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Deliverable 10.1 Policy Gap Analysis

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¹R=Document, report; DEM=Demonstrator, pilot, prototype; DEC=website, patent fillings, videos, etc.; OTHER=other

² PU=Public, CO=Confidential, only for members of the consortium (including the Commission Services), CI=Classified

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1. Executive Summary

The Water-Mining project's goals are to both validate and to ensure the wide-spread uptake of innovative water technologies that harvest value-added resources (i.e. clean water, solid materials, and energy). Among the factors enabling technological solutions to be broadly adopted are policy measures that make the solutions relevant to stakeholders. Thus, as part of the Water-Mining project, the WP10 team is designing a set of three policy packages, which will aid the diffusion of the innovations developed for the three Water-Mining sub-sectors (i.e. Sea-Mining, Urban-Mining and Industrial-Mining).

As a fundamental step in this policy design effort, the WP10 team is also evaluating the gaps in the current policy environment, as it enables a policy package design that better addresses possible barriers toward technological diffusion.

Thus, the overall goal of this policy gap research is to investigate at both the EU and EU member-state levels (as well as the partner country, India), respectively, the existing policy environment, its potential support for the widespread uptake of the Water-Mining technologies, and the policy gaps that need to be further examined and neutralized in the process of devising the packages.

The policy gap analysis presented here, was conducted at both the EU-level, as well as the country level. First, a set of policy objectives were designated for each of the three sub-sectors. These objectives were used both as reference points in the analysis and as means of classifying policies.

At the EU-level, the policy gap team created a database of policy measures that had the potential for supporting any of the objectives of the three Water-Mining sub-sectors. These measures were collected and annotated from a set of the most relevant documents, a total of 31, published by the EU, including Regulations, Directives, Communication (COM), and Staff Working Document (SWD). The analysis was done by analyzing the degree to which relevant policy measures found in the EU documents support the objectives delineated for each of the three sub-sectors. In turn, it was possible to see where gaps exist in each sub-sector and then suggest policies from WP10's policy inventories (designed with the framework of the policy packaging process) that might fill in those gaps.

At the EU member-state level, the policy team also examined the gaps among the policy objectives, based on our respondents' expertise, supplemented by national policy and research literature.

Main findings and conclusions of the EU-level policy gap analysis:

1. The policy measures contained in the EU-level documents can potentially support specific elements of the different Water-Mining objectives, though not all elements.
2. Two notable exceptions of objectives with almost no EU policy support are:
 - Sea-Mining Objective 5: Ensure the widespread use of desalinated water among consumers concerned about its quality;
 - Industrial-Mining Objective 3: Ensuring sustainable production and consumption by adopting innovative business models such as chemical leasing.
3. More specific policy measures are needed for the objectives in all three subsectors, most especially measures which support, financially the uptake of the Water-Mining technology.
4. The large majority of the policies analysed are most closely connected to command and control without the other types of measures: government investment, market-based, encourage-voluntary and integration. We note: that as Water-Mining is an innovation action, financial support policy is crucial to successfully disseminate its technologies). This claim receives support from our interviews with our country respondents.

Responding to these gaps, WP10's policy team devised and suggested comprehensive sets of policy measures, as detailed in the results section, to be considered for each objective in the three subsectors.

Most importantly, the EU-level policy gap analysis provides a comprehensive and structured base necessary for devising the policy packages.

We also analysed the policy support received for the different objective categories across the three different sub-sectors. Here are the main findings from this analysis, presented by category:

Energy objectives:

- There are strong, general, EU-level, policy supports for promoting biofuel (including biogas) use, solar energy and even the recovery of waste heat.

- However, there are almost no specific policies supporting the actual harvesting of energy sources, such as waste heat in Sea-Mining plants (objective 1) or biogas in Urban-Mining plants (objective 4), nor of using alternative energy sources, such as solar in said plants.
- There are policy supports for minimising the use of energy, which might affect any industrial installation, including an industrial wastewater plant), most notably via techniques to improve efficiency.

Waste management objectives

- The EU has created a strong set of policies supporting both waste reduction directly, or indirectly (via decreasing landfilling options).
- EU policy directly favouring reducing the amount of waste may not be specific enough to affect Sea-Mining wastes (brine) or Industrial-Mining wastes (brine, sewage sludge).

Solid material recovery objectives

- The EU strongly promotes the reuse of critical raw materials in-line with CE principles. These materials include magnesium and phosphorus, chemicals that can be obtained from Sea-Mining and Urban-Mining operations, respectively.
- Financial support of these targets is much less common.
- It is questionable whether the current directives connected to the *Sewage Sludge Directive* or *Regulation proposal for CE market fertilizing products*, respectively, would support Kaumera harvesting and its reuse, from Urban-Mining activities
- There are no policies supporting the harvesting of salts or Na or Cl streams connected to Industrial-Mining activities.
- In general, industrial wastewater operations are connected to a wide variety of industrial wastes so current policy could help to support the potential mining of some important secondary and even critical raw materials.

Sustainable consumption and / or production of water (including recovery)

- Our EU document data-base (Table 4-7) contains seven documents dominated by water issues (i.e., with the term “water” in their titles). Nonetheless, it lacks, surprisingly, strong measures associated with sustainable water consumption (i.e. conservation)
- Regarding production (including recovery) much of the existing EU policy is focused on urban wastewater (objective 1) as an alternative water source for agriculture.

- These policies include stringent rules concerning the operation of water reclamation facilities, connected to urban wastewater recovery, which could also affect industrial wastewater facilities as well.
- There are policies connected to general efficient use of water in industrial installations. These could be broadly interpreted as affecting the operation of Industrial-Mining (objectives 1 & 2) but again the policies lack specificity.

Main findings and conclusions concerning policy gaps at the country-level

These are also presented using the cross-sector categories of policy objectives mentioned above:

Energy objectives

- With regards to renewable energy use and waste heat harvesting in desalination plants, policy is weak.
- In contrast there is a long history of harvesting biogas in urban wastewater plants across EU countries and policy is generally strong.
- Concurrently, there is enthusiasm, reflected in strong policy, for alternative energy use in the Urban-Mining subsector.
- Finally, there was no consensus about whether policy supported minimising energy usage, specifically within the industrial wastewater sub-sector (objective 1).

Waste management objectives

- With regard to desalination operations, most of the respondents claimed that policy gaps were small.
- For industrial wastewater there was no agreement among the respondents about the gaps in waste management policies governing operation with ratings for policy that spanned the spectrum from weak to strong.

Solid materials recovery objectives

- Our country respondents were unequivocal about the fact that policy was weak with regards to this objective.
- Nonetheless, research and development of technology that could harvest solid materials from (waste) water is proceeding in many of our respondent countries.

Sustainable consumption and / or production of water (including recovery)³

Consumption:

³ Connected to Sea-Mining objective 2, Urban-Mining objectives 1 & 2, and Industrial-Mining objectives 1 & 2.

- In both the Sea-Mining and Urban-Mining sub-sectors, our respondents claim that policy gaps are small, underlining the idea that conservation is supported. They cited a variety of policies, most notably market-based tools (including pricing) to enforce conservation. EU-level policy seems weaker concerning conservation.
- In the Industrial-Mining sub-sector the picture is less clear, concerning consumption (Industrial-Mining objective 1).

Production:

- Our respondents expressed the idea that policy does not support the closed-loop recovery of water from industrial processes.
- In opposition, in the Urban-Mining sector policies supporting water recovery appeared to be quite strong.
- Concerning the Sea-Mining sub-sector, policy was considered to be anywhere from weak to strong in connection to sustainable production.

2. Introduction

The Water Mining Project

The Water-Mining Project's goal is to develop and validate innovative water resource technologies in pre-commercial case studies, aiming to provide for real-world implementations, within the frameworks of the *EU Circular Economy Action Plan* and the *EU Green Deal*, respectively. These case studies combine water management services with the recovery of value-added, renewable resources extracted (or “mined”) from alternative water resources.

The water management services can be classified into three sub-sectors: Sea-Mining (i.e. desalination), Urban-Mining (i.e. urban wastewater treatment) and Industrial-Mining (i.e. industrial wastewater treatment). The value-added end-products can be largely divided into three general groups: reclaimed water, reclaimed solids/chemical materials, and energy, some of which can be used within the water-mining operations and others which can be transferred to another part of a value chain.

Historically, water from industry, agriculture, and urban areas has been cleaned in preparation for returning it to nature (i.e. rivers, lakes, aquifers), while any solids collected were disposed of. The Water-Mining project is revolutionary in that its goal is to propagate the widespread uptake of technologies that would ensure the reuse of vital, natural resources, which in the past were treated as waste. The result is decreased pressure on natural systems, while creating valuable resources for human systems, thus fulfilling a major principle of the circular economy.

Promoting the adoption of the water mining technologies

Nonetheless, technological innovation cannot propagate in a vacuum. In order that the Water-Mining technologies be adopted on a wide-scale basis, innovative business models must be designed and implemented, to not only stimulate progressive forms of collaboration between public and private actors, but also liberate access to private investment. Concurrently, policy measures must be recommended and adopted to make the proposed technological solutions relevant and accessible to its many stakeholders, including government and business interests.

Thus, as part of the Water-Mining project, work packages have been devised to deal with the business and policy environments, so that new, innovative, effective and viable business models and policy measures are designed. Regarding the policy work package (WP10), the main product of its efforts are three *policy packages* addressing the three sub-sectors of water management mentioned above (i.e. Sea-Mining, Urban-Mining and Industrial-Mining) complemented by additional policy measures necessary for large-scale implementation of each case-study (CS).

Briefly, policy packaging has been advanced in recent years by researchers in a variety of sectors⁴ as a way to combine seemingly disparate policy tools into coherent sets (packages) in a manner that enhances synergies among them, as well as improving their acceptability and implementability. Policy packages are thus synergic combinations of policy tools geared to effectively achieve policy goals, while minimising unintended effects, and enhancing the package's legitimacy and viability.

Policy gap analysis

The policy design process requires a solid understanding of existing policy gaps. Gap analysis is a powerful and efficient step in policy design. It provides focus, direction and accountability for improving policy. In addition, policy elements identified as missing or partially missing, through a gap analysis, can then be examined more closely to both improve them and to support stakeholders' objectives. In addition, its results can be used to set priorities by ranking and comparing the breadth of the gaps. In sum, gap analysis answers the question of "where we are and where do we want to be". Policy can also regulate the performance of technologies and their uptake, as well the financial environment that supports those technologies; thus, policy gap analysis has critical implications for policy design.

Gap analysis, as a tool, has been broadly adopted by international organisations to assess their policies, including the *World Health Organisation* (WHO)⁵, the *United Nations International Children's Emergency Fund* (UNICEF)⁶, and the *International Union for Conservation of Nature* (IUCN).⁷ Closer to the subject of the Water-Mining project, gap

⁴ Feitelson, 2003; Feitelson et al., 2013; Fischhendler and Zilberman, 2005; Givoni et al., 2013; May & Roberts, 1995; Pereira et al., 2017.

⁵ World Health Organization. Available online: www.who.int/influenza/pip/pip_pc_ga.pdf

⁶ Unicef. Available online: https://www.unicef.org/jamaica/gapanalysis_finalreport_sep2016.pdf

⁷ IUCN—International Union for Conservation of Nature. Available online: https://cmsdata.iucn.org/downloads/pag_015.pdf

analysis, as a method for identifying gaps in the management of water services has also been explored.⁸ Nonetheless, there appears to be no peer-reviewed literature that has examined policy gaps influencing desalination, urban wastewater and industrial wastewater systems, respectively.⁹ So in essence our study also fills an important knowledge gap by exposing the existing policy framework and its interaction with these important water technological systems.

Report Structure

This report is structured as follows. Following this *Executive Summary* (Chapter 1), in Chapter 2, *Introduction*, we discuss the concept of the gap analysis, in general and why it is important for policy design (especially within the framework of the Water-Mining Project). In Chapter 3, we document the research goal, definition and central outputs of the gap analysis. In Chapter 4, *Methods*, we explain our methodological rationale (Section 4.1), how we analysed our EU-level policy document database (Section 4.2), as well how we analysed the interviews held with water policy experts from countries participating in the Water-Mining project (4.3). Chapter 5, *Results*, presents the outcomes of the gap analysis we conducted on the EU-level policy documents (5.1-5.4). Chapter 6 highlights the responses of our country-level policy experts, based on our interviews. Chapter 7, *Conclusions*, summarises our findings.

⁸ See for example: Han, Hwang, Kim, Baek, and Park, G. (2015), Han, Koo, Kim, Kim, and Park (2017), Latinopoulos, Sidiropoulos and Kagalou (2018), and Spirandelli, Dean, Babcock, and Braich, (2019).

⁹ The last paper cited, Spirandelli, Dean, Babcock, and Braich, (2019), is peripherally connected to urban wastewater treatment. It assessed Hawaii's regulatory provisions of on-site wastewater treatment sites in relation to the US EPA's recommended guidelines for protecting environmental health. On-site wastewater systems include septic tanks, cesspools or cesspits, aerobic treatment units (ATUs), and composting toilets which can broadly be included within the urban wastewater system (although such systems are decentralised).

3. Research Goal, Definition and Central Outputs

Research goal

The overall goal of this policy gap research is to investigate at both the EU and EU member-state levels (as well as the partner country, India), respectively, the existing policy environment, its potential support for the widespread uptake of the Water-Mining technologies, and the policy gaps that need to be further examined and neutralized in the process of devising the packages.

This is done at two levels of governance, as both levels will influence the fulfilment of the Water-Mining objectives. This is a crucial step in designing policy packages, focused on understanding the current policy environment, including its structure and performance, as it allows the creation of a policy package that addresses the actual gaps in policy.

Policy gaps definition

Policy gaps are defined as:

- Policies that do not exist
- Policies that partially cover the needs of a goal but are not extensive, or detailed enough to fully support those needs
- Policies that do exist, such that they act as barriers toward the effective accomplishment of stated objectives.

This research focuses on the first two types of gaps, as it sets a firm basis for devising policy recommendations. Partial findings of the third type were revealed by the country-level respondents and more will be collected in later stages of the research through further interviews and workshops.

The main output: a comprehensive and structured analysis of policy gaps

In this research, a comprehensive and structured analysis of policy gaps was generated. These outputs will serve further stages of WP10's work, in which the policy team will single out the most substantial gaps and devise appropriate policy responses. This is in accordance



with the work plan as described in the project's proposal which is further elaborated within **D10.5 Policy Packaging and Its Applicability to the Water-Mining Project.**

An additional output of this process is a policy measures database, relevant to the subsectors and case studies that we generated for our analysis, consisting of existing policy measures. It comprises approximately two hundred relevant policies, collected from the most applicable up-to-date EU-level documents. This database is built in a way that permits for adding more policies, if such are found further on in the research process.

4. Methods

4.1 Overview, rationale and integration with policy packages

4.1.1. Overview and rationale

The policy gap analysis is comprised of two stages:

Stage I: Gap analysis of EU-level policy. The analysis was based on a comprehensive and structured analysis of existing EU policy relevant to the subsectors and case studies. Existing policy was derived from EU-level documents including directives, communications, and staff working documents that are relevant and could potentially influence the six Water-Mining case studies included within the three sub-sectors. The analysis was done by analyzing the degree in which relevant policy measures found in the EU documents support the objectives delineated for each of the three sub-sectors. In turn, it was possible to see where gaps exist in each sub-sector and then suggest policies from WP10's policy inventories that might fill in those gaps.

Rationale: These are the main outputs of the deliverable: providing a solid basis of existing EU policy, while exposing potential policy gaps, in order to serve as a basis for devising effective and viable policy packages.

Stage II: Gap analysis for the case-study host-country level. This analysis is based on in-depth, semi-structured interviews with water policy experts connected to the Water-mining case study countries: Cyprus, Italy, India, Netherlands, Portugal and Spain, as well as Greece.¹⁰

Rationale: This is a complementary analysis providing context and initial findings concerning policy at the Member State (MS) level. Further data and analysis will be added later on in the work of the policy packages.

¹⁰ Based on the amended grant agreement Greece replaces South-Africa.

4.1.2 Integration with stages 1 and 2 of the policy packaging process

An important aspect of the gap analysis is the usage of outputs from stage 1 (defining objectives) and stage 2 (generating a policy inventory) of the policy packaging process.¹¹

In the stage, ‘**defining objectives,**’ the policy team delineated the main goal and the derived objectives for each of the three sub-sectors. This process provided a basis for a structured analysis of policies and their gaps, by using the main goals and derived objectives as points of reference and as means for classification.

