Sustainable development pathways

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Chapter 5
Sustainable development pathways

Executive Summary

The attainment of climate-resilient development (CRD) pathways in the coastal areas of the Mediterranean remains a serious challenge. The pursuit of such pathways requires the proper identification of vulnerabilities related to human activities as well as climate change impacts, the assessment of opportunities to reduce risks to the affected communities, and the adoption of actions that are consistent with the Sustainable Development Goals (SDGs). The SDGs aim to shape most of the world's major priorities for improved livelihoods. Transformative actions are increasingly urgent across all sectors, systems, and scales to avoid exacerbating climate change risks and to meet the SDG's goals *(high confidence)*. In climate-resilient development pathways, transformative actions involve leveraging change in key pillars of development that drive societal choices. Climate actions toward sustainability, such as social cohesion and equity, individual, collective and agency empowerment, and knowledge development, have been identified as crucial steps to transform practices and governance systems for increased resilience *(high confidence)*. The efforts made by Mediterranean countries to adopt effective mitigation and adaptation measures are still insufficient to promote desirable and liveable futures, and to increase well-being for all Mediterranean coastal residents *(medium confidence)*. Greenhouse gas emissions (GHG) in northern Mediterranean countries (NMCs) have been systematically decreasing since 2005, whereas in southern and eastern Mediterranean Countries (SEMCs), they have been increasing continuously since the 1960s *(high confidence)*. Economic and population growth, especially in SEMCs, combined with increased demand for the electrification of transportation fleets, are the main factors for the observed rise in net emissions in the Mediterranean region, which has not yet managed to comprehensively decouple economic development from rising GHG emissions *(high confidence)*. The most vulnerable actors of society, such as the elderly, migrants, women, children and low-income earners, who are often more at risk, are not necessarily at the centre of policy measures that aim for an efficient and just

transition to a changed environment and climate *(medium confidence)*. Despite some progress in promoting a sustainable energy transition that shifts away from fossil fuels towards renewable and clean energy sources, including solar energy, as well as efforts to support conservation and restoration of blue carbon pools such as coastal ecosystems, sustainable development pathways are not occurring at a sufficiently fast pace, thus increasing risks and the intensity of climate change impacts *(high confidence)*. Marine renewable energy sources including offshore wind, wave, tidal current and thermal gradient energies are still in the early stages of development in the Mediterranean Sea, with only wind energy currently representing a feasible viable option *(medium confidence)*. More importantly, further research is needed to establish the net impact of renewable energy sources on the unique biodiversity of Mediterranean coastal ecosystems *(medium confidence)*.

Crucial socioeconomic sectors such as tourism, construction and real estate continue to be largely based on linear and extractive models of development, insufficiently embracing circularity and sustainable development practices *(medium confidence)*. A mix of legal, policy, and economic instruments, and behavioural nudges, participation and bottom-up collaborations with citizens, can be used more extensively by local, national and regional authorities to promote effective climate resilient development pathways in the Mediterranean Basin, thus addressing environmental and climate change risks.

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5.1 Introduction

5.1.1 Definitions and context

This chapter builds on the previous parts of the report, assessing challenges and opportunities to operationalise sustainable development trajectories. The concept of sustainable development has spread significantly since the early 1980s to become a core element of many policy documents adopted by governments, international agencies and business organisations (Mebratu 1998). Consolidated in 1987 by the much-acclaimed Brundtland report, the term stressed that humanity has the ability to make development sustainable through efforts to ensure that it meets the needs of the present without compromising the ability of future generations (WCED 1987). It also emphasised the need to impose limits on economic growth, especially in its excessive extractive and wasteful features, which are necessitated by the present state of technology and social organisation with regards to environmental resources, and by the limited ability of the biosphere to absorb the effects of current human activities. The report also brought to the forefront the three pillars of sustainable development, that is, economic, social and environmental factors while pointing out that 'what is needed now is a new era of economic growth — growth that is forceful and at the same time socially and environmentally sustainable' (WCED 1987, p.7).

The three pillars of sustainable development gained a dominant position within the literature, and consequently in key policy documents. The concept is often represented in Venn diagrams or nested concentric circles of the three main pillars, and while efforts to operationalise it has raised some uncertainties and lack of clarity (Purvis et al. 2019), the adoption of the Sustainable Development Goals (SDG) aims and targets contributes to improving the monitoring and evaluation of concrete actions to integrate the three dimensions of sustainable development within the UN system (UN 2012) and across various countries. The need to re-prioritise models of economic development trace back to the Club of Rome with the concept of limits to growth (Meadows et al. 1972), followed by Dasgupta and Heal (1980) who suggested the importance of including natural resources in economic modelling, and Johansson-Stenman, who highlighted the importance of incorporating ethics in environmental economic modelling (1998). In recent years, since the evolution of the concept of sustainable development, other approaches have emerged, such as well-being (Layard 2011), circular economy (Geissdoerfer et al. 2017), doughnut economics (Ross 2019), de-growth (Demaria et al. 2013), and *buen vivir* (Tolentino 2015), all with the aim of minimising the overall carbon footprint, fostering a harmonious relationship between nature and human activities, and a fairer distribution of resources and access to services among human populations. Nevertheless, sustainable development is still firmly enshrined as a global concept among the key trajectories for many international organisations, nation states and their official deliberations.

However, the shift to sustainable development is a complex and gradual process, and particular trajectories need to be actively pursued. These are referred to as sustainable development pathways. The definition adopted in this chapter for these pathways aligns with that adopted in the IPCC AR6 Report (IPCC 2022b). It refers to trajectories that involve 'transitions aligned with a shared aspiration in the SDGs', with 'efforts to eradicate poverty and reduce inequalities while promoting fair and cross-scalar adaptation to and resilience in a changing climate' (IPCC 2022a). These pathways involve the ethics, equity, and feasibility aspects of societal transformations, based on an array of social, economic, cultural, technological, institutional, and biophysical features that characterise the interactions between human and natural systems, with the aim of drastically reducing emissions to limit global warming, while achieving a desirable and liveable future and well-being for all (IPCC 2022a). The pursuit of climate-resilient pathways involves identifying vulnerabilities to climate change impacts, assessing opportunities for reducing risks, and taking actions that are consistent with the SDGs. The SDGs aim to shape most of the world's major priorities for livelihoods. The objectives embedded in the SDGs were ambitious and wide, ranging from the elimination of extreme poverty to major reductions in inequality and switching course to the protection of nature. Ambitious climate policies, as well as economic development, education, technological progress

and less resource-intensive lifestyles, are crucial elements for progress towards the main aims of the SDGs (Soergel et al. 2021). The clean energy share in industry (SDG 7) and air pollution concentration in cities (SDG 11) show positive trends and synergies with climate policies. Most development indicators (SDG 1, SDG 7) are closely associated with environmental indicators and exhibit trade-offs with climate policies (SDG 13), largely driven by higher energy and food prices (Soergel et al. 2021). Country size and sovereignty can also play a role in the capacity of countries to achieve SDGs (Moncada and Randall 2022).

Climate change, coupled with other global change drivers (pollution, urbanisation, rural exodus, population growth), is a growing threat for vital ecosystem services located in Mediterranean marine and coastal ecosystems *(high confidence).* In this chapter, the specific context targeted is the Mediterranean Basin, especially coastal areas and their communities, with the aim of identifying and assessing sustainable development pathways, including barriers to achieve them.

5.1.2 Layout of the chapter

Following this introduction, the chapter will first discuss the regional contributions and responses to climate stress and uncertainty in the Mediterranean Basin, looking at greenhouse gas (GHG) emissions and the current status of Nationally Determined Contributions (NDCs) plans for the countries in the Mediterranean region. Section three discusses the sustainable pathways in the context of the SDGs, while section four focuses on the specific topics of social and climate justice, including climate finance. Section five provides a conclusion.

5.2 Climate change response and related stress in the Mediterranean

GHG emissions are considered the overarching driver of climate induced changes that contribute to local coastal risks and hazards, including sea level rise, flooding, ocean acidification, etc. *(high confidence)* (see *Chapter 2*). This section highlights the regional contributions to global GHG emissions; identifies the mitigation and adaptation measures that individual governments in the Mediterranean Basin communicated in their initial and subsequent NDCs, in addition to other publicly documented measures, to combat climate change in support of SDG 13. It also evaluates the benefits and co-benefits of such measures and finally, determines the extent of the support that these measures provide towards achieving the SDGs.

5.2.1 GHG Emissions in the Mediterranean: a short summary

Over the past 50 years, the distribution of energy consumption within the Mediterranean region has changed dramatically. Energy consumption has increased steadily with figures shifting from 26 exajoules (EJ) in 1980 to 34 EJ in 1995 to 43 EJ in 2016. This represents an annual growth rate of 1.7%. Apart from a small decline in the use of coal, this positive trend accounts for oil, gas, nuclear, and renewables (Drobinski et al. 2020). Variations also exist within the Mediterranean Region. During the early 1970s, North Africa consumed only 4% of the total energy generated, whereas the European countries consumed 81%. By 2016, North Africa's share had increased to 19% while that of the Mediterranean countries within the European Union (EU) decreased to 59%. During the same period, per capita consumption in the Middle East and North Africa also increased relative to Europe, although the gap remains very wide. Türkiye, as a developing country required to fulfil its needs for development, also registered a significant increase in the consumption of fossil fuels and CO_2 emissions, starting in the 1990s (Bartoletto 2020; MedECC 2020a) *(high confidence)*.

By the year 2000, 72% of the GHG emissions consisted of CO_2 originating from energy use — 77% originating from Northern Mediterranean Countries (NMCs) and 64% from the Southern and Eastern Mediterranean Countries (SEMCs).[64] Historically, the growth of CO_2 emissions has been far more rapid in the SEMCs than in the NMCs. Whereas the NMCs reported an increase of 18% (mainly due to the transport sector) between 1990 and 2004, the emissions of the SEMCs increased by 58% over the same period (mainly due to electricity and heating). This growth rate is twenty points higher than the world average rate (European Investment Bank 2008), highlighting potential negative impacts for environmental and climate risks *(medium confidence).*

Despite this, the current share of carbon emissions of the Mediterranean countries accounts for no more than 6% of global emissions (FAO and Plan Bleu 2018), with NMCs contributing the larger proportion. The 2020 report on the State of the Environment and Development in the Mediterranean notes that emissions in NMCs reached their peak in 2005 but have since decreased. On the other hand, in SEMCs, CO_2 emissions have been increasing continuously since the 1960s. In 2014, the two regions were responsible for 1Gt of CO_2 emissions (UNEP/MAP and Plan Bleu 2020) *(high confidence).* This clashes with the requirements of the Paris Agreement, which necessitates that net CO_2 emissions decline significantly. However, according to current and future GHG emission projections, trends do not show a promising path towards their reduction (Ali et al. 2022). This is likely to be the result of the intermediate economic development of SEMCs, together with the final stages of democratic transition, which brought changes in the working population, shifting consumption patterns and resulting in an increase in energy, infrastructure and housing demand (European Investment Bank 2008). Energy demand, especially, is expected to continue its upward trend in the next few decades

64 The Northern Mediterranean Countries (NMCs) gather twelve countries or entities: Croatia, Cyprus, France, Greece, Italy, Monaco, Montenegro, Malta, Slovenia, Spain. The Southern and Eastern Mediterranean Countries (SEMCs) gather ten countries or entities: Algeria, Egypt, Israel, Lebanon, Libya, Morocco, Palestine, Syria, Tunisia, and Türkiye.

(Plan Bleu and EIB 2008) given the expected growth in the population and economies of the southern Mediterranean Region (Ben Jannet Allal et al. 2016), but also in view of the electrification of fleets, which is not being accompanied by the same level of supply of renewable energy production (Milovanoff et al. 2020) *(high confidence).*

The 2019 inventory of net GHG emissions *(Table 5.1)* indicates that NMCs emitted a total of 1.2 million kt CO_2 equivalent, accounting for 11% of the total reported by Annex I[65] countries during this year. While Annex I countries report a decline of 18.94% in net emissions between the base year (1990) and the latest inventory (2019), the Mediterranean Basin countries in Annex I report an increase of 10.26% during the same period, attributed mainly to Türkiye's 158% increase in emissions.[66]

Table 5.1 shows the CO_2 equivalent emissions according to the 2019 inventory for Annex I and Non-Annex I countries. The percentage change of emissions from the indicated base year for every country is in columns 4 and 5. As can be noted, the three Balkan countries — Bosnia and Herzegovina, Croatia, and Montenegro — all registered a substantial decrease, while Egypt and Morocco registered a substantial increase in emissions. Increases were also recorded by Cyprus, Israel, Lebanon, Syria, and Tunisia. No figures are shown for Libya (no entry) and the State of Palestine has an entry limited to the single year 2011. Between 1990 and 2019, GHG emissions from these countries registered a net increase of 391.49% (UNFCCC 2023).

