



UNITED
NATIONS

EP

UNEP/MED WG.509/Inf.7



UNITED NATIONS
ENVIRONMENT PROGRAMME
MEDITERRANEAN ACTION PLAN

10 May 2021
Original: English

Meeting of the MED POL Focal Points

Videoconference, 27-28 May and 6-7 October 2021

Agenda item 6: Review of the new/upgraded Regional Plans in accordance with Article 15 of the LBS Protocol

Assessment of costs of implementation of the main measures proposed in the new/ upgraded Regional Plans and associated socioeconomic benefits

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Annex I: References

List of Abbreviations / Acronyms

BAT	Best available technique
BC	Barcelona Convention
BEP	Best environmental practice
BOD₅	Biological oxygen demand
COD	Chemical oxygen demand
DM	Dry matter
DRRS/ DRS	Deposit return and restoration system/ deposit refund system
ELV	Emission limit values End-of-life vehicles
EPR	Extended producer responsibility
EU	European Union
FfL	Fishing-for-litter
GES	Good environmental status
ICZM	Integrated Coastal Zone Management
IMAP	Integrated Monitoring and Assessment Programme
LBS	Land-based sources
MBT	Mechanical biological treatment
MPA	Marine protected area
MED POL	Mediterranean Pollution Control and Assessment Programme
ML/ MLM	Marine litter/ marine litter management
MSFD	Marine Strategy Framework Directive
MW/ MWM	Municipal waste/ municipal waste management
N	Nitrogen
NBS	Nature-based solutions
P	Phosphorus
p.e.	Population equivalent
POPs	Persistent organic pollutants
RP	Regional Plan
SS/ TSS	Suspended solids/ total suspended solids
SSM	Sewage sludge management
SUP	Single-use plastic products/ items/ packaging
TOC	Total organic content
UfM	Union for the Mediterranean
UNEP/ MAP	United Nations Environment Programme / Mediterranean Action Plan
UWWT	Urban wastewater treatment
WEEE	Waste from electrical and electronic equipment
WEFE	Water – Energy – Food – Ecosystem nexus
WW	Wastewater
WFD	Water Framework Directive
WWTP	Wastewater treatment plant

1. Introduction

1. Implementation of the existing Regional Plans (RPs) took place across a diverse legal, institutional and socioeconomic landscape yet with common objectives and a set of measures developed to protect the marine and coastal environment of the Mediterranean. Recent evaluation of the existing RPs implementation (UNEP/MED WG.473/14) *inter alia* concluded that:

- a. the differing levels of progress in developing wastewater collection and treatment infrastructure throughout the region could be linked to economic conditions in various countries; consequently, most countries in the northern Mediterranean had reached a more advanced stage in wastewater treatment compared to the countries of the south and east;
- b. provisions on basing urban solid waste management on reduction at source and applying the waste hierarchy were far from being achieved in almost half the Contracting Parties; on the other hand, policies (including recycling, Extended Producer Responsibility, reducing the use of single-use plastics) had been put in place in many countries to tackle major marine litter items, and important progress had been achieved in managing sea-based marine litter (in particular through better management in ports and marinas and through implementation of Fishing-for-litter initiatives).

2. Diverse circumstances and the level of progress achieved so far will affect implementation of the new/ upgraded RPs. The new/ broader and more stringent requirements for pollution prevention and control are likely to increase the cost burden for the countries already lagging behind, yet are necessary for a coordinated and effective response to the growing pressures and for securing a continued flow of a range of benefits provided by healthy and productive seas.

3. Development of a framework for the assessment of costs and benefits of the RPs implementation is a challenging task, requiring a flexible and pragmatic approach. A comprehensive cost estimate would be extremely data intensive and time-consuming exercise, even more so for the benefits. It was therefore necessary to focus the analysis on the key cost elements and on identification and evaluation of some of the benefits.

4. Estimation of costs for the Upgraded Regional Plan for Marine Litter Management (MLM) is particularly challenging due to a broad range and a capillary form of several measures (existing and new) that touch upon many areas and affect economic actors, regulators and society at large in various manners. In designing the assessment, the focus was therefore placed on the most mature measures of the existing Plan (with an attempt to address some of the new measures). Given the scope of this exercise and based on collected national data, quantification of specific elements (of e.g. municipal waste management system) needed to implement the upgraded RP proved unfeasible. The assessment was therefore carried out in a more qualitative manner, providing benchmarks and examples of costs and benefits of specific measures.

2. Approach to the assessment and methodology

5. A starting point in the assessment of costs for the Regional Plans on urban wastewater treatment (UWWT) and sewage sludge management (SSM) was to determine the current status of wastewater management in various Contracting Parties and to identify the gap (primarily in terms of physical infrastructure as the most cost-intensive element) between the current status and full compliance with the RPs i.e. provision of tertiary treatment (with appropriate sludge management) for all agglomerations above 2,000 p.e. To this end, a questionnaire was developed (presented in UNEP/MED WG.508/Inf.6) and shared with members of the Expert Working Group on Upgrading the Regional Plan on Urban Wastewater Treatment and developing a new Regional Plan on Sewage Sludge Management. Completed questionnaires were returned for Bosnia and Herzegovina, Croatia, Cyprus, Greece, Malta, Montenegro, Morocco and Slovenia (whereas data on collection systems and data on wastewater loads by agglomeration type were not available for Morocco). Summary of collected information is presented in UNEP/MED WG.508/Inf.6.

6. Investment, operation and maintenance, and administration costs for the implementation of technical measures included in the RPs (such as wastewater collection and treatment, collection and separation of solid wastes, remediation of waste dumps, clean-up campaigns, implementation of deposit-refund systems, etc.) will vary widely from one country to another and even within countries depending on the scope of the measure, the way it is administered, technology applied, costs of inputs such as land, energy and labour, and similar.

