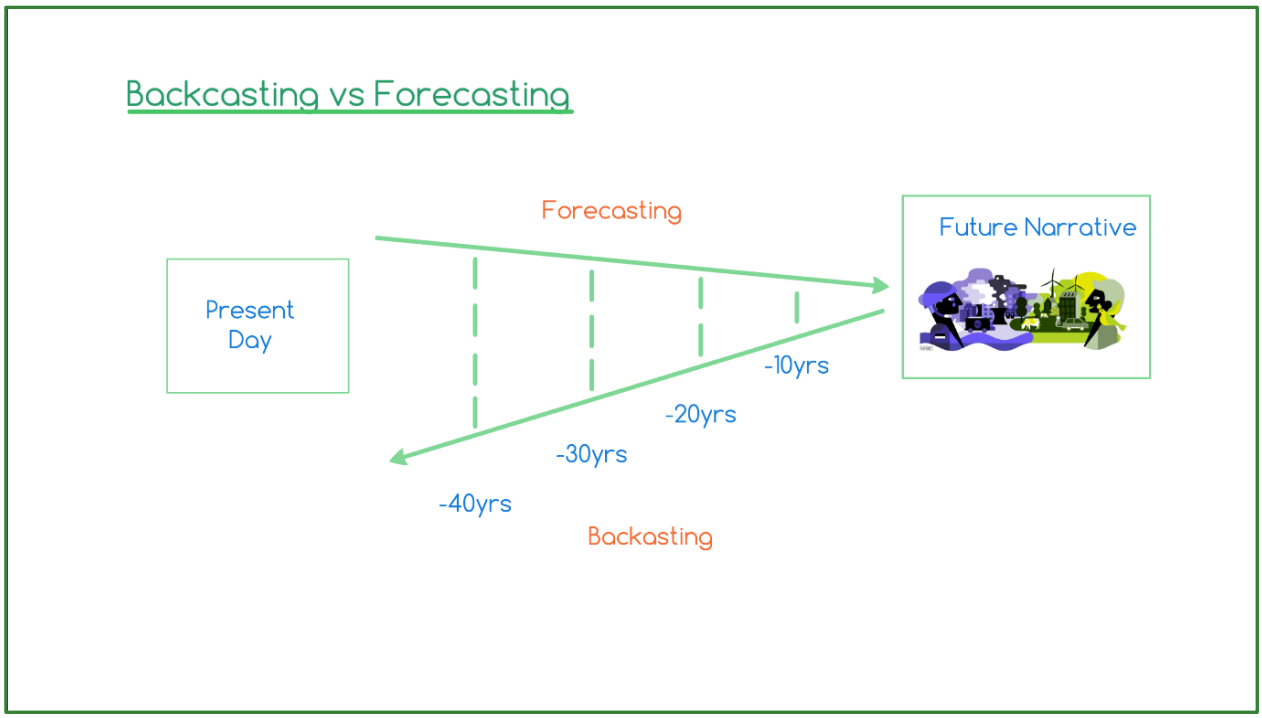

Figure 6: Backcasting and Forecasting

[6] ***Hindcasting*** *refers to the use of historic data to calibrate a model*

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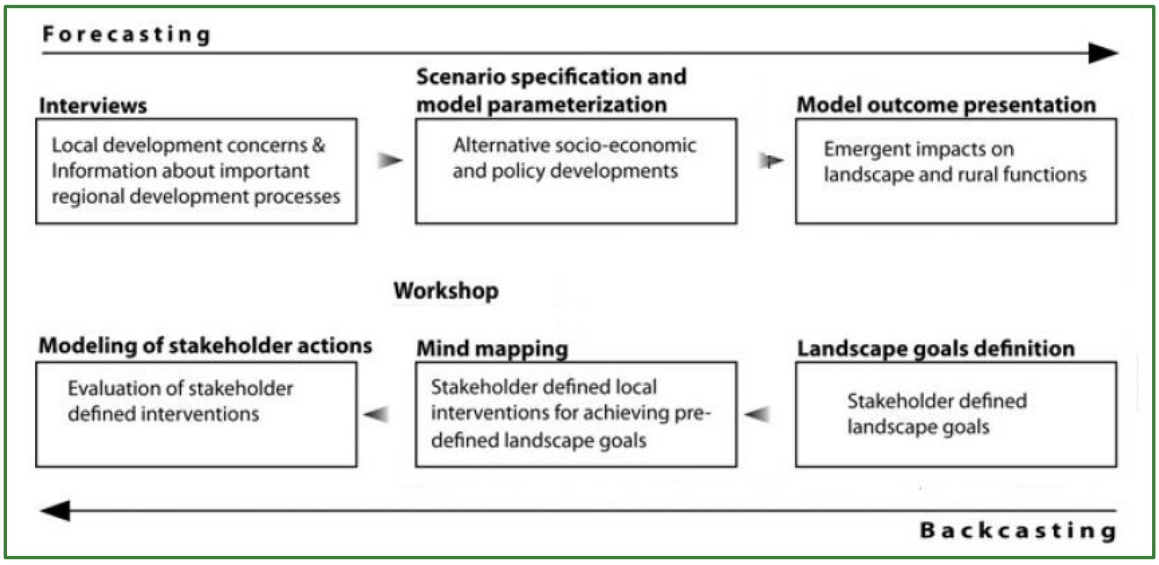

Figure 7: Forecasting vs Backcasting: Using Participatory Scenario Development in Rural Planning (Source: van Berkel and Verburg, 2012)

The use of backcasting as a central method, sits within a wider **Transition Management** methodology. Transition management (TM) has been adopted as a methodological framework to support the activities within Task 5.2. It is a participatory methodology that is used primarily in the field of sustainability and governance in order to deal with persistent problems in order to facilitate sustainable change (van der Brugge and Rotmans, 2007). TM aims at influencing the direction and pace of societal change dynamics in the context of contributing to sustainability by creating space for new ways of organizing, doing and thinking; eventually bringing about a desired transition (Loorbach and Rotmans, 2006). These transitions, refer to processes of change that transform the way societal systems meet societal needs; they are fundamental shifts in structures, mind-sets and practices, involving stakeholders from many different domains and scale-levels (Roorda and Akisnete, 2013). A core strength of the TM methodology is that it allows for the extensive consideration of social transformations within societal transitions, as opposed to the transformative impact of technology which tends to be overestimated by traditional methods particularly associated with forecasting. Vanderbilt T (2015) highlights the fact that 1960's visions of the 'future office space' was able to capture technological developments such as fax machines, however one glaring omission remained – the absence of women. Thus 'social progress', a historical weakness of futurism as a discipline, is addressed within the TM process (Tetlock, 2005; Samuel, 2009). Furthermore, the flexibility of the process makes it applicable across various sectors such as the transport, energy supply, healthcare, agricultural, or water management (van der Brugge and Rotmans, 2007; de Haan et. al., 2016).

The process of TM is highly participatory, and involves bringing together various stakeholders ('frontrunners'[7]) over a series of meetings and workshops, guiding them through the process of envisioning, structuring and implementing a transition. A strategic focus is maintained on the vision of a

[7] ***Frontrunners*** *refer to local stakeholders who come together to envision, develop and effect a transition in the given context*

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sustainable future, which can be captured by various scenarios, while tying these to the present via transition pathways. The entire process involves five key stages:

- Preparation and exploration
- Problem structuring and envisioning
- Backcasting, pathways and agenda-building
- Experimenting and Implementing
- Monitoring and evaluation

In the context of the COASTAL project, the six MALs serve as respective 'frontrunner' groups, with the MAL workshops acting as a forum for problem structuring, envisioning, and backcasting. The scope of the project activities cover the TM processes from stages 1 to 3, with the final two stages (4 and 5), falling outside the project timeframe. Table 2 below maps the activities of the COASTAL project onto the various stages of the TM process.

Table 2 Overview of Transition Management Process in the context of COASTAL Project

Stage	Key TM Activities	COASTAL Activity	Output
Preparation & Exploration	i) Transition Team formation ii) Process design iii) System analysis iv) Actor analysis	i) Formulation of COASTAL consortium ii) MAL process design (WP1) iii) System analysis (WP1, WP4) iv) Stakeholder mapping	i) COASTAL consortium, WP1 Partners ii) WP1 Tasks iii) Case study (MAL) development iv) Preliminary list of MAL participants
Problem structuring & Envisioning	i) Transition Arena formation ii) Participatory problem structuring iii) Selection of key priorities iv) Participatory vision building	i) MAL formation ii) System mapping iii) Identification of key drivers (WP1) iv) MAL envisioning exercise (WP1), generic scenario development (WP5), downscaling scenarios to MAL level (WP1/WP5)	i) COASTAL MALs ii) MAL mental models iii) D03 – Sectoral Analysis (WP1) iv) MAL Future Narratives (WP1), D18: COASTAL Generic Scenarios (WP5), D19: MAL-level scenarios (WP1/WP5)
Backcasting, Pathways & Agenda Building	i) Participatory Backcasting & definition of transition paths ii) Prioritisation of transition paths & Formulation of agenda and specific actions	i) Generic TP development (WP5), downscaling TPs to MAL level (WP1/WP5) ii) Development of business roadmaps and policy guidelines (WP1/WP3), development of exploitation plan	i) D18: Generic TPs (WP5), D19: MAL-level TPs (WP1/WP5) ii) D11: Strategic business roadmaps and policy guidelines (WP1/WP3), D24: Post-project exploitation plan

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		(WP1/WP3/WP6)	(WP1/WP3/WP6)

The activities outlined within this deliverable include parts of stages 2 and 3 of the TM process as outlined in Table 2, and are visualised within Figure 8.

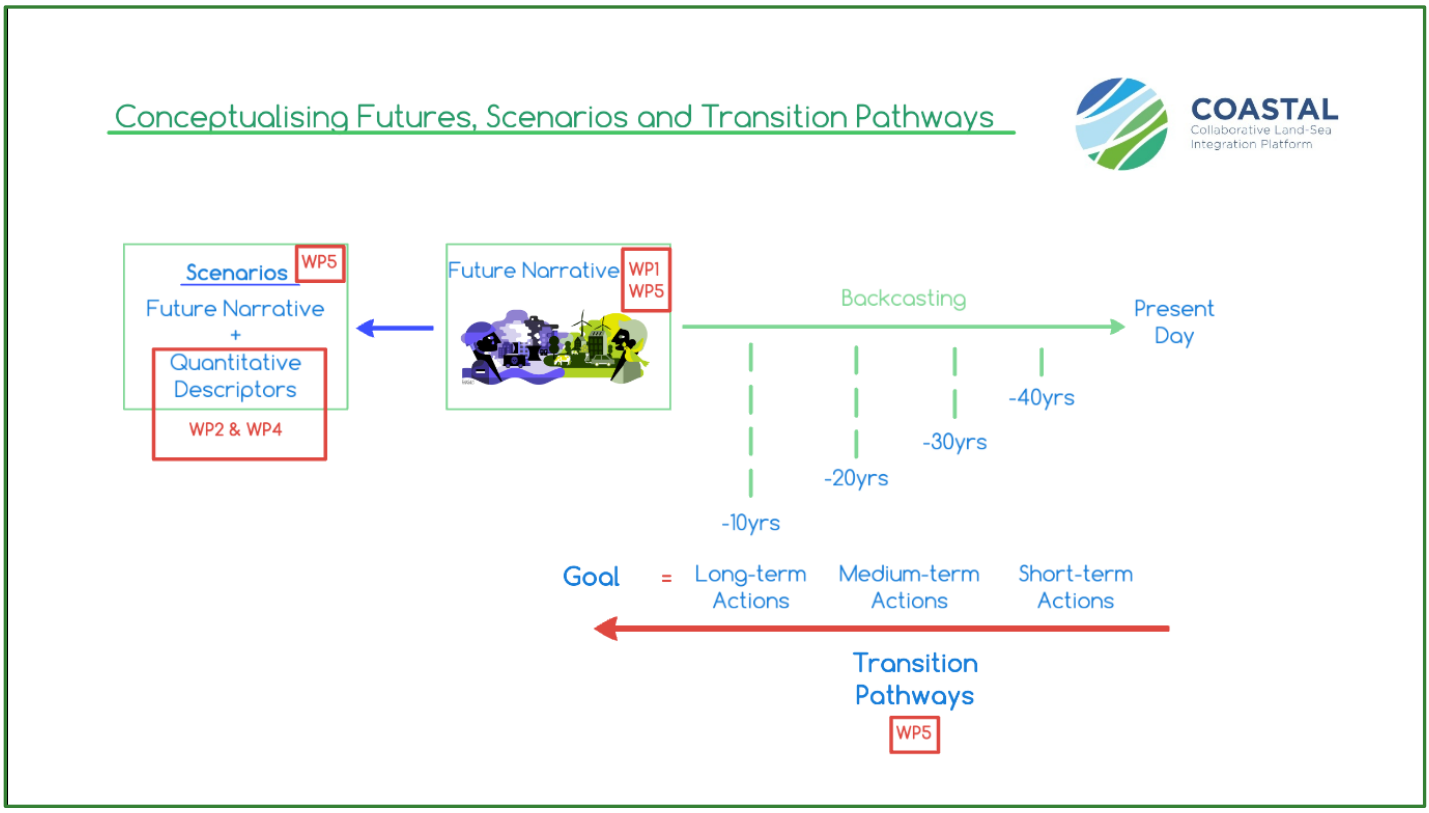

Figure 8: Work Package interactions in the development of scenarios and transition pathways

In the context of the COASTAL project, the scenarios are constructed within **WP5**. These scenarios are developed using input from the MALs (**WP1 MAL Joint Workshops**) and literature review conducted in **WP5** to build the Future Visions; as well as Quantitative Descriptors developed also within **WP5** in collaboration with **WP2 and WP4** partners. A Backcasting process conducted within **WP5** with feedback from the **MALs (WP1 stakeholder interviews via MAL leaders)** is used to develop the transition pathways. The transition pathways provide input to **WP3** in order to support the development of the policy guidelines and business roadmaps. The process of developing the scenarios and TPs is detailed in the following sections.

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2.2.1. Developing the Scenarios

Literature distinguishes between two main kinds of scenarios; projective and prospective (*Schoonenboom et al., 1995; Geurs & van Wee, 2004).* A **Projective** scenario starts by applying the current situation in which an extrapolation is made of current trends resulting in future images *(Geurs & van Wee, 2004)*, while p**rospective** scenarios are designed future-images working back to the present situation. These become usually described by a set of goals or targets established by assumed events between the current and future situations *(Schoonenboom et al., 1995).*

The scenario development process within the deliverable is undertaken in two phases: firstly, a review of existing relevant scenarios based on an analysis of D17 (Inventory of Scenarios and Transition Pathways) and additional literature review; secondly, the development of three generic COASTAL scenarios based on a literature and policy review, as well as input from the MAL teams.

The analysis of D17, focuses on a review of the existing scenarios collated within the inventory of scenarios, and additional literature review; highlighting scenarios of particular relevance to D18 various levels (presented in Section 3). This portion of the deliverable also highlights existing projective scenarios ('business-as-usual' scenarios and potentially unsustainable scenarios) with the potential to be utilised by WP4, seeing as the generic scenarios developed within the deliverable are based on sustainable visions of coastal-rural synergies and development.

The generic scenarios developed within this deliverable are prospective scenarios. The methodological decision to start from the envisioned future was essential to enable the formulation of future-oriented strategies that go beyond "business as usual" solutions and are not constrained by vested interests and stakes; this allows genuine solutions should emerge from creative, inspirational and positive future perspectives, rather than from reactive, defensive and problem-oriented approaches (Roorda et al., 2012; VITO, 2012, Roorda and Akinsete, 2013). The exercise draws on 'Appreciative Inquiry' (Elliott, 1999; Cooperrider and Whitney, 2005; Reed, 2007; Cooperrider et al., 2008), and so while it is possible to envision a dystopian future, the focus here is on the positive and envisioning an ideal situation, as a basis of inspiration towards sustainable transformations (Bennett et al, 2016). The resulting scenarios are often disruptive (making a non-linear break from established trends), challenging the status-quo and thinking amongst stakeholders (European Environment Agency, 2001). They are effectively hypotheses, **"that suggest new ways that existing models could be used or new models created"** exploring novel drivers and social relationships such as patterns of ownership and governance which could **"point to interesting areas for modelers to explore in future generations of scenario models"** (Raudsepp-Hearne et al., 2019) – which is of particular relevance to the use of the scenarios by WP4. The use of positive scenarios has a long-standing history in disciplines such as urban planning and sustainability research, where these visions provide a "direction for actions and behaviour; more so, they create identity and community" (Wiek and Iwaniec, 2014). In the context of urban planning, it has been recognised that urban futures developed around negative discourse disincentivising potential investments, as opposed to positive visions which often serve as a call-to-action to explore not only these desired futures, but also the transitions that will lead communities there (McPhearson et al., 2017).

As part of the scenario-development process within the COASTAL project, the team conducted a review of strategic documents referenced on Figure 2. In addition, the team engaged the respective MALs in order to develop future narratives, based on an ideal vision of coastal-rural synergies within their respective case study areas. In order to support MAL partners in gaining a deeper understanding of the process, and facilitate their contributions towards the scenario development process, the WP5 team developed a set of guidelines (Appendix 2), for the envisioning exercise to be carried out during the

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respective MAL multi-sectoral workshops. The document was meant to serve as a quick reference guide for MAL leaders running joint workshops. The guidelines provide concise definitions of key terms, as well as the methodology adopted by WP5, before going over the co-creation of the qualitative portions of the scenarios – Future Narratives (See examples of Future Narratives developed during the multi-actors workshops in boxes 1-3). The document presents an overview of participatory scenario-development, outlines key steps, and provides useful tips for both facilitators and participants.

In addition, the WP5 team held post-workshop debrief meetings with all 6 MALs. Acting on feedback following the first three workshops, the WP5 team held additional virtual training meetings with the other 3 MALs (France, Romania, and Sweden) prior to their workshops. This yielded a marked difference in the quality of output produced in terms of the richness of the Future narratives.

.Box 1: MAL 5 Future Narrative – Danube's Mouths - Black Sea

The future narratives for Danube's Mouths focus on three main directions, namely *aquaculture, tourism and agriculture*.

The envisaged development of ***marine aquaculture*** in the future foresees the legal settlement of the water body concession issue and the implementation of the shellfish areas sanitary-veterinary classification for safe human consumption. For ***fish farming***, on land recirculating aquaculture systems (RAS) are the solution. In a long-term time frame, four shellfish farms, one cage fish farm in open sea and two RAS fish farms on land are desired. Another potential development direction could be the capitalization of chlorophyll from micro and macroalgae.

With regards to ***tourism*** development, the trend of passing from classic tourism to eco-tourism is clear. As fisheries are declining, most of the Danube Delta population is employed in touristic activities. A green friendly tourism should be approached, by promoting electric transportation and clean technologies (e.g. waste-water treatment). Another key-point is preserving the specificity of the zone with regards to traditions, folklore, gastronomy (during summer 2019 were approved by the Sanitary Veterinary Directorate the operation of *Local Gastronomy Points*). Households can function as guesthouses, offering accommodation and catering services, in an authentic traditional environment.

Another development direction was promoting of different types of tourism activities - sophisticated travelers following belletristic itineraries, routes based on ancient ruins (Greek, Roman) or following literary/cultural routes: multicultural cemetery of Sulina, Lighthouse of Sulina, the houses of the old owners, 2 wrecks very well preserved. One of the mayors of the villages on the Danube delta upstream delivers the village to be a mini port for the Villages from Danube Delta's upstream are mini ports for cruises on the Danube and tourists are following the neighboring wine routes.

The Danube Delta, a rather expensive destination, will be visited especially by foreign tourists whom seek beautiful landscapes and nature, birdwatching, local traditions.

For inland rural areas, the future relies on ***integrated agriculture***, namely each community should focus on a complete production: from cereals, animal farming, processing units, in order to deliver finite products. Moreover, lower interest rates for credits and more subsidies are desirable, together with adapting to novel technologies (smart irrigation systems).

Agriculture practices in the area should change from large land-owners to smaller surfaces cultivated by locals (preemption rights) and the resulting products should be used for their livelihood, marketed in local pensions/hotels, and only the surplus (if any) marketed elsewhere. → *Local instead of global*

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Box 2: MAL 6 Future Narrative – Mar Menor Coastal Lagoon

The Campo de Cartagena and Mar Menor lagoon are internationally recognized as well developed coastal and rural ecotourism destinations. The tourism, agriculture and fishery sectors are now interdependent and collaborating for sustainable development. The strong presence of sustainable tourism activities creates the incentives for developing and preserving healthy rural areas, sea and coasts, combined with good quality infrastructures and level of general well-being for people living in the area. All sectors work together following a problem-based approach and promoting economic benefit transfer from coastal to rural areas and vice versa. New regulations from local to national level are developed, incorporating and considering the environmental, social and economic aspects of sustainable development. All economic sectors have internalized environmental costs and benefits in their business models. The agricultural sector is aware of its role and impact on the Mar Menor lagoon driven by a change in attitude from local and international consumers, who now consciously buy vegetables and fruits produced by means of sustainable land management practices. Thus, agriculture in the area has made a transition to high quality products with a high added value, applying the latest technology for water and nutrient efficiency and concepts of sustainable intensification. Production is increasingly oriented to local markets and tourism and solar energy has become an attractive alternative for agricultural land use. There is an expansion of tourism activities linked to agriculture (agro-tourism) and to alternative activities in rural and coastal areas that attract international (water and land) sport events taking advantage of the soft winters. The blue growth sectors expand, leading to high self-sufficiency in energy and a more circular production of local goods. There is a coordinating body for the Mar Menor and its catchment area formed by public administrations and representatives from all socio-economic sectors that co-manage the area with strong participation from all stakeholders. All sectors follow a common regulation to minimize and mitigate nutrient and pollutant emissions as a long-term goal. This is also supported by building new green infrastructures based on nature-based solutions and the wide scale adoption of sustainable land management practices in the agriculture sector that help protecting the lagoon and villages from flooding and contamination

Box 3: MAL 3 Future Narrative – Norrstrom/Baltic

The Baltic coastal region is everyone's accessible playground. This creates the incentives of developing and preserving healthy sea and coasts, combined with a good level of general well-being for people living around the coasts, not only in the big beneficiaries of the Baltic Sea (Finland and Sweden) but also in all the surrounding countries. All the Baltic Sea states work together following a problem-based approach and supporting/developing the finance flow across countries. A new HELCOM is developed, incorporating and considering all three environmental, social and economic aspects of the sustainable development. This new HELCOM has successfully initiated naming and faming programs to promote competition among all beneficiaries in terms of their investments on effective projects and programs. At the local level, people's behaviour and lifestyle is changed to achieve a level of common knowledge/realization of their roles and impacts within the complex system of the Baltic Sea environment. Green growth sectors expand, leading to high self-sufficiency in food and less transportation, without intensifying the impacts on water quality. A common framework for water quality measurement and its indicators is developed and agreed upon by all sectors on land and at sea. Also, all sectors follow a common regulation to minimize and mitigate nutrient and pollutant emissions as a long-term goal. For this, policies and investments are focused on the upstream, creating market-based innovations that regulate the amount and the type of pollution each sector can/is allowed to emit to the downstream. This is also supported by building new infrastructures based on new technologies (such as parallel systems of storm-water collection for groundwater recharge), and developing circulated economy among sectors.

Figure 9 Box 1-3 Future Narratives developed by local stakeholders during multi-actors workshops in Romania (MAL 5), Spain(MAL 6) and Sweden (MAL 3)

Figure 10: Main themes identified in MALs' visions and strategic documents

In structuring the generic scenarios, the WP5 team adopted a developmental framework based on 'themes, sectors and institutions' – factors, sectors and actors (Rotmans et. al., 2000). In this case, each scenario is built around the indicative factors/themes as illustrated in figure 9. Within the context of the COASTAL project, the future narratives received from the MALs were reviewed and combined, before conducting a qualitative textual analysis including the already existing local/national scenarios and transition pathways (figure 10), distilling three **'Central Themes'**:

- People and Nature
- Governance and Cooperation
- Circular Economy

These themes provided the focal points for the elaboration of the sustainable scenarios for coastal-rural synergy. The first step of this process involved the creation of three '**Future Narratives'** (the qualitative portion of the generic COASTAL scenarios) under each of these themes; the result of a combination of the qualitative analysis of each of the MAL-level Future Narratives, and input from local, national and EU level-strategic documents which include scenarios and territorial visions such as those developed by the

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six most relevant Directorates General[8] of the European Commission in their strategic plans 2016-2020 (Figure 2).

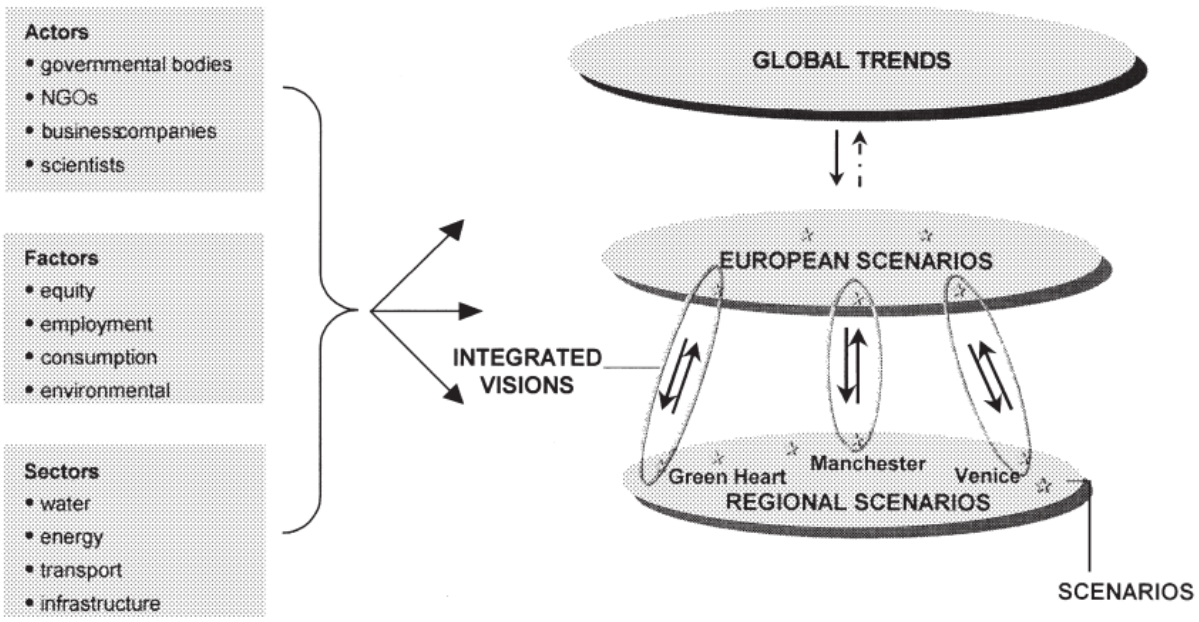

Figure 11: An application of the factors-actors-sectors Framework (Source: Rotmans et. al., 2000)

The second step involved developing the quantitative component of the scenarios; the team identified '**Relevant Drivers**' from each of MALs based on the mental maps (fuzzy cognitive maps and combined causal loop diagrams) created within WP1 (D03: Sectoral Analysis of Coastal and Rural Development). Each individual list of drivers was validated by the MAL teams, before being combined under each of the scenarios. The identified drivers were supplemented by a list of **'Core Narrative Elements'**, which are key features identified within the narrative but not captured by mental models from D03. Next, based on input from the MALs as well as literature, a '**Trend'** (increased, decreased or variable) for each of the relevant drivers and core narrative elements was established within the context of the respective scenarios. Finally, a list of potential indicators for each of the drivers is presented in the form of '**Quantitative Descriptors**'. In order to ensure cohesion between the scenarios and other work packages within the project (such as WP2 and WP4), the Quantitative Descriptors have been aligned where possible with the Model and Data Inventory (D06), developed within WP2, which indicates potential data to be utilised within WP4. While the generic scenarios provide trends, as an indication of the trajectory of each of the drivers, the inherently generic nature of the scenarios means that it is not possible to provide exact figures for each of the quantitative descriptors, as these remain location-specific and vary depending on the MAL being considered. The specification of the quantitative descriptors will be incorporated into the downscaling process, in the application of the generic scenarios

[8] DG Agriculture & Rural Development; DG Climate; DG Energy; DG Environment; DG MARE; DG Transport

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at MAL level (Task 5.3). The three generic scenarios developed as a result of this work are presented within Section 4 of this report.

2.2.2. Developing the Transition Pathways

Similarly to the scenario development process, the development of transition pathways involved both a critical analysis of existing transition pathways as well as the development of a set of 13 generic COASTAL transition pathways, aiming at coastal-rural synergies for regional sustainable development. The pathways, describe different goal-oriented transitions towards sustainability that may be potentially applied to the various case studies in order to move towards sustainable coastal-rural synergies in their respective areas.

To begin with, the team constructed a matrix based on the developed scenarios and chosen focal sectors, in order to structure the identification of the transitions. The chosen sectors were:

- Agriculture
- Tourism
- Energy
- Maritime activities

The sectors were chosen based on the sectors represented by the MAL stakeholders, and identified as being of particular relevance for coastal-rural regions. In addition, the sectors echo the central themes identified by the review of D17. 'Policy', 'local administration', and 'water management' were not considered as individual sectors, but rather the stakeholders within each of these groups were considered as actors across all the identified sectors, seeing as they deal with cross-cutting issues which are represented irrespective of the sector being considered.

Using this matrix, necessary transitions within each of the sectors were identified under the three respective generic scenarios. Based on the analysis of D17, an additional review of the literature, policy, and strategic documents, the team identified a total of 28 initial transitions that would facilitate systemic change towards the envisioned future illustrated by each scenario. These 28 initial transitions, were consolidated into 13 generic transition pathways (See table 3), required to drive costal-rural development towards the futures described within the respective generic scenarios. Next, each of the 13 transition pathways, were elaborated by identifying:

- Key actors necessary to make the transition happen
- Key actions (ascribed to identified actor groups)
- Main barriers and challenges that may be faced in implementing the transition (What would obstruct or hinder the transition?)
- Enabling conditions (What Will Support the Transition? – in terms of a) Existence of Resources: Human, Financial, Political, and Technological; b) Decline/Decrease of undesirable activities and behaviours

The actors, actions, barriers and enabling conditions outlined under the generic transition pathways provide a broad perspective on the issues. During Task 5.3, the downscaling process will be expected to a) select the most relevant transition pathways for each MAL, as well as contextualise the content of each of the afore mentioned sections. In addition, at this stage with support from stakeholders, the actions will be broken down into the short, medium and long-term.