In the stage, ‘**generating a policy inventory,**’ each sub-sector work group devised a list of 70-100 relevant policy measures that should be examined as potential candidates for the policy packages. These lists were used as reference points for the policy gap analysis (i.e. to understand where gaps exist in current policy).

4.1.3 Goals and objectives for each sub-sector

The main goals and derived objectives for each sub sector are listed below in Tables 4-1 – 4-6. Note that for the three tables dealing with objectives (4-2, 4-4, 4-6), the policy team also grouped them (i.e., the objectives) via shared, cross-cutting categories to allow for easier comparison between the policy gaps in the three sub-sectors in the Conclusions section (Chapter 7).

Table 4-1: The goal of the Sea-Mining sub-sector (CS1, CS2) policy package

Goal: To provide high-quality water and mined products, while reducing the environmental impact of the technological solution.

General note: These successful achievements will in turn enable the technology’s widespread implementation.

Table 4-2: The objectives of the Sea-Mining sub-sector (CS1, CS2) policy package

¹¹ See D10.5. Policy Packaging And Its Applicability To The Water Mining Project: A Summary Of A Concept And Methodology

No.	Category ¹²	Objectives
1	Alternative energy / Energy Recovery	Enable the widespread use of renewable energy, as well as the use of waste heat in sea-water desalination processes
2	Sustainable consumption / production of water	Enable the sustainable production and consumption of expanded sources of water.
3	Waste management	Ensure the sustainable management of the brine effluent wastewater from sea-water desalination.
4	Solid Material / Chemical recovery	Enable the sustainable recovery of materials (such as Mg, NaCl and other salts) from sea-water desalination.
5	Promoting sustainable products	Ensure the widespread use of desalinated water among consumers who are concerned about its quality (i.e. not enough minerals, or too much Boron).

Table 4-3: The goal of the Urban-Mining sub-sector (CS3, CS4, CS5) policy package

Goal: To recover water, energy and resources from municipal wastewater treatment plants, while reducing the environmental impact of the technological solutions.

General note: These successful achievements will in turn enable the technology's widespread implementation.

¹² Cross-cutting categories shared with the other Water-Mining sub-sectors.

Table 4-4: The objectives of the Urban-Mining sub-sector (CS3, CS4, CS5) policy package

No.	Category ¹³	Objectives
1	Sustainable production of water	To sustainably recover water in urban settings to provide a new, secure, supply of this resource (for industry and agriculture) which leads to decreased water stress.
2	Sustainable consumption of water	To promote sustainable use of (all) water sources available to different sectors.
3	Solid Material / Chemical recovery	To recover and valorise waste material from urban wastewater treatment into useful resources
4	Alternative energy / Energy Recovery	To recover energy from waste water treatment, as well as using alternative sources of energy, in order to close the loop in urban wastewater treatment plants.

Table 4-4: The goal of the Industrial-Mining sub-sector (CS6) policy package

Goal: To conserve and recover water for reuse in a closed loop, recover heat, as well as mine crucial chemicals (such as Cl and Na), while reducing the environmental impact of the technological solution.

General note: These successful achievements will in turn enable the technology's widespread implementation.

¹³ Cross-cutting categories shared with the other Water-Mining sub-sectors

Table 4-5: The objectives of the Industrial-Mining sub-sector (CS6) policy package

No.	Category ¹⁴	Objectives
1	Sustainable consumption of water	Promote industrial collaboration along the value chain in order to minimise the use of raw materials (water) and energy. [Note: Energy here refers to waste heat recovery].
2	Sustainable production of water	Enable the continuous reuse of water within a closed-loop system to reduce the use of freshwater.
3	Innovations in business	Ensuring sustainable production and consumption by adopting innovative business models such as chemical leasing.
4	Waste management	Reduce wastewater and waste (brine, organic, sludge) some of which is normally disposed of via incineration or landfill.
5	Solid Material / Chemical recovery	Enable the sustainable recovery of materials (such as Na and CL streams as well as NaCl) from industrial water mining operations.

4.2 Gap analysis of EU-level policy

The analysis was done by comparing relevant policy measures found in the EU documents to the policy inventories to determine to what extent they support the objectives of the three Water-Mining sub-sector. Based on that analysis it was possible to determine the policy gaps and suggest policies based on the WP10 policy inventory to fill in those gaps.

4.2.1 EU-level document inventory

The EU document inventory (Table 4-7, below) includes directives, communications, and staff working documents that are relevant and could potentially influence the six Water-Mining case studies and their three sub-sectors. Table 4-7 lists the EU-level legislation / regulation,

¹⁴ Cross-cutting categories shared with the other Water-Mining sub-sectors

or other policy documents that were analysed by the Policy Gap Team in order to establish whether a Water-Mining sub-sector objective was **supported** by existing policy measures in said document.

Part of Table 4-7 was originally assembled by the project leaders of the Water-Mining consortium, as part of the Grant Proposal. It is supplemented by many more documents. Note that ten of these documents are associated with the Circular Economy (ex. *An EU action plan for the Circular Economy*). The others are distributed among the topics of water (ex. *Water Framework Directive*), waste (ex. *Waste Framework Directive*), chemical use (*REACH*), energy (*on the promotion of the use of energy from renewable sources*) and the *Green Deal*.

Table 4-6: EU-level policy documents utilized in the gap analysis

No.	Legislation / Regulation or other Policy document such as communication (COM), Staff Working Document (SWD)*
1	Directive 2000/60/EC: " Water Framework Directive "
2	Directive 2008/98/EC: " Waste Framework Directive "
3	DIRECTIVE (EU) 2018/200: " on the promotion of the use of energy from renewable sources (recast) (128)
4	COM(2018) 97 final: " Action Plan: Financing Sustainable Growth "
5	Regulation (EC) No 1907/2006: " REACH regulation "
6	Directive 86/278/EEC: "Sewage sludge directive"
7	Directive 91/271/EEC: " Urban Waste Water Treatment Directive "
8	Directive 91/676/EEC: " Nitrates Directive "
9	Directive 98/83/EC: " Drinking Water Directive "
10	Directive 2010/75/EC: " Industrial Emissions Directive " - BREF documents
11	SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) 111 "final amending Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)"
12	Decision C(2013) 8589 regarding the BREF on " Chlor-alkali production "
13	{SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: " Chemicals Strategy for Sustainability Towards a Toxic-Free Environment "
14-15	Circular Economy Package, including:
14.1	COM(2015) 614 final: " An EU action plan for the Circular Economy "
14.2	COM(2018) 29 final: " Monitoring framework for the circular economy "
14.3	COM 2018/337: " Minimum requirements for water reuse "
14.4	REGULATION (EU) 2020/741: " on minimum requirements for water reuse "
14.5	SWD(2018) 36 final: " Report on Critical Raw Material " Part 1, Part 2 and Part 3
14.6	OJ, 14.6.2018, L 150: " Revised Waste Legislative Framework "
14.7	COM(2016) 157: " Regulation proposal for CE market fertilizing products "
14.8	COM(2019) 190: " Implementation of the Circular Economy Plan " and the
14.9	accompanying document SWD(2019) 90 on the progress of the 54 actions
15.0	COM (2020) 98 A new Circular Economy Action Plan for a cleaner and more competitive Europe
15.1	Annex to COM (2020) 98 A new Circular Economy Action Plan for a cleaner and more competitive Europe
16	EU Green Deal
16.1	COM(2019) 640 final: "EU Green Deal"
16.2	Annex to the Green Deal: " Roadmap – Key actions "
16.3	{SWD(2021) 140 final} - {SWD(2021) 141 final}: " Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil' "
16.4	{COM(2021) 400 final} - {SWD(2021) 141 final}: " COMMISSION STAFF WORKING DOCUMENT Digital Solutions for Zero Pollution "

17	BAT reference documents
17.1	Reference Document on Best Available Techniques (BAT) for Energy Efficiency
17.2	Reference Document on Best Available Techniques (BAT) for Waste Treatment
17.3	Reference Document on Best Available Techniques (BAT) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector

4.2.2. Method of analysis

Using the three sets of objectives delineated in Tables 4-2, 4-4 and 4-6 above, the EU-level policy papers, listed in Table 4-7 were analysed. The method of analysis was as follows:

- i. A set of introductory meetings were held among the three policy gap teams, who were members of the Water-Mining Consortium (JIIS, JIN, and USC) to outline the EU policy gap methodology. The result was a tool that permitted both the coding and exemplification of policies that fulfilled the needs of the objectives derived in step 1 of the policy packaging process, and described in Tables 4-2, 4-4 and 4-6, respectively.
- ii. Dyads (i.e. pairs of analysts) from each of the three policy gap teams coded approximately one-third of the document database (Table 4-7). This coding was pursued in pairs to increase the inter-rater reliability by allowing the pairs to check their counterpart's analysis. The dyads coded any policy statement that could potentially support / enable any of the objectives from the three sub-sectors. The codes consisted of quoted policy measures, along with the coders' explanatory comments justifying the reasons for the coding.
- iii. All of the coded policy documents were subsequently entered into a Policy Measures database. This consisted of the policy measure quotes connected to each objective and its accompanying explanation.
- iv. For each objective in each of the subsectors, the recorded EU policies were analysed for gaps by comparing them with the policies that were created in the inventory of policies for each of the three sub-sector, Water-Mining policy packages. As explained in the previous section, these policies were created in stage 2 of the policy packaging process. As part of this process, all policies in the inventory were classified according to the objective they support within the three sub-sectors, as well as "policy type". Table 4-8 below provides the policy types and their definitions. This typology aided in the gap analysis as it indicated whether a

full suite of policies were available to support a stated Water-Mining objective. As, Water-Mining is an Innovative Action (IA) project, financial support policies are key to developing and disseminating the technology that the IA is dependent upon. By classifying measures according to type, it was possible to know if such measures were lacking.

Table 4-8: Policy Types and their Definitions

Policy Types	Definition
Command and Control	Such policy operates by imposing mandatory obligations or restrictions on the behaviour of firms and individuals. Measures include regulations, permits, enforcement, fines and ownership issues.
Market-based	Such instruments work by creating incentives for individuals or firms to change their behaviour. These instruments alter the structure of pay-offs that agents face. Measures include fiscal incentives, grants and fiscal disincentives, charges, tradable permits and deposit refund schemes.
Encourage-Voluntary	Such policies encourage individuals or firms to voluntarily police their own behaviour. Measures include (media) communications, participation and education, nudges and labels.
Government Investment	Investment by the government to resolve environmental issues is typically considered as the provision of public goods. It includes investment in infrastructure, in institutions (e.g. regulatory authorities), and in R&D. While these aspects might be considered stand-alone, there is one thing that unites them: they are basically reliant on expenditure by the government to promote environmental protection.
Integration	Policies that build collaboration at scale among different stakeholders such as between producers and consumers, as well as among actors within a value chain, or between government agencies. It is essentially, therefore, a higher level policy that has more than one target.

4.3 Gap analysis at the case-study host-country level

As was noted, complementary to our EU-level gap analysis, semi-structured interviews were held with policy experts who are stationed in the EU member-states in which the Water-Mining case studies are being conducted: Cyprus, Italy, the Netherlands, Portugal, Spain as well as in Greece (which replaces South Africa) and India (which is a partner with the Netherlands in CS6). These interviews were pursued to provide greater insight into the following questions:

- i. Has the specific country adopted policies that support the policy objectives defined by the Water-Mining consortium (Table 4-2, 4-4, 4-6)?
- ii. How strong are these policies, if they do exist? To answer this question a Likert scale from 1-10¹⁵ was provided so that the respondent could rate how strongly his / her country has erected policies that might support the objective.
- iii. What factors (financial, politician, institutional etc.) are acting as enablers or barriers towards the development of the policy objectives? This question, in turn permits the respondent to justify his rating in part ii above.

Most respondents were interviewed with regard to two subsectors, one connected to the sub-sector of the case-study being conducted in the country and the other dependent on the expertise and preference of the respondent.¹⁶ All interviews were held in English and ran for approximately one hour for each sub-sector discussed.¹⁷

The sample includes at least one respondent from each of the Water-Mining case-study countries. The description of the respondent sample is found in Table 4-9 below. It includes his / her country and interview identifier (ex. Portugal – PT1), role in organisation, and the sub-sector(s) for which the respondent was interviewed. All respondents gave written

¹⁵ A score of 1 indicates the weakest possible ranking, whereas a score of 10 indicates the strongest possible ranking.

¹⁶ The respondents were found in a number of ways. Most of the respondents were contacted by members of the Water-Mining team who were familiar with a specific member-state. In other cases, the respondents were found based on a search through the Water-Mining sector literature, to identify the expertise of the researcher / writer; if appropriate, the researcher / writer was contacted.

¹⁷ In some cases the interviews were also attended by the member of the Water-Mining team who first contacted the respondent to aid with communication.



consent to participate in the interviews (with the guarantee that their identities would be anonymized). A total of 17 interviews were held with 10 respondents.

All respondents signed a release form indicating that they understood that the results of these interviews were to be used as part of the research on policy for the EU-funded Water-Mining Project. The identities of all the respondents were anonymized by using the two letter EU country codes and a number instead of actual names.

Table 4-9: Description of Gap Analysis, Country-level Respondents

Respondents and Country of Origin ¹⁸ (n = 10)	Role in Organisation	Sub-Sector interviews ¹⁹ (n =17)
CY1: Cyprus	Civil / Environmental Engineer (ex-assistant Water Director) for a Cypriot consulting company involved in several EU (environmental) projects including water-mining	SM, UM
IN1: India	Principal Scientists (Soil Physicist and Conservationist) for an Indian Centre of Water Technology and Agricultural Research	IM
GR1: Greece	Senior Researcher (Chemical Engineer) at a Greek University in its Unit of Environmental Science & Technology	SM
IT1: Italy	Technical Manager of an Italian Desalination Company	SM
NL1: Netherlands -	Program Manager for a Circular Economy Research Center, with expertise in water issues	UM, IM
NL2: Netherlands	Advisor in a Dutch Ministry dealing with Economic Affairs and Climate	UM, IM
PT1: Portugal	Board member of a Portuguese Centre for Water	SM, UM
PT2: Portugal	Board Member for a Portuguese Urban wastewater treatment company (and past experience in private sector industry)	UM, IM
ES1: Spain	Regional Manager for a Spanish Water Company	SM, UM
ES2: Spain	Director (General Manager) for public water management organisation	UM, SM

¹⁸ The identities of all the respondents are anonymized by using the (Alpha-2) two-letter country codes (based on the ISO 3166 international standard) and a number instead of their actual names.

¹⁹ SM, UM and IM, refer respectively to the Sea-Mining, Urban-Mining and Industrial-Mining sectors. The majority of respondents were interviewed, in separate interviews concerning two sub-sectors, as indicated in **Table 4-9**.



The interviews were recorded, transcribed and then coded by members of the gap-analysis team. Rather than a grounded-up, emergent coding, the gap analysis team members focused on the specific gaps in policy connected to each sub-sector objective. In simple terms, the stated objectives acted as predetermined codes for analysing the interviews. The findings from the interviews are found in Chapter 6, *Gap analysis at the Water-Mining country-level, based on interviews with policy experts*.

5. Results: Gap Analysis of EU-level Policy

5.1 Section structure

The section structure is as following:

- **Three subsections for each of the Water-Mining sub-sectors:** Sea-Mining, Urban-Mining and Industrial-Mining.
- **Analysis for each objective in the subsectors,** (i.e. the *objectives* that were formulated for each sub-sector).
- The analysis for each objective is divided into two segments:
 - I. **A summary of existing EU policies** that have the potential for supporting the specific objective. This summary is linked with a full list of policy quotes / paraphrases listed in the appropriate Appendix.²⁰
 - II. **A brief discussion of the policy gaps and of suggested policies** to be further examined and developed in later stages of the project.

5.2 Sea mining

Analysis of current EU policy and their gaps is done with regard to the five objectives formulated for the Sea-Mining sub-sector.

5.2.1 Sea -Mining Objective 1: Using renewable energy and waste heat

Objective 1: Enable the widespread use of renewable energy, as well as the use of waste heat in sea-water desalination processes.