7. Unit costs applied in this assessment for wastewater management were selected by reviewing a number of regional, national and EU studies. The cost functions applied in the Union for the Mediterranean (UfM) report on priority environmental investments (LDK and IME, 2013) were identified as suitable for the estimation of costs of additional wastewater treatment needed to meet requirements of the RP for Urban Wastewater Treatment. The approach¹ was originally developed to assess the EU Member States' costs of compliance with Urban Wastewater Treatment Directive. Later on, it was also used (besides in the UfM report) in Turkey and in some accession countries. For the UfM study, corrective factors for the southern Mediterranean countries were considered to address variation in the input costs. The model (as presented in table 1) allows for estimation of investment cost of additional wastewater treatment infrastructure based on technology and capacity; it does not include the costs of sludge treatment and disposal.

Table 1: Cost functions used for calculation of unit costs of additional wastewater treatment

Level of treatment	Costs (€per p.e.)	
	2,000 – 100,000 p.e.	>100,000 p.e.
Primary	$=10^{(-0.2073 \cdot \log(\Delta PE) + 3.6385)} \cdot 0.23$	92
Secondary	$=10^{(-0.2632 \cdot \log(\Delta PE) + 4.0149)} \cdot 0.23$	115
Tertiary with P-removal	$=10^{(-0.2808 \cdot \log(\Delta PE) + 4.1823)} \cdot 0.23$	138
Tertiary with N-removal	$=10^{(-0.2612 \cdot \log(\Delta PE) + 4.2600)} \cdot 0.23$	207
Tertiary with N and P removal	$=10^{(-0.2722 \cdot \log(\Delta PE) + 4.3608)} \cdot 0.23$	230

Where ΔPE is population equivalent not connected to WWTP

8. Costs for construction of sewers applied in the wastewater management plan for Montenegro (Agreco, 2019) were used as unit costs for extension of collection systems to achieve full coverage in agglomerations subject to the Regional Plan for UWWT. These costs were derived on that basis of the engineering assessments and/ or feasibility studies, and were assumed as representative for other countries covered in the assessment. Appropriate unit costs for rehabilitation of sewage networks could not be determined as they are highly dependent on the nature and scope of required works (which can range from minor interventions such as pumping stations upgrade, to complex ones such as network replacements or separation of combined sewers); the cost of collecting systems reconstruction was therefore not covered in this assessment.

9. Variety of treatment and disposal options found in practice together with a range of other factors make determination of unit costs for sludge treatment and disposal rather difficult. For the purpose of this assessment, only the costs of sludge management at the treatment plant were taken into account and assessed for the new WWT capacity needed to comply with the RP requirements. Estimates of sludge management investment costs linked to development of new WWTPs in Montenegro were used as a benchmark for this part of the assessment.

10. Operation and maintenance (O&M) costs for wastewater treatment vary widely depending primarily on the size of the plant, but also on the local conditions and levels of input costs. Information presented as a part of the EMWater e-Learning Course showed, for example, that in early 2000s, operation costs for wastewater treatment plants with more than 10,000 p.e. in Europe were amounting up to 25 – 35 €/per p.e. and year; for smaller installations, it was assessed the numbers were likely to be as much as twice this amount (Wendland, 2005).

¹ Part of a comprehensive FEASIBLE cost model developed by COWI in 2010.

11. For marine litter, a questionnaire was developed (presented in UNEP/MED WG.508/Inf.6) and shared with members of the Working Group of Experts on Upgrading the Regional Plan on Marine Litter Management. The purpose was to collect data on the current state of municipal waste and marine litter management practices in different Contracting Parties for the key/ most mature measures of the existing Marine Litter Regional Plan and for some of the new measures proposed in the process of its upgrade. Completed questionnaires were returned for Bosnia and Herzegovina, Croatia, Cyprus, Malta, Montenegro, Slovenia and Turkey; partial information (on removal measures) was provided for Tunisia. Summary of collected information is presented in UNEP/MED WG.508/Inf.6.

12. Establishing a baseline for municipal waste management and determining a distance to target i.e. full implementation of the RP requirements in different countries proved difficult within the timeframe of this analysis. For prevention and removal measures, determination of uniform costs for these interventions across various circumstances and specific implementation arrangements emerged as an important limitation too. For these reasons, the assessment focused on provision of benchmarks for costing the improvements in marine litter management and on highlighting good national practices and their socioeconomic implications.

13. The present assessment is based on the current situation – increases in population and economic activity over time were not taken into account – and on the current prices, trying to answer the question what would be the cost of implementing some of the key measures of the new/ upgraded RPs at this moment and in one go.

14. Costs of regional measures were briefly considered, in particular for the Upgraded RP for Marine Litter Management

15. Identification and evaluation of socioeconomic benefits was carried out having in mind possible impacts of improved wastewater and marine litter management on human health, economy (including circular economy potential) and provision of ecosystem services. Available EU and regional studies, in particular the work done within the Barcelona Convention system, as well as data collected within the present assessment were used to illustrate some of the potential benefits of the RPs implementation.

16. Given the available information and scope of the report, an attempt was also made to look into possible distributional aspects for some of the measures included in the new/ upgraded RPs.

3. Cost estimates for the Regional Plans for Urban Wastewater Treatment and Sewage Sludge Management

17. The key requirements of the Regional Plan for UWWT include upgrade and development of new wastewater collection systems (including, where feasible, separate collection of stormwaters) for agglomerations above 2,000 p.e., WW treatment at tertiary level and pre-treatment of industrial wastewaters discharged into urban sewers. The Plan also promotes reuse of treated wastewater, including (where necessary) additional treatment and storage and irrigation systems. The Regional Plan for SSM refers to treatment, disposal and use of sewage sludge from UWWTPs, aiming to ensure effective reuse of its beneficial substances and exploitation of energy potential, while preventing harmful effects on human health and the environment.

18. Costs of development and operation of new wastewater collection and treatment systems needed to ensure compliance in the area of application² of the RPs were estimated and are presented below (for the countries covered in this assessment). Additional collection and treatment capacity needed was determined as a gap between the current situation and full compliance with the RPs provisions.