Total emissions in the Annex I Mediterranean countries (1.65kt of CO_2 equivalent), listed in *Table 5.1*, are higher than those of Non-Annex I Mediterranean countries (0.75kt of CO_2 equivalent). However, the increased efficiency in reducing emissions in the NMCs resulted in a much less drastic increase in total emissions in the region. In fact, between 1990 and 2019 the net increase in emissions was 72.18%. *(high confidence).*

In general, in the Annex I countries (eight European Mediterranean countries plus Türkiye), listed in *Table 5.1,* emissions are much higher than those of Non-Annex I countries. Türkiye has been recently included in Annex I because it has registered a significant increase in the consumption of fossil fuels and CO_2 emissions, starting in the 1990s *(high confidence).* However, the increased efficiency is mostly in the European Union Member States (EUMS), which resulted in a much less drastic increase in emissions. In fact, between 1990 and 2019, the net increase in emissions was 72.18% *(high confidence).* Therefore, the NMCs reported an increase of 18% between 1990 and 2004, while the emissions of the SEMCs increased by 58% over the same period. This growth rate is twenty points higher than the world average rate *(medium confidence).* This means that energy demand is expected to continue its upward trend in the next few decades given the expected growth in the population and economies and the electrification of fleets *(high confidence).*

65 Parties to the UNFCCC are classified into three main groups according to differing commitments. Annex I countries refer to industrialised countries and economies in transition. Non-Annex I parties are mostly developing countries. In the Mediterranean, 14 countries are Non-Annex I countries, while the remaining nine countries are Annex I. https://unfccc.int/process/parties-non-party-stakeholders/parties-convention-and-observer-states

66 Türkiye is an Annex I country but as stated in Decision 1/CP.16, Article 141, Türkiye's status and development needs are similar to those of Non-Annex I countries. https://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf

Table 5.1 | Changes in GHG Emissions in the Mediterranean. Source: GHG data from UNFCCC. https://unfccc.int/topics/mitigation/resources/registry-and-data/ghg-data-from-unfccc

Country	Party/Region	Base year/2019: net GHG Inventory (kt CO_2 equivalent)	Change in % (base year to 2019 inventory year)	Yearly average change in %
1. Albania	Non Annex I	**1990/2009:** 9,037	15.36	0.76
2. Algeria	Non Annex I	**1994/2000:** 103,143	2.79	0.46
3. Bosnia and Herzegovina	Non Annex I	**1990/2014:** 19,342	−27.34	−1.32
4. Croatia	Non Annex I	**1990/2019:** 18,048	−27.63	−1.11
5. Cyprus	Non Annex I	**1990/2019:** 8,457	58.02	1.59
6. Egypt	Non Annex I	**1990/2005:** 241,632	126.16	5.59
7. France	Annex I	**1990/2019:** 412,579	−21.49	−0.83
8. Greece	Annex I	**1990/2019:** 82,150	−18.81	−0.72
9. Israel	Non Annex I	**1996/2019:** 79,045	37.99	1.41
10. Jordan	Non Annex I	**1994/2016:** 31,037	68.96	2.41
11. Italy	Annex I	**1990/2019:** 376,719	−26.88	−1.07
12. Lebanon	Non Annex I	**1994/2013:** 22,766	43.10	1.90
13. Libya	Non Annex I	nil	nil	nil
14. Malta	Annex I	**1990/2019:** 2,175	−16.43	−0.62
15. Monaco	Annex I	**1990/2019:** 83,000	−19.59	−0.75
16. Montenegro	Non Annex I	**1990/2011:** 1,697	−58.33	−4.08
17. Morocco	Non Annex I	**1994/2012:** 100,545	152.10	5.27
18. Slovenia	Annex I	**1986/2019:** 16,964	8.66	0.25
19. Palestine	Non Annex I	Single entry (2011): 3,226	nil	nil
20. Portugal	Annex I	**1990/2019:** 59,617	−10.49	-0.90
21. Spain	Annex I	**1990/2019:** 276,952	9.03	0.30
22. Syria	Non Annex I	**1994/2005:** 79,216	50.07	3.76
23. Tunisia	Non Annex I	**1994/2000:** 32,096	37.35	5.43
24. Türkiye	Annex I	**1990/2019:** 422,085	157.69	3.32
Annex I	**Total**	**1990/2019:** 14,555,211	**−18.94**	**−0.72**
Non Annex I	**Total**	**na**	**na**	**na**

5.2.2 Mitigation efforts and the NDCs in the Mediterranean Basin

Mediterranean countries have the potential to mitigate climate change through energy transition and actions that include reduced use of fossil fuels and an increased adoption of renewable energy sources *(high confidence).* The implications of Russia's war in Ukraine brought up the issue of energy security into the forefront. Europe's strong dependence on energy supply from Russia is now forcing it to find alternative sources to maintain the security of supply in the region. Diversifying energy sourcing in addition to relying on renewable sources would be the key to energy security in the near future. This is especially relevant for all coastal areas, given their strategic location in terms of production and transportation of such renewable sources *(medium confidence).* According to the Organisation Méditerranéenne de l'Energie et du Climat (OMEC)[67], in 2030, even if all NDCs are reached, fossil fuels will still account for 71% of the energy mix in the region due to the inertia of transport and industry demand that cannot be hastily displaced. In a net-zero carbon future, renewables will need to step-up to reach 57% of the total energy mix by 2050 (OME 2022).

To reach carbon neutrality by 2050, energy demand in the NMCs will need to be reduced by a further 41%, whereas the increase in demand in the SEMCs should be capped at under 2% by 2050 from its current levels. Moreover, the fuel mix will need to be 57% renewables, 17% nuclear and 26% fossil (23% for gas alone — the least carbon intensive fossil fuel). At present, fossil fuels account for 76% of the energy mix (65% in the North and 92% in the South). This needs to decrease to less than 22%. Renewables, although fast increasing, stand at only 12% of the total Mediterranean energy demand and while that share reaches 15% in the North, it is barely attaining 8% of total energy demand in the South (OME 2022).

In the decades ahead, most capacity additions will need to stem from renewables and nearly all from solar and wind technologies. OME (2022) argues that the region needs to generate 600 GW of net additional capacity from solar energy and 500 GW from both onshore and offshore wind energy technologies by 2050.

Current solar capacity stands at 85 GW in the entire Mediterranean region (OME 2022). By the end of 2018, around 2.9 GW of solar photovoltaic (PV) were operating in the Middle East and North Africa, with 12 GW of solar PV projects under construction or awarded. The SEMCs have huge solar irradiation levels making them ideal for large-scale development of solar PV power. For example, while Algeria currently generates just 500 MW of PV power, its national plan for the development of renewable energy indicates that around 60% of new renewable energy power (around 13,575 MW) would originate from solar PV and 5010 MW from wind power (Ciriminna et al. 2019).

Marine renewable energy sources, while feasible for coastal areas in general, are still in the early stages of development in the Mediterranean Sea. Blue energy sources include the use of offshore wind, wave, tidal current and thermal gradient energies. The potential for using these sources of energy varies dramatically in the Mediterranean Basin, with wind energy being a suitable alternative, while wave energy is still a limited option (*low* to *medium confidence*). Numerous offshore wind projects are at a concept or early planning stage in the northern Mediterranean — notably in France, Greece, Italy, Spain, and Portugal. According to Soukissian et al. (2017), the Gulf of Lion and the Aegean Sea are the most favourable areas for offshore wind energy projects in terms of potential (with 1050 and 890 W m^{-2}, respectively) at 80 metres above the sea level. When bottom depth suitability is considered, additional candidate areas include the Adriatic Sea and the Gulf of Gabès. The first offshore wind farm was inaugurated in April 2022 off the coast of Italy with a total capacity of 30 megawatts (MW) and an estimated output of 58,000 megawatt-hours (MWh) per year, enough to power 21,000 homes. By 2028, two offshore wind parks are expected to be operational off the coast of Sicily,

67 Formerly Observatoire Méditerranéen de l'Energie (OME).

with a total capacity of 750 MW, estimated to generate over 2000 GWh of electricity annually, equal to the average annual power demand of about 750,000 homes. Three pilot projects of floating offshore farms have been approved in the Gulf of Lion, France, and are due to be built before 2023 (Plan Bleu 2022c). In December 2021, Spain approved the Maritime Space Management Plans (Planes de Ordenación del Espacio Marítimo, or POEM) with plans to reach 3 GW by 2030, and an overall potential capacity of reaching 17 GW by 2050[68]. The European Wind Energy Association (EWEA)[69] projects that, by 2030, 150 GW could be produced using wind power in Europe's coastal waters; energy sufficient to service the electricity demands of 145 million households. Furthermore, by 2050, EWEA predicts that offshore wind could reach 460 GW, producing 1813 TWh of electricity, equivalent to 50% of the European electricity supply (Piante and Ody 2015). The Mediterranean Sea has a very low wave energy resource with the highest average wave power in the region being around 6 kW m^{-1}. Wave energy is more expensive than offshore wind energy and its technological development is far behind wind turbine technological developments. It is therefore expected that the development of wave energy will be slow and limited in the future. Tidal resources are currently limited to the Straits of Messina, Bosporus, and Gibraltar. The development of electricity based on tides and currents will remain limited in the future (Piante and Ody 2015). The information is summarised in *Table 5.2.*

Almost all countries (except Libya) in the Mediterranean Basin have committed through their initial NDCs or updated NDCs to reducing energy consumption and using renewable energy sources to reduce GHG emissions, by 2030.[70]

In North Africa, Morocco's renewable energy target of 52% stands out as the most ambitious plan in the region. Morocco committed to reducing its GHG emissions by 42%, with an unconditional[71] reduction target of 17% by 2030. Algeria committed to reducing energy consumption by 9% and deriving 27% of all electricity production from renewable sources. It aims to produce 27% of its electricity from renewable resources by 2035, the majority of which will originate from solar power. Tunisia declared its intentions to reduce its carbon intensity by 41% from 2010 levels and adopt renewable energy sources to power desalination plants in addition to using more efficient desalination techniques (OME 2022). Finally, Egypt committed to reducing its energy intensities and promoting low-carbon technologies in addition to decreasing all sources of emissions. In the NDCs which was updated in 2022, Egypt's mitigation targets include a 33% reduction in GHGs compared to a business-as-usual scenario in 2030. Furthermore, it plans to increase its commitment to renewable energy, while reducing coal capacity and replacing inefficient thermal power plants and promoting large and small-scale decentralised renewable energy systems.

The EU, in its initial and binding NDC, has targeted an economy-wide net reduction of at least 55% of GHG emissions from base year values, without contributions from international credits. Considering the implications of COVID-19 on its economy, a decision was made to deliver at least the reductions pledged in the EU's initial NDC. The efficiency of the EU's final and primary energy consumption will be improved by at least 32.5% by 2030 as compared to an historic baseline. A new target for increasing renewable energy in final energy consumption has been set to reach at least 32% by 2030 (Kulovesi and Oberthür 2020).

Elsewhere in Europe, the Principality of Monaco plans to achieve carbon neutrality by 2050. The pledge is to reduce its GHG emissions by 30% by 2020 and 80% by 2050, compared with the reference year of 1990. Albania intends to reduce CO_2 by only 11.5% by 2030 in the period between

68 https://maritime-spatial-planning.ec.europa.eu/countries/spain

69 The EWEA has rebranded to Wind Europe: https://windeurope.org

70 In accordance with Article 4, paragraph 12 of the Paris Agreement (UNFCCC 2015), NDCs communicated by Parties shall be recorded in a public registry maintained by the UNFCCC secretariat. The registry can be accessed here: https://unfccc.int/NDCREG

71 NDCs can be conditional or unconditional — whether or not they depend on international financing and support.

Table 5.2 | Current and future energy policies in the Mediterranean.