Summary of relevant EU policy²¹

²⁰ There are three appendices corresponding to the objectives in the Sea-Mining, Urban-Mining and Industrial-Mining sub-sectors.

²¹ See Appendix 9.1 for the full list of policies, referred to in this section, concerning Sea-Mining Objective 1.

DIRECTIVE (EU) 2018/200: on the promotion of the use of energy from renewable sources (recast) promotes many relevant command and control measures guiding the MS and EC to consider the uses of waste heat and renewable energy. Thus it advises the MSs and EC to:

- **Assess the potential** of energy from renewable sources and the use of waste heat and cold.
- **Facilitate the exchange of best practices** between national authorities to find a common approach to promote a higher uptake of renewable energy projects
- **Establish a strategy to retire technologies** that do not reduce emissions
- **Include provisions for deploying** renewable energy, including waste heat when planning, in building and renovating urban and energy infrastructure.

COM(2019) 640 final: EU Green Deal, promotes measures aiming to make the European Union (EU) climate neutral by 2050 by also making cleaner energy choices including waste heat and renewable energy; thus:

- **The plan is to review each existing law** on its climate merits,
- **Introduce new legislation on the circular economy, building renovation and innovation.**
- **Explore and use the opportunities that digitalisation presents** for monitoring and optimising how energy is used.

{SWD(2021) 140 final} - {SWD(2021) 141 final}: *Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil*, could potentially support this objective by:

- **Introducing stricter requirements to tackle air pollution at source**, such as from industry and energy.
- **Revising the Energy Taxation Directive** so that users are encouraged to choose less polluting energy sources. This is a crucial market-based measure that enforces this document's goals.

Finally, *Directive 2010/75/EC: Industrial Emissions Directive - BREF documents* promotes energy efficiency objectives via:

- **Usage of appropriate tools for identifying energy optimization** including when planning new installations or a significant upgrade.
- **Carrying out systematic comparisons** with sector, national or regional benchmarks.
- **Monitoring key characteristics of operations** that have a significant impact on energy efficiency.

It is important to note that by providing energy efficiency techniques this could influence the choice of using waste heat as one solution.

Gap analysis

Existing EU policy could potentially provide support for some aspects of Objective 1. Nonetheless, none of this policy is directed toward desalination plants, specifically. Further, most are command and control type policies. The outstanding exception is the *Energy Taxation Directive*. In any case, installing renewable energy capacity and/or recovery of waste heat involves expensive infrastructure and technological fixes requiring strong supporting financial policies. Responding to these gaps, WP10's policy team will consider the potential advantages of additional measures such as:

- *Command and Control* policies that address:
 - **Monitoring different types of energy usage**
 - **Setting standards for energy usage by type**
 - **Setting standards for energy efficiency**
- Market-based policies that address:
 - **Subsidising transition into more carbon efficient desalination plants** including more extensive usage of renewable energy and higher energy efficiency.
- *Government Investment* policies that address:
 - **Improving energy efficiencies**
 - **Retrofitting plants** to use alternative sources of energy including solar and waste heat.

5.2.2 Sea -Mining Objective 2: Sustainable production and consumption

Objective 2: Enable the sustainable production and consumption of expanded sources of water.

Summary of relevant EU policy²²

When abstracting water from the sea two main sets of sustainability issues can arise with regards to sustainability (within the framework of the objective):

²² See Appendix 9.1 for the full list of policies, referred to in this section, concerning Sea-Mining Objective 2.

- Production issues. These include the areas needed for desalination plants near the sea shore; the discharge from the pipe into the sea floor which could cause damage to the local ecology.²³
- Sustainable consumption issues. This would include the over abstraction of water sources (i.e. conservation) and misusing this resource once it is in the system.

Directive 2000/60/EC: “Water Framework Directive” provides a brief framework to support objective 2 by guiding the EC and MSs to:

- **Provide for a water framework to coordinate principles** for sustainable water use.
- **Identifying waters** used for the abstraction of drinking water

{SWD(2021) 140 final} - {SWD(2021) 141 final}: Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil also contributes to this objective by aiming to:

- **Ensure that MSs promote sustainable and efficient water consumption**
- **Present a fair water bill to all water users and polluters, making the best use of the revenues for sustainable investments.**

Directive 91/676/EEC: Nitrates Directive is more specialised, as it focuses on how a specific nutrient can affect water sustainability. This could ultimately affect water from any source including water obtained from desalination. It enjoins MSs to:

- **Establish codes of good agricultural practice, while training farmers** about such practices
- **Monitor the nitrate content** of their water
- **Limit the land application of fertilisers**

Gap analysis:

The existing policies deal with sustainable consumption and production of water in general. However, there is little to no specific connection to desalination. As a response to these issues, WP10’s policy team will consider the potential benefits of additional measures such as:

²³ Two other problems connected to sustainable production include: the copious amounts of energy needed to desalinate (leading to high emissions) and the production of concentrated waste brin. These issues are dealt with in Sea-Mining objectives 1 and 3, respectively.

- *Command and Control* policies that address:
 - **Mandate the use of sensors / metres for measuring all uses of water.** (In some places in the EU, water is abstracted illegally without measuring its use).
 - **Mandate that the supply of water be controlled in order to prevent over-consumption** of fresh water, by restricting drilling / pumping permits, and that **above a specified limit, desalinated sources should be used.**
 - **Provide a regulatory framework to guide the sustainable commission of desalination infrastructure** in terms of geographic location, equipment (such as pipeline, membranes etc.) and operations.
 - **Mandate that all EU formulate Regulations / Directives for sustainable production and usage of water** that takes into account regional demand, season etc.
 - **Mandate environmental assessments** on the functioning of desalination plants.
- *Market-based policies* that address:
 - **Disincentivize the use of fresh water sources via taxes or fines to encourage the use of desalinated water.** (The money collected could also be used to support desalination development).
 - **Create a differential pricing scheme for water emanating from different sources to reflect their production and environmental costs** (externalities). This would promote conservation.
 - **Create a variable price range for consumers of water**, as a function of its use.
- *Government Investment* policies that address:
 - **Provide investment in technologies / pilots** that improve the effectiveness/ efficiencies of Sea-water desalination plants in terms of water produced.
 - **Government creates beta-testing sites** in government run seawater desalination plants to provide proof of concept for new SWD technology.
- *Integration* policies that address:
 - **Brokering private-public partnerships** to advance the development of desalination infrastructure.

5.2.3 Sea-Mining Objective 3: Sustainable management of the brine effluent

Objective 3: Ensure the sustainable management of the brine effluent wastewater from sea-water desalination.

Summary of relevant EU policy²⁴

Two policy documents provide the general and most prominent support for this objective:

Directive 2008/98/EC: Waste Framework Directive provides a framework that could be extended to the brine wastes produced by desalination, but there is no specific reference to desalination itself. Further, the majority of its measures are related to command and control promotion of minimising waste via prevention programs. It legislates that:

- **Develop waste prevention programmes** concentrating on key environmental impacts.
- **Guides for safe disposal** that does not involve uncontrolled management of waste, **including unregulated releases into the ocean**, or dumping.
- Hazardous wastes receive special attention with producers responsible for maintaining detailed records of their operations.
- Market-based enforcement measures are less common, but do cast a wide net on both the producers of waste and those responsible for its disposal.

OJ, 14.6.2018, L 150: Revised Waste Legislative Framework expands the *Waste Framework Directive's* intent, by limiting the use of landfill as a waste disposal option. Thus, it forces the producers of waste to adopt technology that both minimises waste and / or recovers waste which could also affect wastes such as brine . Thus it guides the MSs to :

- **Progressively reduce landfilling**; its reduction should avoid the development of excessive capacity for the treatment of residual waste facilities, as this could result in undermining re-use.
- **A review of landfilling targets**, while introducing quantitative targets per capita on landfilling.

²⁴ See Appendix 9.1 for the full list of policies, referred to in this section, concerning Sea-Mining Objective 3.

{SWD(2020) 225 final}: Chemicals Strategy for Sustainability Towards a Toxic-Free Environment and COM(2018) 29 final: Monitoring framework for the circular economy are focused on:

- **Building a monitoring framework for chemical pollution** to better track the activities of waste producers and those that deal with waste.

Finally, *{SWD(2021) 140 final} - {SWD(2021) 141 final}: Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil* **advises the EC to:**

- **Adopt recommendations on how to promote incentives to implement the “polluter pays principle”** (which also addresses externalities).

Gap analysis

In sum, the EU has erected a broad suite of policy directed at reducing, and even reusing, waste, in general; **however there is no policy that tackles the specific wastes emanating from seawater desalination, most noticeably, concentrated brine.** Most EU member-states flush brine out to the sea. This can have deleterious effects on marine wildlife. The alternative of landfilling such waste is obviously not a better solution; thus, **there is a requirement for policy that guides and regulates this practice of flushing brine.** In response to these issues, WP10's policy team will consider the potential benefits of added measures such as:

- *Command and Control* policies that address:
 - **Mandate strict regulations for the amount (volume and concentration) of brine that can be discharged** to seas and oceans from desalination plants.
- *Market-based policies* that address:
 - **Provide subsidies / tax abatements to SWD plants that reach specific, set efficiency levels** in terms of elimination of brine (as well as water produced and amounts of energy consumed).
- *Government Investment* policies that address:
 - **Investment into setting up ZLD desalination plants** as these are the most efficient technologies for reducing brine waste.
 - **Invest in technologies that can transform waste brine into other usable chemicals** such as sodium hydroxide and hydrochloric acid.²⁵

²⁵ See the following [link](#).

5.2.4 Sea-Mining Objective 4: Sustainable recovery of materials

Objective 4: Enable the sustainable recovery of materials (such as Mg, NaCl and other salts) from sea-water desalination. [Note: different products obtained]

Summary of relevant EU policy²⁶

The most important policy document connected to objective 4 is: *OJ, 14.6.2018, L 150: Revised Waste Legislative Framework*. Through a set of command and control methods it promotes:

- **Basic definitions of both waste and material recovery.**
- **Reduction of landfilling as a disposal option to promote waste recovery.**
- **Management of Critical Raw Materials (CRMs)** which in the case of Sea-Mining would affect the harvesting of Mg, and elimination of hazardous wastes, which could affect reducing the concentrated brine.
- **Promoting action for the smoother running of markets for Secondary Raw Materials SRMs**, which potentially provides financial incentives for those harvesting / selling materials mined from sea-mining operations.

Another important policy document is *SWD(2018) 36 final: Report on Critical Raw Material (CRM) Part 1 and Part 3* which recommends supporting (including financial support) the reuse of waste containing CRMs, which could affect the harvesting of Mg from sea-mining operations.²⁷

Finally, the following three documents *COM(2015) 614 final: An EU action plan for the Circular Economy*, *SWD(2020) 225 final} Chemicals Strategy for Sustainability Towards a Toxic-Free Environment* and *Directive 2008/98/EC: Waste Framework Directive* advance measures to:

- **Create standards for Secondary Raw Materials (SRMs).**
- **Develop a (web-based) communication platform** on chemicals which could also be used as part of the standardisation process.
- **Create a series of tools (including financial tools) enabling the re-use of products** also by promoting the development of an internal market for harvested materials.

²⁶ See Appendix 9.1 for the full list of policies, referred to in this section, concerning Sea-Mining Objective 4.

²⁷ Mg is considered to be one of the 30 critical raw materials according to the EC Communication: *Critical Raw Materials Resilience: Charting a Path towards greater Security and Sustainability*. See the following [link](#) (p. 3).

Gap analysis

The EU has designed a broad set of policies that promote the harvesting and reuse of SRMs and CRMs from waste, in line with the aspirations of creating a truly circular economy (CE) in the EU. These measures have the potential to be applied to the materials derived from a Sea-Mining operation, even though the term desalination is not mentioned specifically in any policy measure. More than that, these measures are, for the most part, only command and control. To establish a truly CE, **more pragmatic financial support measures will be needed to both develop the technology to harvest raw materials, as well as create the internal market to catalyse uptake.** To address these gaps, the WP10 team will consider the potential advantages of measures such as:

- *Command and Control* policies that address:
 - **Mandating that salts recovered from desalination processes are certified for purity** so that consumers are convinced that it is of high value / standard
- *Market-based policies* that address:
 - **Providing financial incentives to subsidise the price of salts**, in form of tax breaks or price supports, produced in local desalination plants.
 - **Providing subsidies to the operators of desalination plants** for investing in Sea-mining technologies.
- *Government Investment* policies that address:
 - **Increasing investment into setting up ZLD desalination plants**, as these are the most efficient at harvesting solid materials / chemicals from the sea.
 - **Investing in technology / pilots that improve the ability of SWD plants to harvest materials** (such as Mg and NaCl) more efficiently / effectively from sea-water.
 - **Invest in technologies that can transform waste brine into other usable chemicals** such as sodium hydroxide and hydrochloric acid.²⁸
- *Integration* policies that address:
 - **Brokering partnerships between SWD plants and the chemical industry** so that the materials are properly marketed and sold.

²⁸ See the following [link](#).

5.2.5 Sea-Mining Objective 5: Ensure widespread use of desalinated water

Objective 5: Ensure the widespread use of desalinated water among consumers who are concerned about its quality (i.e. not enough minerals, or too much Boron).

Summary of relevant EU policy²⁹

There is but one policy measure that supports Objective 5. *COM(2015) 614 final: An EU action plan for the Circular Economy* promotes:

- **Using the EU ecolabel designed to support environmentally friendly products.** It is possible that its application towards desalinated water could aid its uptake among consumers, but this one encourage-voluntary type measure is likely not enough.

Gap analysis

As can be seen, there is only one EU policy that shows a potential for supporting this objective, and again it does not specifically mention desalination. Based on this gap, the Water-Mining's policy team will consider the potential benefits of additional measures, such as:

- *Command and Control* policies that address:
 - **Mandating quality standards for the desalinated water** that is produced by desalination plants.
- *Market-based* policies that address:
 - **Providing subsidies / tax abatements to SWD plants that invest in technology that re-infuses minerals into the desalinated water it produces.**
- *Encourage-Voluntary* policies that address:
 - **Public campaigns (media) to explain to consumers that the quality of water emanating from desalinated sources is safe and high quality.**
 - **Promoting the transparency of SWD plant operations, performance, management,** and quality of product to improve the social acceptance of desalinated water.
 - **Creating a safety / quality label** that informs consumers that desalinated water is safe to drink.

²⁹ See Appendix 9.1 for the full list of policies, referred to in this section, concerning Sea-Mining Objective 5.

5.3. Urban-Mining

Analysis of current EU policy and their gaps is done with regard to 4 objectives formulated for the Urban-Mining sub-sector.

5.3.1 Urban-Mining Objective 1: Sustainable production

Urban-Mining Objective 1: To sustainably recover water in urban settings to provide a new, secure, supply of this resource (for industry and agriculture) which leads to decreased water stress.

Summary of relevant EU policy³⁰

The central document affecting Urban-Mining objective 1 is *REGULATION (EU) 2020/741: on minimum requirements for water reuse*.³¹ All of its measures are command and control and set out the requirements for reuse, including:

- **Standards for both the water and food grown with reused water;**
- **Compliance with rules by the reclamation operators** including being responsible for water quality, and supplying water to agriculture via a permit
- **Compliance with rules by end users.**
- **Designing risk management plans for water reclamation.**
- **Competent authorities for verifying compliance** to regulations on behalf of operators

This provides a structured framework certifying that consumers are provided with a healthy product, water, as well as validating the agricultural products grown with said water. The goal is to ensure the healthy operation of the internal market.

Directive 91/271/EEC: Urban Waste Water Treatment Directive also provides support to the objective by promoting reuse, while minimising deleterious environmental effects, by guiding that:

- **Treated wastewater shall be reused whenever appropriate.**
- **Disposal routes shall minimise the adverse effects on the environment.**

Gap analysis

³⁰ See Appendix 9.2 for the full list of policies, referred to in this section, concerning Urban-Mining Objective 1.