The 13 generic scenarios are presented in Section 4 of this document.

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Table 3 Summary of Generic Transition Pathways

SECTORS	SCENARIO 1: (Theme: People and Nature)	SCENARIO 2: (Theme: Governance and Cooperation)	SCENARIO 3: (Theme: Circular Economy)
Agriculture	TP1: FROM Conventional Agriculture TO Sustainable Agriculture	TP6: FROM fragmented and competitive farming structures TO Local cross-sectoral cooperations within the sector	TP10: FROM linear food production models TO circular food production models
Energy	TP2: FROM a carbon emitting economy TO a decarbonized economy (Zero Net Emissions)	TP7: FROM Fossil-based energy sources TO Focus on closed-loop energy production	TP11: FROM Fossil-based energy sources TO Focus on closed-loop energy production
Tourism	TP3: FROM Mass Tourism TO Alternative Tourism	TP8: FROM Sea-side tourism TO Coastal-rural tourism	TP12: FROM conventional models of tourism TO circular models of tourism
Maritime Activities	TP4: FROM Shipping as a major carbon emitting sector TO Shipping as a zero net emissions sector TP5: FROM building against nature TO building with nature	TP9: FROM Sectoral, spatialized planning of activities TO Combined activities and cross-sectoral collaboration in the land-sea continuum	TP13: FROM resource intensive aquaculture at sea TO closed-loop aquaculture

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3. EXISTING SCENARIOS AND TRANSITION PATHWAYS

This section summarises existing information on scenarios and transition pathways based on the inventory collated within D17, as well a further review of relevant literature, policies, directives and strategies.

3.1. Scenarios

One of the key findings from D17, is the fact that there is a marked gap in the literature as relates to scenarios that focus on coastal-rural areas. As such, in addition to actual 'scenarios' by the strict definition of the word, the review covers visions and strategies outlined at various levels, which could effectively contribute to the scenario development process. While some of the actual scenarios reviewed within this section contain narrative aspects which "give voice to important non-quantifiable aspects such as values, behaviours and institutions" GSG, 2002b), as well as quantification tables which capture a range of aspects (similar to the process adopted within the COASTAL project); others are visions, and aspirational targets set out to be strategic documents, which could potentially form the basis upon which normative scenarios are structured.

In addition, the examined scenarios contain a number of 'business as usual' (BaU) scenarios (e.g. Special Report on Emissions Scenarios (SRES) – B1, B1T scenarios, some of RCPs and SSPs of the Intergovernmental Panel on Climate Change (IPCC) 2001, The White paper on the future of Europe Scenario: *Carrying on* (sticking to the same course), Global Scenario Group's Conventional World Scenarios etc.), which are highlighted within the review. These representations of potential BaU scenarios could potentially be useful in supporting the development of BaU scenarios within T5.3 and WP4 (IPCC, 2001; Global Scenario Group, 2002; IPCC, 2012; European Commission, 2016a; European Commission, 2017b; IPCC, 2017; Guillemette and Turner, 2018).

3.1.1. Global and EU Level Scenarios

3.1.1.1. Sustainable Development Scenarios for Rio+20[9]

The purpose of sustainable development (SDe) scenarios is to illustrate in a coherent way what feasibly could be achieved, if we did all "the right things"[10] to move onto a sustainable development trajectory. The majority of these scenarios have been normative. Science and politics have suggested normative SDe goals, and scenarios have tried to explore feasible pathways towards them. They are typically contrasted against Dynamics as Usual (DAU) or Business as Usual (BAU) scenarios, which are by and large a great deal less progressive than the catalogued SDe scenarios. While a number of scenarios reviewed within the 2013 publication are considered outdated today (with a list that includes IIASA's global energy assessment (GEA) scenarios, PBL Netherlands Environmental Assessment Agency's sustainable development, Research Institute of Innovative Technology for the Earth's scenarios, OECD's green growth scenarios: Environmental Outlook for 2050, Stockholm Environment Institute's scenarios, FEEM's goals and targets, and scenarios developed by World Business Council for Sustainable Development, World Wildlife Fund, World Economic Forum, and UNEP), the document still holds an

[9] Sustainable Development Scenarios for Rio+20:
https://sustainabledevelopment.un.org/content/documents/793SD21%20scenario%20report.pdf

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extensive amount of knowledge on historical scenarios and the supporting data (both quantitative and qualitative). In addition, some of the analysed business as usual scenarios such as those of the OECD and the IPCC (Special Report on Emissions Scenarios), are still relevant today (United Nations Department of Economic and Social Affairs, 2013).

3.1.1.2. IPCC Scenarios: Special Report on Emissions Scenarios[10], Representative Concentration Pathways (RCPs)[11] and Shared Socioeconomic Pathways (SSPs)[12]

The IPCC Special Report on Emissions Scenarios (SRES): (2000) presented a set of four scenarios which set out to explore future developments in the global environment. The scenarios considered demographic, social, economic, technological, and environmental drivers (both qualitatively and quantitatively), as they impact development.

- A1 storyline and scenario family: a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and rapid introduction of new and more efficient technologies.
- A2 storyline and scenario family: a very heterogeneous world with continuously increasing global population and regionally oriented economic growth that is more fragmented and slower than in other storylines.
- B1 storyline and scenario family: a convergent world with the same global population as in the A1 storyline but with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies.
- B2 storyline and scenario family: a world in which the emphasis is on local solutions to economic, social, and environmental sustainability, with continuously increasing population (lower than A2) and intermediate economic development

While the SRES are amongst the first generation (including the preceding IS92 also produced by the IPCC) of such global development scenarios to take on an environmental focus and a precursor to the subsequent RCPs and SSPs, one marked gap within the SRES was their failure to capture mitigation policies (Nakicenovic, et. al., 2000). Therefore, as a result of a need for new emissions scenarios, the IPCC proceeded to develop the RCPs. The B1 family of scenarios (specifically B1 and B1T) are recognised as the business as usual scenarios (IPCC, 2001).

With respect to the RCPs and SSPs, the term 'pathway', is used interchangeably with the word 'scenario', as it describes individual scenario components. The RCPs describe GHG concentration trajectories (van Vuuren et al., 2011) and the SSPs are a set of narratives of societal futures augmented by quantitative projections of socio-economic determinants such as population, GDP and urbanization (Kriegler et al., 2012; O'Neill et al., 2014).

[10] Special Report on Emissions Scenarios: https://sedac.ciesin.columbia.edu/ddc/sres/

[11] Representative Concentration Pathways: https://link.springer.com/article/10.1007%2Fs10584-011-0148-z

[12] Shared Socioeconomic Pathways: https://unfccc.int/sites/default/files/part1_iiasa_rogelj_ssp_poster.pdf

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Representative Concentration Pathways (RCPs):

The RCPs are consistent sets of projections 'representative' of possible future emissions and concentration scenarios published in the existing literature. They focus on the 'concentrations' of greenhouse gases that lead directly to a changed climate, and include a 'pathway' – the trajectory of greenhouse gas concentrations over time to reach a particular radiative forcing at 2100. Their report outlines four pathways: RCP8.5, RCP6, RCP4.5 and RCP2.6, with the numerical value reefing to the amount of radiative forcing produced by greenhouse gases in 2100.

RCP 8.5 is characterized by increasing greenhouse gas emissions over time, representative of scenarios in the literature that lead to high greenhouse gas concentration levels (Riahi et al. 2007).

RCP6 is a stabilization scenario in which total radiative forcing is stabilized shortly after 2100, without overshoot, by the application of a range of technologies and strategies for reducing greenhouse gas emissions (Fujino et al. 2006; Hijioka et al. 2008).

RCP 4.5 is a stabilization scenario in which total radiative forcing is stabilized shortly after 2100, without overshooting the long-run radiative forcing target level (Clarke et al. 2007; Smith and Wigley 2006; Wise et al. 2009).

RCP2.6 is representative of scenarios in the literature that lead to very low greenhouse gas concentration levels. It is a "peak-and-decline" scenario; its radiative forcing level first reaches a value of around 3.1 W/m2 by mid-century, and returns to 2.6 W/m2 by 2100. In order to reach such radiative forcing levels, greenhouse gas emissions (and indirectly emissions of air pollutants) are reduced substantially, over time (Van Vuuren et al. 2007a).

Table 4 Characteristics of the four RCPs (Source: Australian Government Department of Environment, 2013)

Scenario	Atmospheric carbon dioxide concentrations in 2100 (used as input for most model simulations)	Temperature increase to 2081-2100 relative to a 1850-1900 baseline		Global mean sea level rise for 2081-2100 relative to a 1986-2005	
		Average	Likely range	Average	Likely range
RCP2.6	421ppm	1.6°C	0.9-2.3°C	0.40m	0.26-0.55m
RCP4.5	538ppm	2.4°C	1.7-3.2°C	0.47m	0.32-0.63m
RCP6.0	670ppm	2.8°C	2.0-3.7°C	0.48m	0.33-0.63m
RCP8.5	936ppm	4.3°C	3.2-5.4°C	0.63m	0.45-0.82m

In comparing the RCPs to the SRES, RCP4.5 scenario is comparable several low emissions reference scenarios in the literature, such as the SRES B1 scenario; while RCP8.5, an extreme scenario which emphasizes high population growth and lower incomes in developing countries was based on a revised version of the SRES A2 scenario. Incidentally, RCP8.5 is often referred to as the 'business as usual' scenario despite this being an incorrect designation. This misinterpretation is largely due to the fact that the development of the SSPs took considerably more time than expected and the integration of the SSPs and RCPs which was due to take place 2012 intended to create fully integrated scenarios, is only just

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underway, as well as the fact that the usage of RCP8.5 within a seminal publication (Raihi, 2011), has been largely taken out of context (Haufsfather, 2019; Raihi, 2019; Peters, 2019).

Indeed the developers of the RCPs, have been quite clear in stating that "compared to the overall literature, RCP8.5 should be seen as a high emission scenario, RCP6 can be interpreted as either a medium baseline or a high mitigation case, RCP4.5 can be considered either as an intermediate mitigation scenario, while finally RCP2.6 is representative of the lowest mitigation scenarios currently in the literature". (van Vuuren et.al. 2011). In fact the choice to develop an even number of scenarios was deliberate in order to avoid a clear middle scenario, as there are no specific likelihood preferences attached to either of the RCPs. In addition, RCP 8.5 is the only non-mitigation policy scenario and is clearly intended to be an extreme with most other non-climate policy scenarios placing emissions in the order of 15 to 20 GtC by the end of the century, which is closer to the emission levels of the RCP6 (van Vuuren et.al. 2011; Wayne, 2013). In other words, while RCP8.5 may be a likely 'business as usual' scenario in a world without any climate policy, RCP6.0 is a more likely business as usual scenario given the current state of things. Data tables (quantitative variables) related to the RCPs can be found in the RCP database (https://www.iiasa.ac.at/web-apps/tnt/RcpDb/dsd?Action=htmlpage&page=welcome).

Shared Socioeconomic Pathways (SSPs):

Following an extended delay, the SSPs were published in 2017. The scenarios which consist of both qualitative storilines as well as quantitative elements with accompanying data on national population, urbanization and GDP (per capita), describe alternative versions of future socio-economic development with a time horizon of 2100. The SSPs comprise five narratives and a set of key driving forces in terms of population, economic growth and urbanization (Raihi et. al., 2017). The SSPs are further based on a range of baseline scenarios spanning between 5.0 and 8.5 W/m2 of radiative forcing by 2100 (see figure 10).

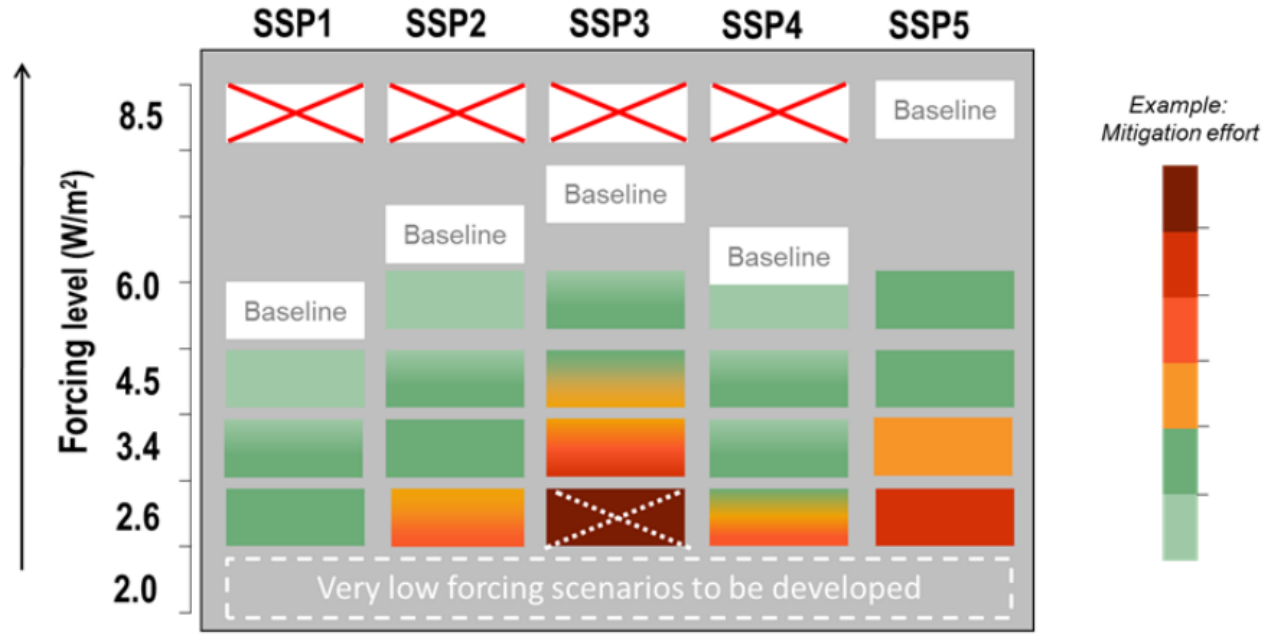

Figure 12: Scenario matrix specified by SSPs and forcing levels (Source: Raihi et. al., 2017)

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SSP1: Sustainability (Taking the Green Road)

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 a broader emphasis on 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.

SSP2: Middle of the Road

The world follows a path in which social, economic, and technological trends do not shift markedly from historical patterns. Development and income growth proceeds unevenly, with some countries making relatively good progress while others fall short of expectations. Global and national institutions work toward but make slow progress in achieving sustainable development goals. Environmental systems experience degradation, although there are some improvements and overall the intensity of resource and energy use declines. Global population growth is moderate and levels off in the second half of the century. Income inequality persists or improves only slowly and challenges to reducing vulnerability to societal and environmental changes remain.

SSP3: Regional Rivalry (A Rocky Road)

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.

SSP4: Inequality (A Road Divided)

Highly unequal investments in human capital, combined with increasing disparities in economic opportunity and political power, lead to increasing inequalities and stratification both across and within countries. Over time, a gap widens between an internationally-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 labor 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 like coal and unconventional oil, but also low-carbon energy sources. Environmental policies focus on local issues around middle and high income areas.

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SSP5: Fossil-fuelled Development (Taking the Highway)

This 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 also 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 the exploitation of abundant fossil fuel resources and the adoption of resource and energy intensive lifestyles around the world. All these factors lead to rapid growth of the global economy, while global population peaks and declines in the 21st century. Local environmental problems like air pollution are successfully managed. There is faith in the ability to effectively manage social and ecological systems, including by geo-engineering if necessary. The quantitative elements related to the SSPs can be found in the SSP database (https://tntcat.iiasa.ac.at/SspDb/).

The ultimate goal of the RCPs and the SSPs is to be merged within a single framework, an ongoing process which will result in the production of nine forcing scenarios being developed for the upcoming IPCC sixth assessment report (AR6) due in 2021 (IPCC, 2017; Haufsfather, 2019). Even as this work continues, current research (Kok et Al. 2015; EU GLOBAQUA Project, 2017; Rault, et al., 2018) have made steps towards the integration of both the RCPs and SSPs. Table 5 below illustrates the likelihood of global integrated scenarios, based on the potential combinations (Kok et al., 2015).

Table 5 RCP and SSP Probability Matrix (Source: Kok et al., 2015)

RCP	SSP1	SSP3	SSP4	SSP5
2.6	Highly Probable	Impossible	Fairly Probable	Highly Improbable
4.5	Probable	Probable	Probable	Fairly Probable
7.0	Impossible	Probable	Impossible	Highly Probable
8.5	Impossible	Impossible	Impossible	Probable

The EU-FP7 GLOBAQUA project also explores the integration of the RCPs and SSPs with the production of four scenarios ranging from economic growth-driven, to sustainable. Two of the mid-range scenarios ('Storyline 3: Adaptation' - pessimistic business as usual and 'storyline 4: Middle of the road' – optimistic business as usual) and are presented below.

Storyline 3- Adaptation (SSP 4 and RCPs 4.5)

Society & Economy: the world is characterised by a strong divide between the elite that benefits from technical development and improved quality of life and the rest of the population that has limited access to education and societal development. GDP per capita is growing at the 25-year average. That level of economic growth mainly benefits the elite. Economic growth is moderate in industrialized and middle-income countries, while low income countries lag behind, in many cases struggling to provide adequate access to water, sanitation and health care for the poor. Highly unequal investments in human capital, combined with increasing disparities in economic opportunity and political power, lead to increasing inequalities and stratification both across and within countries. Over time, the gap widens

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between an internationally-connected society that is well educated and 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. Power becomes more concentrated in a relatively small political and business elite, even in democratic societies, while vulnerable groups have little representation in national and global institutions. This leads to the decline of use of environmental resources, however the level of technology restricts the extensive use of nonconventional energy sources. Institutions work on achieving environmental goals, however only at a slow pace. Consequently, environmental degradation occurs, but there is a significant number of systems with improved quality. Negative environmental effects are integrated in production and consumption decisions and relevant policies (i.e. environmental externalities are not considered by any stakeholder group in the country), but not in every case, due to societal stratification. In summary, economic growth is achieved with the use of physical and natural capital, with the negative effects partly integrated into policies. Social cohesion degrades and conflict and unrest become increasingly common.

Energy: Technology development is high in the high-tech economy and sectors. Uncertainty in the fossil fuel markets lead to underinvestment in new resources in many regions of the world. Oil and gas prices rise and volatility increases. Energy companies hedge against price fluctuations partly through diversifying their energy sources, with investments in both carbon-intensive fuels like coal and unconventional oil, but also low-carbon energy sources. Policies incentivise green energy, but investments in alternative energy sources are restricted by the level of growth and to those that can afford it. Mitigation measures exist, but are limited to the elite. Adaptation is challenging. The rate of growth of C02 emission increases, compared to 2012.

Environment: Environmental policies focus on local issues around middle and high income areas. The combination of some development of low carbon supply options and expertise, and a well-integrated international political and business class able to act efficiently, implies low challenges to mitigation. Mitigation actions are taken at national level with some degree of international cooperation. Challenges to adaptation are high for the substantial proportions of populations at low levels of development and with limited access to effective institutions for coping with economic or environmental stresses. Provisioning and Cultural ecosystem services are considered relevant as long as they are supporting economic growth. Other ecosystem services (i.e. Regulating, Supporting), although well understood by the policy makers, rank low in the global political agenda when not concerning the wellbeing of the elite.

Policies: are aiming at tackling long-run economic and societal issues (education, increase GDP growth, technology). Environmental policies increasingly gain ground in the political agenda but their enforcement is unequal and limited to those that can afford it, otherwise decrease as time passes.

Water Management: Water management encompasses dealing with negative effects on quality and quantity of water resources. Water is considered valuable, and hence managed with care, not only as input in income generating production processes, civil protection and water supply, but also a resource with aesthetic value. Both use and non-use (passive) values are considered.

Storyline 4- Middle of the Road (SSP 2 and RCP 4.5)

Society & Economy: GDP per capita is growing at the 25-year average. That level of economic growth allows moderate investment in human capital and technology. This leads to the decline of use of environmental resources; however the level of technology restricts the extensive use of nonconventional energy sources. Institutions work on achieving environmental goals, however only at a

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slow pace. Therefore, environmental degradation occurs, but there is a significant number of systems with improved quality. Negative environmental effects are integrated in production and consumption decisions and relevant policies (i.e. environmental externalities are not considered by any stakeholder group in the country), but not in every case, due to societal stratification. In summary, economic growth is achieved with the use of physical and natural capital, with the negative effects partly integrated into policies.

Energy: Energy demand and in response supply are at the 25-year average, however the dependency on fossil fuels is slowly fading. Technological advances slowly make non-conventional sources of energy available that substitute fossil fuels. Policies incentivise green energy, but investments in alternative energy sources are restricted by the level of growth. Adaptation and mitigation measures exist, but are limited. The rate of growth of C02 emission increases, compared to 2012.

Environment: Governmental environmental regulation is focused on dealing with degraded ecosystems and achieving a better quality of the environment. Mitigation actions are taken at national level with some degree of international cooperation, but adaptation measures are reactive to only local concerns. Provisioning and Cultural ecosystem services are considered relevant as long as they are supporting economic growth. Other ecosystem services (i.e. Regulating, Supporting) are not well understood by the policy makers and rank low in the global political agenda.

Policies: are aiming at tackling long-run economic and societal issues (education, increase GDP growth, technology). Environmental policies increasingly gain ground in the political agenda and their enforcement increases as time passes.

Water Management: Water management encompasses dealing with negative effects on quality and quantity of water resources. Water is considered valuable, and hence managed with care, not only as input in income generating production processes, civil protection and water supply, but also a resource with aesthetic value. Both use and non-use (passive) values are considered.

The quantitative variables for each of the scenarios are listed within table 6 below, with expected change attributed to each as follows:

- significant increase +++
- moderate increase ++
- slight increase +
- no change compared to the current situation 0
- slight decrease –
- moderate decrease - -
- significant decrease - - -

Table 6: Table of Descriptors for the GLOBAQUA Scenarios (Source: EU GLOBAQUA Project, 2017; Rault, et al., 2018)

Sector	Descriptor	Adaptation	Middle of the Road
Society &Economy	Growth per Capita	0	+
	Unemployment	+	-
	Inequality Index	+++	-
	International trade or globalisation index	+	+
	Population growth (%)	+	+

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	Urbanisation	+	+
Energy	Use of fossil fuel (%)	+	-
	Hydropower production	+	0
	Use of renewable resources (%)	0	+
	Efficiency index (% RE/FF) *can differentiate between consumption and production EI at local scale	0	+
	Oil price	+	0
Environmental Effects	Air Quality	-	-
	Biodiversity	-	+
	Invasive species	+	+
	Deforestation	+	0
	Soil Degradation	+	0
	Water Scarcity (quantity/quality)	+	-
Water management	Technical Measures	+	+
	Non-Technical Measures	+	+
	Economic Measures (*Integrating Environmental Externalities)	0	+
Agriculture	Irrigated surface area (ha)	++	0
	Industrial agriculture (yield levels)	++	+
	Irrigation efficiency (ha/cubic meter)	+	+
	Organic agriculture (yield levels)	0	0
	Meat production	0	0
	Farms connected to public irrigation system/ farms with private supply	0	0
	Use of pesticides	+	0
	New pesticides' Env Effect	+	-
	Area cover with water intensive crops (ha)	0	0
	Self-sufficiency	--	0
	Organic fertilizers	0	0
	Mineral fertilizers	+	+
	Reuse of manure and by-products	+	0
	Abandonment of land	+	0
	Controlled drainage	0	0
	Genetically modified crops	+	0
	Crop rotation	+	+
	Erosion prevention	0	+
	Soil Salinization	+	+
	Subsistence agriculture	+++	+
Industry	Number of industries connected to WWT	+	+
	Investment in technology to emission	+	+

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	reductions		
	Employees with higher education	0	+
	Level of emissions	+	-
Residential	Water consumption/demand	-	0
	Density urban – rural	++	+
	Access to sanitation	+	+
	Equal participation in employment(gender)	+	+
Tourism & recreation	Mass tourism	--	+
	Selected tourism	++	+
Policies	Supports innovation	+	0
	Investment in infrastructure	0	0
	Protected areas	--	+
	Use of resources in alternative ways (use of marine resources for energy production)	0	+
	Water quality standards	0	+
	Planning horizon	0	+
	Food security	-	0
	Desalination for irrigation	-	0
Institutions	International cooperation	0	0
	Focused on environmental issues	0	+
	Well-defined property rights (excluding environmental resources)	0	0

3.1.1.3. 2050 Long-Term Strategy[13]

The strategy is built around the aim of the EU to become climate-neutral by 2050 (i.e. an economy with net-zero greenhouse gas emissions). Tied closely to the Paris agreement and the EU Green Deal, the document sets out a vision for "a prosperous, modern, competitive and climate neutral economy". The strategy does not aim to launch new policies, but rather sets out a "direction of travel of EU climate and energy policy", by making recommendations in the form of pathways towards the economic and societal transformations required; engaging all sectors of the economy and society, to achieve the transition to net zero greenhouse gas emissions by 2050. It seeks to ensure that this transition is socially fair (not leaving any EU citizens or regions behind) and enhances the competitiveness of EU economy and industry on global markets, securing high quality jobs and sustainable growth in Europe, while providing synergies with other environmental challenges, such as air quality or biodiversity loss (European Commission, 2018b).

[13] 2050 Long-Term Strategy: https://ec.europa.eu/clima/policies/strategies/2050_en

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3.1.1.4. White paper on the future of Europe: Reflections and scenarios for the EU27 by 2025[14]

Published in March 2017, the EU whitepaper outlines five possible scenarios with regard to the future of Europe. It reflects on the future of Europe after 'Brexit' and considers European parliamentary elections in May 2019. With the timeline for the scenarios set at 2025, the study starts with an overview of the driving factors that potentially will lead to possible changes in the near future. Based on these driving factors the five scenarios are derived:

- *Carrying on* (sticking to the same course): Europe continues to focus on jobs, growth and investments by strengthening the single market and by stepping up investment in digital, transport and energy infrastructure. Approach: adjustments to the course will only be made if problems arise, priorities will be updated along the road, etc.
- *Nothing but the single market:* The European is gradually re-centred around the single market): scenario dealing with the disability of decision-making amongst the member-states. Single market can be seen as the main "raison d'être" of the EU27. Further progress in policy-making and undertaking actions depends on the capacity to agree on related policies and standards.
- *Those who want more do more*: The European Union allows willing member states to do more in specific areas i.e. new groups of Member States agree on specific legal and budgetary arrangements to deepen their cooperation in commonly chosen domains (earlier example was the introduction of the Schengen-zone). Most likely with regard to defence matters and safety procedures.
- *Doing less more efficiently*: the European Union focuses on delivering more and faster in selected policy areas while doing less in other domains) This is probably the case when there's consensus how to tackle certain problems. New rules and enforcement tools become developed in order to deepen the single market in key areas such as high-tech clusters and the completion of regional energy hubs.
- *Doing much more together:* the European Union decides to do much more together across all policy areas cooperation between all Member States goes further than ever before in all domains. Europe speaks and acts as one in trade and is represented by one seat in most international fora. One voice for the whole of Europe in several domains (European Commission, 2017b).

3.1.1.5. Wind energy in Europe, Scenarios for 2030[15]

This EU-wide scenario study for the potential for wind energy using three scenarios (low, central and high) includes employment, investments and CO2 emissions. This mid-term forecast largely depends upon a dominant governance factor. The European Wind Energy Association (EWEA) describes within this report that to a large extent scenario development depends on recent policy developments in the major EU climate and the given energy priorities and concerned. These scenarios are based on Wind

[14] White paper on the future of Europe: https://ec.europa.eu/commission/sites/beta-political/files/white_paper_on_the_future_of_europe_en.pdf

[15] Wind energy in Europe: Scenarios for 2030: https://windeurope.org/wp-content/uploads/files/about-wind/reports/Wind-energy-in-Europe-Scenarios-for-2030.pdf

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Europe's analysis of the potential conditions determining wind energy deployment post-2020 (Wind Europe, 2017).

Central Scenario:
A clear 2030 governance structure with reporting mechanisms on Member States' progress to 2030 is implemented, and effective regional cooperation mechanisms are established. Member States implement detailed National Energy and Climate Plans in line with the EU's binding targets. The Renewable Energy Directive is implemented as proposed by the European Commission, and national policies for wind energy are streamlined, including repowering. As a result, the EU achieves a 27% renewable energy target. Significant progress on system integration allows for higher penetration of wind energy and other renewables, and power interconnection infrastructure is strengthened to allow the EU to reach the 15% interconnection target. Wind energy provides balancing and other ancillary services in all Member States. Policy commitments on electrification drive demand for renewable power. Onshore wind cost reductions keep apace. Offshore wind cost reduction objectives in 2025 (€80/MWh across all sea basins and distance from shore) are met and governments have a visible pipeline of projects to 2030.

Low Scenario:
No binding templates are agreed for National Energy and Climate Plans leading to weak governance, a challenging implementation of the post-2020 Renewable Energy Directive and failure to deliver the EU-wide 27% renewable energy target. Persistent overcapacity continues to 2030. The new market design is not able to guarantee increased renewable energy penetration, and system costs are therefore not reduced. No significant progress is made in electricity interconnections between Member States. Grid congestion issues continue to slow down new installations. The offshore wind energy pipeline of projects is below 4 GW/year, and cost reductions do not materialise. Unfavourable national policies for permitting and planning in high-potential markets persist, resulting in the slowdown of new and repowered installations.

High Scenario:
The EU-wide RES target for 2030 is increased to 35%. Binding templates for National Energy and Climate Plans are adopted, leading to an efficient governance system and full implementation of the recast Renewable Energy Directive. The EU-wide power transmission network is further developed beyond the European Commission's 15% target. Both the new market design and a reformed Emission Trading System (ETS) contribute to the phasing out of inefficient and uneconomical fossil fuels power plants and pave the way for a sustained development of renewable energy. With a deployment rate of 7 GW/year, the offshore wind industry becomes fully competitive with new fossil fuel generation. Favourable national policies for permitting and planning are in place, resulting in the acceleration of new and repowered installations. Europe accelerates electrification of heating, cooling and transport, bolstering demand for renewable power.