Current energy situation	Projected policies
76% originates from fossil fuel, 12% from renewables (OME 2022).	A significant energy transformation is required to reach carbon neutrality by 2050. The energy fuel mix must reach the following targets: 57% renewables, 17% nuclear, and 26% fossil (out of which 23% is gas) (OME 2022).
Wind energy is gaining popularity. For example, Italy inaugurated a farm with 30 MW that can power 21,000 homes (Plan Bleu 2022c).	More wind energy projects are planned. For example, by 2028, a 750 MW wind farm in Sicily, Italy, with the ability to power 750,000 homes. Similar plans are underway for the Gulf of Lion, France. By 2050, wind energy capacity could reach 460 GW (Plan Bleu 2022c).
The Mediterranean Sea does not provide a high wave energy resource. The highest average wave power within the region reaches 6 kW m^{-1} (Piante and Ody 2015).	Tidal energy potential is constrained due to limitations in wave power. It is still expensive, and technological developments are limited (Piante and Ody 2015).

2016 and 2030. This translates into a 708-tonne reduction of CO_2 emissions by 2030. The country plans to increase the share of renewable energy use (in gross final energy consumption) to 42% by 2030 (IRENA 2021a).[72] Bosnia and Herzegovina set an unconditional GHG emissions reduction target for 2030 of 33.2% and a conditional target (with more intensive international assistance for the decarbonisation of mining areas) of 36.8% relative to 1990 by 2030. The GHG emissions reduction target for 2050 is 61.7% (unconditional) and 65.6% (conditional) compared to 1990.[73] Finally, Montenegro committed to an economy-wide GHG emissions reduction target of 35% by 2030 compared to base year (1990) emissions, excluding Land Use, Land-Use Change and Forestry (LULUCF).[74]

In the Middle East, Türkiye's leading mitigation policies in the energy sector for 2030 include reaching 33 GW of solar, 18 GW of wind, 35 GW of hydroelectric, and 4.8 GW of nuclear-installed power capacity, and to increase renewable energy sources overall in primary energy consumption to 20.4% by 2030. Moreover, the plan intends to reduce losses from electricity transmission and distribution to 15% by 2030. Lebanon intends to reduce emissions and increase renewable energy use by 15% each and improve energy-efficiency levels by 3% by 2030, conditional on financing. Syria pledged to reduce dependence on fossil fuels and intends to increase renewable energy use to 10% by 2030. As per 2012, Syria had an installed renewable energy capacity of 0.84 MW of solar PV panels and 1505 MW of hydro power but

72 Albania intends to sell carbon credits during the period until 2030 to contribute to cost-effective implementation of the low emission development pathway and its sustainable development.

73 See also: https://climatepromise.undp.org/what-we-do/where-we-work/bosnia-and-herzegovina

74 See also: https://climatepromise.undp.org/what-we-do/where-we-work/montenegro

projected to increase PV panels to 1750 MW and wind energy to 2000 MW by 2030. Other forms of renewable energy include the increase of biomass sources to 400 MW by 2030 (IRENA 2014).

Israel committed to an economy-wide unconditional target of reducing its emissions by 26% below 2005 levels, through energy efficiency (17% reduction in electricity consumption) and use of renewable energy (17% of the electricity generated) in 2030.[75] Furthermore, it committed to a 30% reduction of greenhouse gas emissions from electricity generation by 2030 and 85% by 2050 compared to emissions measured in 2015. The information is summarised in *Table 5.3.*

The transition to resilient energy efficient pathways requires a significant transformation of energy policies and economic models in Mediterranean countries (Feleki and Moussiopoulos 2021). While the NMCs have the resources and facilities to make the leap towards the transition, some of the SEMCs need support, knowledge transfer, funding and capacity-building programmes *(high confidence).*

5.2.3 Co-benefits and costs of mitigation and adaptation

Mitigation of and adaptation to environmental pollution and climate change impacts, while not without cost or residual damage, may substantially reduce the adverse risks, and/or enhance co-benefits to possibly spill over to societal well-being (Smit et al. 2001). According to Deng et al. (2017), the co-benefits from GHG mitigation that have received the most attention in the literature include impacts on ecosystems, economic activity, health, air pollution, and resource efficiency, whereas those receiving the least attention include impacts on conflict and disaster resilience, poverty alleviation (or exacerbation), energy security, technological spillovers and innovation, and food security.

Renewable energy sources, such as solar power and wind farms, while usually viewed as benign and sustainable alternatives to fossil fuels, may not be trouble free. The replacement rate of solar panels is faster than expected and given the current high recycling costs, there's a real danger that all used panels will go straight to landfill. The International Renewable Energy Agency predicts that 'large amounts of annual waste are anticipated by the early 2030s' and could total 78 million tonnes by the year 2050 (IRENA and IEA-PVPS 2018).

The construction of offshore wind farms may introduce or add pollutants (synthetic and non-synthetic compounds) to the sea. This is, in addition to the disruption it may cause during the construction phase. The environmental effects of offshore wind farms in the Mediterranean are poorly studied (Bray et al. 2016; Lloret et al. 2022) *(medium confidence).* Since the Mediterranean is a semi-closed sea with particular characteristics including minimal tidal ranges, high levels of biodiversity and endemism (Coll et al. 2010), and a high potential of non-indigenous species invasion (e.g. Kourantidou et al. 2021), the effects of existing offshore wind farms may not be directly applicable to the Mediterranean, highlighting the urgent need for site-specific analyses (Bray et al. 2016; Lloret et al. 2022) *(medium confidence).* In detail, the Mediterranean Sea hosts endemic seabird species for which there have yet to be any impact assessments. It is also a major and crucial transit route for Saharan-Eurasian bird migration, as evidenced by both the Mediterranean-Black Sea flyway and the Adriatic flyway (Bray et al. 2016) *(high confidence).* Wind farms affect resident and migrating birds, through avoidance behaviours, habitat displacement, and collision mortality (e.g. Dierschke et al., 2016). Considering marine mammals, both resident and visiting species, of which most are experiencing a decline in population trends, occur in the Mediterranean Sea. The principal negative impacts on marine mammals and fish populations caused by wind farms are noise and electro-magnetic fields. Although research has indicated that some species of seabirds strongly and consistently avoid offshore wind farms, thus minimising impacts and possible effects on the bird population, other species (mostly cormorant)

75 https://www.gov.il/en/pages/reducing_greenhouse_gases_increasing_energy_efficiency

Table 5.3 | Commitments of selected Mediterranean countries to reduce GHG emissions. Source: UNFCCC 2023, https://unfccc.int/NDCREG.

Country	Targets	Additional comments
1. Albania[A]	↓ CO_2 by 11.5% by 2030 compared to the baseline scenario starting in 2016. This amounts to a 708 kt reduction of CO_2 emissions.	Fossil fuels, mainly crude oil, generate between 46 and 68% of energy while hydropower is the largest energy contributor with a share ranging between 20 and almost 40% (depending on the annual rainfall). The country is endowed with abundant renewable energy potential.
2. Algeria[B]	↓ Energy consumption by 9% by 2030 while 27% of energy is derived from renewable sources.	Strategic partnerships are being sought by the government in the field of renewable energy with multiple countries including foreign suppliers of technological services.
3. Bosnia and Herzegovina[C]	↓ GHG emissions by 12.8% relative to 2014 (unconditional) and 33.2% relative to 1990 (conditional) by 2030.	Plans to install mini hydro power plants, wind farms, and photovoltaic modules with a total energy generation capacity of 120 MW, 175 MW, and 4 MW respectively, by 2030.
4. Croatia[D]	↑ Share of renewable energy to 36.4% by 2030.	Forms part of the EU binding[E] climate and energy target for 2030 to reduce GHG emissions by at least 40%, increase energy efficiency by 32.5%, increase the share of renewable energy to at least 32% of EU energy and guarantee at least 15% electricity interconnection levels between neighbouring countries.
5. Cyprus[F]	↓ Emissions in sectors not covered by the EU Emissions Trading System (non-EU ETS) by 24% compared to 2005. Renewable energy share is set at 19% of gross final energy consumption of energy in 2030.	Forms part of the EU binding climate and energy target.[E]
6. Egypt[G]	↓ Emissions by 33% in the electricity sector, 65% in the oil and gas sector, and 7% in the transportation sector by 2030.	Installation of renewable energy to generate 42% of electricity by 2035.
7. France[H]	↓ GHG emissions by 36% by 2030. Aims to be carbon neutral by 2050.	Forms part of the EU binding climate and energy target.[E]
8. Greece[I]	↓ Non-EU ETS emissions by 14% compared to 2005 ↑ The share of renewable energy to 31% by 2030.	Forms part of the EU binding climate and energy target.[E]

A See also: https://climatepromise.undp.org/what-we-do/where-we-work/montenegro

B See also: OME 2022

C See also: IRENA 2023

D See also: https://energy.ec.europa.eu/system/files/2019-06/necp_factsheet_hr_final_0.pdf

E See also: https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2030-climate-targets_en

F See also: https://energy.ec.europa.eu/system/files/2019-06/necp_factsheet_cy_final_0.pdf

G See also: https://climatepromise.undp.org/what-we-do/where-we-work/egypt

H See also: https://energy.ec.europa.eu/system/files/2019-06/necp_factsheet_fr_final_0.pdf

I See also: https://energy.ec.europa.eu/system/files/2019-06/necp_factsheet_el_final_0.pdf

Country	Targets	Additional comments
9. Italy[J]	↓ GHG emissions by 33% by 2030.	Forms part of the EU binding climate and energy target.[E]
10. Israël[K]	↓ GHG emissions by 26% below the 2005 emissions level by 2030.	To be achieved by improving energy efficiency (17% reduction in electricity consumption) and use of renewable energy (17% of the electricity generated) by 2030.
11. Jordan	↓ GHG emissions by 31% by 2030 as compared to BAU scenario in 2012.	Renewable energy to contribute by 35% by 2030 and improve energy efficient consumption by 9% in all sectors.
12. Lebanon	↓ unconditional and conditional GHG emissions by 20 and 31% compared to 2012 BAU scenario in 2030. ↑ use of renewable energy by 15%.	Improve energy-efficiency levels by 3%.
13. Libya[L]	n/a	Signed the UNFCCC agreement in 2015 but no requisite policies were submitted.
14. Monaco[M]	Carbon neutrality by 2050.	Reduce GHG emissions by 30% by 2020 and 80% by 2050, compared to base year.
15. Montenegro[N]	↓ 35% of GHG emissions by 2030.	UNDP notes that the revised NDC does not specify the adaptation measures.
16. Morocco	↓ 45% GHG emissions by 2030 ↑ 52% of ts installed electricity capacity from renewable sources by 2030.	17% to be unconditionally reduced by 2030.
17. Palestine (State of)	↓ GHG emissions by 26% by 2040 (conditional).	Improve energy efficiency by 20% (business as usual) across all sectors by 2035.
18. Portugal	↓ GHG emissions by 17% as compared to 2005. ↑ Renewable energy to 42% of national gross consumption of energy.	Forms part of the EU binding climate and energy target.[E]
19. Slovenia[O]	↓ GHG emissions by 15% as compared to 2005.	Forms part of the EU binding climate and energy target.[E]
20. Spain[P]	↓ GHG emissions by 26% compared to 2005 levels. ↑ Energy from renewable sources to 35% by 2030.	Forms part of the EU binding climate and energy target.[E]

E See also: https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2030-climate-targets_en

J See also: https://energy.ec.europa.eu/system/files/2019-06/necp_factsheet_it_final_0.pdf

K https://www.gov.il/en/pages/reducing_greenhouse_gases_increasing_energy_efficiency

L See also: https://www.undp.org/libya/environment-and-climate-change

M See also: https://en.gouv.mc/Policy-Practice/The-Environment/The-Climate-and-Energy-Plan-in-the-town

N See also: https://climatepromise.undp.org/what-we-do/where-we-work/bosnia-and-herzegovina

O See also: https://energy.ec.europa.eu/system/files/2019-06/necp_factsheet_si_final_0.pdf

P See also: https://energy.ec.europa.eu/system/files/2019-06/necp_factsheet_es_final_0.pdf