³¹ The policies listed here are repeated in *COM 2018/337: "Minimum requirements for water reuse"*

In comparing existing EU policy with the policy inventory generated by the Urban-Mining policy team, it is evident that existing EU policy provides certain supports for objective 1, especially with regards to regulations connected to the reuse of urban wastewater and the operation of urban wastewater plants. However, more specific measures could be added, especially policy that expands market-based and investment measures which financially support the operation of new or upgraded urban wastewater treatment systems. Thus, the Water-Mining's policy team will consider the potential advantages of supplementary measures, such as:

- *Command and Control* that address:
 - **Creating standards for water derived from UWWT for different sectoral purposes**
- *Market-based* that address:
 - **Providing market incentives to promote private investment into urban wastewater reclamation projects**, either for building new installations or for improving the performance of current UWWT plants.
 - **Providing market incentives to UWWT operators to improve the efficiency of their water reclamation efforts** by integrating new technologies.
- *Encourage-voluntary* policies that address:
 - **Creating education programs certifying that wastewater derived products are safe** to consume and use.
 - **Designing education programmes at the university-level** to train the next generation of water experts.
- *Government-investment* policies that address:
 - **Providing funding to support pilot testing** of new water reclamation technology.
 - **Providing funding for EU geographical areas lacking proper UWWT infrastructure.**

5.3.2 Urban-Mining Objective 2: Sustainable use of (all) water sources

Urban-Mining Objective 2: To promote sustainable use of (all) water sources available to different sectors.

Summary of relevant EU policy³²

REGULATION (EU) 2020/741: on minimum requirements for water reuse supports objective 2 by **creating requirements for the reuse of wastewater** (primarily, urban but also industrial) which could potentially be supplied to different sectors, decreasing the stress on freshwater sources and thus creating the conditions for greater sustainability. It does so via policy that promotes:

- **Standards for both the water and food grown with reused water;**
- **Compliance with rules by the reclamation operators** including being responsible for water quality, and supplying water to agriculture via a permit
- **Compliance with rules by end users.**
- **Designing risk management plans for water reclamation.**
- **Competent authorities for verifying compliance** to regulations on behalf of operators
- **Provide end-user education** as components of implementing and maintaining preventive measures.
- **Lay down rules on penalties** applicable to infringements of this Regulation.

Note, that this document does not dictate or promote how these expanded sources of water should be used. Moreover, for the most part it accomplishes its goals via command and control, but also relies on a very limited number of encourage-voluntary measures (“education”) and market-based policy (“penalties”).

Directive 2000/60/EC: Water Framework directive is another key document. It **promotes sustainable, efficient use**, in contrast to the document cited above (“*on the minimum requirements...*”), but is not sector specific. It proposes:

- **Market-based tools to enforce sustainable compliance** such as the ‘polluter pays’ and water pricing tools.
- **Water-pricing policies** to provide adequate incentives for users to use water resources efficiently.

{*SWD(2021) 140 final*} - {*SWD(2021) 141 final*}: *Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil* provides:

- **General promotion of sustainability to all sectors in society including industry, agriculture** although tellingly it does not suggest specific tools to achieve this goal.

³² See Appendix 9.2 for the full list of policies, referred to in this section, concerning Urban-Mining Objective 2.

The next three policy documents contribute (indirectly) to the sustainability objective by **focusing on pollution protection:**

- *SEC(2022) 169 final* } *final amending Directive 2010/75/EU of the European Parliament on industrial emissions (integrated pollution prevention and control)* is more general, and it **argues for “coherent rules” concerning pollution.**
- *Directive 86/278/EEC: Sewage sludge directive* enjoins the MSs to **use sludge under conditions which ensure that the soil and water are protected**
- *Directive 91/676/EEC: Nitrates Directive* advises the MS to:
 - **Establish codes of good agricultural practice**
 - **Providing training to farmers about these codes**
 - **Monitor the nitrate content** of their waters.
 - **Limit the land application of fertilisers**, while taking into account the characteristics of the vulnerable zone concerned

Thus, the last two directives both focus on pollutants that might affect the agro-sector and the water system connected to it, which in turn influences sustainability.

Gap analysis:

In comparing existing EU policy with the policy inventory designed by the Urban-Mining policy team, it is evident that existing EU policy provides certain support for elements of objective 2. **However, more specific policy could be added, especially policy that financially supports water reuse, and conservation of water sources in general.** To address these gaps, the policy team will consider the potential benefits of added measures such as:

- *Command and Control* policies that address:
 - **Mandate the use of technology to prevent leakage** in the water system.
 - **Mandate that water industries consume a set amount of reclaimed water.**
 - **Gradually ban the use of freshwater for irrigating public spaces** such as parks.
- *Market-based* policies that address:
 - **Providing financial incentives to farmers so they will use reclaimed water in water stressed regions**, incentives for levelling the playing field.
 - **Increase the price of fresh water to encourage and support the widespread use of reclaimed water.**
 - **Create variable pricing for the different sectoral consumers using reclaimed water.**
- *Encourage-voluntary* policies that address:

- **Providing educational campaigns to the agriculture sector** about the safety and benefits of recovered water.
- *Government-investment* policies that address:
 - **Providing funding to support pilot testing** of new water reclamation technology.
 - **Providing funding for EU geographical areas lacking proper UWWT infrastructure.**

5.3.3 Urban -Mining Objective 3: Recover and valorise waste material

Objective 3: To recover and valorise waste material from urban wastewater treatment into useful resources. [Note: materials are phosphorus, kaumera, salts]

Summary of relevant EU policy³³

Seven documents have the potential for affecting the harvesting and valorisation of waste materials from urban wastewater treatment (UWWT).

Documents supporting / promoting the reuse of waste, in general (i.e. secondary raw materials or SRMs) which would potentially also apply to waste recovered from UWWT include five documents:

- *OJ, 14.6.2018, L 150: Revised Waste Legislative Framework* promotes:
 - **Basic definitions of both waste and material recovery**
 - **The Reduction of landfilling as a disposal option** which forces waste to be recovered
 - **The management of Critical Raw Materials (CRMs)**, which in the case of Urban-Mining would affect the harvesting of Phosphorus.
 - **Promoting actions that influence the smoother running of markets for SRMs**, which potentially provides (financial) incentives for those harvesting / selling materials mined from urban-mining operations (such as Kaumera).
- *Directive 2008/98/EC: Waste Framework Directive* promotes:
 - **The recovery of waste in general**
 - **Maintaining that waste ceases to be waste once recovered** which means that it can then be more easily valorised.

³³ See Appendix 9.2 for the full list of policies, referred to in this section, concerning Urban-Mining Objective 3.

- *COM (2020) 98 A new Circular Economy Action Plan for a cleaner and more competitive Europe* aims at:
 - **Stimulating the market for recovered nutrients**
 - **Harmonising national end-of-waste criteria** which works in concert with the *Waste Framework Directive*.
- *COM(2015) 614 final: An EU action plan for the Circular Economy* promotes:
 - **The development of quality standards for SRMs,**
 - **Expanding the Raw Materials Information System (RMIS)**³⁴
 - **Supporting research on raw materials flows.**
- *{SWD(2020) 225 final}: Chemicals Strategy for Sustainability Towards a Toxic-Free Environment* **deals with “materials of concern” which it wants to minimise in recycled materials** via:
 - **Measures promoting public information**
 - **Adjustment of the REACH rules**
 - **Investment into innovations that can decontaminate waste streams.**

A second set of documents **focuses on the recovery of resources that could only emanate from UWWT**. Thus, they could potentially contribute to the harvesting of kaumera (a biopolymer that can be used as a fertilising agent), phosphorus and salts, materials which are specifically connected to the three Urban-Mining case studies (CS3, CS4, CS5).³⁵ They include the following two documents:

- *COM(2016) 157: Regulation proposal for CE market fertilising products* proposes that:
 - **Incentivise large scale fertiliser production in the EU by easing access to the internal market**
 - **Create safety and quality regulations**
 - **Create ease of access to the internal market for phosphorus recycled from sewage.**
- *Regulation (EC) No 1907/2006: REACH* regulation which states that:

³⁴ The RMIS provides a structured repository of knowledge related to non-fuel, non-agricultural raw materials from primary and secondary sources. It focuses on abiotic and biotic materials, covering the entire value chain. The overarching goal of the RMIS is to facilitate: the availability, coherence and quality of knowledge required by specific EU raw materials policies and EC services; and access to key raw materials information from knowledge bases within and beyond Europe.

³⁵ Kaumera is a recent innovation so there is little chance that policy mentions it; however, it is derived from sludge granules which are harvested from UWWT.

- **An exemption from the obligation to register for a certain time period in early stages of substance usage**, when it is not yet intended to be placed on the market to an indefinite number of customers because its application in preparations or articles still requires further research and development.³⁶ The intent is to encourage innovation, product and process oriented research and development. This may have policy implications for Kaumera.

Gap analysis

In comparing the existing EU policy with the policy inventory designed by the Urban-Mining policy team, it is evident that existing **EU policy provides certain supports for objective 3, but for the most part it focuses on waste in general**. Even the more specific policies connected to products emanating from urban wastewater treatment are more traditional, focusing on reclaimed fertilisers. **More specific policy is needed, especially policy that focuses on the products specifically mined by the Urban-Mining CS3, CS4 and CS5, including phosphorus** (a critical material as defined by the EU) **and Kaumera** (a very new product to the market for which there is no truly supporting policy). To address these gaps, the policy team will consider the potential benefits of additional measures such as:

- *Command and Control policies* that address:
 - **Mandating that fertiliser suppliers source a minimum percentage of their raw materials from recovered materials** (including Kaumera and Phosphorus).
 - **Mandating that UWWT plants harvest a certain amount of fertilising nutrients** (such as phosphorus).
 - **Mandating simpler certification requirements for extracted materials** based on standard tests of relevant pathogens / metals, to prevent materials such as Kaumera being blocked from uptake.
- *Market-based policies* that address:
 - **Providing price supports for recovered materials** such as phosphorus and salts from UWWT.
- *Encourage-voluntary policies* that address:
 - **Implement media campaigns to encourage end users to use materials** (such as Phosphorus or Kaumera) from UWWT

³⁶ Performed by the potential registrant himself or in cooperation with a limited number of known customers to regulation.

- **Design a web-platform to match producers of recovered materials with end-users.**
- *Government-investment* policies that address:
 - **Providing funding to support the installation of recovery technologies to UWWT plants** that currently do not reclaim (solid / chemical) materials.
 - **Invest in R&D in new technologies** that can more effectively / efficiently reclaim materials from UWWT.
- *Integration* policies that address:
 - **Creating an intergovernmental agency that promotes cooperation among EU MS concerning the design and upgrade of policy connected products reclaimed from urban-mined processes.** This would overcome the barriers preventing water-mined phosphorus and Kaumera to be permitted on the market. Currently, policy is holding back such uptake. In fact, such an agency could have a wider application to all recovered materials from all water-mining processes in general, to provide security to the internal EU market.

5.3.4 Urban-Mining Objective 4: Recover energy and use alternative energy

Objective 4: To recover energy from waste water treatment, as well as using alternative sources of energy, in order to close the loop in urban wastewater treatment plants. [Note: energy recovery via biogas and alternative sources are solar]

Summary of relevant EU policy³⁷

The subject matter of existing policy documents can be divided into three groups:

The first group **promotes the use of alternative energy in general** (and not necessarily within UWWT plants). Such alternative forms of energy include biogas (a type of biofuel) and solar. It includes the following document:

- *DIRECTIVE (EU) 2018/ 2001: on the promotion of the use of energy from renewable sources (recast)* is the key document; it guides the EC and MSs to create or adopt:
 - **Sustainability criteria for the production of biofuels.**
 - **Monitoring systems and standards for biofuel type.**
 - **Advancing best practices for the uptake of alternative energy projects.**

³⁷ See Appendix 9.2 for the full list of policies, referred to in this section, concerning Urban-Mining Objective 4.

- **Advancing provisions for the integration of renewable energy, when planning and renovating energy infrastructure.**

The second group of policies concerns **reducing emissions, which could enable the increased harvesting of biogas, as well the greater uptake of solar power** in installations such as UWWT plants. It includes the following document:

- *{SWD(2021) 140 final} - {SWD(2021) 141 final}: Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil* focuses on:
 - **Reducing emissions and pollution control in general.** (This could act as an enabler towards greater biogas harvesting and the adoption of renewable energy, for example, in UWWT plants).

The third group of documents **promote energy efficiency measures** which might affect the operation of UWWT plants and their alternative energy systems, as well as the production of biogas. These include general promotion of efficiency, as well as best available techniques (BATs) for achieving efficiency. It includes the following two documents:

- *SEC(2022) 169 final} final amending Directive 2010/75/EU of the European Parliament on industrial emissions (integrated pollution prevention and control)* It guides industrial operations towards:
 - **Energy efficiency minimum levels for industry**, resulting in decarbonization
 - **Establishing an environmental management system (EMS) for the continuous improvement in the performance of an installation.**
- *Reference Document on Best Available Techniques (BAT) for Energy Efficiency* focuses on the BATs for improving energy efficiency which could affect the operations of alternative energy systems in a UWWT. The BATs that are connected to this UWWT plants include:
 - **Using methods to assist with energy optimization, including in new installations and upgrades.**
 - **Systematic comparisons with sector, national or regional benchmarks.**
 - **Monitoring key operation characteristics** with a significant impact on energy efficiency.

Gap analysis:³⁸

³⁸ See Appendix 9.2 for the full list of policies, referred to in this section, concerning Urban-Mining Objective 4.

The general use of alternative energy (both solar and biofuels) in industry is promoted by EU policy, creating an opening for its potential adoption within the Urban-Mining sub-sector. However, **more specific policy is needed within this sub-sector to support its widespread uptake.**

It might be expected that *Directive 91/271/EEC: Urban Waste Water Treatment Directive* would directly address recovering energy in Urban-Mining activity, but in fact it does not. Indeed, the recent evaluation of the Directive³⁹ states that it “does not encourage any efficiency measures for energy consumption, while some wastewater treatment plants could actually be energy producers (via biogas production). It is not integrated to the extent possible into the EU’s energy efficiency agenda.” **Thus there is a strong need for upgrading EU-level policy so that the Urban-Mining sub-sector harvests biogas and / or derives its power from alternative energy.** To address these gaps, the policy team will consider the potential advantages of additional measures such as:

- *Command and Control policies* that address:
 - **Mandating that a certain amount of biogas must be harvested** by UWWT plants, by those that have the capacity to achieve this goal.
 - **Mandating a standard proportion of non-fossil fuel sources that must be used** in UWWT plants (including biogas and / or solar).
- *Market-based policies* that address:
 - **Incentivising the use of alternative energy via subsidies or tax abatements** (such as biogas or solar) in the operation of UWWT plants.
 - **Providing financial incentives to conventional UWWT plants to implement technologies** that recover biogas and / or install alternative energy technology.
- *Government-investment policies* that address:
 - **Investing in infrastructure** that permits UWWT plants to efficiently use biogas or install alternative energy sources.

³⁹ To access the Urban Wastewater Treatment Directive evaluation, please open the following [LINK](#), p. 77.

5.4 Industrial mining

Analysis of current EU policy and their gaps is done with regard to 5 objectives formulated for the Industrial-Mining sub-sector.

5.4.1 Industrial-Mining Objective 1: Minimising raw materials and energy use

Industrial-Mining Objective 1: Promote industrial collaboration along the value chain in order to minimise the use of raw materials (water) and energy.

Summary of relevant EU policy⁴⁰

In terms of existing EU policy that might support objective 1, the emphasis is on energy policy rather than water policy. Measures supporting the water policy are very general and minimal.

REGULATION (EU) 2020/741: on minimum requirements for water reuse **provides the primary support for minimising water use.** This legislation states that:

- **The EU's ability to respond to pressures on water resources could be improved by promoting water savings** through multiple uses for urban waste water.
- **Water- efficient technologies in industry and water saving technology in agriculture are needed.**

The rest of the documents, listed below are concerned with **aspects of minimising the use of energy.** They are divided into promoting the use of renewable energy, including waste heat; reducing emissions which could enable the increased use of waste heat; and promoting energy efficiency, enabling the minimising of energy use via the use of waste heat.

DIRECTIVE (EU) 2018/ 2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources (recast) **promotes the use of waste heat,** guiding the MS to:

- **Assess the potential for developing renewable heating / cooling schemes based on waste energy.**
- **Develop district heating / cooling infrastructure from waste heat and cold,** while making provisions for its integration when planning, urban, industrial and energy infrastructure.

⁴⁰ See Appendix 9.3 for the full list of policies, referred to in this section, concerning Industrial-Mining Objective 1.