Based on an analysis of the scenarios, the document further provides a series of recommendations in order to drive the implementation of the EU Clean Energy Package[16] proposals presented by the European Commission in November 2016.

[16] EU Clean Energy Package:
https://cadmus.eui.eu/bitstream/handle/1814/57264/RSCAS_2018_TechnicalReport.pdf?sequence=1&isAllowed=y

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3.1.1.6. EU Reference Scenario 2016[17]

The EU Reference Scenario is one of the European Commission's key analysis tools in the areas of energy, transport and climate action. The scenario, which serves as a 'business as usual' reference point allows policy-makers to analyse the long-term economic, energy, climate and transport outlook based on the current policy framework. It is not designed as a forecast of what is likely to happen in the future, but it provides a benchmark against which new policy proposals can be assessed. National experts from all EU countries actively participate in its preparation.

The scenarios cover energy transport and GHG emissions trends to 2050, considering elements such as population growth, macroeconomic and oil price developments, technology improvements, and policies. The document projects that the EU and Member States energy, transport and greenhouse gas (GHG) emission-related developments up to 2050. It does so by taking into account global and EU market trends and the energy and climate policies already adopted by the EU and its Member States. The scenarios are quantified with the aid of a number of indicators related to demography, economy, energy production and consumption, electricity supply, transportation, energy efficiency and decarbonisation. These indicators are made available via interactive maps which illustrate the projections through to the 2050 time horizon[18] (European Commission, 2016a).

3.1.1.7. Towards a sustainable Europe by 2030[19]

This Reflection Paper puts forward three different scenarios following the European Council's guidance to lead the discussion on how the implementation of the SDGs could best be achieved and what would be the most effective division of roles. This reflection is intended to inform a debate among citizens, stakeholders, governments and institutions in the months ahead, with a view to inspire the preparation of the EU Strategic Agenda 2019-2024 and the priority setting of the next President of the European Commission.

Scenario 1: An Overarching EU SDG Strategy to guide all the actions of the EU and its Member States: Under this scenario, the United Nations 2030 Agenda and the SDGs would be our compass and map and thus determine the strategic framework for the EU and its Member States. Strategic action by the EU and the Member States, including regional and local authorities, would be pursued and effectively coordinated. A joint approach at all levels of government would be stimulated, in close cooperation with all stakeholders. This would include a strong component in the EU's relations with third countries to further international sustainability action. This also implies the establishment of a 'European process for

[17] EU Reference Scenario 2016: https://ec.europa.eu/energy/sites/ener/files/documents/20160712_Summary_Ref_scenario_MAIN_RESULTS%20%282%29-web.pdf

[18] EU Reference Scenario 2016 – Energy modelling - interactive graphs: https://ec.europa.eu/energy/en/data-analysis/energy-modelling/eu-reference-scenario-2016/energy-modelling-interactive-graphs?type=msline&themes=s_4_population&second_scenario=undefined&index_year=#container-charts-controls

[19] Towards a sustainable Europe by 2030: https://ec.europa.eu/commission/sites/beta-political/files/rp_sustainable_europe_30-01_en_web.pdf

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SDG policy coordination' to regularly assess and monitor progress in implementation, reflecting the cross-cutting nature and inter-connectivity between the SDGs, including in the internal governance of the European Commission.

Scenario 2: Continued mainstreaming of the SDGs in all relevant EU policies by the commission, but not enforcing Member States' action:

Under this scenario, the SDGs will continue to inspire our political decision-making with regard to the EU's policy making, and guide the development of the post-EU2020 growth strategy, while not binding EU Member States to achieving collectively the SDG commitments in the EU. In the European Commission this could mean that a member of the College is granted a broad responsibility for 'sustainability'. This Commissioner could continue working together with other Commissioners in a dedicated project team involving all the Commissioners. To ensure policy coherence, close cooperation with other project teams of Commissioners would have to be sought. Through its Better Regulation Agenda, the Commission would continue pursuing an inclusive and evidence-based decision-making process. Combined with stronger SDG mainstreaming of the European Semester in line with the post-EU2020 growth strategy, the EU's policy coherence is reinforced and it is ensured that the EU moves closer to the SDGs. However, this approach would leave more freedom to Member States, and regional and local authorities as to whether and how they adjust their work to delivering in a consistent manner on the SDGs.

Scenario 3: Putting enhanced focus on external action while consolidating current sustainability ambition at EU level:

External action would be prioritised in the context of the SDGs. As the EU is already a frontrunner in many aspects related to the SDGs, enhanced focus could be placed on helping the rest of the world catch up, while pursuing improvements at EU level. Our social market economy has become an EU trademark, and has allowed the economies of the EU Member States to generate wealth and broad-based prosperity thanks to strong social welfare systems. The EU has some of the world's highest environmental standards already, and our businesses are ahead of the curve compared to global competitors. The EU is also seen as a stronghold for freedom and democracy, with stable institutions based on the rule of law and a vibrant civil society. The EU could therefore decide to promote more strongly its current environmental, social and governance standards through multilateral negotiations and trade agreements. The EU could also further intensify its collaboration with key international organisations and forums, such as the United Nations, including the International Labour Organisation, the World Trade Organisation, and the G20 as well as the supervisory bodies of multilateral environmental agreements, to advance the EU's values-based external policy agenda. The EU's stance in support of multilateralism — with the United Nations at its core — and transparent and reliable international relations would continue to be prioritised.

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3.1.1.8. Global Scenario Group Global Sustainability Scenarios: 'Great Transitions'[20]

The Global Scenario Group (GSG) within their publication, *'Great Transition: The Promise and Lure of the Times Ahead'* (2002), examine the possibilities of a sustainable and desirable world. They outline three future scenarios (with two sub-variants each) of global development which each represent fundamentally different social visions, before driving for the 'Great Transition' path as the preferred route towards a sustainable future; identifying strategies, global actors, and values for a new agenda. The scenarios are:

Conventional Worlds: assume the global system in the twenty first century evolves without major surprise, sharp discontinuity, or fundamental transformation in the basis of human civilization. The dominant forces and values currently driving globalization shape the future. Incremental market and policy adjustments are able to cope with social, economic and environmental problems as they arise.

- *Market Forces:* This variant incorporates mid-range population and development projections, and typical technological change assumptions. The problem of resolving the social and environmental stress arising from global population and economic growth is left to the self-correcting logic of competitive markets.
- *Policy Reform*: adds strong, comprehensive and coordinated government action, as called for in many policy-oriented discussions of sustainability, to achieve greater social equity and environmental protection. The political will evolves for strengthening management systems and rapidly diffusing environmentally-friendly technology, in the context of proactive pursuit of sustainability as a strategic priority.

Barbarization: foresees the possibilities that these problems are not managed. Instead, they cascade into self-amplifying crises that overwhelm the coping capacity of conventional institutions. Civilization descends into anarchy or tyranny.

- *Breakdown:* In this variant, crises combine and spin out of control, leading to unbridled conflict, institutional disintegration and economic collapse.
- *Fortress World:* features an authoritarian response to the threat of breakdown. Ensconced in protected enclaves, elites safeguard their privilege by controlling an impoverished majority and managing critical natural resources, while outside the fortress there is repression, environmental destruction and misery.

Great Transitions: envision profound historical transformations in the fundamental values and organizing principles of society. New values and development paradigms ascend that emphasize the quality of life and material sufficiency, human solidarity and global equity, and affinity with nature and environmental sustainability

- *Eco-Communalism:* incorporates the green vision of bio-regionalism, localism, face-to-face democracy, small technology and economic autarky.

[20] Great Transition: The Promise and Lure of the Times Ahead
https://greattransition.org/documents/Great_Transition.pdf

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- *New Sustainability Paradigm:* shares some of the goals of the *Eco-Communalism* scenarios, but would seek to change the character of the urban, industrial situation rather than to replace it, to build a more humane and equitable global civilization rather than retreat into localism.

The narrative scenarios set out to "give voice to important non-quantifiable aspects such as values, behaviours and institutions", and are buttressed by quantification tables which capture a range of aspects including demography, economy, land use, water usage, GHG emissions, energy consumption and production etc. (GSG, 2002b).

3.1.1.9. OECD Scenarios (Alternative Futures for Global Food and Agriculture[21], The Long View: Scenarios for the World Economy to 2060[22])

The OCED's report on the 'Alternative Futures for Global Food and Agriculture': examines the three key trends currently frame the future challenges facing food and agriculture systems: growing and shifting food demand, constraints upon natural resources, and agricultural productivity uncertainties resulting from climate change. As such, the report explores agricultural markets within these alternative "futures" of the world in 2050.

- **The Individual Fossil Fuel-Driven Growth scenario:** portrays a world driven by the strong focus of individual countries and regions on their own economic growth, and relatively minimal emphasis by governments or their citizens on environmental or social questions.
- **The Citizen-Driven, Sustainable Growth:** world is one in which consumers and citizens drive their governments to emphasise environmental and social protection above all. Global co-operation is relatively limited.
- **The Fast, Globally-Driven Growth scenario:** is characterised by a strong focus on international cooperation to achieve economic growth. Environmental issues receive less attention from governments or their citizens

An analysis of these scenarios (OECD, 2016) indicates that:

"Food prices could once again rise, although the level and related uncertainty varies among the scenarios. Farm incomes should also increase – however, the contribution of the agricultural sector to GDP and employment will fall. Each scenario features its own priority challenges. Growth based on independent decision-making by countries and a high reliance on fossil energy – as is the case in the Individual scenario – could exacerbate food insecurity risks and increase pressure on the environment. Indeed, although global food security may well improve across all scenarios, the degree and speed of progress varies dramatically between them. Meanwhile, the Citizen-Driven scenario would challenge farmers to adopt more sustainable production methods, and the Fast scenario could witness amplified climate

[21] Alternative Futures for Global Food and Agriculture: https://www.oecd-ilibrary.org/agriculture-and-food/alternative-futures-for-global-food-and-agriculture/key-trends-and-long-term-scenarios-framing-the-future-of-food-and-agriculture_9789264247826-3-en

[22] The Long View: Scenarios for the World Economy to 2060: https://www.oecd-ilibrary.org/docserver/b4f4e03e-en.pdf?expires=1581527749&id=id&accname=guest&checksum=0C08379BC0ECFEC5181C32CB7FAF44B6

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change-related risks. All three "futures" see the environment being placed under increasing strain – albeit to varying extents. With the further expansion of agricultural land use and the growing use of farm inputs, the Individual and Fast scenarios indicate serious threats to sensitive habitats and ecosystems. Even in the Sustainable scenario, forests in Sub-Saharan Africa and Latin America would continue to decline – albeit at lower rates than in the other scenarios. Agricultural greenhouse gas emissions would likely continue to increase within all."

The report goes on to propose strategies that could be adopted in order to mitigate the most pertinent threats.

The 'Long View: Scenarios for the World Economy to 2060': on the other hand, builds on short-run economic projections of the OECD (up to 2013), and extend these forecasts to 2060. These long-run forecasts aim to better illustrate the potential benefits of key policy reforms (such as education, governance, labour and product market regulations) which tend to play out over a longer time horizon than is captured by short-run forecasts.

Baseline scenario with no institutional or policy changes

- World trend real GDP growth declines from about 3½ per cent now to 2% in 2060, mainly due to a deceleration of large emerging economies as these continue to account for the bulk of world growth. India and China take up a rising share of world output as the world's economic centre of gravity shifts toward Asia.
- Living standards (real GDP per capita) continue to advance in all countries through 2060 and gradually converge toward those of the most advanced countries, but to varying degrees. Living standards in high-growth emerging market and Eastern European economies converge most, driven by catch-up in trend labour efficiency, but GDP per capita in the BRIICS and some low-income OECD countries remains below half that of the United States in 2060. Demographic change weighs on growth in OECD living standards through 2060.
- Stabilising public debt ratios at current levels while meeting fiscal pressures from higher health spending and demographic change requires the median OECD government to raise primary revenue by 6½ percentage points of GDP by 2060.
- A global saving glut has been putting downward pressure on real interest rates in recent years, a trend that may persist.

Alternative scenarios with institutional or policy reforms:

- Relative to OECD countries, the BRIICS have substantial room to improve the quality of governance and raise educational attainment. In a scenario where both factors catch up with average OECD levels by 2060, living standards in the BRIICS are 30% to 50% higher in 2060 than in the baseline scenario.
- Reforms through 2030 to make product market regulation in OECD countries as friendly to competition as in the five leading countries raise living standards by over 8% in aggregate (as much as 15-20% in the countries furthest away from best practices).
- A reform package to improve labour market policy settings in OECD countries up to those of leading countries raises the aggregate employment rate by 6½ percentage points by 2040, mostly via higher youth and female employment. The package raises living standards by 10% by 2060 and helps alleviate future fiscal pressures related to ageing.

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- Tying future increases in pensionable ages to life expectancy, as some countries have done, raises the aggregate employment rate of older people in the OECD by more than 5 percentage points by 2060 and living standards by about 2½ per cent by 2060 (as much as 5-7% in countries with currently no explicit plans to change pensionable ages).
- Boosting R&D intensity in all OECD countries to the level of the five leading countries raises aggregate living standards by 6% by 2060 (as much as 10-18% in countries currently spending little on R&D).
- Permanently raising public investment in all OECD countries to 6% of GDP raises aggregate living standards by over 4% by 2060 (as much as 6-9% in some countries). Fiscal burdens rise by much less than the cost of the additional investment and the policy is even self-financing in some countries.
- Slipping back on trade liberalisation – returning to 1990 average tariff rates – depresses long-run living standards by 14% for the world as a whole and as much as 15-25% in the most affected countries.

A key omission however of the 'forecasts' of the OECD Long-run scenarios however, is the fact that they do not consider the natural environment (including natural resources, air and water quality, the climate, and sea level). By extension, the scenarios do not consider the potential impacts of climate change (eg temperature rise), which could have profound economic effects that vary by region.

3.1.1.10. World Energy Council[23]

The World Energy Council, an UN-accredited global energy body, representing the entire energy spectrum, in an update to their 2016 report, present scenarios which explore three plausible pathways for an energy transition towards 2040. The scenarios as presented below, focus on the implications of broader and disruptive innovation for the energy industry.

1. **Modern Jazz**: market-led, digitally disrupted world with faster-paced and more uneven economic growth. Recent signals suggest that this entrepreneurial future might accelerate clean energy access on both global and local scales, whilst presenting new systems integration, cyber security and data privacy challenges.
2. **Unfinished Symphony:** A strong, coordinated, policy-led world, with long-term planning and united global action to address connected challenges, including inequitable access and affordable decarbonisation. Recent signals suggest increased activism and commitment to addressing climate change at the sub-national level, and an expansion of the focus from climate change mitigation to a broader, socially inclusive and economically affordable sustainable development agenda.
3. **Hard Rock:** A fragmented world with inward-looking policies, lower growth and less global cooperation. Recent signals, such as the rise of populist leaders and uncertainty about the outlook for international cooperation, imply that this scenario is also evolving into a story of regionally firmer security foundations rather than total fragmentation and "harder rocks (World Energy Council, 2019).

[23] World Energy Scenarios 2019:
https://www.worldenergy.org/assets/downloads/Scenarios_Executive_summary_FINAL_for_website.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773782.

3.1.2. National and Case Study Level Scenarios

3.1.2.1. Belgium

North Sea 2050 Long-term Vision[24]

The vision is based on three core principles are used to develop activities at the Belgian part of the North Sea (BNS) or basic rules to which all future activities - ideally - must be tested. These core principles can be defined as follows:

- Naturalness is a basic precondition for the development of the BNS within all its dimensions.
- In 2050, the BNS will continue to offer important user functions, including for society well-being.
- By 2050, the principle of multiple use of space is the norm for all use of space within the BNS.

The document is closely tied to the EU Directive on Marine Spatial Planning (MSP), with the MSP viewed as a tool to achieve the goals outlined within the Long-term vision.

3.1.2.2. Greece

An analysis of long-term scenarios for the transition to renewable energy in Greece[25]

The document develops long-term scenarios for the Greek transition to renewable energy, investigating how EU and National targets on renewable energy are reflected in economic and environmental terms. Specifically, the research provides a look to the 2030 horizon in the energy and power system in Greece. Three scenarios are generated under different options, baseline (which is based on historical trends), target 2020 (which is based on the European target set in 2020) and target 2030 (which is based on the European target set in 2030). These scenarios are elaborated below:

Baseline Scenario: The first scenario is the "Baseline", which is based on historical trends from 1990 till 2010.

Target 2020 Scenario: The second scenario is based on the European target set in 2007, in order to develop an energy efficient and low carbon Europe via an increase in the share of EU energy consumption produced from renewable resources to 20%. According to the government, Law L3851/2010 states that the protection of the climate or the reduction of GHG emissions, through the promotion of electrical energy production from RES is a crucial element of the energy sector of the country. The further specific targets include RES electricity share (40%), RES heating and cooling share for the household sector (20%), and RES transport share (10%) in order to achieve the national target of 20% contribution of the energy produced from RES to the gross final energy consumption. This target will be achieved through the large penetration of RES technologies in electricity production, heat supply and transport sector.

The GDP in current prices and its annual growth rates are the same as for the Baseline Scenario. Finally, we assume a 50% increase of RES capacity, which corresponds to 5.311,7 MW. Specifically, as the Hellenic Transmission System Operator S.A. publishes binding and final Offers for Connection System or

[24] North Sea 2050 Long-term Vision: http://www.thinktanknorthsea.be/en/downloads?permalink=visie2050_en

[25] An analysis of long-term scenarios for the transition to renewable energy in Greece: https://pdfs.semanticscholar.org/16a4/8d7b3abfa547b2a02455ce87163ec5dab5ba.pdf

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Network for power stations of Renewable Energy and Stations and cogeneration plants of Electricity & Heat and High Performance (CHP), we assume that till 2020 will be achieved half of the non-binding offers.

Target 2030 Scenario: We follow the target set in 22 January 2014 by the European Commission towards a renewable energy economy. Specifically, the share of renewable energy penetration in final consumption is set to increase at least 27% by 2030. This will be achieved by the introduction of RES in industry. Following Heaps et al. (2009) concerning the industry sector, CO2 emissions can be further reduced through the increased use of biomass, natural gas and increased participation of RES in electricity, the iron and steel production sector, the cement production, chemicals production and other industrial subsectors. As far as the changes in GDP which are used in Target 2030 Scenario, these are given as for the Baseline and Target 20202 Scenarios. Finally, we assume a 100% increase of RES capacity, which corresponds to 10.563,2 MW (Halkos et. al., 2014).

3.1.2.3. Sweden

VASAB Long-Term Perspective for the Territorial Development of the Baltic Sea Region [26]

The 'Long Term Perspective' serves as a transnational strategic spatial planning document on territorial integration and cohesion in the Baltic Sea Region. The document focuses on urban networking and urban-rural relations, accessibility and management of the Baltic Sea, and proposes a list of actions to stimulate territorial development potentials and to overcome currently existing gaps. While the document does not specifically outline given scenarios for the region, it lays out a vision for the Baltic Sea region in 2030, as stated below:

"In 2030 the Baltic Sea Region is a well-integrated and coherent macroregion. It has overcome the socio-economic development divides between its individual parts and turned the global challenges into assets. It is regarded a model for successful implementation of the territorial cohesion policy and effective cooperation between the European Union countries and the neighbouring countries for the development of a transnational area. It features a well-balanced setup of metropolitan centres, which act as the global and the BSR gateways, and small and medium-sized cities and towns, which secure a high quality of life for their residents in both urban and rural areas. It accounts for fast, reliable and environmentally efficient technologies of transport, information and communication that link the territories along and across the Baltic Sea, making the community of the Baltic Sea Region well-connected and highly accessible in the contacts both internally and with the outside world. It has an integrated energy production and supply system with well-diversified sources of energy, including renewable energies. It is a veritable European sea macroregion, which demonstrates an integrated land and sea-space planning and management. The Baltic Sea is acknowledged as a common asset and a development resource of all the countries, and the maritime spatial planning principles alleviate the potential sea use conflicts for the present and future generations."

Baltic Sea Action Plan[27]

In 2007, the Baltic Marine Environment Protection Commission (HELCOM) developed the Baltic Sea Action Plan (BSAP). The plan is an ambitious programme to restore the good ecological status of the

[26] VASAB Long-Term Perspective for the Territorial Development of the Baltic Sea Region: https://vasab.org/wp-content/uploads/2018/06/vasab_ltp_final-2.pdf

[27] Baltic Sea Action Plan: https://helcom.fi/baltic-sea-action-plan/

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Baltic marine environment by 2021. The plan focuses on eutrophication, biodiversity, hazardous substances and maritime activities, incorporating innovative management approaches into strategic policy implementation, multilateral cooperation around the Baltic Sea region. The plan sets outs out a vision for:

"A healthy Baltic Sea environment, with diverse biological components functioning in balance, resulting in good environmental/ecological status and supporting a wide range of sustainable human economies and social activities."

3.1.2.4. France

Nouvelle-Aquitaine Regional Plan[28]

The regional plan for the sustainable development of the region (on-going process, ready for 2020) involves the development of a vision with a participatory process, and the integration of all the existing plans - willingness to recognized the dichotomy of the territory coastal/rural region. "Making a region together" means building a new territory in the image of its local cultures and specificities; it also means blowing, everywhere, a wind of attractiveness, solidarity and innovation; it is also to create new forms of proximity, to restore the links between politicians and citizens. The Plan establishes four Pillars of Regional Action:

- Develop employment
- Train youth
- Develop the territory
- Preserve our environment and our quality of life

3.1.2.5. Romania

Danube Delta Integrated Sustainable Development Strategy (2030)[29]

The strategic document is an attempt to balance environmental protection, economic development and quality of life within the Danube Delta Region. Using participatory processes and technical analysis, the strategy outlines a sustainable future for the region with a 2030 time horizon, as well as an action plan to implement the strategy. It incorporates the vision:

"An attractive area – with precious biodiversity and vibrant, small/medium scale (artisanal and modern) agriculture and business - where people live in harmony with nature; integrating economies of tourism, farming and fishery; and supported by urban service centers."

[28] Nouvelle-Aquitaine Regional Plan: https://www.nouvelle-aquitaine.fr/

[29] Danube Delta Integrated Sustainable Development Strategy (2030): https://www.mlpda.ro/userfiles/delta_dunarii/draft_Danube_Delta_Strategy.pdf

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3.1.2.6. Spain

Lagoons Project: Mar Menor[30]

For the Mar Menor, the climate change impacts are expected to have severe consequences in major hydrodynamic and water quality parameters defining the current functioning of the lagoon. The rise in sea level is going to cause a marked decrease in water residence times. In this hypersaline lagoon, and despite the parallel increase in water temperatures (and therefore evaporation rates), this will be translated into a decrease in salinity, since this parameter is mostly defined by the amount of water that enters the lagoon from the Mediterranean Sea and not by the amount of freshwater inputs that are extremely low and are expected to decrease. A similar event occurred during the early 70s after the enlargement of El Estacio channel and caused the colonization of the lagoon by Mediterranean species as salinity ranges became less extreme. This future "Mediterraneanization" of the lagoon might have unexpected consequences for the functioning of the entire lagoon and the support of valuable ecosystem processes and services. Equally (if not more) important is the expected impact on C. prolifera distribution and survival. As predicted by Lloret et al. (2008), the increase in summer temperature as a consequence of climate change will cause a deleterious impact on macroalgal beds in the Mar Menor. The impact goes beyond the death of huge masses of the algae and will have a profound effect on the ability of the benthos to process nutrients and, therefore, on ecosystem resistance to eutrophication (Lloret and Marin, 2009; Lloret and Marin, 2011). Although the models predicted a recovery phase for C. prolifera biomass after the summer in the modelled scenarios for the last years of the century, this situation is very unlikely to happen, since other 'undesirable' macroalgal species are likely to occupy the empty niche, limiting C. prolifera re-colonization and causing the collapse of the system.

3.2. Transition Pathways

The notion of 'pathway' can have different meaning in the literature, often used as individual scenarios in the climate literature (IPCC, 2018). In COASTAL WP5 'pathway' is used as a solution-oriented trajectory through a set of actions to achieve the future vision pre-established, such as Sustainable Development Pathways[31], Adaptation pathways[32], and more specifically pathways pushing for transformational change involving iterative and inclusive processes ((Harris et al., 2017; Fazey et al., 2018; Tàbara et al., 2018) in IPCC (2018).

Few documents collected during the inventory at the local / national level (Task 5.1) can be considered as transition pathways from COASTAL WP5 approach, many of them are strategic documents (see COASTAL Deliverable D17) stating objectives for the future. These strategic documents usually provide strategic goals per sector, they can be used as guidance but lack the practicality of designated actions for specific actors in order to realize the transition needed to reach coastal-rural sustainable future

[30] Lagoons Project: Mar Menor: https://cordis.europa.eu/project/id/283157/reporting

[31] Sustainable Development Pathways describe national and global pathways where climate policy becomes part of a larger sustainability transformation (Shukla and Chaturvedi, 2013; Fleurbaey et al., 2014; van Vuuren et al., 2015) in IPCC (2018).

[32] Adaptation pathways are understood as a series of adaptation choices involving trade-offs between short-term and long-term goals and values (Reisinger et al., 2014) in IPCC (2018)

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envisaged in the COASTAL project. Following the inventory of COASTAL D17, an additional screening at an international level was conducting, as part as Task 5.2, to collect additional relevant transition pathways (e.g. transition pathways developed by the Food and Land Coalition (2019), the Exponential Climate Action Roadmap coalition (2019), the Energy Transition Commission (2019), the Food and Agriculture Organization of the United Nations (FAO, 2018)) and EU funded projects offers valuable transition pathways options.

The most relevant documents providing inputs for generic coastal-rural transition pathways concern the agricultural sector (to reach a sustainable agro-food system), climate change and the energy sector (driving the energy transition by reaching the EU 20/20/20 headlines targets[33] and limiting global rise temperature below 2°C.). The COASTAL inventory at case-study level provide inputs related to the tourism sector and strategic documents for coastal-sea regions (for the Baltic Sea region, the Belgian North Sea region, the French South Atlantic Sea region, the Danube Mouth region) which are oriented towards maritime activities.

3.2.1. The Future of Agriculture

Agriculture is a major sector in coastal-rural areas as shown in COASTAL local case-studies and farmers have a key role to play in the sustainable transition. The Food and Land Use Coalition (FOLU) argue that "food and land systems can help bring climate change under control, safeguard biological diversity, ensure healthier diets for all, drastically improve food security and create more inclusive rural economies" while "delivering the Sustainable Development Goals (SDGs) and the Paris Agreement targets on climate change" (FOLU, 2019). The coalition developed critical transition paths with specific actions in order to reach specific targets ought to drive the society towards a sustainable future: a healthy diet (e.g. taxes and regulations on unhealthy food); a productive and regenerative agriculture (e.g. improve training and access to technology); protect and restore nature (e.g. establish a Global Alliance Against Environmental Crime); diversify protein supply (e.g. Increase R&D spending in alternative proteins such as insect-based and laboratory-cultured); reduce food loss and waste (e.g. regulate and incentive companies to reduce food loss and waste); harness the digital revolution and enable a stronger rural livelihoods as well as the need for gender equality and controlled demography in rural areas. With similar objectives, the FAO developed alternative pathways to 2050 for the future of food and agriculture sector (FAO, 2018a), which also propose specific actions that align with FOLU transition paths. The transition toward a sustainable agriculture able to feed the increase worldwide population will have to include actions such as rising consumer awareness on environmentally sustainable diets as well as healthier diet, regulating and discouraging food waste, limiting the use of biofuels, rehabilitate degraded land and practices that limit degradation, increase the efficiency of water use, improve farmers expertise in managing natural resources, the need of investing in research and development of sustainable technologies and practices is also a key aspect of the transition. The Fifth Assessment Report (AR5) from IPCC, on the other end, focuses on adaptation pathways to mitigate the effect of climate change onto the food production systems (Porter J.R et al, 2014) as well as rural areas (Dasgupta P., 2014). It proposed actions such as increase variability of crops productions (and more

[33] A 20% reduction of greenhouse gas emissions compared to 1990, raising the share of EU energy consumption produced from renewable resources to 20% and a 20% improvement in the EU's energy efficiency (or reduced energy consumption), all by 2020 (DG CLIMATE ACTION, 2016).

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generally the need of an effective adaptation of cropping), diversification of activities, increase water use efficiency, and also investment in new technologies, infrastructure, information, and engagement processes. Interestingly, the IPCC (2018) highlight the fact that most actions don't aim at a transformative change, implying that the potential adaptation benefits of more radical actions focusing on system transformation could be much greater (Rickards and Howden (2012) in IPCC (2018).

At a European level, the EU Farmpath project (2011-2014) also explored transition pathways in order to bring the agricultural sector socially, environmentally and economically sustainable with a particular emphasis on young farmers. EU subsidies focus on encouraging young farmers and sustainable farming practices, increasing rural development as well as exchanges of experience across stakeholders in Europe should be part of the transition (Sutherland, 2014).

At the COASTAL case-studies level, sustainable agriculture or organic agricultural practices have the attention of most regional and national authorities developed policies to support the development of such practices. The French ministry of Food and Agriculture launched the program "Ambition Bio 2022"[34] which gives a great opportunity for the French organic agriculture sector to step up. The program has the main objective of developing the organic production to up to 15% of the total agriculture production. It gives concrete actions oriented towards different axes: Structuring the sectors (e.g. by increase by 50% of dedicated financial fund), developing consumption and support the supply of organic products for all consumers, including for the poorest and most vulnerable publics (e.g. by offering 20% of organic food in public collective restaurants), strengthen the research by dedicated research programs, adapt the regulations to promote the sector, and train farmers to develop organic practices. In Romania, the Danube strategy draw a path for a sustainable agriculture by giving high priority to adequate soil and water management, supporting practices that curb Green Gas emissions and by increasing farmers' resilience to risks, promoting the integration of agri-food (especially organic producers) into the value chain to take advantage of local market, and supporting young farmer's access to land. In Greece, the Captain Vassilis foundation[35] mandate the Foundation for Economics and Industrial Research (IOBE) to develop a plan) for a sustainable rural development in Messinia region (Tserkezis L. et al. 2013) with proposed actions for the development of the agricultural sector in the region focused on a sustainable management of natural resources (e.g. efficient use of water resources by modernization of the irrigation techniques; utilization of olive tree biomass and olive mill waste for energy purposes)

To reach a sustainable agriculture able to feed the growing population while reducing the current environmental impacts of the sector, the transition pathway implies actions that will support a modern agriculture system that uses natural resources in an efficient manner with the help of innovative technologies and the application of the circular economy principals in order to reduce the Green Gas emission of the sector. Supporting young farmer to settle is also a necessity. However a transition pathway enable to reach the agriculture of the future also implies actions tackling the whole agro-food system in order to reduce food waste and shift towards a plant-based diet. The agriculture system transformation won't succeed without investments in research and development.