19. Partial country data was collected for the management of wastewater from industries that fall under the scope of the Regional Plan on UWWT. Due to diversity of processes and pre-treatment options for industrial wastewater it was not possible to determine appropriate unit costs for

² Determined in line with Article 3 of the LBS Protocol.

investments needed to comply with the RP requirements. Consequently, costs of implementation of the RP's measures related to industrial wastewater were not assessed.

20. Few data were made available on the national experiences with the reuse of treated wastewater and utilisation of sewage sludge, as well as with the application of nature-based solutions – measures that are promoted and/ or regulated under the two Regional Plans. The costs of their implementation were not estimated, but some of these measures were partly addressed in this assessment through the analysis of benefits.

21. Depending on the agglomeration in question, estimated costs of constructing one kilometre of new collection system in Montenegro range from around €188,000 to as high as €356,000 in agglomerations with old urban areas where performance of such works is quite demanding. The average cost of €225,000 per km was taken as a benchmark for the regional assessment.

22. Specific unit costs applied to estimate investments needed for new WWT capacities are shown in table 2, derived from the cost functions introduced above. As WWT gaps were determined for agglomerations with 2,000 – 15,000 p.e. and for those with more than 15,000 p.e., unit costs for agglomerations of 8,500 and 35,000 p.e. were used for the estimate – the first as the mid-range population for the agglomeration category 2,000 – 15,000 p.e., and the latter having in mind predominance of smaller size agglomerations in the area subject to the assessment. For Morocco, a corrective factor (70% of the unit costs or other appropriate figure) can be applied to adjust results of the assessment to national conditions; for this assessment, however, the same unit costs were used as for other countries. The costs of upgrading the existing WWTPs to a higher level of treatment were estimated as a difference between the unit costs for various treatment types.

Table 2: Unit costs for new WWTPs depending on the size of agglomeration and type of treatment

Type of treatment	Costs per p.e. (€)				
	8,500	15,000	35,000	57,500	>100,000
Primary	153	136	114	103	92
Secondary	220	189	152	133	115
Tertiary with P removal	276	235	185	161	138
Tertiary with N removal	394	340	272	239	207
Tertiary with N and P removal	450	385	306	267	230

23. Based on the review of current WW projects and plans in some of the countries included in the assessment (while also keeping in mind other available sources), it was concluded that the O&M costs of wastewater collection and treatment systems are likely to be in the range of €30 – 35 per p.e. served per annum. Lower range figure (€30) was applied in this assessment.

24. Investment costs for sludge management were only estimated for the new WWT capacity and for the processes applied within the wastewater treatment plant, taking a unit cost (€30 per p.e.) identified in the wastewater management plan for the coastal area of Montenegro (Agreco, 2019) as representative for the countries included in the assessment.

3.1 Main national measures

25. Development of urban wastewater infrastructure as the main measure to implement provisions of the Regional Plans on UWWT and SSM on the national level typically includes:

- Rehabilitation/ reconstruction of the existing wastewater collecting systems;
- Extension of wastewater collection to the area/ population not covered with adequate service;
- Provision of adequate UWWT; and
- Measures related to sewage sludge management.

Information collected from the Contracting Parties (presented in UNEP/MED WG.508/Inf.6) was used to identify gaps against the RPs requirements for all the elements of WW infrastructure listed above; results of the analysis are presented in table 3. Costs were estimated for all the elements except for rehabilitation of sewers. For sewage sludge, costs of treatment in the new WWTPs were only taken into account. Estimated investments costs (total and per capita) are presented in table 4 whereas total investment costs by country are shown in figure 1. Table 4 also provides information on the estimated annual O&M costs for the new wastewater treatment capacity (required to implement the RPs).

Table 3: Identified gaps for collection systems, wastewater and sludge treatment

Country	Collection gap (km)		WWT gap - new (p.e)		WWT gap - upgrade (p.e.)		Sludge (new WWTP p.e.)
	constr.	rehab.	2,000 - 15,000	>15,000	2,000 - 15,000	>15,000	
B&H	710 ^{a)}	n.a.	289,200	77,100	14,900	12,400	366,300
Croatia	3,640 ^{a)}	1,690 ^{b)}	361,000	591,400	147,450	965,000	952,400
Cyprus	3,200	n.a.	221,700 ^{c)}	11,700	0	0	233,400
Greece	n.a.	n.a.	208,000	980,800	145,600	686,500	1,188,800
Malta	n.a.	81	0	68,300	0	620,800	68,300
MNE	250	45	19,950	93,540	0	29,000	113,490
Morocco	n.a.	n.a.	265,000 ^{d)}	1,720,000 ^{d)}	20,400 ^{d)}	133,400 ^{d)}	1,985,000
Slovenia	67 ^{a)}	230	4,700	1,800	0	0	6,500

Notes:

n.a. – data not available

- a) Estimates based on the existing network density (inhabitants per km) in the country/ region
- b) Refers to both reconstruction and separation of sewers
- c) Includes not collected load and increase in the capacity for several existing WWTPs
- d) A rough estimate of the gap, based on provided data on the number of agglomerations, population, generated and collected/ treated volumes of wastewater (assuming proportional distribution of services in the two types of agglomerations)

26. For Morocco, it was only possible to assess the gap related to wastewater treatment and associated costs in rough terms (results are presented in table 3). This as data on the length of the existing collection systems was not provided, while overall data (not disaggregated by agglomeration type) was provided for wastewater collection and treatment. The assessed WW treatment gap predominantly refers to the need for development of new WWTPs as only one quarter of generated WW is treated at the moment³. However, the existing WWTPs provide for tertiary treatment of as much as 78% of wastewater entering the plants.