{SWD(2021) 140 final} - {SWD(2021) 141 final}: *Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil* focuses on **reducing emissions and pollution control** which in turn could act as an enabler towards the greater use of waste heat. It advises the EC to:

- **Align its air quality standards with the WHO recommendations**
- **Strengthen its provisions on monitoring air quality**
- **Introduce stricter requirements to tackle air pollution** also from agriculture and industry

SEC(2022) 169 final - *final amending Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control)*, **concerns industrial emissions**, with the following policies focused on **promoting energy efficiency**. It guides MS that:

- **Energy efficiency levels will be introduced**, to minimise energy consumption, resulting in decarbonization.
- **Industrial installation operators must implement an environmental management system (EMS)** in accordance with relevant BATs.

Reference Document on Best Available Techniques (BAT) for Energy Efficiency focuses on **BATs for improving energy efficiency** which **could potentially** affect the use of waste heat in an industrial-mining installation. These (practical) BATs connected to such industrial installations include:

- **Auditing aspects of an installation influencing energy efficiency.**
- **Using methods for identifying energy optimization including with new installations or upgrades.**
- **Establishing energy efficiency indicators.**
- **Carrying out maintenance at installations to optimise energy efficiency.**
- **Monitor key operation characteristics with a significant impact on energy efficiency.**

Gap analysis⁴¹

Given the crucial need and use of water in industry, second only to agriculture in the EU, **it is surprising that there is little to no policy connected to minimising water-use in industry. In contrast, energy minimisation measures are more prominent in the EU, although not**

⁴¹ See Appendix 9.3 for the list of full policies, referred to in this section, concerning Industrial-Mining Objective 1.

necessarily connected to waste heat recovery. Thus there is a need to improve EU-level policy so that the Industrial-Mining sub-sector can contribute towards maximising the use of these valuable resources among different industries. To address these gaps, the policy team will consider the potential advantages of additional measures, such as:

- *Command and Control* policies that address:
 - **Mandating that industry must recover a minimum percentage of the water they use** (depending on industry type, location etc.).
 - **Set stricter regulations for the use of freshwater especially in those areas of the country which suffer the most from water scarcity** (resulting in the use of reclaimed IWW).
- *Market-based* policies that address:
 - **Providing subsidies / tax relief to different sectors for using purified water from IWWT plants** instead of drawing upon freshwater.
 - **Provide incentives to catalyse collaboration among firms to create joint IWWT facilities**, or other similar actions in the value chain, **thereby tapping into industrial symbiosis benefits**, such as the sharing of reclaimed water.
- *Integration* policies that address:
 - **Creating a government agency and / or regional hubs that are responsible for facilitating industrial symbiosis among industries to reclaim and reuse its wastewater and for minimising energy use.**

5.4.2 Industrial-Mining Objective 2: Continuous reuse of water

Industrial Objective 2: Enable the continuous reuse of water within a closed-loop system to reduce the use of freshwater.

Summary of relevant EU policy

*REGULATION (EU) 2020/741: on minimum requirements for water reuse*⁴² is the primary document affecting Industrial-Mining objective 2. Along with general water reuse, the EC promotes the following measures to member-states:

- Setting standards for water reuse.
- Compliance with minimum standards (in line with the UN's SDG6 and SDG12).

⁴² The policies listed here are repeated in **COM 2018/337: Minimum requirements for water reuse**

- Designing risk management plans for water reclamation.
- Rules to be followed by reclamation operators including being responsible for water quality, compliance to rules, supplying water to agriculture via a permit.
- Competent authorities should verify operators' compliance to regulations.

This document however, does not specifically reference “closed loop” solutions although reuse implies (part of) this idea.

SEC(2022) 169 final - *{SWD(2022) 110 final}* - *{SWD(2022) final amending Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control)}* provides a much more **general emphasis on promoting water reuse, along with energy efficiency.**

Reference Document on Best Available Techniques (BAT) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector provides a **single (general) best practice for industries in the chemical sector:**

- **Reduce the pollutant load of wastewater streams, to enhance the water reuse and to recover raw materials.**

Finally, although technically not policy, *{COM(2021) 400 final}* - *{SWD(2021) 141 final}*: *COMMISSION STAFF WORKING DOCUMENT Digital Solutions for Zero Pollution* stresses the **importance of digital solutions to enhance water reuse systems in industry, as well as the specific infrastructure** (including *Decision Support Systems*) that supports industrial water reuse.⁴³

Gap analysis⁴⁴

Along with minimising water use along the entire value chain (Industrial-Mining objective 1) there is also a need to reduce the use of water using “closed loop” solutions / technologies within industry, in general and connected to IWWT, specifically. **The current EU policies provide a general framework for water reuse which of course contributes to this objective although most measures do not reflect the CE philosophy of closed loop systems, nor of course do they specifically deal with industrial wastewater operations.** To address these gaps, the policy team will consider the potential benefits of additional policies, such as:

⁴³ Such digital solutions are being developed under the CT4Water cluster: a community of 61 EU-funded research and innovation projects on digital innovations for water. See: <https://ict4water.eu/>

⁴⁴ See Appendix 9.3 for the full list of policies, referred to in this section, concerning Industrial-Mining Objective 2.

- *Command and Control* policies that address:
 - **Mandating standards, as well as efficiency levels for use of technologies in IWWT plants to recover materials including water** (and solid materials).
 - **Mandating that industry must recover a minimum percentage of the water they use** (depending on industry type, location etc.).
- *Market-based* policies that address:
 - **Providing subsidies / tax relief for investments in “in-house” equipment to permit firms to recover water (and other materials)** from their industrial processes (rather than sending the water to another off-site treatment centre).
 - **Creating a taxation scheme to disincentivize the use of fresh-water by industry** (and so they will invest in Industrial wastewater technology and its use).
- *Government-investment* policies that address:
 - **Investing in developing water leak detection infrastructure** (software, hardware) to minimise waste water in Industrial wastewater plants.

5.4.3 Industrial-Mining Objective 3: Innovative business models

Industrial-Mining Objective 3: Ensuring sustainable production and consumption by adopting innovative business models such as chemical leasing. (Note: Could be other innovative BMs aside from chemical leasing)

Summary of relevant EU policy ⁴⁵

Existing policies are very general and do not support this objective substantially; there are but two documents that could potentially support objective 3:

{SWD(2020) 225 final}: *Chemicals Strategy for Sustainability Towards a Toxic-Free Environment* briefly mentions that the EC will:

- **Support financially and through R & D, innovative business models to ensure a more efficient use of chemicals and other resources** (These models include chemical leasing).

⁴⁵ See Appendix 9.3 for the full list of policies, referred to in this section, concerning Industrial-Mining Objective 3.

OJ, 14.6.2018, L 150: Revised Waste Legislative Framework briefly mentions innovative business models that would affect a product's lifecycle:

- **Member States should facilitate innovative production, business and consumption models that reduce hazardous substances in products** in order to encourage increased lifespan and re- use.

Gap analysis

There are very few EU policies supporting the use of innovative business models, let alone chemical leasing in industry, in general. It should be noted that Chemical Leasing is a new business model innovation (directed towards the efficient use of chemicals) and no EU countries outside of Germany, Austria and Switzerland are officially part of the Chemical Leasing Group founded by UNIDO (*United Nations Industrial Development Organisation*),⁴⁶ so it is not surprising that policies within the EU, overall, are lacking. Consequently, the WP10 policy team will consider the potential benefits of additional policies, such as:

- *Command and Control* policies that address:
 - **Mandating efficiency levels for IWWT plants that use chemical leasing models.**
- *Market-based* policies that address:
 - **Providing subsidies to companies that market / sell / buy water-mined products who adopt chemical leasing models**
 - **Provide subsidies and / or tax benefits to IWWT plants that adopt chemical leasing models (or other innovative business models) for the solid products they recover and provide.**
- *Encourage-Voluntary* policies that address:
 - **Having MS sign the Joint Declaration of Intent on Chemical Leasing with UNIDO** for promoting chemical leasing among companies dealing with Industrial-mined products.
 - **Establishing training programs that educate companies** that deal with water mined products and to adapt to chemical leasing (or other innovative business) models. Promote Chemical Leasing (and other sustainable BMs) by

⁴⁶ See the following about the [Joint Declaration of Intent on Chemical Leasing](#) signed by these countries.

investing in platforms (electronic / colloquia etc.) that share information on how companies can integrate such BMs into their operations.

- *Integration* policies that address:
 - **Creating platforms (electronic / colloquia etc.) that share information on how companies can integrate such BMs into their operations.**

5.4.4 Industrial-Mining Objective 4: Reduce wastewater and waste

Industrial-Mining Objective 4: Reduce wastewater and waste (brine, organic sludge) some of which is normally disposed of via incineration or landfill.

Summary of relevant EU policy⁴⁷

Although there are no EU policies dedicated specifically to the objective, there are policies which potentially could support various aspects of it.

The first three documents, listed below, are most **specifically focused on practical techniques for reducing sludge and wastewater in industry**, in general.

Reference Document on Best Available Techniques (BAT) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector:

- **Provides techniques for reducing sludge and wastewater, such as pre-treatment, a combination of methods, and integrated wastewater management.**
- **Recommends monitoring** (process parameters and emissions) **and inventorying wastewater** which could enable this reduction process.

Decision C(2013) 8589 regarding the BREF on Chlor-alkali production also provides **practical techniques for reducing wastewater and brine specifically in chlor-alkali synthesis operations**, such as:

- **Brine recirculation**
- **Recycling of other process streams**, as well as salt-containing wastewater
- **Using wastewater for solution mining**

Directive 91/271/EEC: Urban Waste Water Treatment Directive is more general and simply promotes:

⁴⁷ See Appendix 9.3 for the full list of policies, referred to in this section, concerning Industrial-Mining Objective 4.

- **Reuse of sludge** which minimises its potential disposal in landfill.

OJ, 14.6.2018, L 150: Revised Waste Legislative Framework is **dedicated to reducing landfilling** which indirectly could enable objective 4, which involves reducing sludge disposal in said landfills; if landfill is not an option then industrial sludge must be reduced. This legislates towards:

- **Progressively reducing landfilling also to ensure that economically valuable waste materials are recovered.**
- **Strengthening targets for landfill restrictions**

The next three documents are all dedicated to **general water-based emissions control**, which potentially could enable sludge reduction:

- *{SWD(2020) 225 final}: Chemicals Strategy for Sustainability Towards a Toxic-Free Environment* promotes:
 - **Developing indicators to monitor drivers / impacts of chemical pollution, as well as the effectiveness of chemicals legislation.**
- *Directive 2000/60/EC: Water Framework Directive* guides the MS towards:
 - **Adopting measures applicable to all river basin districts falling within its territory laying down emission controls for the pollutants concerned, including controls.**
- *SEC(2022) 169 final} final amending Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)* advises the MS that:
 - It is necessary to specify the conditions under which the competent authority, **when setting emission limit values applicable to pollutant releases to water, may take account of the downstream treatment processes in a wastewater treatment plant**, in order to ensure that such releases do not lead to an increased load of pollutants.

Finally, **Directive 2008/98/EC: Waste Framework Directive** contains general policy directed at:

- **Developing waste prevention programmes, based on key environmental impacts.**
- **Ensuring that those responsible for waste / pollution bear the financial costs.** This polluter pays principle is very important as it has an effect on externalities.

Gap analysis

Similar to many of the other objectives in the different Water-Mining sub-sectors, **there is no all-encompassing supporting policy of this objective; instead, there are policies that support certain aspects of it, including the reduction of landfilling, as well as water-based industrial emissions** (both of which could also affect Industrial-Mining Waste). Similar to most objectives, most of the policy is command and control; thus, the policy team will consider the possible benefits of supplementary policies, such as:

- *Command and Control* policies that address:
 - **Gradual banning on landfilling of substances that can be sustainably recovered** resulting from IWWT.
 - **Mandating contaminant standards for sludge obtained from IWWT**, so that it can be used in other value chains such as agriculture.
- *Market-based* policies that address:
 - **Financial disincentives** (such as a tax) **on the disposal of wastewater from IWWT** into surface waters or elsewhere in the environment.
 - **Subsidising industrial plants that install “in-house” water recovery technology** to lighten the pressure on local IWWT.
 - **Pricing of water that is calculated to reflect the externalities of its production**, such that sludge and brine can be minimised and disposed of with the least environmental impact possible
- *Government Investment* policies that address:
 - **Investing in technologies that can transform waste brine into other usable chemicals**, such as sodium hydroxide and hydrochloric acid.⁴⁸
 - **Investing in pilots to improve the efficiency of IWWT plants** in terms of water recovery, as well as brine and sludge management.

5.4.5 Industrial-Mining Objective 5: Sustainable recovery of materials

Industrial Objective 5: Enable the sustainable recovery of materials (such as Na and Cl streams as well as NaCl) from industrial water mining operations.

Summary of relevant EU policy⁴⁹

⁴⁸ See the following [link](#).

⁴⁹ See Appendix 3 for the full list of policies, referred to in this section, concerning Industrial-Mining Objective 5.

The primary document addressing the issue of sustainable material recovery in the Industrial-Mining sub-sector is the same as the other two Water-Mining sub-sectors: *OJ, 14.6.2018, L 150: Revised Waste Legislative Framework*. The policies included in the framework **do not actually mention waste harvesting from industrial wastewater treatment (IWWT) operations, but do provide the potential to include them**. Also industrial wastewater treatment would include a wide range of wastes and not just those specifically listed in case-study 6 of the Water-Mining Project. Certainly, any policy directed towards material harvesting should be broad enough to include many waste streams. Most of the actual measures listed are command and control and can be classified into those that promote:

- **Basic definitions of both waste and material recovery.**
- **Reduction of landfilling as a disposal option** which forces waste to be recovered.
- **The management of critical raw materials (CRMs)**. Note that the Industrial-Mining Case Study 6 does not harvest CRMs but it is certainly possible that other Industrial-Mining operations do so.
- **Elimination of hazardous wastes** which could affect reducing sludge or brine.
- **Promoting actions that influence the smoother running of markets for SRMs**, which potentially provides financial incentives for those harvesting / selling materials mined from industrial wastewater. This is important as it provides market-based measures needed for the uptake of reclaimed materials.

Regulation (EC) No 1907/2006: REACH may not have policy implications for the specific products of Water-Mining's Industrial-Mining (such as Na and Cl); nonetheless, it could influence other products from industrial wastewater operations, in general, by supporting the harvesting of a wide variety of (new) solid / chemical materials⁵⁰ from waste water. It legislates that:

- **Product and process oriented R&D should be exempted from the obligation to register for a certain time period where a substance is not yet intended to be placed on the market** because its application requires further research and development.

SWD(2018) 36 final: Report on Critical Raw Material Part 1 & 3 could potentially impact on industrial wastewater operations in general by promoting the harvesting of CRMs. (As noted

⁵⁰ This claim is based on the fact that there are a broad variety of industries, and thus a broad variety of potentially recoverable materials.

above, they do not connect with the Industrial-Mining operations of the Water-Mining project as they are not involved in CRM mining). It counsels the MS to:

- **Take measures to achieve the best management of waste containing significant amounts of CRMs.**
- **Support the development of new / optimisation of existing chemical processes and/or technologies that enable the safe CRM reuse.**

{SWD(2020) 225 final}: *Chemicals Strategy for Sustainability Towards a Toxic-Free Environment* deals with chemicals, including “materials of concern” which might inhibit the harvesting of potential valuable materials from industrial waste water treatment; it advises the EC:

- **To minimise substances of concern in recycled materials** via measures promoting public information, adjustment of the REACH rules and investment into innovations that can decontaminate waste streams.

Reference Document on Best Available Techniques (BAT) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector **provides best practices for industries in the chemical sector** including:

- **Reducing the pollutant load of wastewater streams**, to recover and reuse raw materials.
- **Implementing a waste management plan as part of the environmental management system (EMS)** that ensures that waste be prepared for reuse, recycled or otherwise recovered.

Gap analysis

There are elements of EU policy which could potentially support the mining of solid / chemical materials from industrial wastewater treatment, but once again, none of the policy is specifically directed at the operation of such plants, in general, let alone the plants being tested in the Water-Mining project. This gap is derived from a number of factors:

1. Industrial mining deals with a broad variety of industries, producing a diverse line of waste, especially when compared to the Sea and Urban-Mining subsectors. Thus, designing a policy framework for harvesting industrial waste is likely more complex and subtle.
2. The concept and accompanying technology of industrial waste mining is an historically new phenomenon. This means that authorities may not have had the time nor

experience to formulate measures to deal with this technology and the many waste streams it could potentially mine.