[34] Ministere de l'Agriculture et de l'alimentation (2018)

[35] A Non-Profit Organisation involved in the COASTAL project as local partner

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3.2.2. The Energy Transition towards a zero-carbon emission economy:

The existence of an extensive literature on energy transition is to be related to the climate crisis as a rapid and profound shift in terms of energy production and consumption is mandatory to limit rising of global temperature below 2°C. This current critical analysis will focus on some examples of transition pathways that are relevant for the COASTAL project.

Before analysis the local/national energy transition pathways collected in D17, two interesting transition pathways, from the World Energy Council (an UN-accredited global energy body) and from the Energy Transitions Commission[36] (a group of leaders from public, private and social sector) highlight the much needed actions to shift towards a zero-net-carbon emission economy. The World Energy Council, representing the entire energy spectrum, explored three plausible pathways for the energy transition with a time horizon of 2040-2060[37]. Three potential energy transition pathways are designed around three possible scenarios ("Modern Jazz", Unfinished Symphony" and "Hard Rock" – World Energy Council, 2019). Key enablers to facilitate the energy transition process towards a decarbonized economy include energy infrastructure planning and development, larger investment in electricity storage capacity, research and development in new renewable technologies (e.g. hydrogen accompanied by carbon abatement mechanisms) along with their rapid diffusion. Alongside, significant improvements on carbon removal and carbon capture technologies and policy support are necessary as lever for global decarbonisation. The World Energy Council also point out the need of cross-border, cross-sectoral collaborations to reach a zero-net-carbon economy. Increase citizen's awareness regarding climate change, as already observed in Europe, will accelerate the transition toward the use of renewable energies instead of to fossil fuel energy. The Energy Transition Commission (ETC) took a different approach to develop the transition pathway. In their latest report, "Accelerating the Low Carbon Transition" (Victor D.G. et al., 2019), they focused on the processes of change to meet the climate goals and 2015 Paris Agreement. By understanding how previous technology transitions happened and how international cooperation succeeded in the past, the ETC identified points of leverage and actions from government and businesses which should have the greatest impact to accelerate the low-carbon transition. Nationally the policies should focus on system transition: "topping emissions requires fundamental innovation, rapid diffusion of new technologies, and the reshaping of markets and socioeconomic systems", coordination between actors at an international level within sectors is the second key aspect of the transition. Coordinated international actions such as "identifying viable technologies more quickly; increasing incentives for investment and economies of scale; levelling playing fields so that first-movers are not held back by the constraints of competitiveness" will accelerate the energy transition (Victor D.G. et al., 2019). For the ETC, international cooperation at a sector level and rapid diffusion of renewable technologies are the main enabler of the energy transition pathway. The IPCC, on the other end, followed a system modelling approach to limit warming below a certain limit. The model shows how the system should evolve (between 2020 and 2050 in order to keep a limit global warming to a specific temperature. Using models, the AR5 1.5°C pathway (IPCC 2018) can be then assimilated as a scenario, stating for instance how the share of energy source should be in order to limit global temperature rise to 1.5°C (e.g. it implies a shift of energy source, from coal and gas to renewable energies: "From 2020 to 2050 the primary energy supplied by oil declines in most pathways (−39 to −77% interquartile range)" while "By 2050, renewables (including bioenergy, hydro, wind, and solar,

[36] http://www.energy-transitions.org/

[37] World Energy Scenarios 2019:
https://www.worldenergy.org/assets/downloads/Scenarios_Executive_summary_FINAL_for_website.pdf

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with direct equivalence method) supply a share of 52–67%" in IPCC (2-18)), the modelled 1.5°C pathway also show a global reduction of energy demand as well as the impact of lifestyle choices that can limit energy, resource, and GHG-intensive food demand to support a sustainable development. The 1.5°C pathway needs very ambitious international cooperative policy environment enable to transform supply and demand, it includes policies actions supporting a high price on emissions (carbon pricing).

Over the past decade, the European Union have been leading the energy transition setting up targets as early as 2007 (20/20/20[38] EU goals) to reduce green gas emissions of Member States, other strategic documents such as the Strategic Plan 2016-2020 from the DG Energy (European Commission, 2016b) and the Europe 2020 strategy for smart, sustainable and inclusive growth (European Commission, 2010), shape the national energy policies of Member States.

The international climate context combined with the obligation for member states to develop national energy strategies to reduce carbon emission and comply with EU targets and strategy led to a wide number of research and strategic documents available at an EU and Member State level when it comes to tackle the energy transition. In the EU long-term strategic vision for a prosperous, modern, competitive and climate neutral economy (European Commission 2018b), technology development in terms of new, carbon neutral fuels and energy efficiency is again a key aspect of the transition as well as better interconnections of the energy grid system between Member States energy system (European Commission, 2018b; PriceWaterhouseCooper, 2010) with more flexibility and storage capacity with a meteorologically driven production system. The energy Transition pathways at a national level and EU level also need actions towards a better efficiency in energy consumption, material production chain and transport and increase use of biomass as energy source (Association Megawatt, 2019; Kern et Smith, 2008; PriceWaterhouseCooper, 2010). Ultimately, as presented in different reports (e.g. 100% renewable electricity: a roadmap to 2050 for Europe and North America[39], Scenario megaWatt 2017-2050: "Réussir la transition énergétique en France"[40)], Zero Carbon Britain: Rising to the Climate Emergency[41]), a zero net carbon economy is possible and plausible with the proper actions taken in time.

3.2.3. Transition toward a sustainable tourism sector:

Compare to energy transition pathways, tourism transition pathways are not as common in the literature despite the fact that the current model of mass tourism is becoming less and less sustainable, and the need to adapt to climate change. According to the IPCC (Dasgupta et al., 2014), certain market segments, such as rural-based tourism and more specifically coastal tourism and nature-based tourism (particularly relevant for the COASTAL project), will most likely be affected by climate change. Tourism is coastal-rural areas will need to adapt and evolved to reduce its environmental externalities and mitigate the impact of climate change in order to reach a state of sustainable tourism (UN World Tourism Organisation, 2019). The literature related to sustainable tourism, alternative forms of tourism and eco-

[38] 20% reduction of CO2 emissions compare to 1990 ; 20% of the energy, on the basis of consumption, coming from renewables and a 20% increase in energy efficiency cf. https://ec.europa.eu/clima/policies/strategies/2020_en

[39] PriceWaterhouseCoopers 2010

[40] Association NegaWatt 2017

[41] Allen P. et al. 2019

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tourism is quite extensive, nevertheless few studies propose actual tourism transition pathways as defined for the current purpose.

The EU CIRTOINNO Interred South Baltic project can be mentioned as one of the research study exploring transition pathways for the tourism sector to reach a circular tourism economy, since the concept of circular economy, on its own, implies a radical system transformation, supported by system innovations (Manniche et al., 2017). Policies are seen as main enablers for the development of circular business models, while lack of information, promotion, investment and innovation are some of the barriers for the implementation of such a model. A circular tourism business model will need a system transformation within tourism accommodation and restoration with change of material flow in the building, construction, and operation services such as waste management, water management, food management, energy use, and also implementation of circular practices for the staff (training) as well as creating new type of interaction with the guests. A transition toward a circular tourism model will be based on the implementation of 'green', resource-effective and environment-friendly innovative technologies supported by a change in tourists' consumption.

At the local / national level of the COASTAL case-study, the Danube Strategy provides a list of local interventions in order to develop a "sustainable nature- and culture-based tourism: with the local community at its heart (e.g. "Establish a local destination management mechanism that is based on active participation and ownership of local stakeholders"). In France the region Aquitaine conducted a prospective reflexion study (GIP Littoral Aquitain, 2013) on coastal tourism which defines regional orientations and proposals for operational actions to meet the challenges of future tourism, by basing policies on the assets of the coast and by anticipating demographic, societal, environmental and economic changes in the best possible way. Preserving natural areas and the biodiversity, controlling land consumption, facilitate eco-mobility are among the 10 goals identified for the future of coastal tourism in the French South Atlantic coast.

3.2.4. A blue growth for coast and sea regions:

Seas and coastal regions are drivers for the European economy. The potential of economic development in the maritime sector will be unlock by the EU Blue Growth strategy[42], which is refers as the maritime contribution to achieving the goals of the Europe 2020 strategy for smart, sustainable and inclusive growth (European Commission, 2010). The strategy focuses on the sustainable development of 5 sectors (aquaculture, coastal tourism, marine biotechnology, ocean energy, seabed mining), along the development of marine knowledge, the implementation of maritime spatial plan and an integrated maritime surveillance systems.

Blue Growth concept has its roots in the conceptualisation of sustainable development (Eikeset et al. 2018), the term has been widely used since the RIO + 20 Conference where the FAO highlights the fact that a healthy ocean ecosystem ensured by sustainable farming and fishing operations was a prerequisite for a blue growth. Since following the principle of blue growth implies the sustainable use marine resources, one can argue that a blue growth strategy can be seen as a transition pathway sustainable sea and coastal areas which will imply a sustainable development of maritime activities

[42] https://ec.europa.eu/maritimeaffairs/policy/blue_growth_en

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within healthy coastal and marine ecosystems. However this assumption needs to be taken with precaution, as Eikeset et al. highlighted, (Eikeset et al. 2018), many challenges still remain when it comes to put into practice the concept of Blue Growth: depending on the stakeholders the concept's approach seems to be variable (the focus on economic development or innovation opportunities can sometimes obscure the environmental preservation aspect of the approach); the lack of common agreement upon the goals of blue growth can also lead to antagonistic results and conflicts of interest (salmon farming in Norway, off-shore windmills…). If not carefully implemented and monitored, blue growth could result in an unsustainable use of marine resources and further pressures on the coastal ecosystems through increase development of coastal infrastructures. Nevertheless blue growth strategies (as shown in the North Sea vision 2050[43], the French South Atlantic Maritime strategy 2030[44], the Danube Delta Strategy[45], The EU Baltic Sea Strategy[46], the Initiative for the sustainable development of the blue economy in the western Mediterranean[47], strategies relevant for the COATSAL project) can lead the sustainable maritime transition since they have the potential to transform coastal area into economically dynamic region within an healthy environment, which could also be beneficial to rural areas through extended collaborations and combined activities.

The blue growth, however, is not focus on the ports and shipping industry, sector which will have to engage in a system transformation to reduce their carbon-net emission following the targets of the Paris agreement. Pushing by policy regulations (for the shipping industry) or forecasting business opportunities (for the ports Authorities), the transition toward a decarbonised sector as already started. For instance the Wuppertal Institute for Climate, Environment and Energy has formulated three possible decarbonisation pathways for the Port of Rotterdam[48], focusing either on a radical shift to renewable energies and the use of Carbon from fossil feedstock in a circular system of production and recycling, or a renewable energy production originated for biomass and supported by Carbon Capture and Storage technology, both of these pathways lead to a 98% Co2 reduction by 2050 compare to 2015. The third

[43] The North sea Vision 2050 provide steps towards sustainable naturalness of the Belgian coast- http://www.thinktanknorthsea.be/

[44] Focus on the synergies between coastal and marine activities through collaboration and harmonized development as well as a focus on high environmental quality, job creation, the resilience of coastal areas, and transformation of marine activities by an environmental and energy transition.

[45] Develop a vision for the area and transition pathways for the fishery & aquaculture among other sectors.

[46] The European Union Strategy for the Baltic Sea Region (EUSBSR) is the first Macro-regional Strategy in Europe. It is divided into three objectives, which represent the three key challenges of the Strategy: **saving the sea**, **connecting the region** and **increasing prosperity**. Each objective relates to a wide range of policies and has an impact on the other objectives. https://www.balticsea-region-strategy.eu/about/about

[47] Launch in 2017, the initiative fosters collaborations between the Western Mediterranean countries for the sustainable development of the blue economy. https://westmed-initiative.eu/

[48]

https://wupperinst.org/fa/redaktion/downloads/projects/Decarbonised_Port_Infographic.pdf

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transition pathway is driven by technological progress, reaching a 75% decrease of CO2 emissions. Another example is the port of Amsterdam, which is entering a port system transformation path by embracing the circular economy approach and ought to be a European leader in the sector.

A zero-net-carbon emission scenario for the shipping industry is currently more challenging to achieve. Lloyd's Register (a maritime classification society owned by Lloyd's Register Foundation dedicated to research and education in science and engineering) and University Maritime Advisory Services in the UK have released in 2019 a 'Zero-Emission Vessels Transition Pathways' study[49]. In order to go beyond 50% reduction of carbon emission by 2050, policies, standards and rules will have to push toward alternative use of energy source in the 2020-2030 decade. Consumer pressure will be a driven force. Batteries and on-shore power supply will play in important role as well as sustainable biofuel and methanol. The design of the ships themselves will be designed to fit the new needs. Ultimately the transition of the shipping sector will be closely link to the transition and transformation of the energy sector and depends on investment in renewable electricity, bio-energy and fossil fuels with Carbon Capture and Storage (CCS). As a forward message, the shipping industry needs clarity on the future of energy system in order to take the right direction for a zero-net-carbon shipping system with limited risk uncertainty.

Wrap up on Transition pathways relevant for the development of generic coastal-rural scenarios and transition pathways, the literature is driven by the need to reach a decarbonized economy and a healthy environment through functional ecosystem services for the sake of the human being. Therefor transition pathways are mainly focused of the agro-industrial and energy sectors which must take a radical turn to shift toward sustainable systems. On the contrary, few studies have drawn transition pathways for a sustainable, resilient tourism sector as if the future of the sector will lies into a combination of different models already in place (coastal mass tourism, eco-tourism, agro-tourism) without engaging in a real system transformation thinking. Additionally, very few transition pathways are geographically related, when it comes to local / national level of the COASTAL project, most of the literature available concerns strategic documents which generally give objectives for the future development of specific areas without seeking a real transformation of the current system.

[49] https://www.lr.org/en/latest-news/lr-and-umas-release-new-zero-emission-vessels-transition-pathways-study/

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4. GENERIC SCENARIOS AND TRANSITION PATHWAYS

4.1. Core theme 1: People and Nature – "Naturally Better"

4.1.1. Future Narrative

In a decarbonized economy, people live and behave in harmony with nature with a low consumption of natural resources, for healthy sea, coastal and rural ecosystems and their communities. Nature is central to every aspect of society; by working with nature and building with nature, the use of space is rationalized allowing more room for the natural environment and supporting the ecosystem services it provides to humans.

Coastal-rural communities have easy access to innovation and latest technologies. In addition, high level of environmental awareness and knowledge means people behave in such a way that human environmental impacts no longer jeopardize life on Earth.

The sustainable economic development of coastal-rural areas is based on alternative forms of tourism, sustainable local agriculture, and a clean (zero-net emission) maritime sector. Tourism activities focus on natural, cultural and historical heritage. The precious biodiversity is highly protected, preserved, respected as well as enjoyed by everyone, and recognized as part of the local heritage. The flow of tourists is spread along the whole coastal-rural territory with activities related to eco-tourism and agro-tourism as attractive and accessible as the beach. The tourism industry plays a central role in preserving the natural richness it is relying on, with tourists' behaviour minimizing the environmental footprint of the sector.

The sustainable local agriculture model benefits from the wide use of nature-based solutions and ecosystem-based practices, which enable production in accordance with the natural cycle of the ecosystems and their complementarities. The locally well-organized agricultural sector uses the latest technology available to efficiently grow and monitor crops, fruits, vegetable and animals. The integrated and diversified production is based on the sustainable use of resources and minimum artificial inputs. It creates a local value chain and a high quality and quantity of products with a rationalised use of water. This model of production relies on strong partnerships and cooperation within the sector making it highly efficient and resilient. It is financially sustainable, which makes it economically attractive to new famers.

The maritime activities complement the economic development of the coastal-rural area by offering skilled jobs to the community, clean energy, healthy food products and innovative solutions through marine biotechnology research. The marine renewable energy sector is well-developed; offshore wind farms, tidal and wave energy systems are widely implemented, providing jobs and clean, affordable energy sources to inland communities. Seafood production is mainly supported by artisanal fishery and sustainable aquaculture, offering high quality products with a low impact on the marine ecosystems. Maritime transports along with other forms of transports rely on clean energy supply, being a carbon-free sector. Ultimately the activities from the blue and green economies are perfectly integrated providing peaceful and economically prosperous coastal-rural communities.

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4.1.2. Quantitative Descriptors

Table 7: Quantitative descriptors for 'Naturally Better' scenario

*Relevant Drivers	Trend (of Drivers/ Elements)	**Quantitative Descriptor
Demography - population growth	variable	Population growth rate
Cooperation	variable	Number of cooperatives
Local Economic Development	increased	GDP growth rate (local)
		GDP per sector
		Unemployment rate
		Employment per economic sector (%)
Urbanisation	decreased	Population density (in rural area)
		Rate of expansion
		Land use change (re-designated green-belt-zones)
Agriculture (sustainable practice of)	increased	Number of organic farms
		Percentage of organic crops (yield levels)
		Total irrigated area
		Irrigation Efficiency (ha/cubic meter)
		Total agricultural water extraction/use
		Use of pesticides
		Use of organic fertilizers
		Use of mineral fertilizers
		Reuse of manure and by-products
		Erosion prevention
		Soil salinisation
		Subsistence agriculture
		Crop rotation
		Livestock density
Tourism (sustainable practice of)	increased	Stress: Number of Tourist (annum/peak month)
		Use Intensity: Intensity of use – peak period (persons/km2)
		Social Impact: Ratio of tourists to locals (peak period and over time)
		Site protection: Category of site protection according to International Union for Conservation of Nature and Natural Resources (IUCN) index

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		Development Control: Existence of environmental review procedure of formal controls over development of site and use densities
		Planning process: Existence of organised regional plan for tourist destination region (including tourism component)
		Consumer satisfaction: Level of satisfaction by visitors
		Local Satisfaction: Level of satisfaction by locals
		Tourism Contribution to Local Economy Proportion of total economic activity generated by tourism only
		Ecological destruction: % ecosystem in degraded condition
		Beach degradation: % of beach eroded
		Fish stocks depletion: Effort to catch fish/ Fish counts for key species
		Overcrowding: Persons per metre of accessible beach
		Disruption of fauna (e.g. whales): Species counts/number of species/change in species mix/ number of key species sightings
		Water quality: Pollution levels - fecal coliform and heavy metals counts
		Adopted national policies to frame sustainability in tourism operation
		Geospatial data : to visualize interactions with environment
Market Demand (for local products)	increased	% contribution to nation GDP
		Value of production per sector
Local Production	increased	% contribution to nation GDP
		Value of production per sector
Blue Economy (associated activities: Coastal Tourism, Marine living resources, Marine non-living resources, Port activities, Shipbuilding and repair and Maritime transport)	increased	Turnover (from associated activities)
		Gross value added (from associated activities)
		Employment - % of market share
		Average annual salary
		Investment in infrastructure
		Net investment

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Climate Change (impacts of)	variable	temperature
		humidity
		sea level rise
		sea-surface temperature
Water Availability (Quantity and Quality)	increased	Seasonal/ annual demand (per sector)
		Total water extraction
		Water use per sector
		Population connected to water network
		Population connected to sewage network
		Temperature
		Nitrogen
		Phosphorus
		Pesticides
		Sediments
		Phenol
		Salinity
		Chlorophyll
Nutrient Pollution	decreased	Nitrogen
		Phosphorus
Ecological Status (of ecosystems)	improved	% protected areas
		Air quality
		Biodiversity
		Invasive species
		Deforestation
		Soil degradation
Environmental Policy	stronger/ more coherent	Existence of relevant policy
		% funding directed to implementation and infrastructure
Economic Policy	environmentally focused	Existence of environmentally relevant component
Maritime Policy	environmentally focused	Existence of environmentally relevant component
Land-use Policy	environmentally focused	Existence of environmentally relevant component
Agricultural Policy	environmentally focused	Existence of environmentally relevant component
Funding	environmentally focused	Funding for sustainability focused programs
Environmental Management Bodies	stronger/more coherent	Existence of relevant bodies
		% funding received

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Monitoring	stronger/ more coherent	% funding directed to monitoring and enforcement agencies
		amount in fines collected
***Core Narrative Elements	Trend	**Quantitative Descriptor
Education/Knowledge/Skills	increased	Amount of funding directed to relevant activities
		Number of relevant active NGOs
Environmental Awareness	increased	Number of campaigns
		Amount of funding directed to relevant activities
		Number of relevant active NGOs
Aquaculture including shellfish (sustainable practice of)	increased	% of farms using new technologies
		% of farms with Aquaculture Stewardship Council (ASC) sustainability label
Integrated Lifestock and Crop Farming	increased	% of farms practicing an integrated approach
Space for Nature	increased	current % of natural area
		% of earmarked green space (zoning)
Multifunctional Use of Space	increased	% of land use allocation per activity
Use of Renewable Energy	increased	renewable energy as % of total energy generated
		renewable energy as % of total energy consumed
Use of Fossil Fuels	decreased	fossil fuels as % of total energy consumed
Energy Efficiency	increased	Energy efficiency focused legislation or action plan implemented
		minimum energy efficiency standards
		number of patents on energy union priorities
Nature based solutions (use of)	increased	number of projects
		number of planning permits applied for per annum
Salty Agriculture (practice of)	increased	number of farms

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4.1.3. Transition pathways

4.1.3.1. Transition Pathway 1: FROM Conventional Agriculture TO Sustainable Agriculture

The transition pathway for the agricultural sector in the People and Nature scenario focuses on a shift from unsustainable food and land systems, which rely on the chemical industry and are traditionally water intensive and major sources of carbon emissions to an industry that will adopts innovative technologies and more ecosystem-based approaches which are less chemical and water intensive, reducing pollution and carbon emissions.

Key Actors:

- Farmers
- Farmers' organisations
- Citizens
- Extension agents
- Policy Makers
- NGOs
- Academia
- Water Management Bodies
- Government (national, regional and local)

Transition pathways in action

Agriculture 4.0
The Innovative Dutch Farm grows food with minimal water, no soil, zero pesticide, 50 % less energy and still allows more space and water for nature, using innovative technologies and artificial intelligence.
Despite expensive labour and land, the Netherlands has become one the largest vegetable exporter in the world.

World Economic Forum – https://www.youtube.com/watch?v=QOm1JG5o8SY

Actions for Farmers:

1. Switch from primarily monoculture farming towards the integration of 'target' innovative cropping systems. An example of this is intercropping, it produces a greater yield on a given piece of land by achieving more efficient use of the available growth resources that would otherwise not be utilized by each single crop grown alone

2. Installation of crop planning procedure at small farms to structure the transition towards innovative crop systems

3. Reduce the use of chemical fertilisers and pesticides

4. Integrate and take advantage of natural services provided by ecosystems (ecosystem services) for soil restoration, soil fertility…

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Action for Farmer Organisations:

1. Support the transition by enabling knowledge acquisitions and transfer of good practices between farmers, diffusion and adoption of innovative technologies (e.g. proposing training, organising open-day in innovative farms)

2. Promote local products, support alternative agricultural practices (agro-ecology, biological farms) and local supply chain

3. Support local policy in favour of sustainable agricultural practices

(de Boer et Van Ittersum, 2018, Chantre et al., 2015; Future Farm and Fork Strategy[50], 2020; Lithourgidis et al., 2011; Mohler et al., 2011; Pereira et al., 2018; Petel, 2015; Mohler and Stoner, 2012)

Actions for Government:

1. Scale up payments for ecosystem services (soil carbon/health and agro-bio diversity) plus improve extension services (training and access to technology, seeds, etc.) (soil carbon/health and agro biodiversity)

2. Internalize environmental cost in agricultural activities

(Food and Land Use Coalition 2019; Koleva et al., 2011)

Actions for Water Management Bodies:

1. Collaborate with farmers, scientists, and government to increase irrigation efficiency in order to improve water efficiency as envisaged by SDG's. The ratio of water requirements of a crop over the amount that needs to be abstracted from surface water and groundwater resources should be calculated and adjusted to improve overall efficiency

2. Support and promote natural-based solutions to increase resilience to flood and drought e.g. preserve wetlands and marshes

(FAO, 2018; Kalantari et al., 2018)

Actions for citizens:

1. Prioritize products from sustainable agriculture, local products, seasonal products, ethic products (respect animal well-being)

2. Support policies and NGOs in favour of sustainable agriculture and environmental protection

3. Reduce consumption of animal-based products; adopt a plant-based diet

(Zakeossian et al., 2018; FAO, 2018; Food and Land Use

Transition pathways in action

Plant-based products

NOtCo is an innovative Chilean start-up, using AI and plants only to produce cow based products with the exact same taste.

http://www.notco.com/index

[50] EU Commission, Green *New* Deal, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

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Transition pathways in action

*The **biological farm of Bec d'Hellouin** France):*
This is an example of a low impact farm by implementing the principals of permaculture and developing innovative methods which appear to be particularly productive.
Permaculture is a set of design principles centred on whole systems thinking, simulating, or directly utilizing the patterns and resilient features observed in natural ecosystems. It uses these principles in a growing number of fields from regenerative agriculture, re-wilding, and community resilience

https://www.fermedubec.com/english/

Coalition 2019)

Joint Actions:

Governments, NGO's, Industries, R&D institutes, knowledge institutions, food experts, Farmers:

1. Should work together to redesign the food process, and to stimulate the consumers to move towards a more balanced diet in which the use of animal-based products will lower. This action plan will help to reduce global emissions

Governments, NGOs, Citizens:

1. Capacity development strategies for behaviour change should be implemented, including consumer empowerment and effective food and nutrition education

Government, NGOs, Academia, Extension agents, Farmers:

1. Work towards building capacity and knowledge around implementing sustainable and resilient food-system approaches and agro-ecological practices which favour favouring biodiversity and ecosystem services (e.g. landscape and territorial approaches, managing soil fertility, integrated nutrient management and integrated pest management) All Actors:

1. Develop a sustainable agriculture framework, which gives farmers the possibility to change their current farming activities towards new sustainable practices.

2. Accompanying measures including funding for pilot studies, scientific and governmental support.

3. Before establishing this framework, some conditions need to be fulfilled which comprises additional actions such as mapping of the hydrological processes, the introduction of an accurate soil quality monitoring system and an assessment of the current agricultural activities with the intention to downscale the negative impact on the ecosystem

(de Boer et Van Ittersum, 2018, Dauwe et al., 2019 ; FAO 2018a, 2018b ; FAO & WHO 2019 ; Food and Land Use Coalition 2019; Sutherland, 2014 ; Zalidis et al., 2002)

Barriers: What would obstruct or hinder the Transition?

1. Intercropping requires extra care and effort in planning and maintaining a viable crop rotation, to decrease the chances of crop disease and attraction/spreading of certain insects attracted to certain crops

2. Sustainable agricultural framework is subjected to local context, guidelines and funding schemes are discussed at higher institutional level while practical implementations is very case specific

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3. Conventional agriculture still widely subsidies

(Mohler and Johnson, 2011; Sutherland 2014, Zalidis et al., 2002)

Enabling conditions: What Will Support the Transition?

Existence of resources (Human, Financial, Political or Technological)

1. Species available for intercropping: There are many different kinds of species that can be used for intercropping such as annuals, e.g. cereals and legumes, perennials, including shrubs and trees, or a mixture of the two (annuals and perennials)

2. Technological innovations: should be leveraged to support drastic reduction in agricultural GHG emissions.

3. Changing Consumer Preferences: consumers are already changing the habits and will tend to keep on changing in terms of more balanced diets, reduce food loss and waste.

(Lithourgidis et al., 2011 ; FAO 2018a; Mohler and Stoner, 2012)

Decline/Decrease of undesirable activities and behaviours

1. Decrease of conventional agriculture

(Chantre, 2015)

4.1.3.2. Transition Pathway 2: FROM a carbon emitting economy TO a decarbonized economy (Zero Net Emissions)

Climate change is a direct effect of the increasing amount of greenhouse gas emissions. Countries have to largely 'decarbonize' their energy systems by moving away from fossil fuels while increasing their energy efficiency. This transition incorporates a holistic approach in which all relevant stakeholders have to take measures.

Key actors:

- Energy Suppliers & Producers
- Government (national, regional, local)
- Transport actors
- Industry
- R&D institutes
- Agriculture actors
- Construction industry
- Shops
- Civil Society

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Actions for Energy Suppliers, Energy Producers:

1. Rethink the energy grid design: Expand, reinforce and upgrade the grid to maintain high reliability, and swiftly determining where reinforcement is most needed to keep up with the rapid deployment of distributed generation and most suitable for low-carbon future.

2. Focus on Renewable energy integration by use of different energy storage technologies and system regulation strategies. Storage technologies will play an important role in the development of future energy systems. Energy efficiency can restrain consumption and decouple economic growth from growth of energy consumption as it basically creates added value by reducing energy consumption.

3. Boost Ocean energy production (e.g. from tides, waves, currents).

4. Increase use of bio energies (biomass, biogas)

5. Increase production of wind and solar energies

(Association NegaWatt 2019; Pöntynen R. & Erkkilä-Välimäki A., 2018; Smudde T., 2019; Townsend, B.2019)

Actions for Governments:

1. Implement an environmental tax system that could drive consumers vigorously to energy saving and reduce fossil-fuel consumption.