27. The analysis of the current situation in the Contracting Parties covered in this assessment shows some countries are quite close to the implementation of the main urban wastewater collection and treatment requirements. Slovenia, for example, already has near-necessary and adequate WWT capacity, whereas further work is needed on the extension and in particular on rehabilitation of the existing sewers. All the WWTPs in Cyprus and Slovenia provide tertiary treatment; on the other hand, Malta has a good coverage with WWT infrastructure, but will need an upgrade from secondary to tertiary treatment to comply with the RP. For Greece, the main gap would be to ensure collection and treatment for (a part of or entire) population currently served by Individual Appropriate Systems (IASs), i.e. for WW load estimated at around 1.2 million p.e. A large gap has been established for Croatia – both in terms of collection and in terms of providing adequate treatment (for non-collected/ not treated WW load as well as for loads undergoing primary, or to a small extent, secondary treatment). The non-EU countries (Bosnia and Herzegovina, Montenegro) also have significant gaps

³ Construction of ten more WWTPs is underway, for settlements with a total population of around 120,000.

for both collection and treatment. The same holds true for Morocco, where the treatment gap was estimated at close to 2 million p.e. (while it was not possible to estimate the collection gap in km).

Table 4: Overview of estimated investment costs

Country	Investment costs (mill €)			TOT INV. COST (mill €)	Inv. cost per capita (€)	O&M new WWT capacity (mill €p.a.)
	collection	WWTPs	sludge			
B&H	159.75	159.07	10.99	329.81	731	10.99
Croatia	819.00	572.34	28.57	1,419.92	1,391	28.57
Cyprus	720.00	103.35	7.00	830.35	807	7.00
Greece	-	532.93	35.66	568.60	53	35.66
Malta	-	116.50	2.05	118.55	240	2.05
Montenegro	56.25	42.07	3.40	101.72	665	3.40
Morocco	-	677.22	59.55	736.77	275	59.55
Slovenia	15.08	2.67	0.20	17.94	207	0.20

28. Estimated investment costs range from close to €18 million in Slovenia (country with a small share of population within the area of application of the RPs and with well-developed wastewater infrastructure) to €1.41 billion for Croatia (with a long coast and significant gap in relation to the RP requirements). Major share of the total investment costs refers to extensions of the collection network (except for Greece, Malta and Morocco). Per capita investment costs reflect the overall figures and are highest for Croatia where an estimated €1,391 per inhabitant would be needed to comply with the RP. For Montenegro, Bosnia and Herzegovina and Cyprus, estimated per capita investment cost ranges from €665 in Montenegro to €801 per inhabitant in Cyprus, the latter mainly driven by the plans for construction of 3,200 km of collection network (primarily in agglomerations 2,000 – 15,000 p.e. where current connection rate stands at around 34%). For Greece, no data was reported on the need for construction of new collections systems, therefore estimated per capita investment cost (€53) is quite low. It should be noted however that the country has planned an investment of €880 million to improve collection systems over the period 2019 - 2023⁴. Taking into account this investment would increase per capita costs for Greece to €135. Per capita investment cost (€275) is also quite low for Morocco as it only refers to the estimated need for new/ upgraded WWT capacities, while the (expectedly significant) cost of collecting systems extension⁵ is not included.

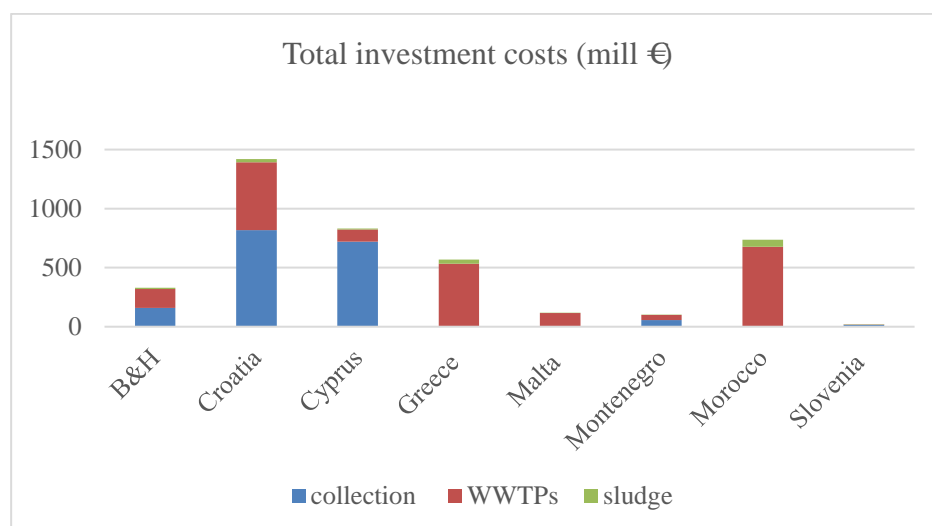


Figure 1: Total investment costs by country

⁴ As reported in the 10th Technical assessment on the UWTT Directive implementation (EC, 2020).

⁵ Current rate of connection to sewage systems is around 35% for the overall population.

29. Operation and maintenance costs for the new infrastructure that would be developed in response to the RPs requirements were estimated at €147.4 million annually for all the countries included in this assessment; the estimated costs are highest for Morocco and Greece, followed by Croatia, Bosnia and Herzegovina and Cyprus. The O&M costs for the existing infrastructure are slightly above €338 million per year (estimate is based on the load entering the operational WWTPs and it excludes Morocco).

30. The above cost estimates are indicative (specific costs will vary from country to country and depending on a set of specific conditions within countries) and should be considered as conservative (at least for the northern Mediterranean countries) since low range or median unit costs were applied. Moreover, they do not include costs of rehabilitation of sewage networks, cost of industrial water pre-treatment and costs of additional treatment of the effluent and sludge for potential further uses. Further examination of the unit costs applied would be welcome, whereas country-specific adjustments can be made for potential national-level assessments.