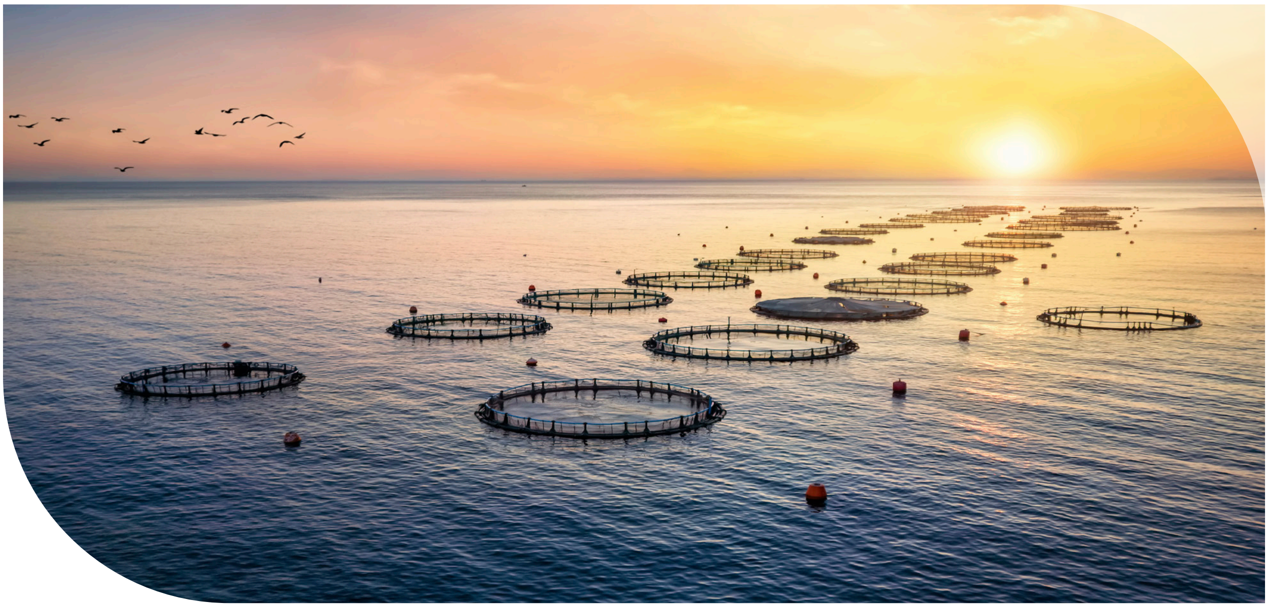
Country	Targets	Additional comments
21. Syria[Q]	↓ Dependence on fossil fuels. ↑ Renewable energy use to 10% by 2030.	Renewable energy target focused on PV panels, wind and biomass.
22. Tunisia	↓ GHG emissions by 41% below 2010 levels by 2030 (27% unconditional).	Modernise desalination plants with renewable energy.
23. Türkiye	↓ GHG emissions by 41% by 2030 compared to BAU scenario. This is double the previous target of 21%.	10 GW derived from solar power, 16 GW from wind power, the remaining from nuclear and hydroelectric power. Reduce losses from electricity transmission and distribution to 15% by 2030.

tend to be more negatively impacted by such wind farms (Dierschke et al. 2016), calling for further investigation in the Mediterranean (Bray et al. 2016; Lloret et al. 2022) *(medium confidence).* Some studies argue that offshore wind farms could be beneficial for benthic habitats and animals, because they offer an artificial reef that may provide space for settlement, shelter and foraging (e.g. Mavraki et al. 2020). This apparent benefit should be carefully assessed in the case of the Mediterranean Sea, due to its high habitat heterogeneity. On the one side, long-term effects of ecosystem shifts are unknown; on the other side, the creation of new and artificial substrates favours colonisation by opportunistic species and the arrival of non-indigenous species that can alter the local biodiversity balance (Lloret et al. 2022) *(medium confidence).* All this considered, systematic scientific information on the risk of each potential interaction between offshore wind farms and different ecosystem elements is needed to inform managers and decision-makers during offshore wind farm planning in order to minimise adverse effects and adopt mitigation measures (Galparsoro et al. 2022) *(high confidence).*

While mitigation efforts are important, enhancement of adaptive capacity is a necessary condition for reducing vulnerability, especially for the most vulnerable regions and socio-economic groups. Activities that usually improve adaptive capacity also promote sustainable development *(high confidence).* In coastal zones, improving adaptive capacity may require a wide array of measures including planting salt-tolerant varieties of vegetation, establishing agricultural practices that are more resistant to flooding (Maggio et al. 2011), developing desalination techniques, establishing mechanisms for disaster response, and empowering communities to build resilience to extreme events (Iglesias et al. 2018), etc.

Pollution reduction (mainly water pollution from wastewater and urban runoff) improves human health (waterborne diseases, food poisoning from chemical discharges and contaminated fish consumption) (Analitis et al. 2008), development of sustainable energy systems for both use in industrial production and consumption (renewable energy production and use) (Pisacane et al. 2018; Kougias et al. 2019), employing less-intensive industrial fishing practices (Giordano et al. 2019), although these must be appropriately regulated for environmental recovery programmes in order to be effective and not damage marine ecosystems (Enrichetti et al. 2019) *(high confidence).* Maritime emissions from ships (especially sulfur oxides (Sox), particulate matter (PM), nitrogen Oxides (Nox)) in the Mediterranean Sea area are a serious threat to public health and the economy. Action to address these risks by reducing maritime emissions can yield health benefits that outweigh the costs to the maritime shipping sector by a wide margin (on average, by a factor of 7 in 2030 and by a factor of 12 in 2050; Cofala et al. 2018), especially when also taking into account the co-benefits of various climate policies.

Q See also: IRENA 2014



Mitigation and adaptation efforts will potentially affect the availability and prices of energy, food (fisheries, aquaculture), and other ecosystem-intensive services (tourism) (*medium* to *high confidence*). Sustainable development pathways will require social mobilisation and necessary investments in capacity-building to avoid exclusion, and protection of the interests and rights of people vulnerable to the impacts of climate change and of future generations (UNEP 2019).

Boyd et al. (2022) argue that the alignment of adaptation and development goals is a more common aim than the alignment of adaptation and mitigation. They therefore advocate creating incentives to meet multiple policy priorities, reduce costs, and increase resource efficiency and institute co-benefit approaches that cover adaptation, mitigation, and development goals.

Although climate change adaptation has been identified as an essential policy response (Eriksen et al. 2011), it has received less attention when compared to mitigation in terms of legislative and funding initiatives (Sietsma et al. 2021). In the Mediterranean region, especially in its coastal areas, climate change adaptation can play a central role to support the resilience of ecosystems to climate risks (Aurelle et al. 2022). Furthermore, the vast traditional ecological knowledge heritage present in the Mediterranean can be used for adaptation, promoting for instance, more agroforestry practices that would improve livelihoods while adapting to climate change (Aguilera et al. 2020) *(high confidence).* Within the combination of solutions to foster climate change adaptation there is also the prevention, or removal of settlements, infrastructure and assets in areas affected by SLR/erosion/storms, which can reduce risks in the first place, but also be a more cost-effective solution in the long-term (Siders et al. 2021) *(medium confidence).* As such, the long-term, potentially transformative option of managed retreat must be considered for some areas and for specific sectors, including agriculture (Fraga et al. 2020) *(medium confidence).* This can indeed be challenging in regions where inland areas face desertification and other compound risks (wildfires, floods, etc.) but with the appropriate planning can be a sustainable solution (Siders et al. 2021) *(medium confidence).*

While it is relevant to understand the relative importance of different kinds of actions (mitigation and adaptation), it also essential to understand the potential positive and negative synergies between them. A proper assessment of outcomes would require that policymakers conduct a cost-benefit analysis complemented by an analysis of distributional effects to prioritise adaptation programmes as well as other development programmes to promote an efficient and just transition to climate change (Bellon and Massetti 2022) *(high confidence).*

Box 5.1

Capacity-building and knowledge transfer for sustainable development

Capacity-building is an essential catalyst to sustainable development and human welfare on the planet and is essential for enabling all countries to benefit from all-natural resources and conserve their future. Capacity-Building is an important part of the means to implement the Sustainable Development Goals (UN General Assembly 2015, para. 41). Each of the SDGs contains targets related to the means of implementation, including capacity-building. For example, SDG 17, which covers the means of implementation and the global partnership for sustainable development, contains Goal 17.9 which aims to strengthen international support for the implementation of effective and targeted capacity-building in developing countries to support national plans to implement all development goals, including through North-South cooperation, South-South cooperation and triangular cooperation.

What does capacity-building mean? How best to define it?

Capacity-building (or capacity development, or capacity strengthening) is the improvement of an individual, organisation, or country's ability to produce, perform, or deploy. The terms capacity-building and capacity development are often used interchangeably. The Organisation for Economic Co-operation and Development (OECD) stated that capacity development is the preferred term (OECD-DAC 2006).

The general definition of capacity development is as follows: 'Capacity development is a transformative approach that enables individuals, leaders, organisations and societies to acquire, strengthen and maintain capabilities to set and achieve their own development goals over time.' Simply put, if capacity is the means to plan and accomplish, then capacity development describes the methods of those means. Capacity development refers not only to the acquisition of new knowledge and skills, but also above all to the change of values and behavioural patterns (UNDP 2015).

Capacity-building is one of the boundless terms most often used to describe the distance between developed and developing countries. It is very rich and complex and is undoubtedly a prerequisite for saving our planet. However, it is usually underestimated and implemented in an inefficient and traditional 'business-as-usual' scenario.

Historical context

Capacity-building has long been recognised as one of the means of implementation for achieving sustainable development action plans and development strategies. Agenda 21, adopted at the 1992 United Nations Conference on Environment and Development[76], addresses capacity-building in its Chapter 37 (UN 1992). Decisions relating to capacity-building were taken by the United Nations Commission on Sustainable Development at its fourth (1996), fifth (1997) and sixth (1998) sessions and by the United Nations General Assembly at its Special Session to review the implementation of Agenda 21[77] (1997).

The Johannesburg Plan of Implementation (JPOI), adopted at the 2002 World Summit on Sustainable Development[78] also recognised the importance of capacity-building for the achievement of sustainable development. Similarly, the outcome document of the Rio +20 Conference, the Future We Want, emphasised the need for enhanced capacity-building for sustainable development and for strengthening technical and scientific cooperation (UN 2012). Capacity development is also recognised as a key issue in the 2014 SAMOA Pathway[79] for a wide range of areas, such as climate change, sustainable energy, ocean sustainability, management of chemicals and waste, as well as financing.

UNDP integrates this capacity-building system into its work on achieving the Millennium Development Goals (MDGs). It focuses on building capacity at the institutional level because it believes that 'institutions are at the heart of human development, and that when they are able to perform better, sustain that performance over time, and manage 'shocks' to the system, they can contribute more meaningfully to the achievement of national human development goals.' (UNDP 2015).

In the context of restoration and conservation of the world's oceans and coasts; the UN Ocean Decade for sustainable Development (2021–2030) Implementation Plan (IP) recognises capacity development as an essential tenet to achieving evenly distributed capacity across the

76 https://www.un.org/en/conferences/environment/rio1992

77 https://www.un.org/en/conferences/environment/newyork1997

78 https://www.un.org/en/conferences/environment/johannesburg2002

79 https://www.un.org/ohrlls/content/samoa-pathway

globe, across generations, and across genders and thus reversing asymmetry in knowledge, skills and access to technology (UNESCO-IOC 2021).

Capacity-building as a transformative system for the world's climate-environment risk management

One of the most pressing challenges in the world is coastal urbanisation, impacting the well-being of ecosystems, with climate change exacerbating this process, thus the need for advanced knowledge and capacities to deal with coastal inundation, coastal pollution, and multi-hazards. Ocean acidification and climate change caused by ocean absorption of anthropogenic carbon dioxide from the atmosphere, and acidification of ocean surface waters, mostly due to carbon dioxide emissions, can severely threaten the existence of various marine species. Since the mid-19th century, sea level has risen as a result of human-induced climate change. A number of coastal cities and coastal resources are becoming heavily impacted by sea level change.

Within the Mediterranean Sea, national, regional, and international entities have launched many effective initiatives for global coastal observation, prediction, and scientific capacity development for the decade. However, beyond scientific capacity development, it is crucial to create new awareness at the policy and civil society level, identify alternative solutions, reduce fragmentation, and facilitate cooperation between countries. The effective use of unprecedented achievements in capacity development, is indispensable to ensuring that growing development demands, and a sustainable healthy ocean coexist in harmony.

5.3 Sustainable pathways and significant targets across SDGs

This section briefly introduces the SDGs and discusses current efforts to achieve their targets, including a focus on sustainability pathways in the Mediterranean Basin. It also highlights the impacts of sustainability measures on a range of different sectors, especially those that most significantly impact climate change in the context of coastal communities. It will continue by discussing short-term (2021–2040), versus medium-term (2041–2060) and long-term (2061–2100) efforts to achieve sustainability pathways and how the trade-offs between different SDG targets can potentially lead to favourable transition for new sustainable pathways. This section will also discuss how policies, data, technology and communication can act as catalysts for effective and long-lasting development pathways.