2. Investments in sustainable energy, clean tech and smart grids

3. Policy in favour of low consumption of energy in building construction.

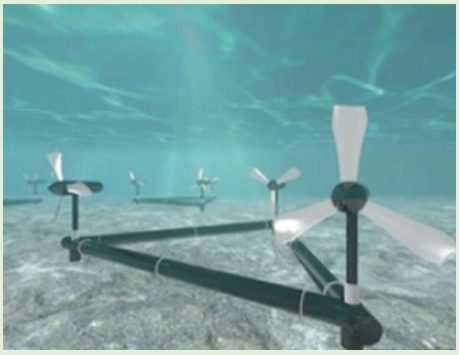
4. Financial support for the energy transition.

5. Support employment market: training for job in new energy sector, "retraining" for transfer of working force from fossil fuel industry to alternative energy sector.

(Association NegaWatt 2019 ; Jorquera R.hH. & Nordén A. 2017)

Transition pathways in action

*A **tidal project** in Scottish waters just generated enough electricity to power nearly 4,000 homes*



The Electricity Forum – https://www.electricityforum.com/news/scottish-tidal

Actions for government and transport actors:

1. Increase availability and efficiency of public and clean transports and network (trains, buses, bicycle).

2. Facilitate remote work.

3. Facilitate transport by train and river against road transport for goods

4. Reduce transport of goods

(Association NegaWatt 2019)

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Action for industries and R&D:

1. Increase industry process efficiency (uses of latest technology with low consumption of energy.

(Association NegaWatt 2019)

Action for Agriculture actors:

1. Change of production model toward ecological practices, biological production and integrated production

Actions for R&D Institutes:

1. Strengthen technology innovation efforts (development and deployment of clean energy technologies)

2. Increase energy efficiency of truck.

(Association NegaWatt 2019)

Transition pathways in action

*The most powerful **floating solar power plant** in Europe was inaugurated in southern France in October 2019 (17 megawatt). The floating structure helps reduce conflicts over land use*

Euractiv – https://www.euractiv.com/section/energy/news/europes-

Actions for Civil Society:

1. Realise that decarbonisation and reduction of emissions are needed to gain a good state of environment and to slow down climate change and behave accordingly, changing consumption-based attitudes and lifestyle and, if needed, pressuring governments to take actions in this direction.

(Jorquera R.hH.& Nordén A. 2017)

Action for government, construction industry, industry, shops, citizens:

1. Reduce energy consumption: by a better energy efficiency of products, improving building isolation, reduce use of business lights at night, uses of led, reductions of product packages…

(Association NegaWatt 2019)

Barriers: What would obstruct or hinder the Transition?

1. High costs associated with Expanding and reinforcing the current grid.

2. Detailed planning of all economy sectors required in order to install adequate RES-systems.

3. Lack of Adequate Financial Support: Multilateral development banks, public banks, and private banks generally do not offer soft credit, or programs aimed specifically at energy technologies. This acts as a further barrier to capital-intensive energy projects.

4. Legal and Regulatory Framework: Many energy supply sources are subject to a lack of regulation other than for safety, inadequate tariffs for transport and distribution and no incentives to increase efficiency.

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5. Social and Cultural Constraints: The environmental impacts and risks of technologies, such as nuclear power and hydropower generation, may not be acceptable to many social groups. The real or perceived environmental risks of such technologies pose a significant barrier to their Implementation.

6. Climate change mitigation technologies (CCMT) related to power generation, transport, buildings, manufacturing, and carbon capture and storage (CCS) indicated a notable drop-off in number of patents since 2012.

(Association NegaWatt 2019 ; Krajačić G. et al., 2011; Cárdenas Rodríguez, M. et al., 2019 ; IPCC 2014)

Enabling conditions: What Will Support the Transition?

Existence of resources (Human, Financial, Political or Technological):

1. Engaging consumers and governments alike in the smart grid project. Awareness becomes generated by consumers in terms of control and visualization of their demand for energy. An example could be the implementation of a subscription-based fundament in the tariff model. It's a model that can be found in telecom and broadband markets. In terms of adjusting desirable/undesirable activities, it provides the customer a certain freedom of choice, as customer can select the bandwidth most suitable for its consumption pattern.

2. More emphasize on “pull” policies that can accelerate deployment will accelerate the shift towards a decarbonized economy.

3. Energy coaches to help facilitate the implementation of the smart energy framework.

4. Increasingly energy efficient consumer behaviour (as a result of smart energy management systems and increased consumer awareness).

5. New low-carbon consumption patterns and the emergence of innovative low carbon business models.

6. Responding to economic opportunities and intensifying climate-related disasters, a growing number of states will implement ambitious climate policies, leading to calls from business for a more harmonized national response.

7. Appointing new "test' areas for the development and deployment of; ocean energy pilots, pre-commercial devices, etc., to provide opportunity not only to test but also validate the predicted environmental impacts.

8. By introducing the Just Transition Mechanism (JTM), The EU enables the Member states by offering both technical advice as well as financial support, to upscale their current activities regarding their compliance with EU's Green Deal.

(Association NegaWatt 2019; DRIFT institute 2017; European Commission 2013, 2019; IPCC 2014; Jorquera R.H. & Norden A., 2017; Lempert R. et al., 2019; Smudde T., 2019; Townsend, B. 2019; United States Department of Energy 2009)

Decline/Decrease of undesirable activities and behaviours:

1. Decline of fossil fuel industry, fossil fuel as source of energy (source of electricity).

2. Decrease of number of vehicles using fossil fuel based.

3. Decrease of national level governance and control in the energy sector.

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4. Decrease of meat consumption.

5. Decrease of fossil-fuel subsidies

(Association NegaWatt 2019)

4.1.3.3. Transition Pathway 3: FROM Mass Tourism TO Alternative Tourism

The tourism sector should transition from a sector traditionally focused on generating high industry profits and high consumer satisfaction- approach towards a more tailored sustainable and inclusive sector while reducing the ecological and social costs from its environment i.e. the coastal zone. Sustainable consumption and production conditions should be met in the development of alternative tourism.

Key Actors:

- Civil Society (local communities)
- Tourists
- Travel agencies
- Hospitalities Industry
- Heritage and Culture actors
- Government (national, regional, local)
- Touristic voluntary organisations
- Water management bodies

Actions for Government (local/ regional):

1. Adjusting touristic policies in order to mitigate the seasonality in tourism. These mitigation measures will have to include actions relating to the demand side of tourism as well as adjustments to the supply (destination).

2. Implement the concept of Social Consumption and Production (SCP) Impact Area" in coastal areas in order to sustainably manage coastal high natural capital.

(Butler, R. 2014; DG Maritime Affairs & Fisheries 2013; United Nations World Tourism Organization 2019)

Actions for Hospitality Industry, Government, Touristic voluntary organisations, Travel Agencies, Civil Society, Cultural Stakeholders, Water management bodies:

1. Promote alternative forms of tourism (agro-tourism, ecotourism, slow tourism...) based on natural environment, authentic atmosphere, gastronomy, local and cultural heritage which have the clear intention to design unique tourism experiences.

2. Development of Smart tourism to create sustainable tourism activities, allow smarter use of resources and improve the quality of life for residents and tourism experience through sustainable ways.

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Transition pathways in action

The MEET Network

An association of Mediterranean protected areas developing high-quality ecotourism products that benefit conservation. It offers a portfolio of 3-7 night nature and culture itineraries for the experiential traveller designed in and around Mediterranean national and regional parks. The packages are

- *Developed by parks alongside their local communities*
- *Featuring 100% local suppliers including guides and activity providers*
- *Nature, culture, cuisine and adventure instead of sun, sand, and sea*
- *Direct funding for local conservation projects*
- *Product quality, sustainability, and impact management monitored through the MEET Network*

https://www.meetnetwork.org/meet-guide/

3. Train the working force in alternative form of tourism: Resources and relevant expertise should be available to enable adequate training. Examples of training relate to: historical heritage; environmental management; training protected area management staff in nature interpretation; raising environmental awareness among the local population; introducing a visitor information programme (including environmental information).

4. Adoption of Green Space Maintenance practices to maintain the local area. According to this maintenance principle, use is made of nature's advantages [8]. Examples of these are:

- Weeds on slabs and on pool edges can be eliminated using a thermal weed control technique. It procures intense heat flashes that don't burn but disturb weeds metabolism and make them die quickly.

- Provide storage with a waterproof floor to store retention trays and label them as well as absorption kits.

5. Create pro-sustainability tourism agency.

(Bulgarian Association for Alternative Tourism 2009; DG Maritime Affairs & Fisheries 2013; Folgado-Fernández, J. A. et al., 2019; Force, A. et al., 2017; Green Tourism 2015; Pirlone, F., 2017; Shafiee, S. et al., 2019)

Joint action for all stakeholders:

1. Systematic use of green practices in tourism businesses to reduce water and energy consumption, waste production (e.g. reduced flush, laundry on demand, use of led light, durable and recyclable supplies…).

(European Commission 2014; Gössling, S., 2012; Green Tourism 2015; Jorquera R.H. & Norden A., 2017)

Barriers: What would obstruct or Hinder the Transition?

1. Anti-littering programmes are mostly conducted in consultation with local community, engaged local civilians, etc. These environmental programmes are less known by temporary residents than permanent residents and other visitors.

2. Lack of incentive to adopt green space maintenance practices.

3. Lack of interest for alternative forms of tourism.

4. Lack of environmental awareness (from tourists and workers) and consumption responsibility

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(DG Maritime Affairs & Fisheries 2013; Force, A. et al., 2017; Green Tourism 2015; Shafiee, S. et al., 2019; United Nations World Tourism Organization 2019)

Enable conditions: What Will Support the Transition?

Existence of resources (human, funding, technological, political):

1. Up-to-date ICT infrastructure and IT technologies in tourist areas.

2. Improving Transport infrastructure will stimulate tourists to come through the year.

3. Change of tourist travel pattern/habits.

4. Provision of information leading to increased awareness and knowledge of alternatives.

(Butler, R., 2014 ; Force, A. et al., 2017; Green Tourism 2015; Shafiee, S. et al. 2019)

Transition pathways in action

We are Water Foundation and Diamonds Resorts partner to launch sustainable water usage initiative at European resorts

Diamond Resorts will be educating members, owners, guests and team members to make a reasonable and sustainable use of water within all of the company's European properties.

https://www.greenhotelier.org/our-themes/water/we-are-water-foundation-and-diamond-resorts-partner-to-launch-sustainable-water-usage-initiative-at-european-resorts/

Desirable/Undesirable activities and behaviour:

1. Decrease of tourism focus on sea and beach.

2. Decrease of inefficient consumption of resources in tourism activities.

(Force, A. et al. 2017; Green Tourism 2015)

4.1.3.4. Transition Pathway 4: FROM Shipping as a major carbon emitting sector TO Shipping as a zero net emissions

The needed transformation of the shipping sector toward a carbon free sector will increase the quality of living in port's cities, reduce the pressure on marine ecosystems and risk of environmental disasters (oil spills, spread of invasive species) while reducing global greenhouse gas emissions

Key Actors:

- Port Authorities
- R&D Institutes
- Ship owners
- Charter companies
- Logistic cluster organizations
- Government (national, regional and local)
- International Maritime Organization (IMO)
- Industry

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Action needed: Actions for Port Authorities

1. Should adapt and develop adequate infrastructure to accommodate the needs of ships equipped with alternative source of energy.

(United Nations Conference on Trade And Development 2019)

Action for R&D Institutes:

1. Validate current conceptual renewable energy technologies (e.g. 2sd and 3rd generation of biofuels for vessels>50 000 tonnes).

(García-Olivares A., 2018; International Renewable Energy Agency, 2015)

Transition pathways in action

Port of the future

Singapore Port Authority's "Next Generation Port 2030" vision embraces automation, digitisation and Artificial Intelligence to make Port smart and green.

The Green Port Programme encourages ocean-going ships calling at the Port of Singapore to reduce the emission of pollutants. MPA will reduce port dues by 25% for ocean-going vessels that burn clean fuels, LNG or use approved measures to control emissions for their entire port stay.

http://www. maritimegateway.com/sustainable-development-ports/
https://www.mpa.gov.sg/web/portal/home/maritime-singapore/green-efforts/maritime-singapore-green-initiative

Action for logistic cluster organizations, industry, government, port authorities:

1. Optimization of logistics and work, in order to reduce travel demand.

(García-Olivares A., 2018)

Actions for all:

1. Enable rapid implementation of renewable energy options for shipping propulsion as well as on-board and shore-side energy use (e.g. use of wind energy, solar photovoltaic, biofuels, hydrogen fuel cells).

2. Introduce financial solutions that reward sustainable performance and enable large scale uptake of innovation, technology, design and operational efficiencies.

3. Revision of current fleet and port infrastructure.

4. Investments in highly specialized port facilities.

(ERDF, 2019; International Renewable Energy Agency, 2015; Sustainable Shipping Initiative, 2013; United Nations Conference on Trade And Development, 2018)

Barriers: What would obstruct or Hinder the Transition?

1. On an organizational/structural side, there is a lack of cooperation between stakeholders (government, classifications societies, IMO, financial institutes)

2. Limited R&D financing, particularly for initial proof-of-concept technologies

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3. High costs to make shift from carbonized technologies to renewable technologies. Ship owners' have concerns about the risk of hidden and additional costs, as well as opportunity costs for renewable energy solutions.

4. The development of renewable energy solutions for shipping has been hampered by the over-supply of fossil fuel-powered shipping in recent years and the related depressed investment market.

5. No current consensus on whether the responsibility and cost of the change to renewable options for shipping should fall to the ship owner or to the ship operator.

6. The lacking of profound evidence indicating the commercial viability for several renewable energy solutions.

(International Renewable Energy Agency, 2015)

Enable conditions: What Will Support the Transition?

Existence of Resources: Human, Financial, Political, and Technological:

1. LNG, LPG, methanol, biofuel and hydrogen already attract interest as the most promising solutions. Among new technologies, the classification society believes battery systems, fuel cells and wind-assisted propulsion will offer potential for ship applications.

2. Better sharing of performance data, access to venture capital or seed funding, and strong market incentives are an essential part of this transition.

3. The shipping industry is investing heavily in technologies that have the potential to transform business as usual.

4. Supports investments in new technologies, appropriate facilities, economic incentives and enforcement. It also encourages the ports sector to implement measures that can stimulate the use of green vessels.

5. Currently wave of environmentally driven regulation is affecting shipping market dynamics and putting pressure on the maritime transport industry to deliver on the environmental and social responsibility imperative.

6. In April 2018, the International Maritime Organization (IMO) agreed to reduce GHG emissions by at least 50% by 2050 compared with a 2008 baseline, with carbon intensity reduction targets for 2030 and 2050.

7. IMO shows the importance of sustainable shipping as they have chosen this topic for the 2020 World Maritime theme.

8. Mandatory technical and operational measures requiring ships to be more efficient in energy use and to reduce emissions through the MARPOL Convention.

(Benson Wahlen C., 2019; ERDF, 2019; García-Olivares A., 2018; IMO, 2018 ; International Renewable Energy Agency, 2015; Sustainable Shipping initiative, 2013; United Nations Conference on Trade And Development, 2018;

Decline/Decrease of undesirable activities and behaviours:

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1. Decline of availability of cheap fossil fuel.

(International Renewable Energy Agency 2015)

4.1.3.5. Transition Pathway 5: FROM building against nature TO building with nature

Coastal Communities no longer over exploit the marine environment or protect themselves against the nature by building walls but instead sustainably use marine resources, take advantage of services the nature provides to limit coastal risk and hazards (nature-based solutions against erosion, sea-level rise, floods), increase and diversify renewable energy production, develop innovative products to support the sustainable life of coastal-rural communities.

Key Actors:

- Government (National, regional, local)
- EU
- Industry
- Knowledge Institutions
- R&D Institutes
- Civil Society
- Water management bodies
- Port sector
- International Maritime Organization (IMO)

Actions for government:

1. Increase % of Marine protected area surface (Tonin S., 2018)

Actions for water management bodies, government and EU:

1. Ensure efficient implementation of EU Water Framework Directive and Floods directive.

2. Increase use of nature-based solutions to prevent rivers and sea contamination.

(DeGeorges et al., 2010; European Commission 2019)

Action for governments, knowledge institutions, industry & civil society:

1. Development of adequate training programmes leading to new skilled workers with knowledge in blue-biotech development and innovations.

(The European Marine Biological Resource Centre 2017)

Transition pathways in action

Supporting sustainable fishing practices

Dedicated in creating a sustainable future for our seas, the Marine Conservation Society supports responsible seafood by developing a "Good fish guide" for consumer to make sustainable choices when it comes to buy fishes, along numerous sustainable ocean awareness campaigns.
While the Marine Stewardship Council support sustainable fishing with the Blue MSC label.

https://www.msc.org/
https://www.mcsuk.org/

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Action for Governments and citizens:

Transition pathways in action

Nature Based Flood Defences: The Sand Motor Delfland Coast
A new coastal maintenance strategy designed to harness the power of winds, waves and currents to help protect part of the Dutch coast, while encouraging the development of new dunes, as well as the valuable flora and fauna associated with them.
The Delfland Sand Motor experiment is a mega nourishment operation that involved depositing 21.5 million m³ of sand in a single location, with the height of the deposit rising to 5 metres above the mean sea level. The wind and currents are gradually redistributing the sand along the shore face, beach and dunes. By using natural processes to spread the sand, this innovative approach aims to limit the disturbance of local ecosystems, while also providing new areas for nature and more leisure opportunities.

https://www.ecoshape.org/en/themes/nature-based-flood-defences/#/en/projects/the-delfland-sand-engine/

1. Increase public awareness about sustainable seafood with emphasis on local seafood production.

(Kinds, A. et al., 2016)

Joint actions by Government, EU, Knowledge Institutions, Industry, R&D Institutes:

1. Increase research and development related to "Building with nature" concept, practical innovations and solutions; Develop an international central information portal to centralized all available information regarding "Building with nature"

2. Systematic Robust environmental impact assessment to coastal water ecosystem when developing new projects/activities in coastal and sea areas.

3. Promote nature-based solutions in coastal risk management for increasing resilience of coastal areas and spatial planning of green infrastructures.

4. Unlock the potential of marine biotechnologies by facilitating research and support rapid industrial applications of blue-based potential commercial products (biofuels, bio-plastics, food, chemicals, medicine and cosmetics, nanotechnology…). E.g. use of alga for pharmaceuticals purpose, food, biofuel, water filtering.

(Clark J.R., 1992; European Commission 2007; Engineering with Nature[51]; Haines-Young R. & Potschin M., 2011; Pedersen Zari, M. & al. 2019; Prabha, S. P. & al 2020; Sterckx, T. et al., 2019)

Joint actions for government, EU, Fishery & Aquaculture sector:

1. Adoption of sustainable practices in aquaculture and support their implementation.

2. Proper incentives for fishermen to convert to sustainable fishing methods.

3. Increase knowledge (knowledge exchange platforms…) in sustainable practices and environmental awareness of fishermen related to their practices.

[51] https://ewn.el.erdc.dren.mil/

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4. Improve monitoring and data collection as well as better geographical spread of fishing effort, regulation efforts and improve selectivity through technical adaptations to fishing gears.

5. Develop a cross-policy sustainable "food systems" framework (based on the food-generating capacity of the Ocean) supported by an integrated policy on fishery and aquaculture.

6. Implement management policies and practices to tackle the challenge of abandoned, lost and discarded fishing gears, in collaboration with waste management sector (prevention and mitigation actions).

(Akpalu W. et Bitew W. T., 2011; Cross S.F., 2013; European Commission 2017a; Goodman A. J. et al., 2019; Kinds, A. et al., 2016; SDSN Northern Europe 2017)

Joint action for water management bodies, government, port sector, IMO:

1. Efficient implementation of the Ballast Water Management (BWM) Convention in order to curb the number of invasive species spread by ships' ballast water. (Schneider G. et al. 2018; IMO 2017)

Joint actions for all:

1. Increase awareness about marine ecosystems and ecosystem services.

2. Implement efficient waste management policy and practices to reduce impact on coastal and marine ecosystem

3. Implement sustainable practices in water resource management and consumption

4. Implement Ecosystem-Based approach to marine ecosystem management.

(Akpalu W. et Bitew W. T., 2011; FAO 2010; Tonin S., 2018)

Barriers: What Will Support the Transition?

1. Marine Spatial Planning and Land Spatial planning are different planning systems in which other actors are involved.

2. Deficiencies in the knowledge and innovation system in which government, businesses, civil society organisations and knowledge institutes participate when it comes to building with nature aspects.

3. Building with Nature is still a relatively new concept.

4. Not all nature-based solutions can be used for every coastal location.

5. Not all aquaculture systems can produce consistently.

6. Distrust and an aversion to state government decisions in some countries.

7. Lack of funds and state support.

8. Inherent resistance to change and new practices.

9. Main bottlenecks to the development of marine biotechnologies is the difficulty in the sampling of marine species, as well as the high cost of some of the sampling methods; problem of conflict in property rights and confusion in benefit sharing.

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(Davies C., and Lafortezza R., 2018; Engineering with Nature[52] ; European MSP Platform 2019; De Graeff et al., 2019; Gustavsson, M., 2018; Haines-Young R. and Potschin M., 2011; Kinds, A. et al., 2016; Prabha, S. P. et al. 2020; Sterckx, T. et al., 2019; Tonin, S., 2018)

Enable conditions: What Will Support the Transition?

Existence of Resources: Human, Financial, Political, and Technological:

1. The concept of building with nature (BWN) should become scientifically assessed with respect to its innovative approach and which technologies could help support this concept[53]

2. Policy supporting nature-based solutions

3. Financial support is required for researchers and industry to implement and assesses the principles of Building With Nature.

4. Align the Principles of ICZM Protocol and Ecosystem-Based approach with institutional structures, priorities and funding streams.

5. Change in fishermen attitude and practices to enable the fishing sector to become sustainable.

6. Implement integrated Sustainability Assessment (ISA) approach as a model for managing the transition to sustainable fishing practices.

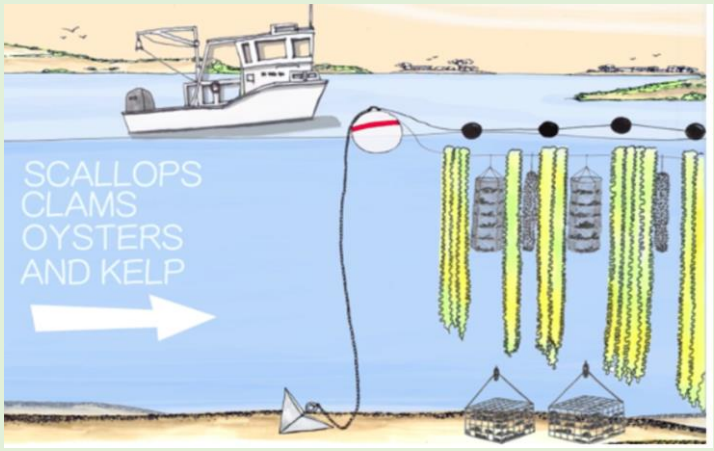
7. Adoption of cleaner technologies and framing policies to support environmental solutions and collaboration of private with the public sector to solve environmental problems related to marine-resource utilization will further strengthen the blue biotechnology sector.

8. Proper funding, efficient planning, governance, and enforcement levels in MPAs.

9. Involvement of private parties is crucial in the commercialization of new marine products.

Transition pathways in action

Ocean Farmers:
Transforming fishermen into restorative ocean farmers to create a new blue-green economy: in North America vertical underwater farming grow a mix of seaweeds and shellfish for food, fuel, fertilizer, and feed. Staked below lines of kelp and other seaweeds are oysters in cages and then clams buried in the sea floor. By opposition to aquaculture monoculture, this ocean farming model produces different type of seaweed, shellfish and harvest salt.
Beside food production theses farms function as storm-surge protectors, breaking up wave action to reduce the impact of hurricanes and rising tides. And they serve as artificial reefs, attracting more than 150 species of aquatic life



https://medium.com/invironment/an-army-of-ocean-farmers-on-the-frontlines-of-the-blue-green-economic-revolution-d5ae171285a3

[52] https://ewn.el.erdc.dren.mil/

[53] https://www.ecoshape.org/en/the-building-with-nature-philosophy/

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10. Implementing blue biotechnology friendly policies and thus help in exploiting the full potential of blue biotechnology.

11. Increase law enforcement.

12. Successful coastal adaptation requires stakeholders' willingness to engage in decision making, as well as mutual trust between the public and policymakers.

13. Government, Knowledge institutions, R&D institutes should plan and facilitate more dialogue between each other in order to create more synergies between research programmes.

(European Commission 2014, 2019; EU 2016; Gustavsson M., 2018; Haines-Young R. and Potschin M., 2011; Kinds, A. et al., 2016; Prabha, S. P. et al. 2020; Tonin, S., 2018)

Decline/Decrease of undesirable activities and behaviours:

1. Decrease of careless attitudes towards the marine environment

2. Reduction of unsustainable practices in fishing and aquaculture

3. Decrease of amount of waste and polluted water entering the ocean

(Gustavsson M., 2018; Kinds, A. et al., 2016; Tonin, S., 2018)

4.2. Core theme 2: Governance and Cooperation – "Stronger Together"

4.2.1. Future Narrative

Coastal-rural areas are economically, environmentally and socially balanced territories, thanks to strong governance at river-basin scale, and citizen participation in the decision-making process. Partnerships and cooperation both between and within sectors is the norm which allows for the development of integrated approaches towards economic activity, increasing the competitiveness of each activity. Natural resources are sustainably used, as result of a high-level environmental awareness and proper law enforcement.

Cooperation is the new rule at the supra-national level, and marine-coastal areas benefit from the efficient management of governing bodies at the regional sea basin scale with a holistic approach: they are responsible for the sustainable use of the sea basin with extended competences in environmental, economic and social aspects, as well as ensuring cross-border cooperation and open-data access between countries. This allows easy and fast transnational agreements to be validated and implemented. The EU integrated maritime and inland policies facilitate this process, supporting the effectiveness of EU directives at a national and local level. The sustainable management of natural resources and land is encouraged by combined activities and multi-use of space. Sustainable agriculture, fishery, aquaculture and tourism industries, and other marine activities benefits from unified policies which rewards environmentally-friendly and decarbonized activities as well as social justice.

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Local coastal-rural areas benefit from governing bodies at river-basin scale, in charge of the strategic sustainable development of the coastal-rural areas, based on a single marine-coastal-inland spatial planning document (following the concept of "source-to-sea", the integrate coastal zone management principles and ecosystem-based approach). The coastal-rural strategic planning document is fully integrated into a Marine Spatial Planning document at a sea-basin scale. This allows for sustainable management of the water resource throughout the whole river-basin, to capitalize on land-sea interactions by emphasizing synergies between marine, coastal and rural activities. The tourism and agricultural development strategies support coastal-rural territorial cohesion by facilitating collaboration between coastal and rural stakeholders.

Community-driven energy projects further enhance cooperation between coastal and rural communities and ensure equal access to cheap, local and clean energy. The predominance of renewable energy sources is facilitated by the Resilient Energy Union which contributes to the decarbonisation of the economy. Increase synergies between sectors, development of new technologies, wide-use of nature-base solutions and general environmental and climate change awareness drastically reduce energy consumption and fossil fuel dependency.

Based on a participative approach, local stakeholders and the general public are engaged in the strategic decision-making process related to the sustainable development of their community. Citizen integration to the governance process is supported by a life-long learning systems based on Information and Communication technologies. The development of a network of coastal-rural hubs for innovation and education in agriculture, energy, environment and blue economy sectors allows local stakeholders to benefits from the latest innovations adapted to local context via knowledge transfer, sharing, and exchange between sectors, regions and countries.

The coastal-rural society is characterized by a strong environmental, social and economic sense of justice, responsibility, equality and tolerance.

4.2.2. Quantitative descriptors

Table 8: Quantitative descriptors for 'Stronger Together' scenario

*Relevant Drivers	Trend	**Quantitative Descriptor
Demography - population growth	variable	Population growth rate
Cooperation	increased	Number of cooperatives
Trust	increased	Number of cooperatives
Membership of Cooperatives	increased	Number of cooperative members
Local Economic Development	increased	GDP growth rate (local)
		GDP per sector
		Unemployment rate
		Employment per economic sector (%)
Urbanisation	decreased	Population density
		Rate of expansion
		Land use change (re-designated green-belt-zones)

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Agriculture (sustainable practice of)	increased	Number of organic farms
		Percentage of organic crops (yield levels)
		Total irrigated area
		Irrigation Efficiency (ha/cubic metre)
		Total agricultural water extraction/use
		Use of pesticides
		Use of organic fertilizers
		Use of mineral fertilizers
		Reuse of manure and by-products
		Erosion prevention
		Soil salination
		Subsistence agriculture
		Crop rotation
		Livestock density
Tourism (sustainable practice of)	increased	Stress: Number of Tourist (annum/peak month)
		Use Intensity: Intensity of use – peak period (persons/km2)
		Social Impact: Ratio of tourists to locals (peak period and over time)
		Site protection: Category of site protection according to International Union for Conservation of Nature and Natural Resources (IUCN) index
		Development Control: Existence of environmental review procedure of formal controls over development of site and use densities
		Planning process: Existence of organized regional plan for tourist destination region (including tourism component)
		Consumer satisfaction: Level of satisfaction by visitors
		Local Satisfaction: Level of satisfaction by locals
		Tourism Contribution to Local Economy Proportion of total economic activity generated by tourism only
		Ecological destruction: % ecosystem in degraded condition
		Beach degradation: % of beach eroded

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		Fish stocks depletion: Effort to catch fish/ Fish counts for key species
		Overcrowding: Persons per meter of accessible beach
		Disruption of fauna (e.g. whales): Species counts/number of species/change in species mix/ number of key species sightings
		Water quality: Pollution levels - fecal coliform and heavy metals counts
		Adopted national policies to frame sustainability in tourism operation
		Geospatial data : to visualize interactions with environment
Market Demand (for local produce)	increased	% contribution to nation GDP
		Value of production per sector
Local Production	increased	% contribution to nation GDP
		Value of production per sector
Blue Economy (associated activities: Coastal Tourism, Marine living resources, Marine non-living resources, Port activities, Shipbuilding and repair and Maritime transport)	increased	Turnover (from associated activities)
		Gross value added (from associated activities)
		Employment - % of market share
		Average annual salary
		Investment in infrastructure
		Net investment
Climate Change (impacts of)	variable	temperature
		humidity
		sea level rise
		sea-surface temperature
Water Availability (Quantity and Quality)	increased	Seasonal/ annual demand (per sector)
		Total water extraction
		Water use per sector
		Population connected to water network
		Population connected to sewage network
		Temperature
		Nitrogen
		Phosphorus
		Pesticides
		Sediments
		Phenol
		Temperature
		Salinity

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		Chlorophyll
Nutrient Pollution	decreased	Nitrogen
		Phosphorus
Ecological Status (of ecosystems)	improved	% protected areas
		Air quality
		Biodiversity
		Invasive species
		Deforestation
		Soil degradation
Environmental Policy	stronger/ more coherent	Existence of relevant policy
		% funding directed to implementation and infrastructure
Economic Policy	environmentally focused	Existence of environmentally relevant component
Maritime Policy	environmentally focused	Existence of environmentally relevant component
Land-use Policy	environmentally focused	Existence of environmentally relevant component
Agricultural Policy	environmentally focused	Existence of environmentally relevant component
Funding	environmentally focused	Funding for sustainability focused programs
Environmental Management Bodies	stronger/more coherent	Existence of relevant bodies
		% funding received
Monitoring	stronger/ more coherent	% funding directed to monitoring and enforcement agencies
		amount in fines collected
***Core Narrative Elements	Trend	**Quantitative Descriptor
Education/Knowledge/Skills	increased	Amount of funding directed to relevant activities
		Number of relevant active NGOs
Environmental Awareness	increased	Number of campaigns
		Amount of funding directed to relevant activities
		Number of relevant active NGOs
Collaboration/Partnership (between actors, sectors, geographic location and scale)	increased	Amount of funding directed to public-private partnerships,
		Amount of funding directed to civil society partnerships
Multifunctional Use of Space	increased	% of land use allocation per activity
Use of Renewable Energy	increased	renewable energy as % of total energy generated
		renewable energy as % of total energy consumed

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Use of Fossil Fuels	decreased	fossil fuels as % of total energy consumed
Energy Efficiency	increased	Energy efficiency focused legislation or action plan implemented
		minimum energy efficiency standards
Energy Union	stronger/ more coherent	electricity interconnection: % installed capacity
		number of patents on energy union priorities
Holistic scope for Management bodies	increased	number of agencies with multi-sector focus

4.2.3. Transition Pathways

4.2.3.1. Transition pathway 6: FROM fragmented and competitive farming structures TO Local cross-sectoral cooperation and within the sector

Increased cooperation and synergies within the sector (between farmers, livestock breeders and crops farmers) and between sectors (throughout the land-sea continuum) will lead to a more resilient agriculture thanks to a diversification of activities, share knowledge and a rational and sustainable use of natural resources.