3. Industry is a nationally diverse phenomena so creating an overarching EU-level policy would be challenging.

Understanding these factors, the WP10 policy team will consider the possible benefits of additional policies, such as:

- *Command and Control* policies that address:
 - **Reconfiguring the REACH regulations to include industrial wastewater mined products more explicitly.**
- *Market-based* policies that address:
 - **Providing subsidies to enable IWWT plants' mined products competitiveness** with other producers of the same materials (a financial act of levelling the playing field).
 - **Incentivizing the use of sustainable, safe and by design chemicals** between actors / players in the value chain, including chemicals produced by IWWT plants.
- *Encourage-Voluntary* policies that address:
 - **Creating a certification / labelling scheme for products derived from IWWT processes**, attesting to their quality.
- *Government Investment* policies that address:
 - **Providing seed money for companies that act as agents for IWWT facilities to handle the regulatory and market functions** connected to the mined products obtained from IWWT processes.⁵¹

⁵¹ [Aquaminerals](#) in Netherlands is an example for the Urban waste water industry

6. Results: Gap analysis at the Water-Mining country-level

1. Sea-Mining (SM) sub-sector (Desalination, CS1, CS2)

SM Respondents: CY1, ES1, GR1, IT1, PT1 (n = 5)

SM Objective 1a: *Enable the widespread use of renewable energy in sea-water desalination processes.*

- **Overall:** Ratings ranged from **weak to intermediate** indicating that **some gaps existed** in national policy.
- **Ratings⁵²:** In **Cyprus** (3), **Spain** (3-4) and **Italy** (3-4) respondents rated policy as **weak** resulting in substantial gaps for this objective.
Rationale: In Spain, desalination plants can acquire green energy from a separate grid, but there is little encouragement for in-house solar generation. In Cyprus and Italy the adoption of renewable energy is influenced via tenders which might encourage its incorporation into desalination plants.
- **Ratings: Greek and Portuguese** policies are rated as **intermediate** (7),
Rationale: The Greek government provides partial financial support towards coupling desalination and renewable energy. In Portugal, renewable energy policy is strong enough to encourage the use of such power sources in desalination systems.

SM Objective 1b: *Enable the widespread use of waste heat in sea-water desalination processes.*

- **Overall:** All respondents rated policy a **weak**, resulting in **major gaps** for this objective.
- **Ratings: Cyprus** (1), **Greece** (1), **Italy** (1), **Portugal** (1) and **Spain** (1-2)
Rationale: The respondents from **Greece** and **Spain** questioned whether the RO (reverse osmosis) desalination system which is widespread in their countries (and many other EU countries where RO occurs) would generate enough heat to make it worthwhile to harvest.

⁵² Policy ratings span a scale from 1 (very weak) to 10 (very strong).

SM Objective 2a: *Enable the sustainable production of expanded sources of water (resulting from sea-water desalination).*

- **Overall:** Opinions diverged on the gaps present in policy, **from small to large**.
- **Ratings: Cyprus (1) and Italy (1)**
Rationale: Cyprus simply stated that policy does not exist. In **Italy** desalination has been limited to older technologies and to certain regions with no other sources of freshwater, so policy has not needed to stay apace with this conservation objective.
- **Ratings: Spain (5-6)**
Rationale: Spain noted that desalination is incorporated in their River Basin plans, implying that support could be stronger. Practicalities are influencing the development of policy in areas where desalination is needed
- **Ratings: Portugal (7-8), Greece (7-8)**
Rationale: Portugal argues that its country policy is strong regarding sustainable production. **Greece** adds that its country policy is also quite strong as it provides funding for (new) renewable technology, as well as to modernise desalination plants via ZLD systems.

SM Objective 2b: *Enable the sustainable consumption of expanded sources of water (resulting from sea-water desalination).*

- **Overall:** All countries rated policy as **intermediate to strong** (with **Italy** an exception) resulting policy with small gaps.
- **Ratings: Greece (5-6), Spain (5-6), Cyprus (9)**
Rationale: All cited the use of financial measures for encouraging sustainable water consumption, including quotas, tariffs and block pricing (affecting the entire water package).
- **Rating: Italy (1)**
Rationale: Italy also noted the use of block pricing in its country to control water demand, but suggested that there were not any specific (conservation) policies relevant to desalinated water.

SM Objective 3: *Ensure the sustainable management of the brine effluent wastewater from sea-water desalination.*

- **Overall:** Ratings rank from **intermediate** (with one exception: **Italy** which is low) to high resulting in few policy gaps.
- **Ratings: Greece (4-5), Cyprus (8), Portugal (8), Spain (8-9)**

Rationale: With the exception of **Portugal** all of the other EU countries surveyed claimed that their countries permit flushing brine back into the sea. This is generally controlled by environmental authorities after environmental impact assessments are conducted. Nonetheless **Greece** would like to see widespread adoption of Zero Liquid Discharge (ZLD) technology, to reduce brine flushing, which is not seen in this country's view as sustainable.

- *Rating: Italy (1)*

Rationale for rating: Italy also permits brine flushing but argues that policy is not harmonised between regional and autonomous regions weakening brine management.

SM Objective 4: *Enable the sustainable recovery of materials (such as Mg, NaCl and other salts) from sea-water desalination.*

- *Overall:* Very large policy gaps exist among our respondent countries.
- *Ratings: Greece (1), Italy (1) Cyprus (1), Portugal (1), Spain (1)*

Rationale: Our respondents could not reference policies connected to solid material mining (from desalination processes). **Spain** argued that there may not be an available market for mined materials from the sea (primarily NaCl). **Greece** provided a counter argument to Spain's claim, suggesting that policy is needed to promote the adoption of ZLD systems which could support their activities by efficiently mining high-value materials, such as MgOH and Li.

SM Objective 5: *Ensure the widespread use of desalinated water among consumers who are concerned about its quality (i.e. not enough minerals, or too much Boron).*

- *Overall:* Policy was rated as either **weak or strong**, resulting in a disagreement on whether or what gaps in policy existed.
- *Ratings: Cyprus (1), Italy (1), Spain (1)*

Rationale: In all cases, populations that receive desalinated water as all, or part of their water allotment are generally unaware of possible quality problems, which means that there is no need for a promoting-type policy. Indeed in some cases, as well, there are no alternatives to desalination, so the populace must accept this source, as a default (**Italy, Spain**).

- *Ratings: Greece (8), Portugal (8)*

Rationale: Similar to what was said above, citizens in **Greece** and **Portugal** are not attentive to possible quality problems, which means that there is no need for

promoting desalinated water. The respondents here do not think of this as a gap. In the case of **Portugal**, minerals are re-infused into the water to restore what is lost by desalination. In **Greece**, there are strict directives about water quality (even if the populace is unaware of the policy structures). Moreover, the networks themselves are viewed positively by consumers, so they have confidence in desalinated water in **Greece**.

2. Urban-Mining (UM) sub-sector (Urban wastewater treatment, CS3, CS4, CS5):

UM Respondents: CY1, NL1, NL2, PT1, PT2, ES1, ES2 (n = 7)

UM Objective 1: *To sustainably recover water in urban settings to provide a new, secure, supply of this resource (for industry and agriculture) which leads to decreased water stress.*

- *Overall.* Policy is rated as **intermediate to high**, indicating small gaps in policy.
- *Ratings:* **Cyprus (9), Netherlands (7-9), Portugal (4-6), Spain (6)**

Rationale: **Cyprus** and **Portugal** use financial measures to encourage agriculture to use recovered water. Nonetheless one of the Portuguese respondents is worried over the lack of a national vision, requiring support from all stakeholders. In the **Netherlands**, policies are connected to security and quality, although reclaimed sources are not used specifically in agriculture in contrast to the countries cited above. **Spain** appears to have strong regulations permitting the country to recover wastewater; nonetheless, one of the Spanish respondents noted there were difficulties in applying these regulations to the urban area, due to poor coordination with the General plans, echoing his Portuguese counterpart.

UM Objective 2: *To promote the sustainable use of (all) water sources available to different sectors.*

- *Overall:* The countries ratings ranked from **intermediate to high** indicating few policy gaps overall.
- *Ratings:* **Netherlands (4), Portugal (5-7), Spain (6-7)**

Rationale: These countries claimed that there is general provision of policy towards this objective. However, they criticise the lack of global vision promoting cooperation among different sectors in their countries, the lack of enforcement promoting sustainable use and the disconnect between good policy and its application.

- Ratings: **Netherlands (8), Spain (9)**⁵³

Rationale: This group judges the availability of policy strong enough to promote sustainability. For example in **Portugal** the tools include the “national plan, the basin plan, and the institutions (i.e. water companies).” In Spain, there are hydrological plans in which water demands are fixed and assessed, and these numbers must be balanced, also at the level of control and monitoring.

UM Objective 3: *To recover and valorise waste material from urban wastewater treatment into useful resources. [Note: materials are phosphorus, Kaumera, salts].*

- *Overall:* Ratings ranged almost universally from **weak to intermediate** with one exception (**Netherlands**) indicating sizable gaps in policy.
- *Ratings :* **Cyprus (2), Portugal (4-5), Netherlands (4 / 9)**⁵⁴, **Spain (3-4)**

Rationale: **Portugal** noted the high cost of mining materials and the lack of incentives to support such products, and thus policy could not be rated higher than intermediate. **Cyprus** also noted the treatment cost and the fact that it is cheaper to throw away these materials. **Spain** acknowledges the existence of EU regulations permitting the retention of resources from wastewater (such as struvite). Unfortunately, EU regulations are not very well transposed to Spanish regulations. She argues that **Spain** has the ability to obtain resources from wastewater, but she sees legal difficulties in the Spanish regulations due to the fact that they classify these recovered materials as wastes rather than resources. One of our **Netherlands** respondents rates policy as being strong, based on the ambitions of the authorities involved in promoting solid material mining; however, this is only being realised in scattered innovation projects.⁵⁵

UM Objective 4a: *To recover energy from waste water treatment, in order to close the loop in urban wastewater treatment plants. [Note: energy recovery via biogas].*

- *Overall:* Based on the ratings, policy gaps are small.
- *Ratings:* **Portugal (6-7), Netherlands (6 / 9)**⁵⁶, **Spain (7-8)**

⁵³ The respondents from Netherlands and Spain disagreed with their counterparts in their own respective countries.

⁵⁴ The two Netherland respondents strongly disagreed about the depth of policy.

⁵⁵ See for example: <http://uest.ntua.gr/swws/proceedings/presentation/04.Zeeman.pdf>

⁵⁶ The two Netherland respondents strongly disagreed about the depth of policy.

*Rationale: In the Netherlands there is a long history of harvesting biogas.⁵⁷ In Portugal, biogas recovery is supported by policy, but one of our Portuguese respondents, argues that there are barriers towards injecting this energy source into the grid. In **Spain**, biogas is harvested but there is a problem in scale; not all regional urban wastewater centres have the capacity to harvest biogas.*

- **Ratings: Cyprus (2)**

Rationale: Cypriot policy is weak, due to the fact that the sewage stream is mixed with rainwater making it incompatible with biogas harvesting.

UM Objective 4b: *To use alternative sources of energy, in order to close the loop in urban wastewater treatment plants. [Note: alternative sources are solar].*

- *Overall:* No real trend can be discerned. Policy ratings range from **weak to strong**.

- **Ratings: Netherlands⁵⁸ (9-10), Portugal (7-8), Spain (9)**

Rationale: Spain claimed that the ability to recoup energy investments is a strong enabler for adopting alternative energy. **Netherlands** does concede that support for alternative energy, in general, could lead to its adoption in urban wastewater treatment; our respondents in **Netherlands** added the fact that the national SDE+++ funding program acts as important policy lever for funding alternative energy projects.

- **Ratings: Spain (2), Netherlands (4)⁵⁹, Cyprus (1).**

*Rationale: Our second Spanish respondent does not see the same policy support in **Spain**, as does his Spanish counterpart, but acknowledges that urban wastewater treatment plants are nonetheless installing solar grids. Finally, in the case of **Cyprus**, policy support is rated as low. Urban wastewater treatment plants do have the option to purchase alternative energy from the electricity grid.*

3. Industrial-Mining (IM) sub-sector (Industrial wastewater, CS6)

IM Respondents: ES2, IN1, NL1, NL2, PT2 (n = 5)

⁵⁷ Winquist, Van Galen, Zielonka, Rikkonen, Oudendag, Zhou, and Greijdanus, (2021) note that Combined Heat and Power (CHP) projects in the Netherlands, using biogas were eligible for government support through the competitive auction-based Stimulation of Sustainable Energy Transition Incentive Scheme (SDE++) scheme.

⁵⁸ One of the respondent from the Netherlands referred to the SDE+++ funding program, as an important policy lever.

⁵⁹ The respondents from Netherlands and Spain disagreed with their counterparts in their own respective countries.

IM Objective 1a: *Promote industrial collaboration along the value chain in order to minimise the use of raw materials (water).*

- **Overall:** Policy ratings range from **weak to intermediate** suggesting some policy gaps exist.
- **Ratings: India (1), Portugal (3-4), Netherlands (5 / 7)**
Rationale: **Spain** claimed that the ability to recoup energy. Most of the countries agreed that policy is not facilitating water conservation / recovery. According to the Netherlands, water is being saved because of market forces forcing greater efficiencies. **Portugal** cites sectoral difficulties, reducing the ability to create collaboration among most industrial sectors, which in turn makes it difficult to create a unified system in Portugal. Different sectors find loopholes to dodge compliance. Our Portuguese correspondents believe that a combination of regulatory penalties and better governance could improve the situation. In **India** any compliance towards water conservation is due to the existence of fines; unfortunately they are often not enforced.

IM Objective 1b: *Promote industrial collaboration along the value chain in order to minimise the use of energy. [Note: Energy here refers to waste heat recovery.]*

- **Overall:** No real trend can be discerned. Policy ratings range from **weak to strong**.
Ratings: Portugal (1), India (2-3)
Rationale: **Portugal** and **India** see no to little policy support for this objective in their respective countries. **India**, however, did see some support for the use of other forms of alternative energy in industrial wastewater recovery systems.
- **Ratings: Netherlands (5)**
Rationale: Our first respondent from the **Netherlands** is aware of general policy concerning energy conservation that could apply to industrial wastewater recovery, but nothing specific to the sub-sector.⁶⁰
- **Ratings: Spain (8), Netherlands (9)**
Rationale: Our second respondent from the **Netherlands** believes that funding mechanisms can specifically affect this sub-sector, so rates policy more strongly than her counterpart discussed above. **Spain** rates policy as strong (although this may be

⁶⁰ FME (employers' organisation for the technology industry) collaborates with RVO (Netherlands Enterprise Agency) to encourage entrepreneurs in **sustainable**, agrarian, innovative and international business.

due to the general enthusiasm in **Spain** for alternative energy) even though he could not identify projects involved with heat recovery.

IM Objective 2: Enable the continuous reuse of water within a closed-loop system to reduce the use of freshwater.

- *Overall:* Policy is rated as being **weak to (low) intermediate** (with the exception of one respondent from the **Netherlands**, who rates policy as **strong**) indicating substantial policy gaps.
- *Ratings:* **Portugal** (2), **Netherlands** (4 / 9⁶¹), **Spain** (4), **India** (4-5)
Rationale: For most countries, policy does not exist, or the objective is being met, in select industries, but foiled by other large sectors (such as agri-business in **Portugal**, which uses substantial amounts of water). In **India** (similar to **Portugal**) some industries are using closed-loop systems to save water and are encouraged to do so by policy, but our respondent believes the government does not provide the correct policy mix including infrastructure and financial support. According to one respondent from the **Netherlands**, policy seems to be strong, as closed loop systems are becoming widespread in his country; more than that, policy is not preventing such activities. However, his counterpart disagreed and argued that such policies are more limited.

IM Objective 3: Ensuring sustainable production and consumption by adopting innovative business models such as chemical leasing. [Note: can be other innovative BMs aside from chemical leasing]

- *Overall:* No trends exist as policy ranges from **weak to intermediate**.⁶²
- *Ratings:* **Netherlands** (1), **Portugal** (2-3), **IN1** (1)
Rationale: In these countries such policies do not exist; however, the objectives they are trying to accomplish are encouraged but receive little support, financially from government sources.
- *Ratings:* **Netherlands** (9), **Spain** (7)
Rationale: In contrast to his colleague cited above, this respondent from the **Netherlands** believes that his home country government is promoting a strong

⁶¹ The two respondents from the Netherlands were in disagreement about policy in their home country.