In 2015, 17 SDGs were adopted by all UN member states. Also known as Global Goals, the SDGs aim to provide a universal call to end poverty, protect the planet and ensure that by 2030 all people are on the path to enjoy peace and prosperity. Each SDG has a set of indicators, some of which are multipurpose and are used to monitor more than one SDG, and more than one of the three pillars of sustainable development.

For the first time since the adoption of the SDGs, the average score for the 2020 Global Sustainable Development Goals Index has fallen from the previous year, affecting all three dimensions of sustainability. The COVID-19 pandemic, a growing population, and other crises have clearly been major setbacks for attaining sustainable development (Sachs et al. 2020). In 2021, the negative impacts brought by the COVID-19 pandemic, especially in the area of reduced connectivity and economic activities, continued to be a major factor contributing to high rates of poverty and unemployment, which prompted an overall decline in the performance of the sustainable development goals at the global level (Shulla et al. 2021). The economic and financial shocks associated with COVID-19 also impacted the funding for sustainability, making it more difficult and undermining the general approach toward achieving the 17 SDGs by the established 2030 deadlines, therefore slowing down the set trajectory of development (*medium* to *high confidence*). The overarching aim of 'leave no one behind' is threatened by the current growing inequalities (Shulla et al. 2021). A lack of resources, especially in funding, ought to prompt a need for interdisciplinary thinking systems, allowing key policies, such as trade and technological innovation, to support the attainment of the sustainable development goals (Sachs et al. 2022).

Mediterranean countries have the potential to mitigate climate change and contribute to the achievement of other SDGs through the proper conservation and restoration of blue carbon ecosystems such as coastal wetlands (e.g. coastal lagoons, seagrass meadows and salt marshes; see for instance Eid et al. 2017), but also of coastal terrestrial ecosystems (Filho et al. 2020), including coastal dunes (Drius et al. 2019). These coastal ecosystems are important and contribute to the well-being of people and nature by providing good-quality water, acting as a barrier to the negative effects of extreme climate events, contributing to food production, and by preserving biodiversity (Spalding et al. 2014; Aurelle et al. 2022). The carbon sequestration capacity of coastal wetlands is about 10 times that of terrestrial ecosystems (Mcleod et al. 2011). *Posidonia oceanica,* endemic to the Mediterranean Sea and sometimes referred to as 'the lungs of the Mediterranean', is the most widespread seagrass species in these waters *(high confidence).* It has a significant role as a carbon sink, absorbing carbon dioxide, storing carbon at an average rate of 83g C m^{-2} per year, and helping to alleviate the effects of climate change. It covers between 25,000 and 50,000 km^2 of coastal areas, corresponding to 25% of the sea bottom at depths of 0 to 40 m. As a co-benefit, the high levels of primary production contribute to the oxygenation of the water column (Koopmans et al. 2020; Hendriks et al. 2022). The *Posidonia* population, listed on the IUCN Red List of Threatened species[80], has been declining at the rate of approximately 10% over the last 100 years, with recent estimates of over 30% in the past 50 years, in many parts of the Mediterranean, due to pollution, coastal development, fishing activities, the mooring of ships (Boudouresque et al. 2009; Telesca et al. 2015), and climate change (Chefaoui et al. 2018). Proper valuation and pricing of Mediterranean blue carbon ecosystems that primarily include seagrasses and salt marshes could allow conservation and restoration initiatives that may foster sustainable development (Bertram et al. 2021).

Mediterranean countries do not seem to be on the right track to achieve most of the SDGs (Sachs et al. 2022). They appear to be performing well for some of the SDGs, such as eradicating poverty (SDG 1), promoting good health and well-being (SDG 3), and quality education (SDG 4). However, they score poorly and underperform quite alarmingly in areas such as biodiversity protection, including life underwater (SDG 14) and life on land (SDG 15), and climate change (SDG 13); social integration, including gender equality (SDG 5) and reduced inequalities (SDG 10). The Mediterranean region is the second most vulnerable to climate change after the Arctic (MedECC 2020a), broadly connected to political, economic, social and environmental imbalances, also exacerbated by differences across geographical regions, which can grow even bigger due to the negative impacts of climate change in the region. Current regional and cross-country partnerships can favour the uptake of sustainable development initiatives in the Mediterranean, including measures supported by the EU, the Union for the Mediterranean (UfM), the United Nations Environmental / Programme Mediterranean Action Plan (UNEP/MAP), among others, in the spirit of SDG 17 (Partnership for the goals), to foster sustainable pathways. There is *robust evidence* that current development pathways are leading away from sustainable development (IPCC 2022b; Schipper et al. 2022) *(high confidence).*

5.3.1 Determining the pathways to sustainability for major sectors

It is well known that climate change impacts reduce the ability of countries to achieve sustainable development (UN General Assembly 2015) and that these impacts can take away improvements in living conditions and decades of progress on development pathways. For instance, dangerous levels of climate change are likely to limit efforts in reducing poverty, as its negative impacts are more severely felt by low-income and vulnerable people, especially because of their high dependence on natural resources, which are becoming scarcer and less accessible, and the

80 https://www.iucnredlist.org/species/153534/135156882

limited capacity of low-income and vulnerable groups to properly cope with climate variability and extremes (Hallegatte and Rozenberg 2017) *(high confidence).*

The adoption of the Paris Agreement and the 2030 Agenda demonstrated a growing international consensus to pursue the fight against climate change as a key component of the broader objective to achieve sustainable development (UNFCCC 2015; UN General Assembly 2015). For example, increased levels of warming may narrow the choices and options for sustainable development. However, it is important to remember that the Paris Agreement is not static; it is designed to enhance the national efforts of countries over time, which means that current commitments only represent the basis of climate change ambitions. To this end, the largest reduction in GHG emissions is scheduled to happen by 2030 and 2050, and the agreement should provide the tools and innovative approaches to make it happen (NRDC 2021). Furthermore, as reported by the IPCC Working Group II (WGII) contribution to the Sixth Assessment Report (AR6) (IPCC 2022), recent studies assessing the links between development and climate risk shows that actions taken to achieve the goals of the Paris Agreement could undermine progress toward some of the SDGs. Effective sustainable development pathways in this regard are also those that consider the impact of any mitigation and adaptation measures on marginalised and vulnerable people (Hickel 2017). Although considerations of social difference and access to justice might be included in some of those measures, the assumption that economic growth increases opportunities for all, and distributes the newly created financial resources equally, might not be correct, coupled with climate change impacts affecting the most vulnerable sectors of society more disproportionately (Diffenbaugh and Burke 2019) *(medium confidence).*

Achieving the SDGs and consolidating the shift to sustainable development pathways is still possible by the deadline of 2030 if a more ambitious climate policy, international climate finance, gradual redistribution of carbon pricing dividends, technological progress, less resource-intensive

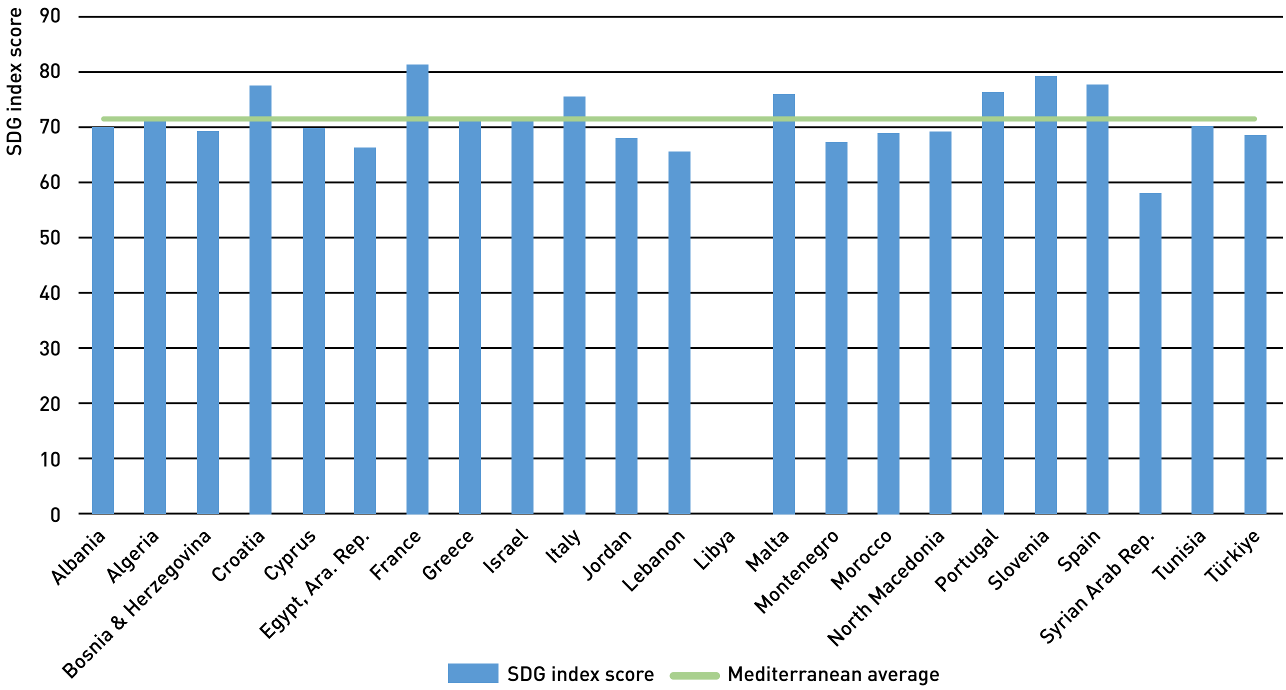


Figure 5.1 | Mediterranean SDG index score. The SDG Index tracks country performance on the 17 SDGs as agreed by the international community in 2015. All 17 goals are weighted equally in the Index. The score signifies a country's position between the worst (0) and the best or target (100) outcomes. The Mediterranean region has an average index score of 71.6 (green bar), hypothetically corresponding to the 49th position of the world rank. Source: Sachs et al. (2019b).

lifestyles, and improved access to modern energy are undertaken in the short-term (2021–2040), as also shown by *Figure 5.1* (Soergel et al. 2021) *(low confidence).*

In 2019, the Sustainable Development Solutions Network published a report which focused on the performance of 23 Mediterranean countries with regards to the SDGs. The report states that the average SDG index for the region reached 71.6 which corresponds to the 49th position in the world rank, and therefore, almost 72% away from the best possible outcomes across the 17 SDGs. The countries registering the most progress with most SDGs are NMCs. Good progress was also made by most Mediterranean countries in the provision of basic services and infrastructure, particularly under SDG 1 (no poverty), SDG 3 (good health and well-being), SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy) and partially in SDG 8 (decent work and economic growth). However, the report points out that even the countries topping the list are far from achieving the highest score of 100 (Sachs et al. 2019b).

5.3.1.1 Pathways for sustainable energy and climate mitigation

Mediterranean countries have a very different mix of energy sources; while most countries are net energy importers others are net energy exporters. These differences complicate envisioning a common pathway for sustainable energy and climate mitigation in the Mediterranean, and even planning observations that can be applied to the region as a whole *(medium confidence).* It is undeniable that the Mediterranean region would benefit from sustainable energy and climate mitigation pathways, since energy and climate issues are at the forefront in the Mediterranean region. Fostering a sustainable and future-proof socio-economic development model based on sustainable low carbon energy and climate mitigation pathways is also an essential component of regional stability (Antonelli et al. 2021) *(medium confidence).*

The EU Green Deal has been framed as a broad political vision that summarises the EU's energy, climate, economic and geopolitical goals of achieving climate neutrality by 2050, supporting measures to reduce the carbon footprint of hydrocarbon production and energy efficiency (EC Secretariat-General 2019). Hydrogen can be a key enabler of Mediterranean decarbonisation intentions, as there is unprecedented momentum for capital-intensive hydrogen projects, including across the Mediterranean *(low confidence).* Accordingly, when promoting green energy and climate mitigation pathways in the region, preference will likely go to low-carbon projects that will in fact contribute to reducing global warming and achieving socio-economic goals in the region, compared to other solutions. They also appear to be future-proof, consistent with net zero targets by mid-century (Antonelli et al. 2021) *(medium confidence).*

All Mediterranean governments must implement clear action plans to close the electricity access gap, backed by determined leadership, increased investments and targeted policies and regulations. Multi-stakeholder partnerships and scaling up to support investments in clean energy across all sectors of the industries introducing the transition to clean energy is essential for reaching the net zero goal by 2050 (Sachs et al. 2019b).