Key actors:

- Policy Makers
- Government Agencies
- EU & International agencies
- NGOs
- Farmers & Farmer associations
- Extension agents
- Consumers & citizens
- Academia
- Water management body

Actions for Policy Makers, Government Agencies, EU & International agencies:

1. Ensure coherence and consistency of policy frameworks and legal instruments across all levels of governance to support the transition to agro-ecological practice. This should be supported by incentives, financing, investments, research, extension and education.

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Transition pathways in action

Association Cap 2000: cooperation around the source-to-sea continuum

Cap 2000 association in North West of France was created with local famers, oyster producers and fishermen to solve conflicts around the water resource. The association develops a form dialogue between the different sectors and led to finding common solutions regarding water issues, acceptable and beneficial to all stakeholders.

https://cap2000.jimdofree.com/

2. Build capacity to implement collaborative approaches that engage multiple actors and sectors simultaneously in order to promote institutional multi-functionality.

3. Prioritize rural accessibility and connectivity in the form of rural roads and digital investments to drive productivity, end rural isolation, to bolster agro-ecological producers' access to market.

4. Promote balanced human-centric territorial development based on social relationships by re-think regional roles (urban, rural, coastal) and their relationship in the context of sustainable community development, and the sectors which drive them (agriculture being key).

5. Create enabling environment (funding for research, rural extension services, communication platforms and networks; while at the same time reducing administrative barriers.

6. Co-develop inter-ministerial interventions to support the design and implementation of integrated policies focusing on creating synergies with similar sustainability approaches and engaging a variety of sectors and partners simultaneously.

(FAO 2018b; Food and Land Use Coalition 2019; Sutherland, L., 2014)

Actions for NGOs, Farmers and Farmer associations, Extension agents, consumers:

1. Drive institutional innovations that promote working collaboratively across different agriculture and food sectors and integrating the different agricultural sectors (crop and livestock production, forestry, aquaculture and fisheries).

2. Shift procurement focus from commodities to supply chains; engaging all stages of the food system and working in collaboration with all stakeholders along the entire supply chain ultimately strengthening the linkages between production and consumption.

(FAO 2018b; Food and Land Use Coalition 2019)

Actions for NGOs, Academia, Extension agents, Farmers and Farmer associations, Government:

1. Raise awareness and provide training on agro-ecological diversification practices for sustainable crop production (including soil fertility, integrated nutrient management and integrated pest management), engaging farmers' organizations, Ministries of Agriculture and Environment, local agricultural officers, extension officers and universities.

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2. Support and develop collaborative structures for the agricultural community such as learning forums for entrepreneurs, and machinery rings.

3. Establish public-private-philanthropic partnerships to train a new generation of young farmer entrepreneurs over the next decade.

(FAO 2018b; Food and Land Use Coalition, 2019; Sutherland, L., 2014)

Actions for Water Management Bodies, Farmers and Farmer associations:

1. Adopt source-to-sea management approaches in order to break through geographical and sectoral barriers by focusing on the system wide impacts and addressing complex, multi-stakeholder issues such as climate change, inclusive economic development, resource security, sustainable water, river-basin, delta and integrated coastal management.

Transition pathways in action

Combining Agriculture and energy production:
Agrinergie® is the intelligent and innovative combination of energy and agriculture that associates farming and energy production on the same site. Using the revenue generated from the sale of electricity, it finances all the improvements needed for the farming of the land, working with the project's agricultural partners. Depending on locally identified needs, Agrinergie® selects the structure best suited to the type of farming proposed: with panels mounted on the ground, on sun-shades or on greenhouses. Agrinergie® is a key concept to solve conflict over land uses and to secure the local production of food and green energy.

https://solarimpulse.com/efficient-solutions/agrinergie

2. Build multi-sectoral partnerships to develop institutional and individual capacity to link activities, impacts and outcomes across the source-to-sea continuum.

3. Work with Farmers to improve irrigation efficiency.

4. Work with R&D Industry, Extension Agents and international agencies to incorporate the use of technological innovations and support the uptake of new technologies by farmers.

5. Prioritize the attainment of environmental objectives, such as water conservation and pollution control to limit adverse impacts on ecosystems.

(Food and Land Use Coalition, 2019; International Commission on Irrigation and Drainage, 2000; OECD, 2010; Stockholm International Water Institute, 2019)

Actions for Citizens:

1. Drive demand by promoting healthy consumption habits (sustainable foods which support food security.

2. Reduce *consumption of meat, shift* diet towards plant-based diet

(FAO 2018b, Food and Land Use Coalition, 2019)

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Actions for all:

1. Work towards the creation of a new regional dynamic by building networks that focus on cross-sectoral synergies; creating 'hybrid networks' of sympathetic actors, pairing agricultural sector actors like farmers with consumers, wine-makers, tourism and energy sectors to support a sustainable transition.

(Sutherland, L., 2014)

Barriers: What would obstruct or Hinder the Transition?

1. Lack of leadership and ownership of the transition process and competitive relationships within and between sectors.

2. Lack of trust between actors.

3. Inconsistency and lack of policy coherence (e.g. contradicting objectives and instruments within the Common Agricultural Policy such as direct payments that are decoupled or recoupled to production).

4. Difficulty in coordinating multiple agencies in order to establish cooperation and coordination to implement source-to-sea approaches.

(Birdlife International, 2017; Stockholm International Water Institute 2019; Sutherland, L., 2014)

Enable conditions: What Will Support the Transition?

Existence of Resources: Human, Financial, Political, and Technological

1. Existing multi-national initiatives such as Sustainable Development Goals, in particular goals 2, 13, 14 and 15.

2. Increased inter-personal collaboration interpersonal collaboration between farmers (and other value chain actors.

(FAO 2018b; Sutherland, L., 2014)

4.2.3.2. Transition pathway 7: FROM national strategies and corporate suppliers TO an EU energy union with coastal-rural community based projects

Based on solidarity and trust between countries, the creation of a resilient Energy Union will ensure an affordable, secure and sustainable energy for businesses and households alike. At a local level, energy community based project and local smart grids will boost renewable energy production and ensure the resilience and autonomy of coastal-rural communities.

Key actors:

- EU Agencies
- Government
- Public entities

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773782.

- Energy suppliers
- Citizens

Actions for EU Agencies & Government:

1. Effectively implement the Energy Union.

2. Developing an integrated European offshore energy grid at a regional sea basin scale with a combination of centralization and decentralization initiatives.

3. Enhance co-operation with other states in matter of energy production and transfer and energy networks.

(Dedecca, J. G., et al., 2019 ; European Commission, 2016b ; Jay, S. A., & Toonen, H. M., 2015 ; Jorquera R.H. et Nordén A., 2017)

Transition pathways in action

Brooklin MigroGrid: a renewable community project using Block chain technology

The BMG marketplace allows prosumers (i.e. residential and commercial solar panel owners) to sell the excess solar energy they generate to NYC residents who prefer using renewable, versus fossil fuel, energy. Brooklyn Microgrid's mission is to assist in the proliferation of solar production and consumption throughout New York City. Through blockchain technology and its own innovative solutions, BMG also developed Exergy, a permissioned data platform that creates localized energy marketplaces for transacting energy across existing grid infrastructure.

https://www.brooklyn.energy/

Action for Public entities, Energy suppliers, Citizens:

1. Develop community renewable energy projects with Institutional support (top-down and bottom-up approach) (e.g Samso island energy project in Denmark see Akinsete et al. 2019).

(Mirzania, P., et al. 2019; Roby, H., et Dibb, S., 2019 ; Rogers, J. C., et al. 2008)

Actions for WMB, Public entities, Energy sectors:

1. Implement a Water-Energy-Food nexus governance to reduce conflicts, identify synergies and mutual benefits, promotes cross-sectoral cooperation.

2. Take into account the complexe governance system behind production of hydroelectricity (multiple uses potentially competing for the water resource, multiple uses take place in dams).

Grubert E., 2020; Salmoral, G., et al. 2019)

Joint Actions for all Actors:

1. Widespread adoption of smart energy systems which will support a decarbonisation of the energy sector by facilitating integration of intermittent low carbon energy sources, e.g. wind and solar, and new types of loads such as electric vehicles.

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2. Develop Local Energy Markets (LEM) supported by blockchain technology, to facilitate the inclusion of renewable energies in the energy supply system; it will enable consumers and prosumers to trade energy within their community, facilitate (near)real time pricing and assist the process of a local balance of supply and demand (e.g. Brooklyn microgrid project.

(Buth, M. C., et al. 2019; Dedecca, J. G. et al 2019; Jay, S. A. et Toonen, H. M., 2015; Mirzania, P. et al. 2019; Renström, S., 2019; Roby, H., & Dibb, S., 2019; Salmoral, G., et al 2019)

Joint Actions for cooperation of government, ship owners, industry, charter companies, R&D institutes, IMO:

1. An Energy cooperation structure should become established for Maritime transport. These stakeholders should work together on an action plan that will open the path for constructive experimentation for assessing renewable energy options.

2. Collective action should be taken by introducing financial solutions that reward sustainable performance and enable large scale uptake of innovation, technology, design and operational efficiencies.

(IRENA, 2019; Sustainable Shipping Initiative, 2013)

Joint action for Civil Society and Energy Suppliers:

1. Training and education for people who want to contribute to project development and management of the energy cooperatives.

(DRIFT institute, 2017)

Barriers: What would obstruct or Hinder the Transition?

1. The dependence of regional planning on national development plans, which consider national interests for offshore energy.

2. Funding and cost allocation are interdependent but unsynchronized due to binding and rigid regulation at a EU level

3. Lack of willingness in involvement within community-based energy project due for instance of low awareness of positive return of investment, low % of house owner.

4. Low public acceptance rate of wind turbines projects (e.g. visual impact).

5. Lack of knowledge and understanding of what public participation means and more generally about community-based energy projects.

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6. Lack of funding for community-based energy project.

7. Inadequate policy to enable peer-to-peer electricity exchange, the creation of LEMs and access to electricity wholesale market.

8. Power imbalances among sectors and stakeholders relate to a lack of cross-sectoral collaboration (e.g. economic interests associated with hydropower development have dominated over sustainability) and current sectoral governance.

9. Difficulties related to transboundary River basin management.

10. Technical issues related to off-shore infrastructures.

(Buth M. C. et al., 2019; Dedecca, J. G. et al., 2019; Jay S. A. et Toonen H. M., 2015; Rogers, J. C. et al.2008; Roby H. et Dibb S., 2019; Salmoral, G. et al., 2019)

Enable conditions: What Will Support the Transition?

Existence of resources (Human, Financial, Political or Technological):

1. Increased regional governance and cooperation at a Sea basin scale.

2. Consensus on the energy and climate policies among European countries.

3. Clean Energy Package governance regulation, leveraging reputational incentives for cooperation.

4. Expansion of the cross-border transmission grid in Europe coordinated centrally following a combined top-down and bottom-up approach.

Transition pathways in action

Samso Island: a sustainable renewable energy island

Following the launch of a competition by the Danish government to support the use of renewable energy in the islands in order to become self-sufficient, the local community (4000 inhabitants) of Samsø became self-sufficient in 10 years. Through the development of a combination of different renewable energy sources, inland wind farms, offshore wind farm (funded by the islander) solar energy and biomass), the local economy has been transformed, with most businesses and citizens benefiting from important savings in terms of energy costs, as well as from the expansion of existing businesses (construction, electricians,…)

https://energiakademiet.dk/en/transition/

5. Increased awareness and knowledge of the possibilities for different types of projects and participation.

6. Increased availability and accessibility to funding for community renewable energy projects, knowledge and guidance.

7. Maximizing public engagement in energy consumption, production and supply system (smart energy system) [2] and participation in local energy planning.

8. Increasing use of alternative technologies for energy supply systems (e.g. Block chain technology, distributed energy generation).

9. Focus of innovation in the energy industry towards software to make the electricity system more resilient, efficient, intelligent, digital and sustainable.

10. Legitimisation of trading within LEMs, which strengthens the position of the prosumers.

11. Development of collaborative adaptive management approach with regards to water diplomacy.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773782.

Buth M. C. et al., 2019; Buth, M. C. et al., 2019; Mirzania, P. et al. 2019 ; Renström, S., 2019 ; Roby H., Dibb S., 2019; Rogers, J. C. et al., 2008; Salmoral, G. et al. 2019)

Decline/Decrease of undesirable activities and behaviours:

1. Decline of fossil fuel industry, fossil fuel as source of energy (source of electricity).

2. Decrease of number of vehicles using fossil fuel based.

3. Decrease of national level governance and control in the energy sector.

(Victor D.G. et al., 2019)

4.2.3.3. Transition Pathway 8: FROM Sea-side tourism TO Coastal-rural tourism

The development of territorial branding at a coastal-rural scale and a cooperative networking approach will diversify the tourism offer from being seaside oriented to the natural and cultural heritage of the whole coastal-rural areas. This new tourism strategy will reduce the tourism pressure on the coastline and support the rural livelihood.

Key Actors:

- Tourism actors (tourism operators, tourism agencies, chamber of commerce, local actors)
- Farmers
- Maritime sector
- Transport sector
- Public entities
- Local communities
- R&D Institutes
- Academia
- Government (national, regional, local)
- NGOs
- Water management bodies

Actions for Tourism actors, Public entities, R&D, universities, local community, NGOs:

1. Develop cooperation networks in order to acquire, create and share information, knowledge and other resources to contribute to gain competitive advantage in the market, access or internalize new technology and know-how beyond their own borders, exploit scale economies and share risk/uncertainty with their partners while supporting a more sustainable tourism.

2. Develop regional networks and initiatives (e.g. territorial branding) at a coastal-rural area scale (innovative scale of governance) to offer a greater diversification of products and markets, to tackle the challenge of the seasonality of the activity (e.g. in Wadden Sea region, Algavre Region, wine route in Italy).

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Transition pathways in action

Collaboration around Local production and tourism

"KM 0", in Portugal is a branding initiative to promote local sourcing. It brings together stakeholders from the entire chain of actors involved in the production, processing, sales, marketing and consumption of fisheries products from the Minho Lima area.

This project aims to promote local sourcing through the branding of local products and awareness-raising of the role of the different actors along the products' supply chain.

Local gastronomy and historical heritage are opportunities and tools to promote "alternative" and sustainable tourism in rural coastal hinterland, increase economic activity in/during the off-season, safeguard culinary heritage and raising awareness on the importance of local production, processing and knowledge.

Akinsete et al., 2019 (COASTAL Deliverable D09)
http://www.fao.org/family-farming/detail/es/c/286437/

3. Implement co-management and adaptive co-management (collaborative on-going learning process) approaches for sustainable management of natural resource and tourism.

(Alipour H. et Arefipour T., 2019 ; Akinsete et al., 2019; Brandão, F., et al., 2019; Festa, G., et al., 2020; Islam, M. W., 2017; Jesus. C., et FrancoM., 2016; Lorenzini, E. et al., 2011; Mendonça, V. et al., 2015 ; Ramos D., et Costa, C., 2017)

Actions for Tourism actors, public entities, NGOs, local communities:

1.Develop inter-organisational environmental cooperation and pro-sustainability agencies to foster nature-based tourism.

2. Work together to reduce the amount of marine litter.

(Force A. et al., 2017; Huybers, T. et Bennett J., 2003)

Action for Tourism actors, farmers, maritime sectors, public agencies, government:

1. Facilitate combined activities with other sectors (agriculture, fishing, environmental protection). (Depellegrin, D. et al., 2018)

Actions for Tourism and transport sectors:

1. Enhance cooperation between transport and tourism sectors to combat climate change.

2. Establish partnerships with local food producers in order for the former to rely on the latter as a major source of food. This will help reducing greenhouse gas emissions associated with farming and transport, and at the same time it will enhance poor regions economic development.

(Modern Diplomacy, 2019; United Nations World Tourism Organization, 2019)

Barriers: What would obstruct or Hinder the Transition? 1. Lack of resource, knowledge and skills to develop cooperative networks particularly in rural areas.

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2. Problems associated with motivating self-interested members to participate in the network and to share valuable knowledge openly.

3. Lack of incentives and communication to develop cooperation for joint use of environmental resources ('tragedy of the commons').

4. High level of competition in the sector.

(Huybers T., et Bennett J., 2003 ; Jesus C., et Franco M. 2016)

Enable conditions: What Will Support the Transition?

Existence of resources (Human, Financial, Political or Technological):

1. Development of cooperative relationships within the tourism sector.

2. Commitment and cooperation between actors: trust, communication, exchange, mutuality,

3. Strong identity within the network through processes of socio-economic bonding that facilitates the transfer of knowledge.

4. Access to information technology.

5. Capacity to innovate.

6. Regional networks of certification programmes should be consolidated & Territorial brands should be included in a process of destination management (e.g. improve networking effort).

7. Community involvement.

8. Tourism policies that protect natural, social and cultural resources.

9. Development of new form of governance (scale, type of actor involved, extend of competences) and effective integrated planning process.

(Alipour H., et Arefipour T., 2019; Brandão F. et al., 2019; Festa G., et al., 2020; Force A., et al., 2017; Islam M. W. et al., 2017; Jesus C., & Franco, M., 2016; Lorenzini E., et al., 2011; Mendonça V. et al., 2015; Ramos D., et Costa C., 2017)

Decline/Decrease of undesirable activities and behaviours:

1. Decrease of tourism destination focus on sea & sun / Decline of interest for beach tourism.

2. Decrease of competition between rural and coastal tourism activities.

(Ramos D., et Costa C., 2017)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773782.

4.2.3.4. Transition Pathway 9: FROM Sectoral, spatialized planning of activities TO Combined activities and cross-sectoral collaboration in the land-sea continuum

The development of maritime activities will switch from a sector-oriented view to a multi-use of space on the coast and at sea. The policies will support an integrated land-sea approach to maritime activities and increase land-sea synergies for a healthy and productive ocean.

Key Actors:

- Maritime ports
- Government
- EU agencies
- Farmers
- Shellfish industry
- Fishermen
- Water management bodies
- Knowledge institutions

Actions for Port sectors, Government:

1. Develop cooperation between maritime hubs in close geographic location (between ports sharing similar hinterland).

2. Active sharing of management authority between different stakeholders should be supported by and in between government and requires cross-level interactions and cooperation to improve social-ecological resilience of coasts.

(Neil Adger W. et al., 2005; Shinohara, M., et Saika T., 2018; Yoshitani, T. 2018)

Action for Government and EU agencies:

1. The EU should integrate its policy which touch on fisheries and mariculture and all elements linked to the food-generating capacity of the Ocean into a cross-policy sustainable "food systems" framework. This includes also the integration in EU's Integrated Maritime Policy (IMP).

(European Commission 2017a)

Actions for Farmers, shellfish actors and fisherman, water management bodies:

1. Establish local partnership to sustainably co-manage and monitor the water resource; develop cross-sectoral collaborations to share knowledge, resources while avoiding conflicts. (e.g Etel RB, France).

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2. Developing new and innovative fishing practices by participatory governance approach and co-management of fisheries, following local ecological knowledge and culture (co-created, co-managed and co-developed for a more holistic account of 'fisheries sustainability').

(Akinsete et al., 2019; Goodma, A. J. et al., 2019; Gustavsson, M. 2018)

Actions for water management bodies, government and EU:

1. Improve social-ecological resilience of coasts by an active sharing of management authority between different stakeholders (increase cross-level interaction and cooperation)

(Neil Adger W. et al., 2005)

Joint Actions for all:

1. Develop combined activities and multi-use of space for a more sustainable and efficient use of maritime space for a sustainable use of the Ocean, reduce energy and water consumption (e.g. tourism and other activities, coastal protection and wave energy production, aquaculture & land farming, underwater cultural heritage and environmental protection, Offshore-wind farm and desalinisation units, decommissioning oil & gas platforms and artificial reefs.

2. Implement a holistic and integrated approach in governance, planning and developing activities throughout the land-sea continuum and an Ecosystem-Based Management approach which by nature focuses on regional areas as opposed to traditional sectoral driven policy approaches.

3. Development of adequate training programmes to boost blue-biotech development and innovations.

(Calado, H. et al., 2019; Cross S.F., 2013; Depellegrin, D. et al., 2018; Akinsete et al., 2019; Abanades, J. et al., 2018 ; Soma K. et al., 2015)

Transition pathways in action

Tomato Masters and Aqua4C: Combining horticultural production and fish breeding in Belgium

Tanks for growing fish use water captured from the greenhouse roofs. The water used by the fish farm is recycled after advanced filtering and post-treatment with UV sterilisation. Separated waste water is used to irrigate the tomato greenhouses. The surplus electricity by the CHP plant is used for the tomato greenhouses to run the pumps, aerators, lighting and other electrical equipment. The surplus heat is used to keep the temperature in the fish tanks at 27° Celsius.

EIP-AGRI Workshop 'Opportunities for Agriculture and Forestry in the Circular Economy

https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/field_event_attachments/ws-circulareconomy-20151028-

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773782.

Barriers: What would obstruct or Hinder the Transition?

1. In the port & shipping sector, the current context is led by competition rather than cooperation.

2. Existing port governance structure.

3. Multi-use of space suffers from inappropriate regulations (operational, environmental, health and safety, societal and legal aspects).

4. Current technological constraint to multi-use of space and combined activities.

5. The sustainable use and management for the European seas is still hampered by a patchwork of conflicting, sectoral policies and a diversity of authorities with their own rules and policies.

6. Marine Spatial Planning and Land Spatial planning are different planning systems in which other actors are involved.

(Calado H. et al., 2019; Depellegrin, D. et al., 2018; Shinohara M. et Saika T., 2018; Soma K. et al., 2015; Yoshitani T. 2018)

Enable conditions: What Will Support the Transition?

Existence of Resources: Human, Financial, Political, and Technological:

1. The EU integrated maritime policy.

2. Development of regional strategies with better cooperation and integrated approach, involving littoral states and multiple actors [9] and with effective and legitimate governing structures.

3. Better regional planning and cooperation which support cross sectoral interactions, cooperation and combined activities.

4.The full implementation of MSP Directive that aims at promoting sustainable development of the sea space and manage conflicts by encouraging "multi-purpose" uses, synergies and land-sea interactions.

5. Blue Growth strategies and initiatives that support diversification of activities.

6. Availability of Funding.

Transition pathways in action

Pesca Tourism: Combining fishing and tourism

Pesca Tourism is a way to develop new activities combining tourism and fishery. The main goal of the practice is to diversify the touristic offers, raise awareness regarding local fishery products and the natural marine environment as well as offering an additional source of income for fishermen. As an example in the Valencia region, in collaboration with local partners, the region developed an itinerary guide, inviting Individuals to a journey on a traditional fishing boat where they will experience the traditional fishing technics, discover the natural marine protected area, and observe birds and learn about local fish species. Additionally, visitors will enjoy an authentic seafood lunch with fresh local products.

https://fishingtourism.net/en/fishermen-en/23-vicente-bayo

7. Early engagement of innovative stakeholders with decision making power.

8. Better understanding of cumulative impacts (environmental, economic and social).

9. Change in the mind-set of actors in order to become multi-functional (e.g. fishers and tourist agents), raise awareness, share experience and education.

10. Partnerships among all levels of government, fishery associations, and local residents (community).

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(Calado, H., et al.,2019; Chen, J.-L., et al., 2019; Depellegrin, D. et al., 2018; Morf A. et al., (2019 ; Shinohara, M., & Saika, T., 2018; Soma, K., et al.,2015; Van Tatenhove, J., et al., 2014)

Decline/Decrease of activity and behavior:

1. Decrease on competition between maritime ports.

2. Decrease of sectoral vision and strategy in managing maritime activities, marine ecosystems and water resource.

3. Decline of conventional Aquaculture farming.

(Cross S.F., 2013; Morf A. et al., 2019; Shinohara M. et Saika, T., 2018)

4.3. Core theme 3: Circular Economy – "What Goes Around Comes Around"

4.3.1. Future Narrative

Coastal-rural areas are examples of a decarbonized systems, which operate based on the principles of circular economy (reduce, reuse, recycle). They provide equal opportunities for all, high quality standards of living, and a healthy productive environment. Based on the multi-functional use of spaces, they are sustainable and dynamic, supporting strong rural livelihoods, and blue circular growth.

Economic activities have eliminated the production of waste and pollution; products and materials are either reused or recycled, constantly producing new raw materials and thus helping regenerate natural systems. The bio-marine industry is a leading sector, supported by a 'full circle model' in the blue industry value chain and a high level of innovation. Bioplastics have replaced conventional carbon-intensive plastic products, which eliminate further micro-plastic contamination in the environment.

Sustainable aquaculture, powered by renewable energy sources, benefits from the latest innovation and is the main supplier of ocean proteins and healthy seafood products. The generalization of close recirculating aquaculture systems (i.e. aquaponic systems) integrates the aquaculture sector into the energy production system, and the inland food production system (for human and livestock consumption). It is fully integrated into the coastal-rural circular economy model where the fishery, forestry, agriculture, and energy sectors undertake sustainable cooperation based on the win-win principle.

The agri-food sector follows the principles of bio-based circular economy by only using renewable biological resources and transforming waste production throughout the value chain into a local source of heat, energy and nutrients; thus reducing the carbon footprint of the sector to near zero. This strong local sustainable agriculture, where livestock and crop farming are perfectly integrated, uses a combination of traditional techniques and advance precision farming technologies. It benefits from the digitalization of food and land-use systems, and is supported by strategic partnerships both within and across sectors. It ensures a high level of productivity and high-quality food products which allow coastal-rural areas to be food self-sufficient.

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Behavior change towards general consumption reduction (of water, energy, consumer goods), and increase demand for high-quality, nutritious and affordable foods (a predominantly healthy plant-based diet) also contributes to the elimination of food lost, waste and unsustainable use of natural resources. Embedding circularity within all economic activities, means that used water no longer reaches the ocean but, instead is recycled through a combination of innovative technologies and nature-based solutions, and/or reused based on cross-sectoral cooperation.

Within a resilient EU Energy Union, coastal and rural areas are part of a single energy grid system where production and consumption are shared from the inner river-basin to the offshore areas. The supply of 100% clean, carbon free energy takes advantage of a diversity of renewable energies sources (wind, solar, biomass, tides and waves, hydropower, geothermic). These are driven by community-based energy projects from different geographical locations (sea, coast and rural areas), where every sector contributes and benefits (based on block chain technology).

Tourism activities are mainly based on natural and cultural heritage, and benefit from a high-quality local environment, contributing to the full circular economy system.

The thriving, resilient, attractive, gender equal coastal-rural community promotes social well-being and environmental quality. It offers diverse work opportunities, supported by innovative technologies and infrastructure across sectors. These circular coastal-rural areas can easily adapt to new challenges, both protecting and regenerating their natural capital.