31. Country-specific data on the reuse of treated wastewater and sludge management suggest these are the areas where the Contracting Parties will need to invest significant efforts and resources in the coming period to ensure high level of environmental protection sought under the two Regional Plans as well as to utilise benefits from these and other circular economy approaches the Plans promote. Among the Contracting Parties covered in the assessment, for example, only Cyprus, Morocco and Malta are reusing part of the treated effluent⁶, while the use of sewage sludge for beneficial purposes is rare, with large shares of generated quantities still being landfilled. Cyprus is an exemption with around 12% of the total quantity of sewage sludge being used in agriculture and on green areas, 58% being composted, and around 16% being used for biogas production. Further compliance with the Regional Plans in these areas could result with significant additional investments and increased O&M costs.

32. Total costs of UWWTPs monitoring in Malta are around €80,000 per annum (referring to two WWTPs with design capacity of >100,000 p.e. and two with design capacity between 15,000 and 100,000 p.e.). These can be taken as indicative amounts for the assessment of monitoring costs across the region. Other measures (legal, enforcement, reporting etc.) envisaged in the Regional Plans also have substantial cost implications (even though far below the costs of technical measures) which should not be neglected. It is assumed that the additional costs due to the RPs implementation would not be significant, due to the fact the administrative capacities need to be developed in any case to ensure adequate implementation of national policies and plans.

3.2 Regional measures for urban wastewater treatment and sewage sludge management

33. The main regional measures included in the Regional Plans for UWWT and SSM refer to technical assistance, transfer of technology and capacity building, including exchange of best practices (directly among the Contracting Parties and/ or with support of the Secretariat) on BAT, BEP, sustainable consumption and production, circular economy, resource efficiency, WEF nexus and similar in the design, construction, operation and maintenance of urban wastewater treatment plants, as well as for monitoring obligations. Regional measures in principle have low costs and can yield significant benefits by facilitating and expediting the RPs implementation.

4. Assessment of costs for the Upgraded Regional Plan for Marine Litter Management

34. Similar to the situation with the Regional Plans on UWWT and SSM, analysis of data collected from the countries covered in this assessment showed there are significant differences in the progress achieved with implementation of the existing regional framework for marine litter management. These differences will have major implications for the investments that will be required in the coming period to implement the Upgraded Regional Plan on MLM. A specificity of the marine

⁶ Reuse of treated wastewater is at an advanced level in Israel where more than one fifth of the total water consumption comes from this source and as much as 40% of all water used for irrigation (figures from Annex I).

litter Regional Plan is that it includes, in addition to investment-heavy development of waste management infrastructure, a wide range of measures (e.g. market-based instruments) that do not require high investment costs and are interesting in terms of distributional impacts (how they affect societal, public sector's and private costs and benefits).

35. Implementation of the waste hierarchy (which was in one way or another a driving force for the waste management policies and plans in the analysed countries) has led to waste reduction and recycling rate as high as 58% of municipal waste in Slovenia. Cyprus recycles 15% of municipal and as much as 65% of plastic packaging waste. In Croatia, 37% of paper, metal, plastic and glass is recycled, while the share of packaging wastes that gets recycled in Malta is 36%. On the other side of the spectrum, recycling rates remain at a low level of just few percent in the countries like Bosnia and Herzegovina and Montenegro. Informal sector does not play a significant role in waste collection and recycling schemes in any of the countries covered in the assessment.

36. The waste hierarchy concept (illustrated in figure 2) – preventing waste as the preferred option and sending it to landfill as the last resort – is embedded in both the existing and the upgraded RP. Its implementation has significant cost implications, primarily due to the need to better organise and develop waste collection and increase recycling, especially for packaging wastes that make a significant share of marine litter.

37. Croatia and Turkey have reported a large reduction in the use of plastic bags due to applying a combination of instruments, including charges paid by consumers and plastic bag taxes, voluntary agreements and/ or bans on free distribution of single-use plastic bags. In Croatia, a 65% reduction was achieved since 2010, while as the introduction of a payment for plastic bags has significantly changed consumers' behaviour in Turkey just over a couple of years period, leading to a 75% reduction in the use of plastic bags. The most common marine litter prevention measures found in the countries are extended producer responsibility (EPR), economic/ fiscal instruments and incentives, and deposit refund systems.



Figure 2: Waste hierarchy

Source: https://ec.europa.eu/environment/topics/waste-and-recycling/waste-framework-directive_en

38. Cyprus has achieved major progress over the past 15 years with closure and rehabilitation of uncontrolled waste disposal sites, with 52 rehabilitated locations. The work is ongoing and closure of additional 42 sites is expected until 2023. The LBS National Action Plans for Bosnia and Herzegovina and Montenegro estimated the costs needed to address the problem of open waste disposal sites (permitted or not) with potential to contribute to marine litter at €40 and 19.8 million respectively.

39. Slovenia was the only country covered in this assessment that reported implementation of actions⁷ to address microplastics – an issue for which new measures were included in the Upgraded Regional Plan for MLM.

4.1 Municipal waste management measures

40. The Upgraded RP for Marine Litter Management does not set specific targets for waste reduction at source, reuse and recycling. Given the relevance of the EU policies for the regional Mediterranean processes (not only for the Member States but also for the accession and the counties of the south and east), the EU Circular Economy Package legislation adopted in May 2018 and the new recycling targets introduced in it were used as a reference point for this assessment. The costs associated with meeting these targets (as estimated in the EC, 2019), in particular for Cyprus and Malta, were used to derive possible per capita investment and operational costs linked to necessary improvements in the municipal waste management for the areas of application of the RP.

41. The new EU targets include recycling of 55% and 60% of municipal waste by 2025 and 2030, and limiting share of municipal waste going to landfill to a maximum of 10% by 2035. Overall, packaging waste targets are advanced to 65% for 2025 and 70% for 2030. As regards individual packaging materials, targets for paper and cardboard are 75% and 85%, and for plastic packaging 50% and 55% by 2025 and 2030.