SEMCs have natural resources that provide opportunities for low-carbon energy production. However, the share of renewable energies in total energy consumption remains low because of widespread fossil fuel subsidies, regulatory restrictions, and limited electrical connectivity *(high confidence).* Clean energy still accounts for a relatively small share of North-South trade. In this context, SEMCs may use green and blue hydrogen as crucial elements of their decarbonisation strategy, such as the initiatives of countries like Egypt, Morocco, and Tunisia, which have recently signed bilateral agreements with Germany for green hydrogen projects *(Figure 5.2)* (Moreno-Dodson et al. 2021).

5.3.1.2 Pathways for sustainable coastal tourism

The Mediterranean attracts about one third of global tourism and it was the main tourist destination in 2019 (Plan Bleu 2022b). Coastal tourism worldwide is likely to reach 26% of the total ocean industry added-value in 2030, becoming the largest blue economy sector (OECD 2016) *(high confidence).* At the same time, this type

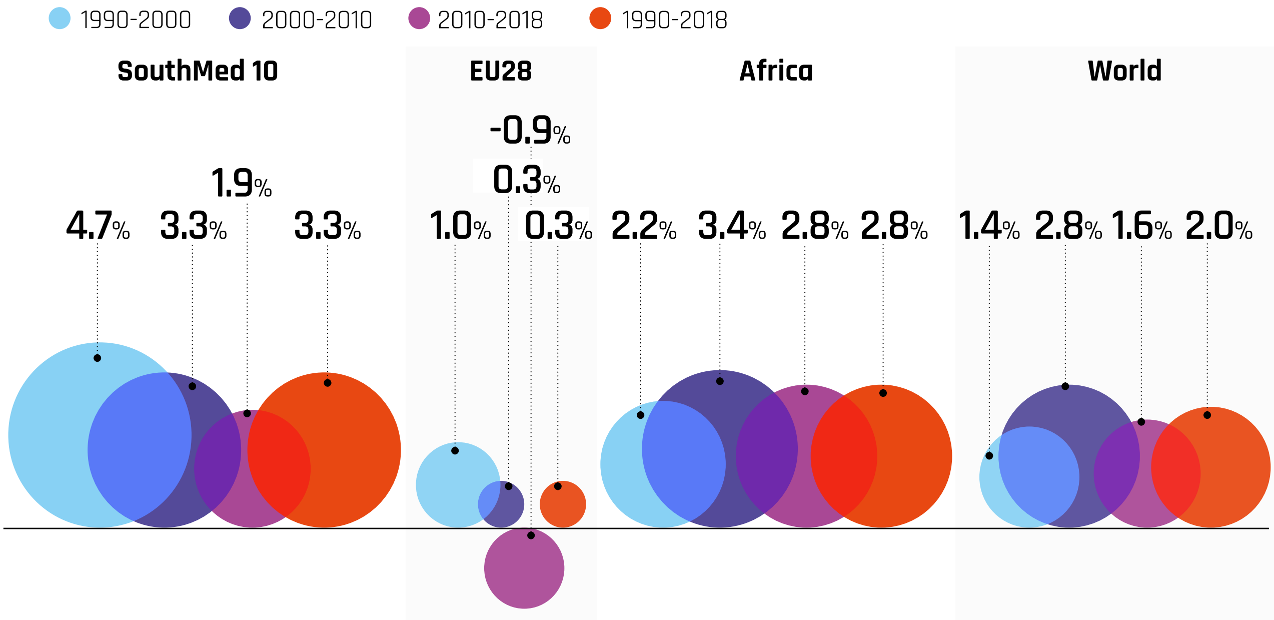


Figure 5.2 | Primary Energy Consumption, annual average growth rates, southern/eastern Mediterranean and other regions. Source: Moreno-Dodson et al. (2021).

of tourism is among the sectors most impacted by climate change, especially in the Mediterranean Basin (Bocci et al. 2018; Tonazzini et al. 2019). Climate change has a significant impact on coastal ecosystems, as it modifies both weather conditions and hydrodynamic processes (e.g. sea level rise, water scarcity, coastal erosion, increase in storm surges, increase in frequency and height of tides). Major climate change impacts affecting Mediterranean tourism destinations include water scarcity, warmer summers, climate instability, marine and coastal biodiversity loss, and increases in disease outbreaks (Simpson et al. 2008; Magnan et al. 2013; MedECC 2020b). These impacts, although not yet perceived as relevant, are going to worsen in the medium- and long-term future (Bocci et al. 2018) *(medium confidence).*

Climate and weather, as well as safety, are important factors in tourists' decision-making and influence the successful operation of tourism businesses (Gómez Martín 2005; Becken 2010), destination choices and therefore, tourist flows. Islands are particularly vulnerable to the above-mentioned risks because of their strong dependency on the ecosystem services provided directly (e.g. fish and seafood) and indirectly (coastal and maritime tourism) by the sea, together with natural resources and space constraints (Tonazzini et al. 2019). For instance, Mediterranean top tourism destinations such as Malta, Corsica, Balearic Islands, Sicily and Sardinia have been experiencing population congestion and over development in recent decades (Manera et al. 2016; M. Briguglio and Moncada 2020) *(high confidence).*

While NMCs are a rather mature tourism destination, some SEMCs have only recently experienced a significant growth in coastal tourism (e.g. Egypt, Türkiye). One of the consequences of this is that most of the pressures associated with this economic sector tend to be stationary in the NMCs, whereas there are likely to increase in the coming years in SEMCs (Randone et al. 2017; Tonazzini et al. 2019). In addition, some Mediterranean countries (Egypt, Israel, Jordan, Lebanon, and Palestine) are *likely* to be most impacted by climate change in the medium (2030) and long term (2050) (Bocci et al. 2018) *(medium confidence).*

Since Mediterranean coastal tourism causes environmental and social impacts which negatively affect its own existence with a loop effect (Randone et al. 2017; Drius et al. 2019), there is an urgent need to reduce such impacts in the region in order to comply with the SDGs of the 2030 Agenda for Sustainable Development and the Mediterranean Strategy for Sustainable Development 2016–

2025 (MSSD 2016–2025)[81], specifically addressing measures that reduce the impacts of tourism on climate change *(high confidence).* The SDGs explicitly related to coastal tourism are SDG 8 (sustainable economic growth), SDG 12 (sustainable consumption and production) and SDG 14 (ocean and coastal areas conservation) *(medium confidence).*

While there is not yet a definitive consensus on whether with warmer temperature the overall number of tourists will increase (Katircioglu et al. 2019) or decrease (Torres et al. 2021), it is evident that national and regional authorities must implement policies to adapt, for instance, to the *likely* increase in energy and water demand, in addition to actively promoting sustainable practices and actions to reduce energy and water consumption. Increasing attention has been focused on how climate change might impact tourist destinations (Wall and Badke 1994) and how they might adapt to minimise risks and maximise opportunities (Becken and Hay 2007a). These challenges could be addressed by providing credible, comprehensible, diverse, and replicable alternative tourism models (Randone et al. 2017) *(high confidence).* One example in this sense is ecotourism, a sustainable alternative to traditional tourism practices in coastal and maritime areas, which promotes local communities and the conservation of natural resources. This type of tourism is increasing in popularity even in the conventional tourism market (chain hotels, large resorts, premium cruise ships) (Tonazzini et al. 2019). Sustainable tourism models are also encouraged by various international organisations (e.g. UfM) and programmes (e.g. Interreg MED Community 'Sustainable tourism' financed by the EU)[82] Very recently, the Glasgow declaration for climate action in tourism has been receiving attention from public and private organisations who commit to implement a series of actions to cut tourism emissions (One Planet Sustainable Tourism Programme 2021) *(medium confidence).*

An additional pathway to coastal tourism sustainability could be a set of policy tools that national and local governments can use to facilitate sustainable tourism. These range from green taxes, directed to penalise practices that are harmful to the environment, to sustainable tourism indicators and eco-labelling tourism schemes (Randone et al. 2017) *(high confidence).* Many Mediterranean countries have developed their own Integrated Coastal Zone Management (ICZM) — a multidisciplinary and iterative process to promote sustainable management of coastal zones. Morocco, for instance, has put in place a series of measures to tackle coastal erosion, which have implications on tourism-related infrastructure, such as reducing the removal of beach sand and riverbed aggregates to be used as building materials; restricting the urbanisation of the coasts; introducing beach monitoring programmes, protection and regeneration of some of the remaining dunes; and strengthening of watershed erosion protection through replanning of dams (Bocci et al. 2018) *(high confidence).*

5.3.1.3 Pathways for sustainable small-scale fisheries

Small-scale fisheries contribute significantly to the livelihoods and food security of coastal populations along the Mediterranean Sea *(high confidence).* Their contribution is crucially important to the more vulnerable populations, particularly in rural coastal communities. Small-scale fisheries represent over 84% of the total fishing fleet, employ nearly 62% of the total workforce on board fishing vessels, account for 29% of total revenue from marine capture fisheries, and claim 15% of the total catch (FAO 2020). Revenue is distributed disproportionately between small-scale fisheries and industrial fisheries, with significant variation across countries. The contribution of small-scale fisheries to total fishery employment ranges between 70 and 80% in Türkiye, Tunisia, Croatia, France, Slovenia, Lebanon, Greece, and between 25 and 35% in Algeria, Egypt, and Spain (FAO 2020).

Over 80% of the fish stock in the Mediterranean is threatened by overfishing, sometimes at rates six times higher than the maximum sustainable yields practice *(high confidence)*, a practice that is

81 https://www.unep.org/unepmap/what-we-do/mediterranean-strategy-sustainable-development-mssd

82 https://sustainable-tourism.interreg-euro-med.eu

bound to reflect negatively on small-scale fishers. The pathway to sustainable small-scale fisheries would require the meaningful participation of small-scale fishers in the co-management of the sector to minimise the long-term impacts on the fish population and the livelihood of fishing communities. Specific actions to limit overfishing would include promoting best practices to maximise the value of the catch by directing fishing activities towards the catch of selective, high-value products and supporting fishers by creating vertically-integrated distribution channels (Randone et al. 2017). Income diversification, through the creation of alternative job opportunities, would also contribute to the well-being of fishing communities. The Regional Plan of Action for Small-Scale Fisheries in the Mediterranean and the Black Sea (RPOA-SSF) recommends strengthening value chains, improving market access for small-scale fisheries products and increasing the profitability of the sector.[83]

5.3.2 Scenarios and pathways to achieve the Sustainable Development Goals (SDGs)

Sustainable development pathways are part of different scenario frameworks developed by the research community to describe major social, economic, and environmental developments including those achieved through climate change adaptation and mitigation measures. There are multiple possible pathways by which the Mediterranean region can pursue sustainable and climate-resilient development. There is robust evidence that current development pathways are leading away from sustainable development (IPCC 2022) *(high confidence).* On the other hand, pursuing sustainable development goals and climate resilience increases their effectiveness.

5.3.2.1 Best practices and successful case studies in Mediterranean coastal areas

The case of cruising: pathways to sustainability?