4.3.2. Quantitative descriptors

Table 9: Quantitative descriptors for 'What Goes Around Comes Around' scenario

*Relevant Drivers	Trend	**Quantitative Descriptor
Demography - population growth	variable	Population growth rate
Cooperation	increased	Number of cooperatives
Trust	increased	Number of cooperatives
Membership of Cooperatives	increased	Number of cooperative members
Local Economic Development	increased	GDP growth rate (local)
		GDP per sector
		Unemployment rate
		Employment per economic sector (%)
Urbanisation	decreased	Population density
		Rate of expansion
		Land use change (re-designated green-belt-zones)
Agriculture (sustainable practice of)	increased	Number of organic farms
		Percentage of organic crops (yield levels)
		Total irrigated area
		Irrigation Efficiency (ha/cubic meter)
		Total agricultural water extraction/use
		Use of pesticides

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		Use of organic fertilizers
		Use of mineral fertilizers
		Reuse of manure and by-products
		Erosion prevention
		Soil salination
		Subsistence agriculture
		Crop rotation
		Livestock density
Tourism (sustainable practice of)	increased	Stress: Number of Tourist (annum/peak month)
		Use Intensity: Intensity of use – peak period (persons/km2)
		Social Impact: Ratio of tourists to locals (peak period and over time)
		Site protection: Category of site protection according to International Union for Conservation of Nature and Natural Resources (IUCN) index
		Development Control: Existence of environmental review procedure of formal controls over development of site and use densities
		Planning process: Existence of organised regional plan for tourist destination region (including tourism component)
		Consumer satisfaction: Level of satisfaction by visitors
		Local Satisfaction: Level of satisfaction by locals
		Tourism Contribution to Local Economy Proportion of total economic activity generated by tourism only
		Ecological destruction: % ecosystem in degraded condition
		Beach degradation: % of beach eroded
		Fish stocks depletion: Effort to catch fish/ Fish counts for key species
		Overcrowding: Persons per meter of accessible beach
		Disruption of fauna (e.g. whales): Species counts/number of species/change in species mix/ number of key species sightings
		Water quality: Pollution levels - fecal coliform and heavy metals counts

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		Adopted national policies to frame sustainability in tourism operation
		Geospatial data : to visualize interactions with environment
Market Demand (for local produce)	increased	% contribution to nation GDP
		Value of production per sector
Local Production	increased	% contribution to nation GDP
		Value of production per sector
Blue Economy (associated activities: Coastal Tourism, Marine living resources, Marine non-living resources, Port activities, Shipbuilding and repair and Maritime transport)	increased	Turnover (from associated activities)
		Gross value added (from associated activities)
		Employment - % of market share
		Average annual salary
		Investment in infrastructure
		Net investment
Climate Change (impacts of)	variable	temperature
		humidity
		sea level rise
		sea-surface temperature
Water Availability (Quantity and Quality)	increased	Seasonal/ annual demand (per sector)
		Total water extraction
		Water use per sector
		Population connected to water network
		Population connected to sewage network
		Temperature
		Nitrogen
		Phosphorus
		Pesticides
		Sediments
		Phenol
		Temperature
		Salinity
		Chlorophyll
Nutrient Pollution	decreased	Nitrogen
		Phosphorus
Ecological Status (of ecosystems)	improved	% protected areas
		Air quality
		Biodiversity
		Invasive species
		Deforestation
		Soil degradation
Environmental Policy	stronger/ more	Existence of relevant policy

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	coherent	% funding directed to implementation and infrastructure
Economic Policy	environmentally focused	Existence of environmentally relevant component
Maritime Policy	environmentally focused	Existence of environmentally relevant component
Land-use Policy	environmentally focused	Existence of environmentally relevant component
Agricultural Policy	environmentally focused	Existence of environmentally relevant component
Funding	environmentally focused	Funding for sustainability focused programs
Environmental Management Bodies	stronger/more coherent	Existence of relevant bodies
		% funding received
Monitoring	stronger/ more coherent	% funding directed to monitoring and enforcement agencies
		amount in fines collected
*****Core Narrative Elements**	**Trend**	
Education/Knowledge/Skills	increased	Amount of funding directed to relevant activities
		Number of relevant active NGOs
Environmental Awareness	increased	Number of campaigns
		Amount of funding directed to relevant activities
		Number of relevant active NGOs
Aquaculture including shellfish (sustainable practice of)	increased	% of farms using new technologies
		% of farms with Aquaculture Stewardship Council (ASC) sustainability label
Integrated Lifestock and Crop Farming	increased	% of farms practicing an integrated approach
Multifunctional Use of Space	increased	% of land use allocation per activity
Use of Renewable Energy	increased	renewable energy as % of total energy generated
		renewable energy as % of total energy consumed
Use of Fossil Fuels	decreased	fossil fuels as % of total energy consumed
Energy Efficiency	increased	Energy efficiency focused legislation or action plan implemented
		minimum energy efficiency standards
Natural Capital Protection	stronger/ more coherent	policies aimed at protecting natural capital
		funding directed to protecting natural capital
Energy Union	stronger/ more coherent	electricity interconnection: % installed capacity

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		number of patents on energy union priorities
Nature based solutions (use of)	increased	number of projects
		number of planning permits applied for per annum

4.3.3. Transition pathways

4.3.3.1. Transition pathway 10: FROM linear food production models TO Circular food production models

A model that prioritizes reduction of raw materials and the reuse and recycling of what once was considered waste; in the face of rising global demand for food, feed, fuel and fibre, while natural resources are increasingly becoming more scarce.

Key Actors:

- Farmers
- Breeders
- R&D Institutes
- Citizens
- Water Management Bodies
- Government (national, regional and local)
- NGOs

Actions for Farmers:

1. Recycle and reuse agricultural waste: There are many ways to do it, agricultural waste can be used to produce heat, energy and nutrients.

2. Exploit the existing technology to save resources and reduce environmental impact e.g. precision agriculture techniques, which utilises the capabilities of information technology systems to optimise the application of agricultural inputs, ensuring that the minimum resources needed are used at the production stage in order to achieve optimum performance with minimal environmental impact.

3. Use nutrients such as phosphorous and nitrogen from animal manure, sewage waste and food chain waste (especially slaughterhouse waste), instead of relying on non-renewable mineral phosphorus and the manufacturing of nitrogenous fertiliser using the fossil fuel natural gas.

4. Increase the cultivation of plants that can be used to produce bio-plastics. Plant-based plastics and materials could be crucial for the transitioning towards a circular economy since they would reduce waste, lower greenhouse gas emissions, conserve ecosystems and biodiversity, and at the same time benefit farmers' activities and promote rural investments.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773782.

5. Work with energy sector to capitalise on renewable energy production opportunities, leveraging physical resources that farmers can access most easily (land, field crops and manure).

(De Boer et al. 2018; Buckwell, A. et Nadeu, E. 2016; Shogren, R. et al., 2019; Sutherland, L., 2014 ; Ward S. et al., 2016)

Action for Breeders and Farmers:

1. Establish partnerships and synergies in order to reuse each other waste materials, e.g.: residual flows from agriculture and the food industry (e.g. foliage and straws) can be used to feed animals. Also manure from livestocks can be used to fertilize crops.

(Ward S. et al., 2016)

Action for R&D Institutes:

1. Investigate new practices and technologies, as well as develop and improve existing technologies (as the ones arised with the 4th Industrial Revolution, like Artificial Intelligence, Internat of Things, drones, etc.) that have the potential to minimise the input of finite resources, increasing instead the use of regenerative ones, and that can prevent the leakage of natural resources (e.g. carbon (C), nitrogen (N), phosphorus (P), water).)

(De Boer et al. 2018)

Actions for Citizens:

1. Be aware of the impact that their food choices have on the environment and start behaving accordingly. E.g. they lower personal consumption of animal protein, since livestock sector is inherently biologically inefficient and 'leaky'.

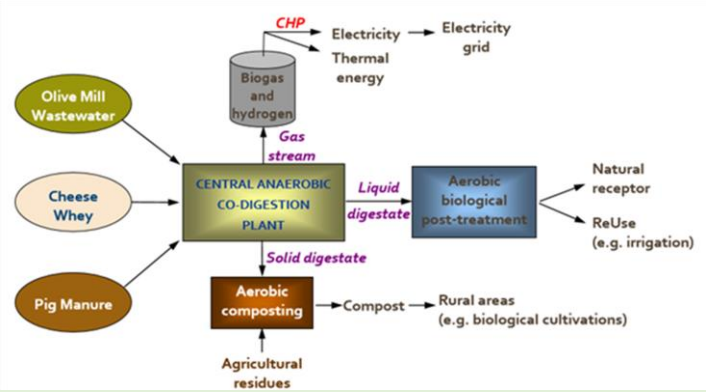
(Buckwell, A. et Nadeu, E. 2016)

Transition pathways in action

INTEGRASTE: An integrated agro-industrial waste management to maximise materials recovery and energy exploitation in Western Greece

Use of agro-industrial waste in Western Greece comes from many sources like olive mill waste, cheese whey, manure, slaughterhouse waste etc. The disposal causes serious environmental problems while re-use is difficult since many of the industries are small-scale family type businesses that cannot afford to process the waste themselves. Connection to central waste treatment facilities is difficult. The experimental pilot plant for central anaerobic co-digestion tries out, at local scale, different treatment methods to produce electricity, thermal energy, compost and liquid digested for e.g. irrigation and use as liquid fertiliser.

EIP-AGRI Workshop 'Opportunities for Agriculture and Forestry in the Circular Economy



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773782.

Action for Water Management Bodies:

1. Prioritize the use of wastewater, already used for domestic purposes in cities or towns for crops irrigation. Apart from its value as water, it may also contain nutrients which benefit agricultural production.

(The International Water Association, 2016)

Actions for Governments:

1. Establish different incentives that can encourage farmers and breeders to adjust their current ways of thinking and acting, adopting a more circular approach

2. Increase public and private funding for circular economy research, technology and innovation (R&D/I), enhance research collaboration and reduce regulatory barriers to innovation.

3. Establish and fund circular economy-related education and capacity building programmes, in order to build highly qualified human capital with specific qualifications and competences, capable to adapt to innovation and structural changes.

4. Establish programmes focused on the transfer of knowledge and technology to farmers, in order to enhance innovation adoption.

5. Increased measuring and monitoring of EU agriculture resource use and impact is needed and targets need to be set for waste prevention in agriculture.

6. Incentivize the production of salt-tolerant crops, in order to generate an increase in the use of sea water and a decrease in the use of freshwater, which is more and more scarce.

(The International Water Association, 2016)

Joint Actions:

Governments and NGOs: Invest and encourage greater consumer awareness of the impact of their food choices. [4]

(Diakosavvas, D. et C. Frezal, 2019)

Barriers: What would obstruct or hinder the Transition?

1. Resistance to change, which is still very strong in the agricultural sector and which makes the transition lagging behind.

2. The financing of new business models, coupled with taxation systems makes systemic transformation costly.

3. Lack of understanding of the true costs of not transitioning towards circularity.

4. The initial investment to adopt new technologies can be very high and could hinder the willingness of the farmer to transit towards a more circular economy.

5. Legislative constraints in terms of accessing the energy market.

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(Houston J., et al., 2019; Sutherland, L., 2014)

Enable conditions: What Will Support the Transition?

- *Existence of resources (Human, Financial, Political or Technological):*

1. Increasingly stringent environmental regulations, and a greater focus on resource efficiency, are already paving the way for water utilities in agriculture to move towards the circular economy.

2. Since Europe is a highly developed region with a highly intensive agriculture, and since the transition to a more sustainable and circular agriculture is unavoidable in the long run, starting this transition right now would create first mover advantage and economic opportunities for Europe.

3. Citizen engagement and individual level of environmental awareness, which is rapidly increasing in the last years and which is essential in pushing local sustainability agendas forward. Citizen bottom-up initiatives in favour of a circular economy contribute to achieving the systemic change needed for circular business transformation to occur.

4. Policies play an important role in directing the private sector towards business transformation. At EU policy level, some very important steps have already been taken in this direction. E.g. the EU Action Plan for the Circular Economy; EU Funding through programmes such as Horizon 2020, with whom the EU provides funding to support innovation and the transition from linear to circular economy business model; Regulatory measures, such as EU Directives (on waste, packaging, etc.) supporting the circular economy agenda or the EU Ecolabel to certify services and products with low environmental impact.

(Buckwell A. et Nadeu, E. 2016; The International Water Association, 2016; Sutherland, L., 2014)

Decline/Decrease of activity and behaviour:

1. Decrease of crop production dedicated to feed animals.

2. Decrease of freshwater availability for the agriculture sector.

3. Decrease of meat consumption.

4. Decrease of fund available for unsustainable agricultural practices energy-use intensives and water-use intensive, not following circular economy principles (reduce-reuse-recycle) .

(Ward S.M., et al., 2016; Houston J. et al., 2019; Shogren, R. et al., 2019)

4.3.3.2. Transition Pathway 11: FROM fossil-based energy sources TO closed-loop energy production

A shift towards renewable energies (carbon free, abundant and sustainable) as the key to solving humanity's major challenges of the 21st century, climate change and energy security.

Key Actors:

- Energy suppliers
- Industries

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- Consumers
- Governments (national, regional, local)
- R&D Institutes
- Water Management Bodies (WMB)

Action for Energy Suppliers:

1. Rely more on Waste-to-Energy (WtE) solutions, which can be crucial to minimise both production of waste and use of resources. WtE doesn't comprise just incineration, there are actually many other waste treatments processes generating energy (for instance, in the form of electricity or heat or producing a heat-derived fuel).

(Malinauskaite J. et al., 2017)

Action for Industry:

1. Implement industrial symbiosis, which means build partnerships and collaborating in order to harness and use each other's excess energy (but also resources and by-products), cutting this way their impact on the environment and at the same time reducing costs.

(Neves et al., 2019)

Action for Consumers:

1. Reduce and recycle energy at home. Hot water production is the biggest energy consumer in the household. Most of this energy goes down the drain, but it could be saved through more efficient appliances such as washing machines and installation of heat exchangers, for showers for example.

(The International Water Association, 2016)

Actions for Governments:

1. Have at the core of every energy policy discussion, energy efficiency and conservation, independent of the technologies or scenarios favoured to meet future demand.

2. Strategically plan at a European level in order to determine the future grid architecture and to identify the new technologies needed to satisfy demand and allow a greater integration of renewables in the future.

(PriceWaterhouseCoopers, 2010)

Action for R&D Institutes:

1. Intensify research on improvements to all forms of renewables in the design, cost, efficiency etc of the technology. Substantial investment in R&D will be needed to drive this, along with a reduction in overall costs to a point where renewables achieve cost parity with other sources of energy.

(PriceWaterhouseCoopers, 2010)

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Action for Government and Industry:

1. Develop Eco Industrial Parks that support industrial symbiosis and use of renewable energies.

(International Renewable Energy Agency, 2019)

Actions for Water Management Body:

1. Save energy at water treatment plants & distribution systems.

2. Work with Governments to incentivize energy production from biosolids (often known as treated wastewater sludge). The four most common processes for energy recovery are Pyrolysis, Combustion of biosolids, Biogas production and Gasification. (The International Water Association, 2016)

Barriers: What would obstruct or Hinder the Transition?

1. Conventional resources, mainly fossil fuels, are still dominant and remain competitive in terms of costs.

2. Renewable energy sources (RES) are generated locally and some of them, such as wind and solar, are volatile.

3. The regulatory framework in the context of renewable energy sources keeps changing over time.

4. Within Europe most of the existing transmission infrastructure will struggle to cope with the expected increase in future electricity demands.

Transition pathways in action

Using residues from paper recycling for energy production

Through the use of flexible multi-fuel boiler, which allows for the use of paper mills' residues as fuel, Hamburger Containerboard was able to reduce 95 % of the waste generated at the site, using the majority for energetic purposes. As a consequence, the site is now independent from natural gas and power supply systems and it has a full and uninterrupted energy supply.

https://www.valmet.com/globalassets/media/events/2018/customer-days-2018/energy/the-future-of-the-

5. Investment costs: simply keeping up with increasing electricity demand is likely to require significant new investment in infrastructure. If low carbon technologies are included, this figure increases further.

(EIT Innoenergy, 2016, PriceWaterhouseCooper, 2010)

Enable conditions: What Will Support the Transition?

- Existence of resources (Human, Financial, Political or Technological):

1. The existence of European policies that set very ambitious targets in terms of greenhouse gas reduction, energy efficiency and increase of renewables shares, as the '20-20-20 goals', '2030 Policy Framework for Climate and Energy' and the 'Winter Package 2016'.

2. The transition does not require fundamental technological breakthroughs. Most of the

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required technical components are available in principle already today.

3. EU ETS will play a key role in the decarbonisation of the power sector, by encouraging investment in renewables and discouraging new fossil-fired power generation.

4. Implementation of smart multi-energy system (use of various renewable energy sources for generating both electricity and heat (hybrid-RES), and in combination with other generation systems such as tri-generation technologies (combined cooling, heat and electricity)) and micro-grid.

5. Concentration of many firms in the same location enables them to take advantage of common services and common service providers.

6. Planning and managing of Eco Industrial Parks should include a collective energy strategy stimulating the use of renewable energy, through the purchase of RES generated electricity, individual or collective self-production of green electricity, energy cooperation among industries through infrastructures sharing.

(EIT Innoenergy, 2016; International Renewable Energy agency, 2019; PriceWaterhouseCoopers, 2010)

4.3.3.3. Transition Pathway 12: FROM conventional models of tourism TO circular models of tourism

Adopting circularity principles in the tourism industry will enable the tourism sector to drastically reduce its carbon footprint and environmental impact as well as to contributes to a sustainable development of tourism destinations and management natural resources.

Key Actors:

- Tourism actors
- Local food producers
- Consumers
- Governments (national, regional, local)
- Water Management Body

Actions for Tourism actors:

1. Reuse disused historic, industrial, or even residential buildings, instead of building new ones. This can save energy and reduce greenhouse gas emissions by avoiding new construction and can divert demolition waste from landfills.

2. Encourage the implementation of better waste management and measurement systems in order to minimize its negative environmental impact. E.g. educating every member of the team about methods of monitoring, storage, and recycling. Employee engagement should be further promoted through educational opportunities, bonuses, and competitions.

3. Propose diverse green, resource-saving ‘offerings’ to guests, such as the option of choosing not to have daily laundry washing actions.

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4. Recover food "waste". This could be done sharing excess food on sharing platforms, cascading food resources back to the agricultural food production, cascading food resources into biofuel, recovering and reusing nutrients in waste.

5. Build relationships with upstream suppliers of products that are re-usable and remanufactured and down-stream buyers that redistribute the hotels' discarded products.

6. Optimise the energy efficiency of buildings and make them self-reliant for water supply and waste management, use green energy sources and set strict targets for waste disposal and landfill.

7. Invest in innovation opportunities, such as food monitoring technologies or circular food packaging products.

(Brightley, C., 2017; Green Ideas for tourism, 2015; Manniche J. et al., 2017; Nedyalkova S.,, 2019)

Action for Local food producers and Tourism actors:

1. Establish partnerships in order for the former to rely on the latter as a major source of food. This will help reducing greenhouse gas emissions associated with farming and transport, and at the same time it will enhance poor regions economic development.

(Nedyalkova S., 2019)

Transition pathways in action

Circularity in practice in a hotel

Beside using the latest innovations for energy efficiency and the use of renewable energy, in the QO Amsterdam hotel all water used in the showers and sinks is then reused to flush the toilets and furniture such as carpets are made from 100% recycled yarn previously used in fishing nets. The principals of circular economy is also applied in the hotel's restaurant with a fully functioning rooftop greenhouse, a self-sufficient and self-regulating ecosystem that not only grows fresh vegetables above the hotel, but also houses fish in an integrated aquaponics system, products that are then use in the kitchen of the restaurant.

https://news.wtm.com/the-future-of-hotels-is-circular-and-two-of-them-are-opening-soon/
https://www.qo-amsterdam.com/about/

Actions for Consumers:

1. Be aware of the environmental footprint they have as tourists and reduce it behaving in a more sustainable way. e.g. recycling, reducing wastage of food, water, energy and other resources as much as possible.

2. Find alternative more sustainable options to travel to their destinations. Traveling activity of tourists is often connected to high CO2 emissions and pollution as destinations often are distant from tourists' residence and traveling therefore often is done by airplane or car. Some alternatives could be: fewer travels per year, shorter distances travelled, longer stays per travel (which in relative terms would reduce the share of the travelling component of the entire environmental impact of the holiday), travelling by use of transportation systems which do not rely on fossil energy to the same degree.

(Manniche J. et al., 2017)

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Actions for Government:

1. Educate both consumers and the tourism industry with regard circular economy themes and good practices.

2. Implement national tourism strategies that embrace the concept of sustainability, concerns for and action-oriented priorities on issues such as sustainability, environmental protection, renewable energy etc.

(Manniche J. et al., 2017)

Actions for Water Management Bodies:

1. Harvest rainwater, which in hotels can be reused for laundry and toilet flushing or, if treated, even as drinking water.

2. Recycle greywater for non-potable reuse, e.g. once treated it can be used for toilet flushing or garden irrigation.

3. Prevent water loss, e.g. through pressure reduction and repairing of leakages.

(The International Water Association, 2016)

Barriers: What would obstruct or Hinder the Transition?

1. Institutional barriers, such as regulations against food surplus distribution, regulations regarding waste separation and handling.

2. Lack of capital for investments in new technologies as well as lack of 'circular infrastructures'.

3. From the perspective of individual businesses, it is difficult to comply with idealised CE principles like described above. Moreover, the immense obstacles of realizing true system change might prevent businesses and policy actors from starting work on finding and implementing circular solutions as these may be considered fruitless efforts.

(Manniche J. et al., 2017)

Enable conditions: What Will Support the Transition?

- Existence of resources (Human, Financial, Political or Technological):

1. Customer demand for sustainably sourced food has increased a lot in the last decades. At the same time, the sector of small-scaled local food producers is growing globally to meet rising consumer demand. Such a trend carries major opportunities for implementing a circular economy in the hospitality industry.

2. Environmental credentials are becoming increasingly important to consumers and they're starting to choose more and more zero waste hotels for their holidays.

3. Decrease of polluting activities by tourists in the natural environment, increased attention to recycling and not leaving waste in natural areas.

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4. Hotels and resorts rely less and less on resource-intensive solutions and more and more on sustainable and circular ones, not just because it is resource saving but also because they are more aware they are also cost cutting. (Manniche J. et al, (2017); Nedyalkova, S., 2019)

4.3.3.4. Transition pathway 13: FROM resource intensive aquaculture at sea TO closed-loop aquaculture

The integration of a circular economy model in the aquaculture sector (multi-trophic aquaculture system, recirculating aquaculture system) will eliminate the negative environmental impacts of the sector, provide quality products and additional resources (water, food, energy) for other activities.

Key Actors:

- Maritime ports
- Shipping industry
- EU agencies
- Fishing sector
- Aquaculture sector
- Horticulture sector
- R&D Industry
- Water management bodies

Actions needed: Actions for Shipping industry, Government and EU:

1. Increase reuse and remanufacturing in the maritime sector.

2. Transforming hydrocarbon waste produced by ships into reusable products (diesel like fuel.

3. Transform food waste (cooking fats and other waste) and wastewater to produce biogas, electricity, fertilizer, and steam).

4. Share data within the sector to quickly identify components for a circular flow

(De Langen P., et Sornn-Friese H., 2019 ; Milios, et al., 2019; TRABE 2019 ; Wan Mahari et al., 2017)

Transition pathways in action

Port of Amsterdam: the state-of-the-art circular economy ventures

The latest circular economy innovation in the Port of Amsterdam is to be in the plastic recycling sector. The new facility, through a combination of prove science with patented technology born in Australia, will be able to produce fuel for the population of Amsterdam city from non-recyclable plastics with no further processing, blending or refining.

https://www.portofamsterdam.com/en/business/settlement/port-amsterdam-perfect-hub-circular-economy#updates

Action for Ports:

1. Implement circular economy and biobased economy principals in port areas to reduce the use of energy, the production of waste, and the need of transport, as well

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as creating synergies between industries (e.g. co-locating companies with synergies, developing new infrastructures (steam, heath, smart electricity grids) together with utility companies;

Action for Fishing & Aquaculture, R&D Industries:

1. Reducing waste production from seafood industry (uses of seafood waste to create bio-based packaging materials).

(Dyson J., 2019; De la Caba, K et al., 2018)

Action for Aquaculture, horticulture sector, water management bodies and R&D Industry:

1. Widespread of sustainable ecological aquaculture (e.g. Recirculating Aquaculture System on land, Multi-trophic aquaculture system, aquaponic system sector) [5-6-7-8]

Barriers: What would obstruct or Hinder the Transition?

1. Current negative perception of product life extension (perceived as affecting growth which discourage development of new technologies) as well as consumer's preference for new products.

2. The maritime industry is hardly represented in environmental and circular economy policies, the policy is also unfavourable for reuse and

remanufacturing.

3. Lack of specialised skills for reuse and remanufacturing
4. Acceptance in the market of innovative products in the food chain.
   (De la Caba, K et al., 2018 ; Milios, et al., 2019)

Transition pathways in action

Facilitating the circular economy in the maritime industry through share data

ReFlow Maritime offers digital tools for maritime stakeholders to harvest the benefits of circular maintenance. It aims to help the industry facilitating circular economy through increased traceability and data exchange using AI and advanced algorithms.

http://www.re-flow.io/

Enable conditions: What Will Support the Transition?

- Existence of Resources: Human, Financial, Political, and Technological:

1. Collaboration between supply chain members, as stakeholders increasingly works to align and converge their interests.

2. EU and national policies support and promote the principles of circular economy by implementing legislations.

3. Better information about the quality of remanufactured products and eco-design requirements.

4. Economic conditions: make reuse and remanufacturing profitable.

5. Research funds (additional research in technology).

6. Use of environmentally friendly and cost-effective processes for the extraction of materials to ensure that the innovative biorefinery practices designed to add value to by-products contributes to the sustainable development of materials.

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7. Availability research funds.
8. Consumers favouring marine products originate from sustainable practices

(De la Caba, K et al., 2018 ; Calone, R., et al., 2019 ; Milios, et al., 2019)

- Decline/Decrease of activity and behaviour:

1. Decrease of conventional aquaculture farming.
2. Decline of use of plastic from petrochemical industry in food packaging.
3. Decline of stand-alone industrial units (without synergies with other industrial units located close by).

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5. CONCLUSION

Following a literature review (D17), scenarios and transition pathways applicable to coastal-rural areas appear rather scarce, most of the literature focuses on sectors while few are spatially localized, the coastal-rural scale being rarely approached. Thus the scenarios and TPs presented here fill in a gap in the current literature. The development of generic coastal-rural scenarios and transition pathways within WP5 took a voluntary positive direction using system innovation approach which aims to drive a fundamental shift in the way society functions and meets its needs. Transition Management (TM) methodological framework was applied to create space for new ways of organizing, doing and thinking, triggering the "out of the box" way of thinking from local stakeholders, in order to create a fundamental shift in structures, mind-sets and practices. TM was combined with a backcasting method to collectively create pathways to an envisioned future, taking the future as starting point and going step-by-step back in time.

The generic scenarios were developed based on a literature and policy review, as well as input from the MAL teams, from where three themes emerged (People & Nature; Governance & Cooperation; Circular Economy) which creates 3 different scenarios ("Naturally Better", "Stronger Together", "What Goes Around Comes Around"). At the core of each scenario is the Future Narrative (qualitative portion of the scenario), an ideal vision of a sustainable coastal-rural area, and giving ambitious goals for the coastal-rural community to reach. The Future Narrative is a combination of visions developed by local stakeholders at COASTAL case study level during the multi-sectoral workshops where cross-sectoral group of actors were asked to co-design a common envisioned future for their local coastal-rural areas. The cross-sectoral aspect of each group was a crucial component of the vision to ensure the development of a shared and common future amongst the different sectors as well as fostering collaborations and synergies. The Future Narrative also integrated the main components of regional, national and European strategic documents relevant to coastal-rural areas, and perfectly align with the newly European Green Deal despite not being integrated in the first place since the scenarios were developed prior to its release. The quantitative portion of the scenario is referred as the quantitative descriptors: 'Relevant Drivers' based on the MALs' mental maps (fuzzy cognitive maps and combined causal loop diagrams) created within WP1 (D03: Sectoral Analysis of Coastal and Rural Development), and a list of 'Core Narrative Elements' (key features identified within the narrative). Each scenario is associated with multiple transition pathways that are sector focused (Agriculture, Tourism, Energy and Maritime activities, sectors most relevant for coastal-rural regions) in order to structure the identification of the transitions. 13 transitions pathways were elaborated following the application of the factors-actors-sectors framework (Rotmans et al., 2000). Following a literature review, key actors and actions were identified as well as main barriers and challenges that could hinter the transition, and enabling conditions that will support the transition (existence of resources but also decrease of undesirable activities) in order to reach the envisioned future. These relatively theoretical transition pathway frameworks are illustrated by practical examples of listed actions already implemented. Indeed many of the actions mentioned to trigger the transition are already taking place locally but need to be scaled up and adopted at a national / supra-national level as well as adequate fund and policy support.

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The scenario and TPs presented here are generic and will serve as a methodological framework for developing quantitative, detailed scenarios and transition pathways at a case study level (downscaling process as part as Task 5.3). Each MAL will adapt its scenario to its local context, following the future vision already developed with the local stakeholders, and select the most relevant transition pathways. The actions will be quantified and broken down into short, medium and long-term. As a validation process, the transition pathways will be tested by the land-sea interactions models developed within WP4. The coastal-rural scenario at a case study level will have to identify and integrate the structural uncertainty of the system inherent to each local context and define the boundaries of the coastal-rural system most relevant to each case study. The downscaling of the scenarios and TPs will be an iterative process between WP4 and 5 with the active support of each MALs which will ensure the coherence, applicability and acceptability of the scenarios and TPs by local stakeholders bearing in mind the COASTAL project main objectives: tackling current local challenges and fostering a sustainable development of coastal-rural areas by increasing coastal-rural collaborations and land-sea synergies.

The downscaling of the generic scenarios and TPs is a crucial and challenging step within the COASTAL project, requiring the integration of quantitative and qualitative data. The success of this task will depend, to some extent, on the robustness of the system dynamic models developed within WP4, at case study level, as well as data availability for quantifying the needed actions as part as the transition pathways. Capturing the future impacts of policies and social changes and the uncertainties of the system could also be challenging depending on the case studies. The lack of previous scenarios and transition pathways at a case study level to support the downscaling of COASTAL generic scenarios and TPs will also be a constraint for some case studies. The ambitious generic coastal-rural scenarios will also be challenged by the realistic approach of local stakeholders which might be less enthusiastic if the application of scenarios and TPs in their local context will imply a radical system transformation in their current practices. Adequate funds and policy supports are keys for the TPs.

The downscaling of the TPs is a cornerstone for the COASTAL project since it pre-defined the business roadmaps to be developed as part as WP3, and highlight policy recommendations for a sustainable development of coastal-rural areas, one of the main outcomes of the project. WP3 will follow the close collaboration required between WP4, 5 and the MALs to ensure the robustness of the business roadmap at case study level.

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APPENDIX 1.