42. Additional capacity (in terms of collection, biowaste treatment, sorting and recycling) needed to meet the new EU targets was modelled and total investment costs for Cyprus and Malta for the period 2021 – 2027 were assessed at €74 and 34 million respectively (EC, 2019). This means the two countries that have already achieved high recycling rates (Cyprus reported 15% for municipal and 65% of plastic packaging waste placed on the market, Malta reported recycling 36% of the overall packaging and 19% of plastic packaging waste by 2017) will need to invest €69 – 72 per capita over the 10-year period to be on track for compliance with the new EU waste legislation. Waste management operational costs⁸ (including for the additional capacities) were estimated at €53 per capita for Cyprus and €38 for Malta in 2027 (EC, 2019).

43. These figures can be used as benchmarks for national assessments of the costs of implementing municipal waste management measures of the Upgraded Regional Plan for MLM, while adjusting the investment costs to take into account the existing level of development of countries' MWM systems and operating costs to take into account national specificities. More populous countries are likely to benefit from economies of scale leading to lower per capita investment costs: for example, capital costs for Greece's compliance with the new EU recycling targets were estimated (in the EC, 2019) at €32 per capita for the period until 2027, whereas available information suggests current separate collection and recycling rates in the country are not at an advanced level. It is interesting to note the LBS National Action Plan for Bosnia and Herzegovina estimated per capita investment of €30 would be needed just to improve the waste separation part of the MWM system so the national operational targets set for marine litter would be achieved.

4.2 Marine litter prevention and removal measures

44. Prevention measures found in most of the countries covered in this assessment include EPR schemes (usually applied to packaging waste, WEEE, batteries and accumulators, tires, and ELVs), restrictions (or bans) and payments/ taxes for single-use plastic bags, and deposit refund systems for beverage containers. In some countries, single-use plastics are also targeted by sustainable/ green procurement policies and voluntary agreements. Specific measures related to port reception facilities as well as those addressing marine litter from fishing and aquaculture are less frequent.

⁷ In 2016, the first WWTP with membrane technology was constructed to remove microplastics from wastewater.

⁸ Including operational costs for waste collection, sorting of dry recyclables, recycling revenues, biowaste treatment, and disposal (excluding disposal taxes).

45. As regards removal measures, all the countries have reported clean-up activities (resulting with as high amounts as 66,250 t of collected litter in Turkey in 2019) and experiences (or considerations on) with Adopt-a-Beach and Fishing-for-Litter (FfL) initiatives. In Croatia, 15.6 t of marine litter were collected through clean-up actions in 2019; FIF activities implemented over the course of 3 – 4 years resulted in around 68 t of removed litter. In Tunisia, actions to remove litter from protected areas were implemented in 2016/ 2017, resulting with 2,111 m³ of collected wastes from an area of some 839 ha at a cost of cca €42,000; the country is currently moving on with implementation of Adopt-a-beach and Fishing-for-litter concepts. The way in which these measures are implemented vary widely as regards targeted litter (beach of water column/ seabed), scope, participation, financing and continuity (*ad hoc* or systematic activities). Removal activities are often accompanied with/ supported by awareness raising and training.

46. Plan Blue has carried out an analysis of the costs and benefits of different measures/ actions that help with reducing and preventing usage of single-use plastic bags and bottles (De Paoli et al., 2019). The starting point was analysis of concrete measures (e.g. bans on plastic bags, deposit refund systems, FIF) found in various Mediterranean countries including their:

- a. Direct costs and benefits (i.e. financial costs and benefits linked to design, implementation and enforcement of the measure);
- b. Direct economic impact (including, economic losses or gains for specific sectors following the introduction of measures); and
- c. Indirect benefits resulting from environmental improvements (including benefits for some economic groups – such as fishing sector savings due to less cleaning and reduced damages to boats and fishing gear, as well as enhanced delivery of ecosystem services).

The costs and benefits of individual measures were then scaled-up for an assumed application across the entire Mediterranean.

47. Some of the findings most relevant for this assessment are as follows:

- a. Implementation of Mediterranean-wide ban on plastic bags (resulting in an estimated litter reduction of 27,700 t/ year) would incur implementation costs to regulators and compliance costs to retailers, as well as significant cost to consumers (for purchasing substitute/ reusable bags), possibly at the level of €6.9 per household in the first year of implementation; negative impact/ losses were identified for plastics industry (but it was not possible to quantify them);
- b. Deposit refund system (with maximum potential reduction of 32,000 t of litter per year) would result in costs to regulators, plastic industry and retailers (the level of costs was impossible to quantify);
- c. Cost of implementing a FIF scheme leading to a maximum reduction of 88,000 t of litter annually would be €73 million/ year for regulators and €11 million/ year for the waste management sector.

48. In a recent SCP/ RAC analysis, key SUPs (beverage bottles, including caps and lids; food containers – bowls, clamshells, trays; straws; and cigarette filters) in four Mediterranean countries – Egypt, Morocco, Montenegro and Greece – were studied and environmental and socioeconomic impacts of potential policy measures to reduce/ prevent pollution from these items were appraised on the basis of actual data for the observed countries (Eunomia, 2021). The appraised measures were information campaigns, EPR (full cost of litter to be covered by producers), DRS for beverage containers, consumption levies (predominantly for food packaging) and bans.

49. Modelling of economic impacts of measures targeting consumptions of SUP products (bans and consumption levies) showed both increases and losses in sales were possible, depending on what type of products were used as substitutes. All the measures would lead to losses for producers of plastic products whereas net gains would only be made when the increased turnover for producers of alternative products would be greater than this lost revenue. Producer fees for EPR schemes for litter were estimated at around €121 million, and at €185 million for DRS scheme (assuming a 1 euro cent

producer fee). The analysis showed DRS schemes would have the most significant positive impact on employment, with creation of an estimated 11.5 thousand jobs (full time equivalents).