Worldwide, the ocean cruise industry is one of the most dynamic segments of the tourism sector, with 31.7 million passengers in 2023 — surpassing pre-pandemic 2019 levels by 7%. The industry is expected to continue this upward trend, with passenger volume projected to exceed 2019 levels by more than 12% by the end of 2026 (CLIA 2022b, 2023a). It is a highly impacting sector in terms of CO_2 emissions, from ship building to ship dismantling, as well as polluting harbours and their inhabitants (Lloret et al. 2022) *(high confidence).* The actual cruise shipbuilding process

83 https://openknowledge.fao.org/handle/20.500.14283/cb7838en

takes two to three years and should follow a technical measure for reducing CO_2 emissions, the Energy Efficiency Design Index, whose requirements are tightened every five years (Tonazzini et al. 2019). When finally dismantled, the disposable vessels comprise a vast range of hazardous substances such as PCB, asbestos, and waste oil products (Tonazzini et al. 2019) *(high confidence).* Cruise ships in operation are the most carbon intensive means of transportation: according to Howitt et al. (2010), a voyage ranges from 250 to 2200 g of CO_2 per passenger per kilometre. Cruise ships operate on fuels rich in carbon and sulphur and their engines are kept running close to city centres. In the Mediterranean Basin, cruise ship traffic is second only to the Caribbean, and it has been producing increasing air pollution in ports over recent years, with three top cruise terminals, in terms of emissions: Barcelona, Palma de Mallorca (Spain) and Venice (Italy) (Karanasiou 2021) *(high confidence).* The case of Venice has been largely studied, showing how cruise tourism is a complex issue in relation to sustainability, as many actors involved in the market identify benefits and costs (also in terms of environmental impacts) of the cruise industry in different ways (Asero and Skonieczny 2018). This considered, a long-term management strategy involving international agencies, cruise line operators and host communities seems to be a reasonable pathway towards sustainability. There is no international coordination of the cruise industry at the regional level, which leaves the Mediterranean area open to exploitation (Asero and Skonieczny 2018) *(medium confidence).* A remarkable step for the reduction of the environmental impacts caused by the cruise industry has been the approval of the designation of the Mediterranean Sea as an Emission Control Area (ECA) for sulphur oxides (SO_x) and particulate matter (IMO 2022).[84] This measure will be effective on 1 May 2025 and should lead to a 79% reduction in sulphur oxide emissions and a 24% reduction in fine particles (Plan Bleu 2022a) *(medium confidence).*

An increasing number of cruise companies voluntarily report on their environmental impact. However, those reports are often 'self-assessments' and can therefore be too focused on 'soft' indicators, not always including full carbon footprint, quality of employment or human rights enforcement (MacNeill and Wozniak 2018) *(medium confidence).*

A concrete measure to reduce CO_2 emissions and air pollution is the electrification of ports, called Short-Side Electricity (SSE), also known as cold-ironing, which allows cruise ship operators to turn off the ship engines while in port (Stolz et al. 2021) *(high confidence).* Winkel et al. (2016) found that SSE offers the potential to reduce CO_2 emissions by over 800,000 tons in Europe alone. This technology is currently available in few berths worldwide (64 in Europe; 9 in Asia), whereas only 25 cruise vessels are equipped with the necessary technology for shore power connection. The main disadvantages of SSE are the relevant initial investments, and the lack of know-how needed to let cruise lines and ports cooperate. In addition, the electricity provided should originate from renewable resources. SSE does not only address climate action (SDG 13), but encompasses nine SDGs: SDG 3 (good health and well-being), SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 8 (decent work and economic growth), SDG 9 (industry, innovation and infrastructure), SDG 11 (sustainable cities and communities), SDG 13 (climate action), SDG 14 (life below water), and SDG 15 (life on land) (Stolz et al. 2021) *(high confidence).*

Cruise ship tourism is gaining in popularity with movements within the Mediterranean tripling in the last decade with 13,194 cruise ship calls in 2015 (MedCruise 2017) *(high confidence).* This increase in cruise ship tourism, while increasing the financial performance of cruise and port operators, might also carry negative effects on unique Mediterranean ecosystems and on the social fabric of some of the visited communities, due to changes in traditional value systems and

84 At their 22nd meeting, the Contracting Parties to the Barcelona Convention adopted Decision IG.25/14 agreeing to submit a joint and coordinated proposal to designate the Mediterranean Sea, as a whole, as an Emission Control Area for Sulphur Oxides (Med SOX ECA) under Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL). The proposal was submitted to the International Maritime Organization's Marine Environment Protection Committee (MEPC) for consideration at its 78th session, held from 6 to 10 June 2022. At that session, the MEPC approved the designation of the Med SOX ECA. See also: https://www.rempec.org/en/news-media/rempec-news/mediterranean-sea-emission-control-area-for-sulphur-oxides-and-particulate-matter-med-sox-eca-approved-by-the-imo2019s-marine-environment-protection-committee

lifestyles at destinations, including gentrification (Jones et al. 2016; Mejjad et al. 2022). The average dimension of a modern cruise ship is 200 m long, 26 m beam, and a passenger capacity of 3220 people. This marks a shift from the early 2000s, when there were very few ships carrying more than 2000 people (Pallis 2015). In fact, these ships can well be compared to 'floating cities' resulting in the generation of large waste volumes which includes sewage, wastewater from bathrooms, hazardous waste, solid waste, oils, etc. (Tonazzini et al. 2019). Waste reception facilities are therefore a necessity in ports with containers being the basic storage method offered for most waste except cooking oil. According to Pallis et al. (2017), who analysed 52 cruise ports in the Mediterranean Sea, waste segregation is limited due to the fact that the majority of ports of call assign this job to an external contractor with most waste ending in landfill, followed only marginally by recycling. The latter relates to plastic waste, whereby 80% of Mediterranean cruise ports recycle plastic waste (Pallis et al. 2017) *(high confidence).* Measures to address water pollution and waste segregation and disposal may include technological applications for on-board water treatment, the use of eco-friendly cleaning and anti-fouling products, and fiscal measures to incentivise reduced waste production both for ships and for ports and marinas (Plan Bleu 2022a) *(high confidence).*

5.3.2.2 Transformative pathway for sustainable development

5.3.2.1.1 Transformation pathways for climate resilience

Transformative actions are increasingly urgent across all sectors, systems, and scales to avoid exacerbating the risks of climate change, and to meet SDG targets. In the context of climate resilient pathways, transformative actions concern leveraging change in the five pillars of development that drive societal choices and climate actions, toward sustainability such as, social cohesion and equity, individual and agency, and knowledge developments, which have been identified as steps to transform practices and governance systems for increased resilience. However, in some cases, transformative actions face resistance from the political, social, and/or technical systems and structures they are attempting to transform. There is mounting evidence that many adaptation efforts have failed to be transformative, but instead have increased inequality and imbalance, especially when following free market measures too strictly. Marginalised and vulnerable groups would therefore need to be placed at the centre of adaptation planning (Veland et al. 2013; Atteridge and Remling 2018; Reckien et al. 2023a, Reckien et al 2023b).

5.3.2.1.2 Transformation pathways to achieve the SDGs and challenges

The need for coordinated transformational action schemes is a pressing concern. Achieving the 17 SDGs and the goals included in the 2015 Paris Agreement is challenging and complex. However, prioritising the following six major societal transformations can foster the achievement of those goals: quality education (SDG 4); access to good quality and affordable health care (SDG 3); renewable energy, and a circular economy (SDGs 7, 12, and 13); sustainable land and marine management (SDGs 2, 14, and 15); sustainable urban infrastructure (SDGs 6, 9, and 11); and universal access to digital services (SDG 9). In this context, cooperation among actors and partnerships to achieve all goals (SDG 17) acquires an even more important role. Each transformation contributes to several SDGs and describes a significant change in the social, economic, political, and technological framework to achieve sustainable development over the long term. Dropping any of them will make achieving the SDGs even more challenging. The six transformations can be implemented in every country to help address trade-offs and synergies across the SDGs (Sachs et al. 2019a).

The six societal transformations operate at the global, regional, and national levels. They must be adapted to country contexts, such as levels of development, natural resource base, and ecosystem governance challenges and structures. Each of the six transformations requires a significant scaling-up of public investments, and coordination among public and private authorities and civil society. However, the financing needs for SDG investments are far greater than the fiscal space available to governments of low-income developing countries (Sachs et al. 2021).

5.4 Social equity and climate justice

5.4.1 The links between social inequalities and sustainable pathways in coastal communities

The social and economic characteristics of coastal communities differ greatly across the Mediterranean Basin. These are informed by a clear difference in the levels of human development, as captured by the Human Development Index (HDI), ranging from a ranking of 150th (over 189 countries) for The Syrian Arab Republic, and 123rd for Morocco, to the very high development of Israel (22nd) and Malta (23rd), or in the levels of per-capita wealth, ranging from the 4192 USD Gross National Income (GNI) of Syria to the 42,840 USD of Italy (UNDP 2022). Historical events, including colonisation and conflicts, have also played a major role in shaping the current levels of well-being, governance, and social status of many citizens across the Mediterranean (Gürlük 2009). Furthermore, economic policies that prioritised strict macroeconomic balancing measures and short-term gains for a selected number of stakeholders, at the expense of long-term sustainable development for a larger part of society, are also responsible for growing social inequalities in the Mediterranean region (Lehndorff 2012). Examples in this area can be found in the excessive privatisation of health and education services, which, when faced with a crisis like the COVID-19 pandemic, brought many countries (Assa and Calderon 2020) to the realisation that the original gains obtained from the budget cuts were overwhelmingly outweighed by the costs incurred to deal with such an emergency, compounded by the lack of preparedness often linked to reduction in budgets for these crucial sectors (Williams 2020) *(medium confidence).*

Climate change is adding a further layer of constraints to existing social inequalities, especially on women, the elderly and children (Ali et al. 2022). Young people, who are the fastest growing population in the eastern and southern Mediterranean region, are potentially the most affected by climate change. Infants and children are less able to survive extreme weather events and diseases, particularly those living in poverty and experiencing displacement (Al-Jawaldeh et al. 2022). In recent years, coastal communities have experienced an increasingly higher level of social inequalities, which, besides cyclical socio-economic drivers, tend to be more pronounced due to the specific pressure that climate change extremes exert on coastal areas (Lionello et al. 2021). The capacity to respond to climate extremes, and more general disasters, is often linked to development levels, with the assumption that the higher the wealth and the lower the social inequalities, the better the capacity to cope in the short term and adapt in the long run (L. P. Briguglio 2016). Therefore, existing social inequalities can act as a further barrier to climate change adaptation, and more generally to sustainable development pathways. Addressing social inequalities among coastal communities can therefore be an important tool to promote better adaptation and ensure sustainable development pathways (Cinner et al. 2018) *(high confidence).*

To this end, it is crucial to identify a number of best practices in Mediterranean countries that while reducing social inequalities, can support post-pandemic climate resilient socio-economic systems. Among these, the use of economic instruments, such as taxation and subsidies, play a central role in supporting the most vulnerable categories (Panayotou and UNEP Environment and Economics Unit 1994; Bräuninger et al. 2011). The successful practices have the potential to also be scaled-up to other countries in the Mediterranean Basin. However, for this to happen, besides forward-looking policymaking, there must be an opportunity to improve existing gaps in data collection within and among countries in the Mediterranean Basin, thus providing policy with data that can drive policy models potentially in many settings *(medium confidence).*

5.4.2 Access to social infrastructure

Social infrastructure includes health, educational, cultural and environmental factors that enhance social comfort (Torrisi 2009). Availability of, and access to social infrastructure such as schools, hospitals, green areas, and cultural spaces are among the standard indicators of the quality of life of a country. Poor healthcare, cultural services and education affect the poor ranking of Mediterranean cities, such as Algiers, Damascus and Tripoli in the Global Liveability Index (EIU 2022).

The COVID-19 pandemic also drove a move down in the ranking of some European Mediterranean cities such as Barcelona, which, in 2022 alone, fell 19 places. Social infrastructure also has positive impacts on social cohesion, by ensuring equal access to basic services (such as healthcare and education) across cities and regions (OECD 2021) *(high confidence).* On the other hand, existing disparities in access to social infrastructure can exacerbate pre-existing inequality within and among countries and undermine social cohesion. In the EU, the importance of bridging critical social infrastructure gaps to ensure sustainable and climate resilient development has been emphasised in the aftermath of the COVID-19 pandemic, when in several countries, including European Mediterranean countries such as Greece and Slovenia, over 50% of households were at risk of descending into poverty (CEB 2020). Here, investments in social infrastructure such as schools, health and social care services can help to advance several SDGs, including SDG 3 (health), SDG 4 (education) and SDG 5 (gender equality). According to a recent OECD study (OECD 2020), only a few regions in the OECD area have achieved the outcomes suggested for SDG 3 and SDG 4, with significant inequalities existing within countries, including Mediterranean countries, such as France and Spain. For SDG 4, for example, while the Basque country has achieved the end value for the used indicators (i.e. bring school dropout rates to 8% or lower and tertiary education to at least 46% of the adult population), the Balearic Islands are halfway to meeting it *(medium confidence).*

In terms of gender equality, where the indicators used for SDG 5 are the same employment rate and part-time employment for both women and men, the Mediterranean countries with the most significant regional disparities are Türkiye and Israel (OECD 2020). Here, eastern Anatolia and the North of Israel are the two farthest regions that perform the lowest to the end values in the respective country, while the capital regions (eastern Black Sea and Tel Aviv) are the best performing regions. However, the country that displays the greatest disparities in employment for women and men across its cities is Italy, with the coastal city of Venice facing one of the largest possible distances to the end value for SDG 5 *(medium confidence).*

5.4.3 Inclusion

Social inclusion is a context-dependent concept (Silver 2015) which depends on several factors including availability of resources, mechanisms and processes that enhance people's capabilities and opportunities to participate in economic, social, cultural and political arenas. Being multidimensional and dynamic, social inclusion can be hardly measured, especially when standard data sources across countries are lacking (UN DESA 2016). With respect to the Mediterranean, available literature (e.g. ILO 2016; UN DESA 2016; Capasso et al. 2018) shows that lack of social protection, informal and insecure employment and high numbers of young people not completing secondary education affect the SEMCs in particular (Egypt, Lebanon, Morocco, Palestine, Tunisia, Türkiye), and especially young women (Murphy 2018) *(high confidence).* In these countries, and mainly in Egypt, relatively higher income inequality has also been observed (Alvaredo et al. 2014, Alvaredo et al. 2019). Also, NMCs, which are generally more inclusive than the SEMCs, if compared with northern European countries show limited welfare protection and greater socioeconomic inequalities (Conde-Sala et al. 2017) *(medium confidence).*