⁶² Nonetheless, with regards to Chemical Leasing policy is weak for all of these countries. As noted previously, no EU countries outside of Germany, Austria and Switzerland are officially part of the Chemical Leasing Group founded by UNIDO (United Nations Industrial Development Organisation) which would impede their ability to promote this innovative business model.

package of innovative (circular) economic business models (if not the specific chemical leasing model). ES2 (7) believes that the regulatory framework exists in **Spain** to support such business models, but it is not taken seriously by all parties.

IM Objective 4: Reduce wastewater and waste (brine, organic, sludge) some of which is normally disposed of via incineration or landfill.

- *Overall:* There are no policy trends, as three divergent groups were identified.

- *Ratings:* **Portugal** (2), **Spain** (4)

Rationale: In **Portugal** there does not appear to be any national policy, although it does follow EU-level policy with regard to this objective (remembering that EU policy is general and does not specifically focus on wastes emanating from industrial wastewater installations. **Spain** would like to see policy broadened to cover a larger variety of waste materials and even find a way to valorise them to make the system more circular; currently this is not the case.

- *Ratings:* **Netherlands** (5)

Rationale: Our first respondent from the **Netherlands** rates policy as intermediate because it is based on market forces, rather than government-based regulation.

- *Ratings:* **India** (8-9), **Netherlands** (8).

Rationale: Our second respondent from the **Netherlands** sees the national waste regulations as having a strong influence on the water sector and even forcing reuse. Our **Indian** respondent is also positive about the Indian regulatory framework but unlike her counterpart from the Netherlands, she does not see them being enforced.

IM Objective 5: Enable the sustainable recovery of materials (such as Na and CL streams as well as NaCl) from industrial water mining operations. [Note: different products obtained].

- *Overall:* Ratings ranged from weak to **low-intermediate** for four of the five countries indicating significant policy gaps; the exception was Netherlands (in which one of our respondents rated policy as **strong**).

- *Ratings:* **India** (1) **Netherlands** (4), **Portugal** (1), **Spain** (4)

Rationale: For these countries, policy does not exist or is not encouraging waste recovery from wastewater streams; instead, most acts of solid material recovery are being pursued independently, via private sector initiatives. In the **Netherlands**, *AquaMinerals*⁶³ is carrying out some of these activities by reusing by-products of

⁶³ AquaMinerals is a Netherlands based company seeking destinations for the material streams that are generated in water treatment processes. The organisation was initially established for all drinking water

drinking water production such as calcium carbonate. However, this is happening due to private, market-driven initiatives (i.e. their products are more “valuable” due to their more sustainable approach), rather than due to an actual policy. Thus one of our Netherlands respondent’s policy rating is based on the fact that the policy framework does not limit such activity, rather than actually being supportive.

- **Ratings: Netherlands (9)**

Rationale: One of **Netherlands**-based correspondents believes that existing policy in his country can support this activity, which results in his strong rating. Certainly, there are pilot programmes in the Netherlands including the Water-Mining project for testing this concept. His colleagues reference to the company AquaMinerals also seems to indicate that activity is trending in this direction.

companies in the Netherlands, but they are also connected to a Belgian drinking water company and for a number of Dutch Water Authorities.

7. Conclusions

7.1 Main findings of the EU-level policy gap analysis

7.1.1 Main Findings

1. The policy measures contained in the EU-level documents can potentially support specific elements of the different Water-Mining objectives, though not all elements.
2. Two notable exceptions of objectives with almost no EU policy support are:
 - Sea-Mining O-5: Ensure the widespread use of desalinated water among consumers concerned about its quality;
 - Industrial-Mining O-3: Ensuring sustainable production and consumption by adopting innovative business models such as chemical leasing.
3. More specific policy measures are needed for all objectives in all three subsectors.
4. Responding to these gaps, WP10's policy team devised comprehensive sets of policy measures to be considered for each objective in the three subsectors.

We note that in order to trigger eco-innovation, there is a need for a “double policy response”:⁶⁴ an environmental policy, which internalises external effects to create a market, and a technology policy to promote technology development and diffusion. For this reason, the Water-Mining Policy teams have suggested many market-based and government investment measures to support the specific command and control policies already existing in EU policy.

Most importantly, the EU-level policy gap analysis provides a comprehensive and structured base necessary for devising the policy packages.

7.1.2 Further Findings

1. *Much of the EU policy is general and does not fully support the specific operations of desalination, industrial wastewater treatment and urban wastewater treatment plants.* This is not surprising as only two documents from our analysed data base of 31

⁶⁴ Sandler (2016, p.152)

deal specifically with even one of these sub-sectors, urban wastewater (or Urban-Mining): (1) *Directive 91/271/EEC: Urban Waste Water Treatment Directive*; and (2) *Directive 86/278/EEC: Sewage sludge directive*.

2. *The large majority of the policies analysed are most closely connected to command and control without the other types of measures: government investment, market-based, encourage-voluntary and integration.* Command and control measures either promote or restrict the actions of various actors (including the EC and MS). However, this leads to large policy gaps, as high-level policy packages cannot be effective without the other types of measures mentioned above. As the Water-Mining technologies are an innovation action, the first two types are crucial as they provide financial support for developing and piloting technologies (via government investments), as well as creating the market conditions for ensuring the product uptake of both water and solid materials recovered from Water-Mining technological activity, by creating a well-functioning internal EU market.

This claim receives support from our interviews with our country respondents who suggested that not only were there few national policies promoting resource recovery, but more importantly that they were being held back because of a lack of financial incentives to support the market and technologies to recover such materials.

7.1.3 Existing policy support and gaps for cross-sector categories.

We also analysed the policy support received for the different objectives across the three different sub-sectors. We grouped these objectives according to cross-cutting categories that emerged from a comparison of the three sub-sectors. These categories are: *energy; waste-management; solid materials recovery, and sustainable consumption and / or production of water (including recovery)*. These categories are listed in Tables 4-2, 4-4 and 4-6.

Energy objectives⁶⁵

- *There are strong, general, EU-level, policy supports for promoting biofuel (including biogas) use, solar energy and even the recovery of waste heat; This support also includes measures that would reduce emissions, stimulating the greater use of such energy sources.*

⁶⁵ Connected to Sea-Mining objective 1, Urban-Mining objective 4, and Industrial-Mining objective 1.

- *However, there are almost no specific policies supporting the actual harvesting of energy sources, such as waste heat in Sea-Mining plants (objective 1) or biogas in Urban-Mining plants (objective 4), nor of using alternative energy sources, such as solar in said plants.*
- *There are policy supports for minimising the use of energy, which might affect any industrial installation, most notably via techniques to improve efficiency. These could potentially support the energy minimisation efforts of an Industrial-Mining installation (IM objective 1), but again there is no direct policy for this sub-sector.*

Waste management objectives⁶⁶

- *The EU has created a strong set of policies supporting both waste reduction directly, or indirectly (via decreasing landfilling options). The latter certainly could have an effect on both the Sea and Industrial Mining sub-sectors, respectively.;*
- *EU policy directly favouring reducing the amount of waste is probably not specific enough to affect Sea-Mining wastes (brine) which in most MSs is flushed back into the sea (and could cause damage to the local ecology).⁶⁷*

Solid material recovery objectives⁶⁸

- *The EU strongly promotes the reuse of critical raw materials in-line with CE principles. These materials include magnesium and phosphorus, chemicals that can be obtained from Sea-Mining and Urban-Mining operations, respectively.*
- *Financial support of these targets is much less common.*
- *It is questionable whether the current directives connected to the Sewage Sludge or Fertiliser would support Kaumera harvesting and its reuse, from Urban-Mining activities. Indeed discussions with Water-Mining's Kaumera experts support this claim.*
- *There are no policies supporting the harvesting of salts or Na or Cl streams connected to Industrial-Mining activities.*

⁶⁶ A prime concern of Sea-Mining (objective 3) and Industrial-Mining (objective 4)

⁶⁷ Most of our country respondents note that flushing is allowed in their countries under supervision of the national or local authorities, based on submitted environmental impact reports. One respondent, GR1, recommended the installation of Liquid Zero Discharge desalination systems which she argued, are more efficient than other forms of desalination at reducing brine and harvesting valuable minerals such as MgOH.

⁶⁸ This affects all three Water-Mining sub-sectors (Sea-Mining objective 4, Urban-Mining objective 3 and Industrial-Mining objective 5).

- *Industrial wastewater operations are connected to a wide variety of industries (outside of what is being done in the Water-Mining project) so current policy could help to support the mining of some important secondary and even critical raw materials.*

Sustainable consumption and / or production of water (including recovery)⁶⁹

- *Our EU document data-base (Table 4-7) contains seven documents dominated by water issues (i.e., with the term “water” in their titles). Nonetheless, it lacks, surprisingly, strong measures associated with sustainable water consumption (i.e. conservation) such as through the use of technology or enforcement penalties, especially when connected to water derived from desalinated, urban wastewater or industrial wastewater sources; however, policy is much stronger in connection with pollution issues, as noted in our analysis.*
- *Regarding **production (including recovery)** much of the existing EU policy is focused on urban wastewater (objective 1) as an alternative water source for agriculture.*
- *These policies include stringent rules concerning the operation of water reclamation facilities, connected to urban wastewater recovery, which could also affect industrial wastewater facilities as well.*
- *There are policies connected to general efficient use of water in industrial installations. These could be broadly interpreted as affecting the operation of Industrial-Mining (objectives 1 & 2) but again the policies lack specificity.*

7.2 Main findings concerning policy gaps at the country-level

When turning to the country-level findings, obtained via interviews, a number of interesting trends appear, which are not (unsurprisingly) fully aligned with our EU-level findings. We present these findings using the cross-sector categories of policy objectives.

Energy objectives⁷⁰

- With regards to renewable energy use and waste heat harvesting in desalination plants, policy is weak.
- In contrast there is a long history of harvesting biogas in urban wastewater plants across EU countries and policy is generally strong;

⁶⁹ Connected to Sea-Mining objective 2, Urban-Mining objectives 1 & 2, and Industrial-Mining objectives 1 & 2.

⁷⁰ Connected to Sea-Mining objective 1, Urban-Mining objective 4, and Industrial-Mining objective 1.

- Concurrently, there is enthusiasm, reflected in strong policy, for the alternative energy use in the Urban-Mining subsector.
- Finally, there was no consensus about whether policy supported minimising energy usage, specifically within the industrial wastewater sub-sector (objective 1).

Waste management objectives⁷¹

- With regard to desalination operations, most of the respondents claimed that policy gaps were small. The standard procedure, as noted above, is to flush brine out to sea; this is permitted in most EU member states under close supervision of the national or local authorities, based on submitted environmental impact reports.⁷²
- For industrial wastewater there was no agreement among the respondents about the gaps in waste management policies governing operation with ratings for policy that spanned the spectrum from weak to strong.

Solid materials recovery objectives⁷³

- Our country respondents were unequivocal about the fact that policy was weak with regards to this objective.
- In contrast, EU policy strongly promotes solid material (including chemical) recovery, as this also contributes to the reduction of waste, thus achieving a prominent goal of the CE. Thus, from a theoretical perspective, such policy has the potential for being applied to desalination, urban wastewater and industrial wastewater operations.
- Nonetheless, research and development of technology that could harvest solid materials from (waste) water is proceeding in many of our respondent countries, but this has been catalysed by (private) financial prerogatives, rather than policy. This is a perfect example where technology has outpaced policy and where policy may be needed to fill in the void created by that new technology. As one of our correspondents remarked, it is sometimes better when there is a lack of policy, as it permits the rapid exploitation of new technological niches.

⁷¹ A prime concern of Sea-Mining (objective 3) and Industrial-Mining (objective 4).

⁷² Please see a previous footnote which notes that our Greek correspondents, GR1 argued that flushing brine out to sea could be unsustainable.

⁷³ This affects all three Water-Mining sub-sectors (Sea-Mining objective 4, Urban-Mining objective 3 and Industrial-Mining objective 5).

Sustainable consumption and / or production of water (including recovery)⁷⁴

MS policy shows a divergence of views both between sub-sectors and even within sub-sectors.

Consumption:

- In both the Sea-Mining and Urban-Mining sub-sectors, our respondents claim that policy gaps are small, underlining the idea that conservation is supported. They cited a variety of policies, most notably market-based tools (including pricing) to enforce conservation.
- In the Industrial-Mining sub-sector the picture is less clear, concerning **consumption** (Industrial-Mining objective 1); rankings of policy ranged from weak to strong depending on the country.
- EU-level policy seems weaker concerning conservation.

Production:

- Our respondents expressed the idea that policy does not support the closed-loop recovery of water from industrial processes.
- In opposition, in the Urban-Mining sector policies supporting water recovery appeared to be quite strong. This seems to imply that water obtained from urban wastewater is better managed, at least at the policy level, than water obtained from industrial processes.
- Concerning the Sea-Mining sub-sector, policy was considered to be anywhere from weak to strong in connection to sustainable production. Possibly, policy is stronger for the urban wastewater sector because it has existed, historically, for a longer time, providing it with the opportunity to better develop its technology and accompanying policy.

⁷⁴ Connected to Sea-Mining objective 2, Urban-Mining objectives 1 & 2, and Industrial-Mining objectives 1 & 2.

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For the 31 EU-level policy documents utilised in the gap analysis see table 4-7

9. Appendix

9.1 Citations from EU policy supporting the Sea-Mining Objectives

Note: There are five (5) Sea-Mining Objectives

EU Policies supporting Sea-Mining Objective 1:

Sea-Mining Objective 1: Enable the widespread use of renewable energy, as well as the use of waste heat in sea-water desalination processes.

DIRECTIVE (EU) 2018/200: on the promotion of the use of energy from renewable sources (recast).

The directive guides the MSs and the EC to:

- Take into account the contribution of energy from renewable sources in planning structures and legislation, by MSs⁷⁵
- Carry out an assessment of their potential of energy from renewable sources and the use of waste heat and cold, by MSs⁷⁶
- Encourage investments in new, flexible and clean technologies. by the EC
- Facilitate the exchange of best practices between national authorities to find a common approach to promote a higher uptake of renewable energy projects, by the EC⁷⁷.
- Establish an adequate strategy to manage the retirement of technologies which do not contribute to the reduction of emissions or deliver sufficient flexibility, by the EC⁷⁸.
- Ensure that regions should include provisions for the integration and deployment of renewable energy, including the use of unavoidable waste heat when planning, in building and renovating urban infrastructure and energy infrastructure, by MSs.⁷⁹

⁷⁵ **DIRECTIVE (EU) 2018/ 2001: on the promotion of the use of energy from renewable sources (recast)** (p. 88, par.44)

⁷⁶ *ibid* (p. 89., par 49)

⁷⁷ *ibid* (p. 84, par 14).

⁷⁸ *ibid* (p. 84, par 14).

⁷⁹ *ibid* (p. 114, article 15)

COM(2019) 640 final: EU Green Deal advises the EC and MSs that:

- The plan is to review each existing law on its climate merits, and also introduce new legislation on the circular economy, building renovation, biodiversity, farming and innovation.⁸⁰
- Opportunities that digitalisation presents for monitoring and optimising how energy and natural resources are used.⁸¹

Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil⁸² plans on:

- Introducing stricter requirements to tackle air pollution at source, such as from agriculture, industry, transport, buildings and energy.⁸³
- Revising the Energy Taxation Directive in order to help ensure that users are encouraged to choose less polluting energy sources.

Directive 2010/75/EC: Industrial Emissions Directive - BREF documents⁸⁴ recommends the following BATs:

- Energy Efficiency management (BAT1)
- Usage of appropriate tools to assist with identifying and quantifying energy optimization (BAT5).
- Carrying out systematic comparisons with sector, national or regional benchmarks (BAT9).
- Optimising energy efficiency when planning a new installation, or a significant upgrade (BAT10).
- Establishing and maintaining documented procedures to monitor and measure, on a regular basis, the key characteristics of operations and activities that can have a significant impact on energy efficiency (BAT16).

⁸⁰ Simon, Frédéric (2019-12-11). "EU Commission unveils 'European Green Deal': The key points". www.euractiv.com. Retrieved 2022-06-15.