4.3 Regional measures for marine litter management

50. The main regional measures included in the Upgraded Regional Plan on MLM refer to the regional monitoring programme and maintenance of the regional ML database, as well as to preparation of regional marine litter assessments. Moreover, regional measures encompass cooperation (including scientific cooperation focusing on microplastics and new technologies for removal; cooperation on transboundary marine litter etc.) and provision of guidelines and technical assistance including capacity building. Work plan for the implementation of the existing Regional Plan on MLM estimated the costs needed for the implementation of regional measures at around €1.8 million for the period 2014 – 2017. These costs are seen as modest but overall appropriate for the coming period too. Efforts should be made, however, to strengthen provision of technical assistance and scientific cooperation, as well as to further develop regional ML data collection, management and assessment capacities.

5. Socioeconomic benefits associated with the Regional Plans implementation

51. In the 2017 WWF report⁹, total value of the activities that depend on the Mediterranean marine waters was assessed at US\$ 450 billion. This made the ‘Mediterranean economy’ one of the largest in the region, ranking fifth among the regional GDPs (after France, Italy, Spain and Turkey). The value represents about 20% of the world’s annual gross marine product¹⁰ and is generated in an area which makes up only 1% of the world’s ocean. Economic assets of the Mediterranean Sea were conservatively valued at astounding US\$ 5.6 trillion (Randone et al., 2017).

52. The three Regional Plans assessed herewith and the requirements they place on the policy agendas of the Contracting Parties aim to protect Mediterranean coastal and marine environment, related ecosystems and human health from pollution, thus preserving natural and human capital on which the Mediterranean economy depends. The RPs are contributing to the achievement of good environmental status (GES) and unobstructed flow of a wide range of benefits – economic, social and environmental – which are likely to outweigh by far the high costs of their implementation.

53. The costs of implementing the RPs should not be seen solely as a burden imposed on the Contracting Parties but rather as a driver and an impetus for improving the national systems for pollution prevention and control and a means for ensuring sustainable and long-term utilisation of benefits. Socioeconomic benefits associated with the RPs implementation will occur at different points in time and for different actors, and will typically encompass:

- a. Direct benefits (such as the ones inherent to the circular economy including savings, resource efficiency and similar; collected revenues; job creation; etc.);
- b. Avoided losses (e.g. loss of tourism revenue due to reduced attractiveness of polluted areas, losses from reduced labour productivity due to illnesses); and
- c. Indirect benefits stemming from environmental improvements and provision of ecosystem services (such as food, climate regulation, recreation etc.).

Some examples of the type and scale of benefits that are or will be provided through the Regional Plans implementation are presented below.

54. If Cyprus and Slovenia were to use the entire volume of the effluent from their tertiary treatment WWTPs in the area of application of the RPs as irrigation water, the value of the effluent would be in the range of €6.7 – 9.1 million for Cyprus and €1.6 – 2.2 million for Slovenia (based on prices of treated wastewater in Israel and Malta), taking into account the lowest tariffs (for low usage); if higher tariffs were applied, the value could go up to €20.1 million or more in Cyprus and €4.9

⁹ *Reviving Economy of the Mediterranean Sea: Actions for Sustainable Future*

¹⁰ The concept of ‘gross marine product’ is used in the WWF report in a comparable manner to the use of gross domestic product (GDP) as a measure of the size of national economics.

million or more in Slovenia. The higher amounts would offset or significantly exceed annual O&M costs for the currently operational WWTPs in these countries. In addition to providing a stable water supply source for agriculture, high level of treatment reduces the risk of aquifer contamination and is considered cheaper compared to other non-conventional water supply sources. Some disadvantages of the effluent reuse include additional infrastructure needed for storage and transmission as well as potential disagreements on the allocation of costs and benefits between the service providers/ local governments, effluent producers and consumers.

55. A deposit refund system will be introduced in Turkey in 2022 for a range of products and packaging. In an economic assessment of the measure, it was estimated the benefits would outweigh the costs and a contribution to the national economy of €5.8 billion would be made through savings and reduced emissions resulting from the use of recycled instead of raw materials, lower emissions due to avoided landfilling of packaging wastes and reduced waste disposal costs for local governments. It was also assessed that the system would create 3,500 to 6,000 new jobs. A plastic bag levy applied as of 2019, resulting with an estimated 290,000 t of prevented plastic waste and a saving of around €200 million.

56. In Montenegro, socioeconomic impacts of marine litter were assessed, indicating the loss of tourism revenues could reach €5.7 million per year due to marine litter and related degradation of aesthetic and recreational services. Costs and losses (totalling additional €2.12 million) related to marine litter clean-up for different businesses/ public sector were estimated as follows:

- a. €232,000 for fisheries and aquaculture (out of which €224,000 for fishermen);
- b. €98,000 for ports and marinas operators;
- c. €819,000 for tourism-related business; and
- d. €960,00 for public sector/ municipalities (including remediation of inadequate disposal sites and enforcement of regulations to prevent uncontrolled dumping of wastes).

With implementation of marine litter measures, these costs could be partly or fully avoided.

57. Findings of the Plan Bleu's socioeconomic analysis of marine litter best practices suggested tourism is the sector likely to gain the most from ML prevention and removal measures. According to the Plan Bleu study, positive direct impact of Mediterranean-wide ban on plastic bags for tourism would be around €490 million, from DRS €887 million and from FIF €2.4 billion. FIF would render highest indirect benefits from environmental improvements overall, where society would be benefiting the most (€1.4 billion); significant indirect benefits were also assessed for tourism (€79 million) and regulators (€65 million), while they were on a much lower scale (€4 million) for fishery sector (De Paoli et al., 2019).

58. According the Horizon 2020 report, recycling saves resources and energy, and reduces greenhouse gas emissions, water consumption and waste generated. The positive externalities of recycled material or external benefits expressed in monetary terms are assessed at €300/ t (Horizon 2020 and UfM, 2014).

59. Costs of not implementing the EU environmental legislation (i.e. foregone benefits) were assessed (EC, 2019a). For water, the implementation gap costs were estimated as the foregone benefits from water not being of a good ecological status, and as the economic value of damages to water resources, e.g. from nitrogen discharges. For Bathing Water Directive, the costs of non-implementation were assessed as losses in labour productivity due to gastrointestinal illnesses that could be contracted from insufficient bathing water quality. The estimates ranged from €6 – 33 million for Cyprus, 1 – 3 million for Croatia, 5 – 31 million for Greece, 3 – 17 million for Malta, and 1 – 4 million for Slovenia.