GLOSSARY OF TERMS

WP5: Glossary of Terms

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THE PROCESS

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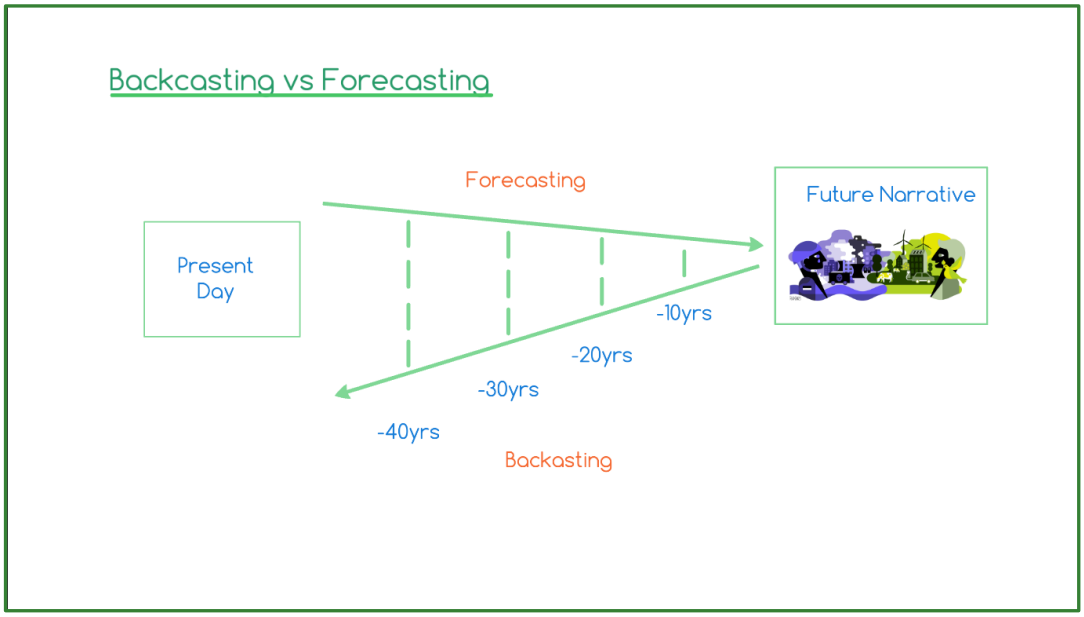
Backcasting is a method to collectively create pathways to an envisioned future, taking the future as starting point and going step-by-step back in time. The choice to start from the envisioned future is essential to enable the formulation of future-oriented strategies that go beyond "business as usual" solutions and are not constrained by vested interests and stakes *(Roorda et. al., 2012; Roorda and Akinsete, 2013)*. The exercise draws on 'Appreciative Inquiry' *(Cooperrider, Whitney and Stavros, 2003),* and so while it is possible to envision a dystopian future, the focus here is on the positive and envisioning an ideal situation. Backcasting is a method within a wider **Transition Management**[55] methodology which will be adopted within WP5.



Backcasting to Forecasting

[54] ***Hindcasting*** *refers to the use of historic data to calibrate a model*

[55] ***Transition management*** aims at influencing the direction and pace of societal change dynamics in the context of contributing to sustainability by creating space for new ways of organizing, doing and thinking (Loorbach and Rotmans, 2006).

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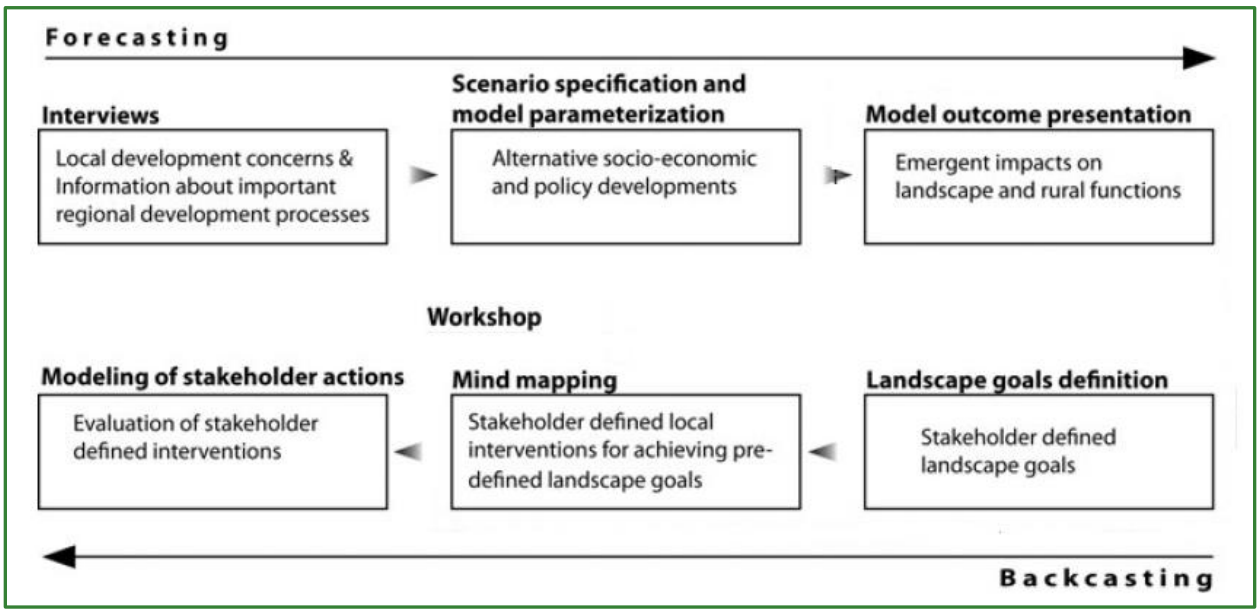

Forecasting vs Backcasting: Using Participatory Scenario Development in Rural Planning (Source: van Berkel and Verburg, 2012)

GLOSSARY OF TERMS

Future Narrative:

This is a qualitative storyline which captures a vision of the **Future** of their coastal areas, based on the principle of **Sustainable Land-Sea Synergies.** Sometimes referred to as a **'scenario plot'** (*Maak, 2001*), it should portray a visionary image of the case study areas in a future where the various sectors work together to enhance sustainable land-sea synergies. In so doing, the Future Narrative should explore the state of key drivers in the context of the envisioned future, building a storyline around them (*Volkery et. al., 2008; Foran et al., 2013*). The Future Narrative should convey the potential to inspire participants, as well as mobilise individuals outside the process (*Roorda et. Al., 2012)*. In the context of the COASTAL project, Future Narratives will be developed both by WP5 researchers and the MALs, and form the **qualitative element of the Scenarios**.

Example 1:
Storyline of a Sustainable Future focusing on the theme of Energy – H2020 GLOBAQUA Project (Source: Rault et al., 2018)

Energy Investments in environmental technologies, together with the phase-out of subsidies for fossil fuels and with lower taxation, make renewable energies more attractive. Fossil fuels are used less and less, reducing also the CO2 emissions compared to the present. As a result of the overall trend to reduce energy and resource use, the resource and energy efficiency increases. This leads to an overall decrease in energy demand.

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Example 2:
Vision for Aberdeen City in 2050 – Interreg MUSIC Project (Source:* Frantzeskaki*, 2012)

In 2050, Aberdeen City provides a high quality of life for all that live in the City. Aberdeen's city centre is a vibrant and attractive place. Aberdeen's City Centre Development Framework quarters have been realised with the city centre designed for people. Flagship projects and ventures will bring more visitors to the city, alongside this Aberdeen's granite heritage and distinctive aesthetic is celebrated. Heritage, arts, culture and leisure sites within the city centre are easily accessible and connected to an integrated public transport system. Aberdeen's has affordable and well-designed housing, in collections of urban villages where communities flourish, services are provided, and there is local economic growth and attractive neighbourhoods. Aberdeen is a tourist destination and offers a wide range of heritage, sport and leisure activities. Aberdeen City is the tourist gateway for visitors to access the Cairngorms National Park and the River Dee.

Quantitative Descriptors:

These refer to a set of **quantitative measures** which outline the **parameter settings** of a given scenario. The descriptors are a list of environmental and socio-economic indicators, such as population, GDP per capita, unemployment, urbanization, percentage use of fossil fuels, percentage use of renewables etc., which drive the system. The Quantitative Descriptors **quantify the main themes of the Future Narrative** and reflect the identified drivers (*Rault et al., 2018*). In the context of the COASTAL project, Quantitative Descriptors constitute the **quantitative element of the scenarios**, and will be developed within WP5 in collaboration with WP2 and WP4 partners, to ensure that they correlate with model variables to be explored by these WPs.

Example: Table of Descriptors used within H2020 GLOBAQUA Project (Source: Rault et al., 2018)

Sector	Descriptor
Society & economy	Growth per capita
	Unemployment
	Inequality Index
	Urbanisation
Energy	Use of fossil fuel (%)
	Use of renewable resources (%)
Environmental effects	Air quality
	Biodiversity
	Invasive species
	Deforestation
	Soil Degradation
	Water Scarcity
Water management	Technical measures
	Non-technical measures
Agriculture	Irrigated surface area (ha)
	Industrial agriculture
	Organic agriculture
	Meat production
	Use of pesticides
	Area cover with water intensive crops (ha)
	Organic fertilizers
	Mineral fertilizers
	Reuse of manure and by- products
	Abandonment of land
	Crop rotation
	Erosion prevention
	Soil Salinization
Industry	Investment in technology to emission reductions
	Level of emissions
Residential	Water consumption/demand
Tourism & recreation	Mass tourism
	Selected tourism
Policies	Protected areas
	Water quality standards
	Food security
	Desalination for irrigation

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Scenario:

A **Scenario** is a description of a potential version of the future, which consists of **both qualitative and quantitative elements.** Within the COASTAL project, scenarios are developed within WP5 using qualitative input from both the literature and MALs in the form of **Future Narratives**, as well as quantitative input in the form of **Quantitative Descriptors.**

Example:

***Development of Exploratory Policy Scenarios for Agriculture* (Source: van Berkel and Verburg, 2012)**

Exploratory scenarios for a period of 25 (2030) years in the future were defined to address stakeholders' concern about Common Agricultural Policy reforms. Scenarios that reflect two opposing policy and subsidy options for the case study region were developed:

iii. More balanced, targeted and sustainable support (BTS)
iv. Abolishment of market and income support (AMIS).

*The scenario description (**Future Narrative**) and parameters (**Quantitative Descriptors**) for the BTS scenario are outlined below.*

SCENARIO 1: Balanced, targeted and sustainable support

In this scenario reforms are aimed at balancing the economic, environmental and social dimensions of rural areas for creating or maintaining synergies between these domains (European Commission 2010). Several reforms to the direct payments scheme are proposed that affect the case study in a number of different ways. A basic flat rate subsidy for all famers would be established. This results in less pressure for small farmers and non-expansionists to increase production through farm expansion. However, the basic rate cap also results in decreased income for both milk producers and large farms leading to fewer resources for production expansion (De Bont et al. 2006). A small-farm subsidy leads to a lesser chance that small farms will sell their holdings due to favourable earning possibilities. Compulsory aid for the provision of 'green' public goods results in a decreased probability that landscape elements will be cut in protection zones (habitat directive areas). In these same zones incentives for landscape elements, such as hedgerows and tree lines, will increase planting or restoration of such features. Furthermore, a focus on rural development will increase subsides for rural residents wishing to diversify.

	BTS	
	2005	2030
Total number of farmers	1705	1230
Average farm size (ha)	14	31
Total agricultural area (ha)	45765	45254
Percentage of multifunctional/diversified farmers	31	16
Percentage of rural resident not primarily engaged in Agri.	38	40
Percentage change in the length of Landscape elements		
Semi-natural areas (ha)	5045	5612
Average distance to farthest parcel of land (km)	15	19

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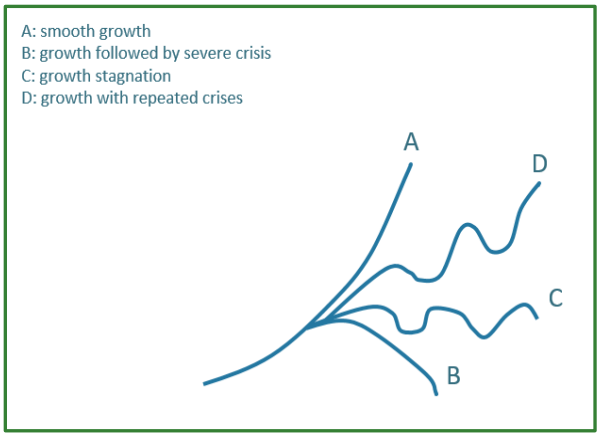
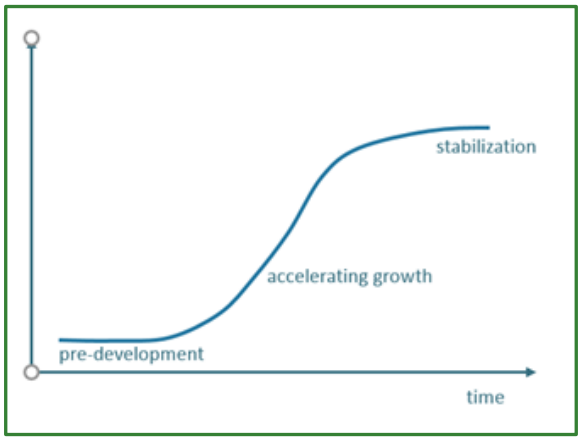
Transition Pathways:

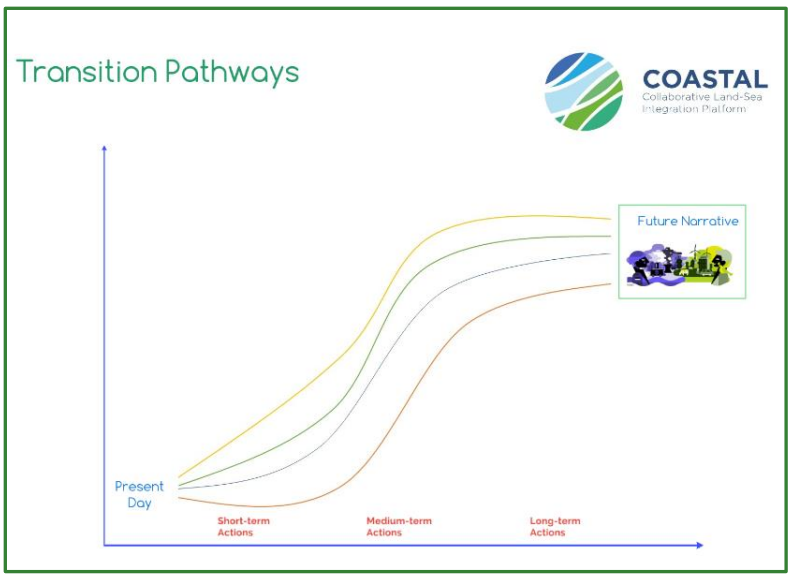
Transition Pathways describe possible routes from now to the envisioned future. Each pathway revolves around a subtheme and describes intermediate goals, barriers that need to be overcome, actors that are/become important and essential actions/interventions. The transition paths provide insight into what is needed to reach the envisioned future and give direction to the subsequent development of the transition agenda *(Roorda et. Al., 2012; Roorda and Akinsete, 2013)*. Within the COASTAL project, Transition Pathways can be considered as goal-oriented descriptions for the different transitions towards sustainability, exploiting innovative business and policy solutions aimed at the development of coastal-rural synergy. The Transition Pathways will be developed within WP5 based on the selected future **Scenarios**. Input from the MALs in the form of recommendations for action, barriers, drivers and key actors will support the development of the Transition Pathways.



Observed patterns of corporate growth (Source: Sterman, 2000)



Graphical Representation of a Transition Pathway (Source: Rotman, 2001)



Linking the present and the Future (Developed: Rotman, 2001; Roorda et. al., 2012)

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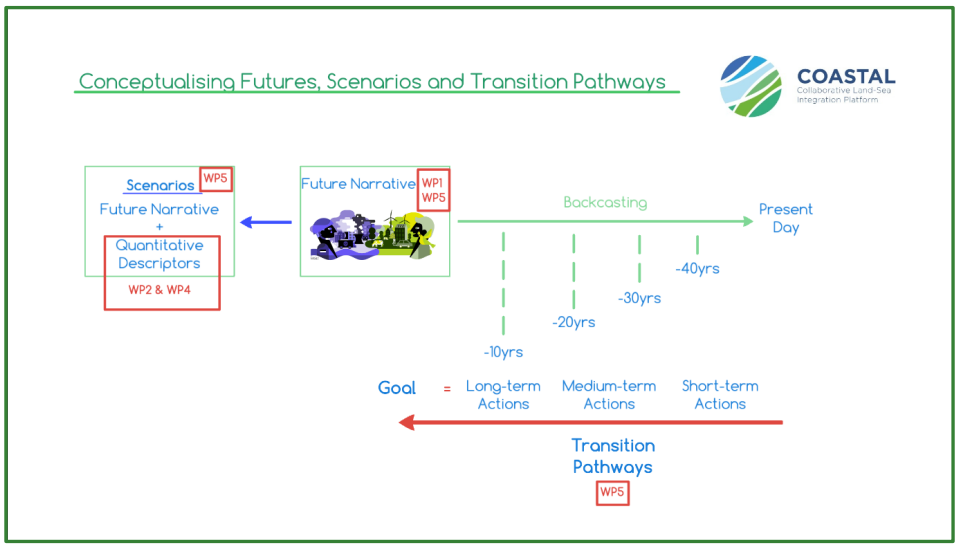
Examples: Transition Pathways from Interreg MUSIC Project (Source:* Frantzeskaki*, 2012) and EPSRC Realising Transition Pathways Project (Realising Transition Pathways Engine Room, 2015)

iv. From an oil-dependent economy to a diverse economy with a diversity of employment
v. From fragmented working to collaborative public private partnerships
vi. Greatly expanded role for civil society in delivering distributed low-carbon generation

HOW DO THESE ALL FIT TOGETHER?



Work Package interactions regarding scenarios

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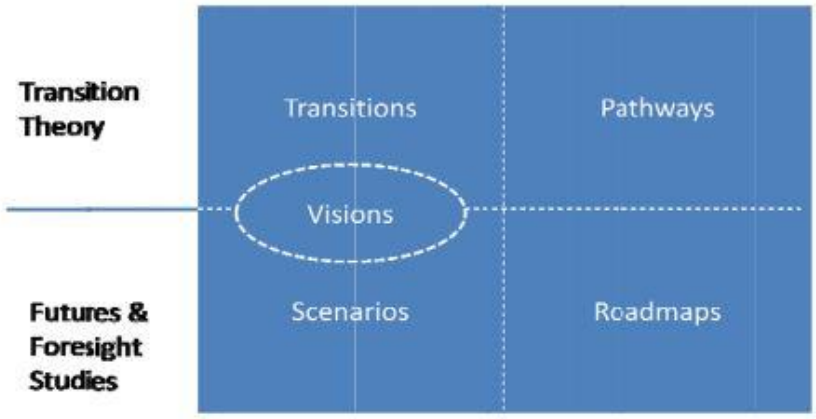
Figure 11 Conceptualising techniques in transition theory and futures/Foresight studies



Conceptualising techniques in transition theory

Source: (Dixon, 2011)

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APPENDIX 2.

Co-Creating 'Futures' within your MALs: Guidelines for MAL Leaders (WP 5)

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INTRODUCTION

This document is meant to serve as a quick reference guide for MAL Leaders who are running joint workshops. The guidelines provide a definition of key terms, as well as the methodology adopted by WP5, before going over the co-creation of qualitative future scenarios (Future Narratives). The guide provides an overview of participatory scenario-development, outlines key steps, and provides useful tips for both facilitators and participants.

KEY TERMS

Scenario:

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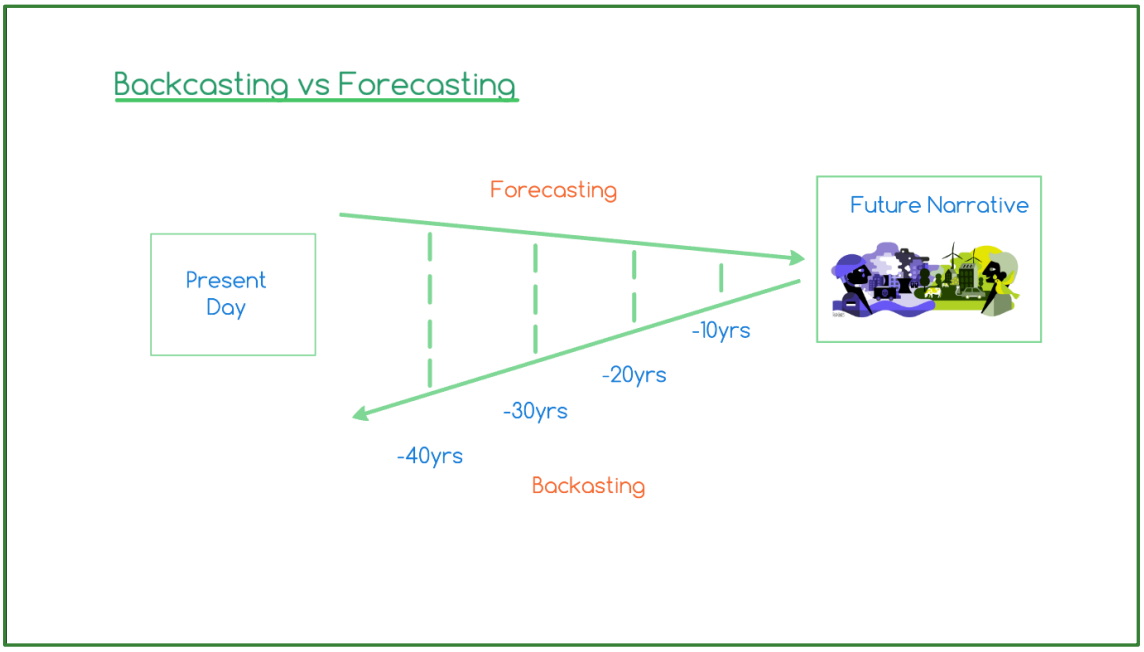

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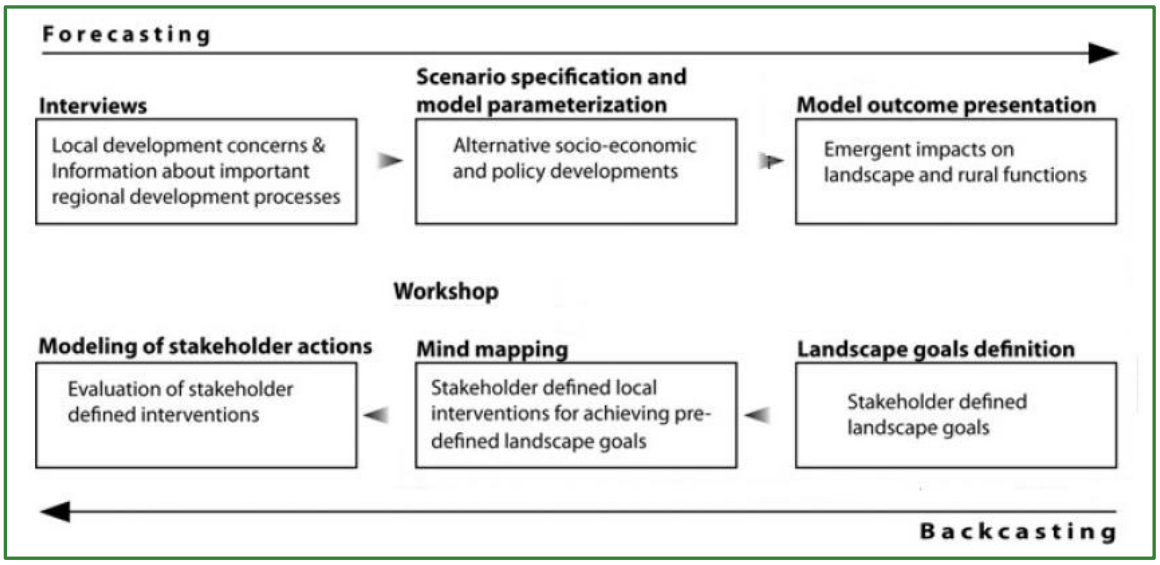

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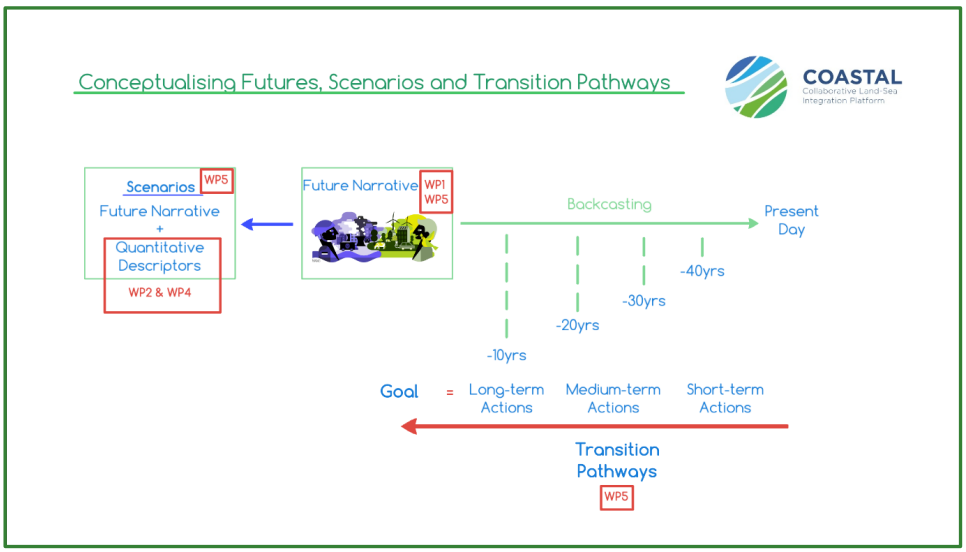

Work Package interactions regarding scenarios

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DURING YOUR WORKSHOPS

> Scenario building is a participatory planning and strategy tool that helps people to imagine a set of possible future outcomes. Scenario building is a form of visioning. It is not a tool designed to build consensus around a particular single vision of the future, but to explore the political, social and economic realities of a situation. The scenarios that evolve can show both positive and negative outcomes of different choices and this can prompt discussion about possible points of conflict and possible points of common interest or agreement among different stakeholders. Scenario building works best in situations that are socially complex and changing, and where uncertainty about the future and different stakeholder positions dominate. The process can help participants to create scenarios that answer the question 'What if...?' creatively and in a way that unifies diverse social groups as they explore the potential futures and ways of getting there.
>
> - *Forestry Commission, 2011*

Resources and requirements

Skills

- Needs experienced, creative and dynamic facilitation to bring out new ideas from participants. Some experience of conflict management and mediation is useful.

Equipment

- Flip chart paper/ whiteboard.
- Cards/ post-its

Time

- Needs time for careful preparation

Activities

- Introduce the activity and the process to participants

- Split up participants into smaller groups (4-6), with a relatively even distribution across sectors within each group.

- In their groups, ask participants to develop visions of the future of their coastal areas (**Future Narratives**), with emphasis on 'What the future of their coastal area LOOKS like' so they may

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illustrate with images or words. The Future Narrative should explore the state of key drivers in the context of the envisioned future, building a storyline around them.
It is important that the focus within this COASTAL project lies on the creation of coastal-rural synergies

- The participants are free to develop multiple visions of the future.

- Within each group, participants (or a nominated scribe) should take notes, or sketch their storyline on the flipchart paper provided; as well as a facilitator who is capable of steering the process a little bit whenever it gets stuck.

- Taking turns, sub-groups should report their Future Narratives back to the larger group

- With each of the Future Narratives pinned up to see, the facilitator should lead a discussion across groups, to gain deeper understanding of each of the narratives and build up a richer picture. At this stage, similar narratives may be merged.

- The timing of each activity will depend on how much time is available for the workshop as a whole, and how many participants are in attendance.
  An ideal **split of a 2hr time slot, with 3 groups of approximately 5 participants** would be:
  - Introduction: **15mins**
  - Envisioning in sub-groups: **45mins**
  - Reporting: **30mins**
  - Discussion and Synthesis: **30mins**

Tips for Facilitators

- Facilitation as well as the process setting is important to enable an open atmosphere with a positive group energy, that will allow for more quiet members of the group wo be heard . An inspiring process setting can be achieved by holding the meetings in different places, thereby physically exploring the challenges and opportunities of the city.

- As facilitator your job is also to inspire, give possible inspiration when the discussion starts to fade and let the rather “introvert” people also talk

- **Backcasting** is a process, and **Envisioning** is just the first step. Let participants know there will be other steps to follow which will address **drivers**, **issues/barriers, potential actions, key actors etc.**

- Some participants want to get to concrete results more quickly, but rushing does not allow time for explicitly elaborating the problem framing and visionary images.
  If you manage to complete the envisioning exercise then you may proceed to discuss drivers, issues/barriers, potential actions, and key actors.

- Encourage participants to think big, and not to be confined by the status quo or the way things are at present.

- **How to think beyond the thinkable?** Our thinking always starts from our current frames of thought, so an envisioned future inevitably seems based on them. People are also often averse to future-thinking: “but... that’s impossible!” and “it has to be realistic!” are common exclamations.

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- To enable thinking beyond what is possible nowadays, it was useful to **drivers**, **issues/barriers, potential actions, key actors** Moreover, it was helpful to have illustrations to support the discussions with sketches to stimulate the imagination.

- Visionary images ought to be conceptually rich enough to be meaningful. They do not, however, need to be fully elaborated; they are not intended to predict the future. Rather, they should provide a sense of direction, as well as the aspiration to get there.

- Useful 'Prompt Questions' to help build a richer picture:

    - What does _____ look like? (to keep the focus on visualization)

    - What is ____ doing? (___ could refer to actors, sectors etc)

    - What would you like to see instead? (to help bring participants back on track when they begin focusing on barriers)

Tips for Participants

- What does the future of your coastal area LOOK like?
- Visualize an ideal situation
- Your 'Future' can be a narrative/storyline, or an image
- Think outside the box; think beyond the thinkable!
- Think back 30 years and realize how much had changed fundamentally

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