In both northern and southern Mediterranean countries, segregation and disempowerment of migrants, due to informal work arrangements and little or no union activity, limit social inclusion, especially of some groups, such as agricultural workers. This notwithstanding, and although youth unemployment is higher in many southern European cities than in some SEMCs (e.g. in Moroccan cities; Surian and Sciandra 2019), the share of young people (15 to 34-year-olds) migrating or willing to migrate from SEMCs to EU countries increased over the past decades, and particularly in the aftermath of the Arab uprisings (De Bel-Air 2016). In 2020, Moroccans were the largest group among new EU citizens (EMN 2021)[85]

85 See also EUROSTAT online database, https://ec.europa.eu/eurostat/statistics-explained/index.php

and the largest number of migrants from Africa living abroad, after Egyptians (McAuliffe and Triandafyllidou 2021). Yet, despite being relatively better integrated in their destination countries than other foreign immigrant communities, their cultural integration remains low (e.g. in Italy: Di Bartolomeo et al. 2015) *(high confidence).*

Climate change can also be a driver of social inclusion as it pushes cities and communities to interconnect and address the common challenges of climate change together, for example by promoting common cultural heritages, including the Mediterranean diet (Tarsitano et al. 2019) *(low confidence).*

However, climate change impacts can also be a limit to social inclusion. The main economic sectors in the Mediterranean region, including fisheries and agriculture, are highly vulnerable to climate-related risks (such as flooding, storms, heatwaves, and sea level rise) and coastal communities and ecosystems are among the most negatively affected by these impacts. Projected increases in climate hazards in the Mediterranean region can put at risk marine species and coastal systems with limited adaptation options, especially in SEMCs (Linares et al. 2020), where capacity to adapt is minor and decreases in food production on land and from the sea can affect income, livelihoods and food security, and further erodes people's economic and social rights *(medium confidence).*

Yet, as discussed by the WG2 contribution to AR6 (IPCC 2022b), social processes can promote transformative adaptation, including in the Mediterranean Basin, where the implementation of institutional frameworks can enhance human rights protection and reduce risks of conflict, displacement and human insecurity (MedECC 2020a) *(high confidence).* Inclusive and participatory approaches exist in Mediterranean countries, as documented for example in the water sector by Iglesias and Garrote (2015), and can be used to promote climate resilient sustainable development pathways in the region. In coastal communities, adaptation responses to climate change include structural defence, ecosystem protection and restoration, and livelihood diversifications. However, these often come with negative gender outcomes that lead to the exacerbation of inequalities (Prakash et al. 2022) and negatively impact the attainment of SDG 5 for gender equality *(medium confidence).*

As highlighted in the Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) of the IPCC (2019), densely populated coastal zones are places at risk, particularly for women and girls, since they have less access than men and boys to information and training on disaster preparedness and response *(high confidence).* However, there is a lack of studies focused on gender in the context of coastal hazards in the Mediterranean region, which generates a gap of knowledge in this respect.

5.4.4 Gender, climate justice, and transformative pathways

The achievement of sustainable development commitments, such as the SDGs, requires transformative changes in social and ecological systems. These transformations are associated with questions such as gender equality, equity, poverty reduction and justice, which are at the core of climate-resilient development. The main sustainable development pillars in Mediterranean countries vary in terms of exposure to key risks, as shown in *Table 5.4*.

Climate change impacts exacerbate social inequalities (IPCC 2022b; UNDP 2022) and its consequences are felt disproportionately by the most vulnerable sectors of the population, including children, young people, migrants, and women (IPCC 2022b). Transformative pathways toward climate-resilient development can be more effective if they reduce inequalities and promote gender equality, prioritising equity and justice in adaptation planning and implementation *(high confidence).*

Achieving climate-resilient development in coastal zones requires synergies between SDG 13 (Climate Action) and SDG 14 (Life Below Water), and the adoption of adaptation measures that, while helping coastal communities to face the risks associated with climate change (e.g. ocean warming and acidification), contribute to the achievement of other SDGs (SDG 1 – Poverty, SDG 2 – Hunger, SDG 3 – Good Health and Well-Being) (IPCC 2022b; Schipper et al. 2022). An example is coastal-focused adaptation measures that bring technological and infrastructural improvements to fisheries and aquaculture, which are crucial sectors for food security and the economy of the Mediterranean (Cramer et al. 2018).

Developing transformative coastal adaptation pathways across the Mediterranean can also contribute to the achievement of SDG 5 (gender equality) *(high confidence)* by empowering women's participation in decision-making and support programmes, for example, in the fishery sector, where women are actively involved, but paid less than men and largely absent from top management positions (FAO 2023). This is particularly true for the Mediterranean countries where gender-based inequality is higher — for example, Algeria, Syria, Egypt, Lebanon, and Morocco, which ranked between the 104th and the 126th position (out of 191) in the global ranking of the Gender Inequality Index (GII) (UNDP 2022).

5.4.5 Diversity

Diversity in natural and human systems is an inescapable fact that depends on the existence of variety and variability among living organisms and societies. When it comes to social equity and climate justice, the concept of diversity is preferable to uniformity, since climate change impacts are not felt evenly across populations, and the ability to adapt varies across different countries and sectors of society. Therefore, response capacity to climate change impacts must be increased, and resources concentrated, where vulnerability to climate change is higher.

In the Mediterranean region, there are differences that stem from biological diversity and socio-cultural richness, but also from history, and diverse socio-economic and human development conditions (with some countries, such as Israel and the EU Mediterranean countries in the highest human development category and others, such as Syria, in the lowest) (dos Santos et al. 2020; UNDP 2022).

These differences are not necessarily taken into account by existing assessment models, including those developed to describe climate change impacts on Mediterranean marine and coastal ecosystems, where climate change, in combination with other global change drivers, such as urbanisation, rural exodus, population growth and tourism (Senouci and Taibi 2019; Petrișor et al. 2020) exacerbate existing environmental problems (Cramer et al. 2018). On the other hand, regionalised Shared Socioeconomic Pathways (SSP), which account for differences between countries in the Mediterranean region, can be used to better assess future exposure, vulnerability and impacts of climate change in different coastal zones (Reimann et al. 2018) *(medium confidence).*

5.4.6 Access to climate finance funds

There are different challenges linked to obtaining access to climate finance, especially when zooming in on specific parts of a country, such as coastal areas. For instance, large-scale infrastructure projects, mainly for mitigation purposes, are more successful in attracting funding than small-scale adaptation projects at local levels (Costa et al. 2022) *(medium confidence).* The main challenge for the Mediterranean region, especially the SEMCs, is upscaling the level of funds available to meet urgent financing needs to support sustainable pathways toward a climate transition. Most of the funds are driven by public sector initiatives with minimal, or little effort by the private sector, with only Egypt issuing green bonds to date (Costa et al. 2022). This limits the mobilisation of private funds that can support the need to achieve an effective transformative and sustainable change. The UNFCCC defines climate finance as 'local, national, or transnational financing — drawn from public, private, and alternative sources of financing — that seeks to support mitigation and adaptation actions that will address climate change'.[86] Climate finance refers to the investments necessary to transition the world's economy to a low-carbon path, to reduce greenhouse gas concentrations levels, and to build resilience of countries to climate change (Hong et al. 2020). The NMCs are viewed as leaders and pioneers of green finance, with an important developing market whereas the SEMCs

86 https://unfccc.int/topics/introduction-to-climate-finance

Table 5.4 | Environment, Social, and Governance (ESG) Risk Ratings in the Mediterranean. Source: Economic Intelligence Unit (EIU), https://www.eiu.com/n/solutions/esg-rating-service/, accessed on September 20, 2023.

EIU's Environment, Social, and Governance (ESG) Risk Ratings				
Country	Overall Assessment	Environment	Social	Governance
Albania	No Data	No Data	No Data	No Data
Algeria	High	High	High	High
Bosnia & Herzegovina	No Data	No Data	No Data	No Data
Croatia	Low	Low	Low	Low
Cyprus	Low	Low	Low	Low
Egypt	High	Moderate	Very High	High
France	Very Low	Very Low	Low	Very Low
Greece	Low	Very Low	Low	Low
Israel	Low	Moderate	Low	Low
Italy	Low	Low	Low	Low
Lebanon	High	High	Moderate	High
Libya	No Data	No Data	No Data	No Data
Malta	No Data	No Data	No Data	No Data
Monaco	No Data	No Data	No Data	No Data
Montenegro	Moderate	High	Low	Moderate
Morocco	Moderate	Moderate	Moderate	Moderate
Palestine	No Data	No Data	No Data	No Data
Slovenia	Very Low	Very Low	Very Low	Low
Spain	Very Low	Low	Very low	Very low
Syria	No Data	No Data	No Data	No Data
Tunisia	Moderate	Moderate	Moderate	Moderate
Türkiye	High	Moderate	High	Moderate

are struggling with inadequate flows of funds to make a transition towards a green economy to fulfil the objectives of the Paris Agreement (Costa et al. 2022) *(medium confidence).*

In accordance with the principle of 'common but differentiated responsibility and respective capabilities' (CBDR-RC), industrialised countries are to provide financial resources to assist the less developed and developing countries in implementing the objectives of the UNFCCC (UNFCCC 2015). International climate finance commitments to the SEMCs accounted for 11% of total global financial flow in 2019, amounting to USD 9.12 billion, with bilateral donations comprising around 37% of the overall amount (Costa et al. 2022). Major bilateral donors include EU institutions (excluding the European Investment Bank, France, and Germany). Multilateral climate funds provided the smallest share of overall climate finance to the SEMCs with only 2%. SEMCs differ in their abilities to access climate funding, with Türkiye, Egypt, and Morocco being most successful, while other countries such as Jordan, Syria, Libya, Algeria, and Montenegro have experienced difficulties (Midgley et al. 2018) *(medium confidence)* .

Alternative scenarios, ranging from all green, shades of green, brown (finance as usual), and crisis and conflicts, for the future of green and climate finance will likely produce dramatically different outcomes depending on political, regulatory and market factors (Costa et al. 2022). The all-green scenario entails NMCs stepping up their financial commitments and delivering beyond their pledges to provide sustainable finance to SEMCs in addition to fostering Euro-Mediterranean cooperation to develop a common strategy and knowledge sharing, and establish common standards and reporting measures. The SEMCs, in turn, need to institute reforms to improve the business environment and allow the use of innovative instruments such as green bonds, guarantees and public-equity co-investments, etc., to ensure the flexibility and attractiveness of green and climate finance. The all-green scenario will produce large, bankable and transformative projects in the energy, building and transport sectors across the Mediterranean. In parallel, green finance reaches small projects benefiting local communities and creating decent and sustainable jobs, contributing to a fair and just transition (Costa et al. 2022) *(medium confidence).* According to Climate Policy Initiative (2021), global climate finance flows reached USD 632 billion in 2019/2020 recording a timid 10% increase relative to the average increase of 24% in previous periods. However, to meet climate objectives by 2030, annual climate finance must increase by at least 59% to USD 4.35 trillion in order to maintain a 1.5-degree trajectory *(high confidence).*

5.5 Final remarks and knowledge gaps

Further research is needed in the area of sustainable energy transition, where gaps exist to identify current energy needs, also in the light of the increasing electrification of transportation fleets, and the socioeconomic categories most at risk when measures are implemented to achieve such a transition.

To support a faster and equitable transition to sustainable development pathways, this is essential to increase investments in research and development to identify the right mix in the use of:

- command and control (laws, regulations, etc.);
- economic instruments (taxes, subsidies, cap-and-trade, etc.);
- private mechanisms;
- education and awareness.

These are essential tools to guide policy in the adoption of evidence-based measures.

New and additional resources are needed to support ongoing research in ecosystem and nature-based solutions, especially blue carbon sinks (seagrass meadows, marshes, etc.), to promote sustainable development pathways, especially through the following activities:

- conservation;
- management;
- restoration.

In this sense, improving coordination and cooperation between Mediterranean countries and actors would be vital to advance knowledge in an area that both supports and provides livelihoods in many Mediterranean coastal areas.

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