60. For waste, the implementation gap cost estimate was based on a number of different cost types for the different waste issues. Health and environmental costs associated with illegal landfills could be as high as €1.3 billion (depending on the exact number of illegal landfills, which was not known at the time of the study) at the EU level. Moreover, benefits from non-realised circular economy market developments would be missed if waste legislation was not implemented (EC, 2019a).

6. Distributional aspects

61. Distributional aspects i.e. who will bear costs and benefits of the Regional Plan's implementation need to be carefully considered when specific measures are designed and introduced. The available analyses discussed in this assessment showed, for example, that plastics industries are likely to sustain losses from measures aiming at reduced use or phasing out of SUP products. On the other hand, other economic actors – most notably tourism – and society as a whole are likely to gain significant benefits overall.

62. Design and implementation of schemes for the reuse of treated wastewater in agriculture is another interesting example for the analysis of distributional aspects that should inform respective development of pricing policies so the costs borne by different parties (water consumers, WWTPs operators) are reflected and the profits made are re-distributed in a fair and equitable manner.

63. Affordability is an important issue for financing of municipal environmental infrastructure. A widely accepted guiding principle is that the affordability ceiling for water supply and wastewater services (collection, appropriate treatment, sludge management) is 3% of the average household income. However, poor households might need to pay much more in terms of percentage of their income. There is no fixed rule as to what the ceiling levels for the poorest deciles should be, but empirical evidence suggests that water and wastewater service charges can consume up to 6% or even as much as 10% of household income in some cases (Agreco, 2019). Situation is also likely to vary between different countries. The affordability problems can be addressed through tariff structures as well as through a number of measures aiming at increased efficiency of service providers. Some general recommendations include:

- a. Reduce water losses, introduce water savings measures, improve collection of receivables;
- b. Improve labour efficiency in water supply companies;
- c. Apply least cost solutions for the same level of service;
- d. Apply targeted subsidies for low-income service users; avoid cross-subsidisation;
- e. Consider mechanisms to redistribute burden across the country (solidarity principle).

64. On the regional level, distribution of costs linked to the implementation of the RPs is assumed to be even in terms of total investments needed over time to reach the set targets. However, timing of the investments might place uneven burdens on individual countries depending on specific socioeconomic conditions faced at the moment when financing decisions are made and concrete actions undertaken. The existing regional cooperation and financing mechanism can be used and further developed to address these concerns.

7. Conclusions

65. An estimated investment of €3.4 billion would be needed to cover the costs of wastewater collection and treatment (including sludge treatment at WWTPs) for agglomerations above 2,000 p.e. in the area of application of the RPs in the seven northern Mediterranean Contracting Parties covered in this assessment, four of which with population of less than 0.5 million in the areas subject to the RPs. A significant share of these costs can be attributed to collection system extensions. Implementation of the RPs provisions on wastewater and sludge treatment in Morocco would add another €736.8 million, bringing the total investment costs to over €4.12 billion (data needed to estimate the collection costs for Morocco were not available). The estimate is at current prices, it does not include a dynamic picture and for the majority of analysed countries it can be considered as conservative.

66. Some countries are already very close to implementing WW collection and treatment requirements of the upgraded/ new RPs, but most Contracting Parties will need to invest high amounts to reach the necessary level of treatment and to ensure adequate operation and maintenance. Per capita investments needed to comply with the main RPs requirements in the analysed countries are in the

range of €135 to 1,391. Annual per capita O&M costs (including for the new infrastructure to be developed to ensure compliance) are likely to be in the range of €30 – 48.

67. Provision of high level of wastewater treatment is expensive, especially for small countries with a large number of agglomerations of less than 100,000 p.e. where economy of scale does not apply. Financing the UWWT and SSM improvements required under the RPs will place much lower burden on the countries that have already made significant investments in the past. Distributional aspects on the national level are very important and can be addressed (partly or entirely) through well designed tariffs.

68. Most Contracting Parties will need to improve sludge management and effluent reuse. Additional treatments and infrastructure for reuse could incur significant costs on top of the assessed amount. Reuse should be further promoted through *inter alia* adequate pricing policies. Benefits from circular economy approaches are multiple and sufficient to offset part of the treatment costs.

69. A more focused research would be needed to estimate the costs of implementation of the Upgraded Regional Plan on MLM. At the same time, there is a need for a more systematic data collection and assessment to understand better socioeconomic impacts of the Regional Plan's measures on the national level. Within this assessment, some indicative benchmarks were provided and national examples shared, including on the benefits related to waste management improvements and marine litter prevention and removal measures.

70. Notwithstanding the need for investment-intensive interventions to develop separate collection and recycling capacities of municipal waste management systems, non-infrastructural interventions should be promoted and expanded as their power in addressing the marine litter problems is evident. Market-based instruments proved effective in changing behaviours and yielding environmental improvements in addition to having positive socioeconomic impacts overall.

71. A more coherent response and more stringent requirements for pollution prevention and control are necessary to ensure healthy and productive sea that can sustain Mediterranean economy. Even though an all-encompassing analysis was not possible, existing evidence and examples highlighted in this assessment clearly suggest that the benefits from the RPs implementation will outweigh the costs. Tourism is the economic sector likely to benefit the most from the RPs implementation. Taking into account all the benefits that come from environmental improvements at which the RPs are aiming, society as a whole will also profit substantially.

72. New/ upgraded Regional Plans should not be perceived solely on the grounds of required higher costs for the national level but also as a driving force to improve environmental management systems and as an investment to achieve significant socioeconomic benefits over time.

73. Contracting Parties can apply/ test the approach used in this assessment in the national context, including further review of the unit costs used.

Annex I

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