⁸¹ COM(2019) 640 final: "EU Green Deal" (p. 14)

⁸² {SWD(2021) 140 final} - {SWD(2021) 141 final}: " Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'"

⁸³ *ibid* , p. 6

⁸⁴ Reference Document on Best Available Techniques (BAT) for Energy Efficiency

EU Policies supporting Sea-Mining Objective 2:

Sea-Mining Objective 2: Enable the **sustainable production** and **consumption** of expanded sources of water.

Directive 2000/60/EC: Water Framework Directive guides the EC and MSs to:

- Provide for a water framework to coordinate, integrate, and, develop the overall principles for **sustainable use** of water⁸⁵
- Identifying waters used for the abstraction of drinking water and ensuring compliance related to the quality of water intended for human consumption.⁸⁶

{SWD(2021) 140 final} - {SWD(2021) 141 final}: Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil ensures that:

- MS promotes sustainable and efficient water consumption... present a socially fair water bill to all water users and polluters, including industry, agriculture and household consumers, making the best use of the revenues for sustainable investments.⁸⁷

Additionally, **Directive 91/676/EEC: “Nitrates Directive”** enjoins the MSs to:

- Designate as vulnerable zones all known areas of land in their territories which drain into the waters identified (according to paragraph 1) contributing to pollution⁸⁸
- Establish codes of good agricultural practice, to be implemented by farmers, voluntarily⁸⁹
- Provide training to farmers, promoting the application of codes of good agricultural practice⁹⁰
- Monitor the nitrate content of their waters⁹¹

⁸⁵ **Directive 2000/60/EC: “Water Framework Directive**, p. 2, par. 18

⁸⁶ Ibid, p. 4, par. 37

⁸⁷ **{SWD(2021) 140 final} - {SWD(2021) 141 final}: Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil**, p. 9

⁸⁸ **Directive 91/676/EEC: “Nitrates Directive”**, p. 4

⁸⁹ Ibid, p. 4

⁹⁰ Ibid, p. 4

⁹¹ Ibid, p. 5

- Limit the land application of fertilisers and taking into account the characteristics of the vulnerable zone concerned; additionally, for each farm, the amount of manure applied each year, including by the animals themselves, shall not exceed a specified amount⁹²

EU Policies supporting Sea-Mining Objective 3:

Sea-Mining Objective 3: Ensure the **sustainable management** of the **brine effluent wastewater** from sea-water desalination.

Directive 2008/98/EC: Waste Framework Directive guides the EC and MSs to:

- Minimise the negative effects of the generation and management of waste on human health and the environment.⁹³
- Provide for effective, proportionate and dissuasive penalties to be imposed on legal persons responsible for waste management, such as waste producers...which carry out waste treatment operations / waste management schemes, in cases where they infringe on the provisions of this Directive.⁹⁴
- Develop waste prevention programmes concentrating on key environmental impacts and taking into account the whole life-cycle of materials.⁹⁵
- Ensure that disposal operations involving release to seas / oceans are regulated by international conventions (especially: *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972)*).⁹⁶
- Ensure that, where recovery... is not undertaken, waste undergoes safe disposal meeting the provisions on the protection of human health / environment.⁹⁷
- Ensure that producers of hazardous waste shall keep a chronological record of its quantity, nature and origin, while making the information available to competent authorities.⁹⁸
- Ensure that the hazardous waste records shall be preserved for at least three years.⁹⁹
- Take measures to prohibit the dumping or uncontrolled management of waste, with provisions on penalties applicable to infringements of this Directive.¹⁰⁰

⁹² Ibid, p. 10

⁹³ **Directive 2008/98/EC: "Waste Framework Directive**, p.1, par.6

⁹⁴ Ibid, p.1, par.6

⁹⁵ Ibid, p.6, para. 40:

⁹⁶ Ibid, p.3, para 21:

⁹⁷ Ibid, p. 11, Article 12:

⁹⁸ Ibid, p. 17, Article 35

⁹⁹ Ibid, p. 17, Article 35

¹⁰⁰ Ibid, p. 18 - Article 36

- Ensure that waste management costs shall be borne by the original waste producer or by the current or previous waste holders.¹⁰¹

OJ, 14.6.2018, L 150: Revised Waste Legislative Framework guides the MS to ensure that:

- Progressively reducing landfilling; that reduction should avoid the development of excessive capacity for the treatment of residual waste facilities, as this could result in undermining re-use and recycling targets.¹⁰²
- Where recovery is not undertaken, waste undergoes safe disposal operations.¹⁰³
- Targets setting landfill restrictions should be strengthened by gradually reducing landfilling to a minimum level; this reduction should fit into an integrated policy based on the waste hierarchy, while enhancing a shift towards prevention.¹⁰⁴
- They review the targets for landfilling, while introducing quantitative target per capita on landfilling and to introducing restrictions to the landfilling of non-hazardous waste other than municipal waste.¹⁰⁵

{SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: Chemicals Strategy for Sustainability Towards a Toxic-Free Environment”

- EC will develop a framework of indicators to monitor drivers / impacts of chemical pollution and to measure the effectiveness of chemicals legislation.¹⁰⁶

COM(2018) 29 final: Monitoring framework for the circular economy

- MF 3a-b: “In a circular economy waste generation is minimised”¹⁰⁷

¹⁰¹ Ibid, p.12. Article 14

¹⁰² **OJ, 14.6.2018, L 150: Revised Waste Legislative Framework**, p. 103

¹⁰³ Ibid, p. 134

¹⁰⁴ Ibid, p. 102

¹⁰⁵ Ibid, p.106

¹⁰⁶ **{SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: Chemicals Strategy for Sustainability Towards a Toxic-Free Environment”, p. 21.**

¹⁰⁷ COM(2018) 29 final: “Monitoring framework for the circular economy, Table 4.

{SWD(2021) 140 final} - {SWD(2021) 141 final}: Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil advises the EC to:

- Adopt recommendations on how to promote relevant instruments / incentives to implement the “polluter pays principle”.¹⁰⁸

EU Policies supporting Sea-Mining Objective 4:

Sea-Mining Objective 4: Enable the **sustainable recovery** of **materials** (such as **Mg, NaCl** and **other salts**) from sea-water desalination. [Note: different products obtained]

OJ, 14.6.2018, L 150: Revised Waste Legislative Framework which enjoins the MSs that:

- The aim of this Directive is to ensure a progressive reduction of landfilling of waste, in particular of waste that is suitable for recovery, and, to provide for measures, to prevent or reduce as far as possible negative effects on the environment from landfilling of waste.¹⁰⁹
- They should progressively be reducing landfilling...to ensure that economically valuable waste materials are recovered. That reduction should avoid the development of excessive capacity for the treatment of residual waste facilities, as this could result in undermining re-use targets.¹¹⁰
- By 2030, all waste suitable for recovery shall not be accepted in a landfill with the exception of waste for which landfilling delivers the best environmental outcome.¹¹¹
- A definition of material recovery should be introduced to cover forms of recovery other than energy recovery and the reprocessing of waste into materials to generate energy. It includes preparing for re-use.¹¹².
- Take measures to ensure that waste that has undergone recovery is considered to have ceased to be waste via the establishment of material and application-specific end-of-waste criteria based on EU harmonised conditions.¹¹³
- Materials that cease to be waste through recovery are to be counted for the attainment of the respective recovery set in those Directives in line with the applicable calculation methods.¹¹⁴

¹⁰⁸ **{SWD(2021) 140 final} - {SWD(2021) 141 final}: “ Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil”, p.13.**

¹⁰⁹ **OJ, 14.6.2018, L 150: “Revised Waste Legislative Framework, p. 104**

¹¹⁰ **Ibid, p. 103**

¹¹¹ **Ibid, p. 105.**

¹¹² **Ibid, p. 113**

¹¹³ **Ibid, p. 105**

¹¹⁴ **Ibid, p. 119**

- Take measures, before / during recovery, to remove hazardous substances.¹¹⁵.
- Take measures to achieve the best possible management of waste containing significant amounts of Critical Raw Materials (**CRMs**).¹¹⁶
- In order to provide operators in markets for SRMs with more certainty as to the waste or non- waste status of substance, it is important that MS take measures to ensure that waste that has undergone recovery is considered to have ceased to be waste if it complies with the conditions laid down in this Directive. Such measures may include:
 - Adopting legislation transposing those conditions supported by procedures for their implementation, such as the establishment of material and end-of-waste criteria, guidance documents, case-by-case decisions and procedures for the ad hoc application of the harmonised conditions established at the EU level.
 - Enforcement provisions to verify that waste that is considered to have ceased to be waste as a result of a recovery complies with EU law on waste, chemicals and products, in particular prioritising waste streams that pose higher risk to human health and the environment due to the nature and volume of those waste streams, waste that is subject to innovative recovery processes or waste that is recovered for subsequent further use in other MS.
 - Setting requirements on operators recovering waste or holders of recovered waste materials to demonstrate compliance with the conditions of this Directive.¹¹⁷

SWD(2018) 36 final: Report on Critical Raw Material (CRM) Part 1 which counsels the MS to:

- Take measures to achieve the best management of waste containing significant amounts of CRMs, and include in their waste management plans appropriate measures regarding waste collection and recovery.¹¹⁸

SWD(2018) 36 final: Report on Critical Raw Material (CRM) Part 3 which advises the EC to:

- (possibly) Support the development of new or optimisation of existing chemical processes and/or technologies that enable/enhance the safe recycling and/or reuse of CRMs.¹¹⁹

¹¹⁵ Ibid, p. 130

¹¹⁶ Ibid, p. 117

¹¹⁷ Ibid, p. 113

¹¹⁸ **SWD(2018) 36 final: “Report on Critical Raw Material” Part 1**,p. 11

¹¹⁹ **SWD(2018) 36 final: “Report on Critical Raw Material” Part 3**, p. 62

COM(2015) 614 final: An EU action plan for the Circular Economy which instructs the EC to:

- Develop quality standards for secondary raw materials where they are needed, while proposing improvements to the rules on 'end-of-waste'; as part of this process the EC is developing the Raw Materials Information System (RMIS)¹²⁰ and supporting research on raw materials flows.¹²¹

{SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: Chemicals Strategy for Sustainability Towards a Toxic-Free Environment which enjoins the EC to:

- Develop a common open data platform on chemicals to facilitate the sharing, access and re-use of information on chemicals from all sources.¹²²

Directive 2008/98/EC: Waste Framework Directive which advises the MS that:

- They should promote the re-use of products and prepare for re-use by establishing re-use networks, the use of economic instruments, procurement criteria, quantitative objectives....¹²³

EU Policies supporting Sea-Mining Objective 5:

Sea-Mining Objective 5: Ensure the **widespread use of desalinated water** among consumers who are **concerned** about its **quality** (i.e. not enough minerals, or too much Boron).

COM(2015) 614 final: An EU action plan for the Circular Economy states that:

¹²⁰ The RMIS provides a structured repository of knowledge related to non-fuel, non-agricultural raw materials from primary and secondary sources. It focuses on abiotic and biotic materials, covering the entire value chain. The overarching goal of the RMIS is to facilitate: the availability, coherence and quality of knowledge required by specific EU raw materials policies and EC services and; access to key raw materials information from knowledge bases within and beyond Europe.

¹²¹ **COM(2015) 614 final: An EU action plan for the Circular Economy**, p. 13

¹²² **{SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: Chemicals Strategy for Sustainability Towards a Toxic-Free Environment**, p. 17

¹²³ **Directive 2008/98/EC: Waste Framework Directive**, p. 11



- The voluntary EU Ecolabel identifies products that have a reduced environmental impact throughout their lifecycle. The EC is examining how to increase its effectiveness and contribution to the CE.¹²⁴

¹²⁴ COM(2015) 614 final: An EU action plan for the Circular Economy, p. 6.

9.2 Citations from EU policy supporting the Urban-Mining Objectives

Note: There are Four (4) Urban-Mining Objectives

EU Policies supporting Urban-Mining Objective 1:

Urban-Mining Objective 1: To sustainably recover water in urban settings to provide a new, secure, supply of this resource (for industry and agriculture) which leads to decreased water stress.

REGULATION (EU) 2020/741: on minimum requirements for water reuse¹²⁵ enjoins the EC and MS to take action on the following issues:

- Council Directive 91/271/EEC(5) [concerning *urban waste water treatment*] requires that treated wastewater be reused in order to decrease water pressure, while reducing the impact of discharge of treated wastewater into water bodies.¹²⁶
- *A Blueprint to Safeguard Europe's Water Resources (2020)*' points to the need to create an instrument to regulate standards for water reuse to remove the obstacles to its reuse.¹²⁷
- Health standards in relation to food hygiene for agricultural products irrigated with reclaimed water can be achieved if quality requirements for reclaimed water destined for agriculture are harmonised in MS. Harmonisation contributes to efficient internal markets. The EU needs to introduce harmonisation by setting minimum requirements for water quality and monitoring.¹²⁸
- Compliance with minimum requirements for water reuse should be consistent with EU water policy and contribute to the achievement of the SDG 6 & SDG 12.¹²⁹
- Risk management is based on the concept of producing reclaimed water of a specific quality required for particular uses; thus, water reuse risk management plans should ensure that reclaimed water is safely used and managed. To develop risk management plans, existing international guidance/ plans could be used.¹³⁰

¹²⁵ The policies listed here are repeated in **COM 2018/337: Minimum requirements for water reuse**

¹²⁶ **REGULATION (EU) 2020/741: on minimum requirements for water reuse**, p.1.

¹²⁷ Ibid, p. 1

¹²⁸ Ibid, p. 2

¹²⁹ Ibid, p. 3

¹³⁰ Ibid, p. 3

- Take measures to ensure that water reuse does not lead to a deterioration in water quality; thus, water reuse risk management plans should pay attention to protecting water bodies.¹³¹
- Reclamation operators should be responsible for the quality of reclaimed water at the point of compliance. For this purpose, reclamation facility operators should monitor the quality of reclaimed water.¹³²
- Reclamation facility operators and end-users should cooperate to ensure that reclaimed water produced is in accordance with the minimum quality requirements regarding crop categories. In cases where this is not the case, water quality requirements could be met by using, at a subsequent stage, several water treatment options alone or in combination with the multi-barrier approach.¹³³
- The reclamation facility operator shall ensure that, at the point of compliance, reclaimed water intended for agriculture complies with minimum requirements for water quality.¹³⁴
- Production / supply of reclaimed water for agricultural irrigation should be allowed on the basis of a permit. In order to ensure a harmonised approach of traceability of reclaimed water the substantive rules for such permits should be laid down by the EU.¹³⁵
- Competent authorities should verify compliance of reclaimed water with the conditions of a permit. In cases of non-compliance responsible parties must take measures to ensure compliance.¹³⁶
- The authorities verify whether compliance meets with the conditions set out in the permit. Compliance is determined by: (a) on-the-spot checks; (b) monitoring data; (c) any other adequate means.¹³⁷

Directive 91/271/EEC: Urban Waste Water Treatment Directive rules that:

- Treated wastewater shall be reused whenever appropriate. Disposal routes shall minimise the adverse effects on the environment.¹³⁸

EU Policies supporting Urban-Mining Objective 2:

¹³¹ Ibid, p. 3

¹³² Ibid, p. 3

¹³³ Ibid, p. 4.

¹³⁴ Ibid, p. 9 - Article 4.

¹³⁵ Ibid, p. 4.

¹³⁶ Ibid, p. 4.

¹³⁷ Ibid, p. 11, Article 7.

¹³⁸ **Directive 91/271/EEC: Urban Waste Water Treatment Directive**, p. 4 - Article 12.

Urban-Mining Objective 2: To promote sustainable use of (all) water sources available to different sectors.

REGULATION (EU) 2020/741: on minimum requirements for water reuse¹³⁹ advises the EC and the MS to:

- More widely reuse treated wastewater to decrease water pressures, while reducing the impact of discharge of treated wastewater into water bodies; thus Council Directive 91/271/EEC(5) (concerning urban waste water treatment) requires that treated wastewater be reused whenever possible.¹⁴⁰
- Harmonise quality requirements for reclaimed water destined for agricultural irrigation in order to achieve health standards connected to hygiene for products irrigated with reclaimed water. Harmonisation contributes to the efficient internal markets. Thus, there is a need to introduce harmonisation by setting minimum requirements for water quality and monitoring.¹⁴¹
- Ensure optimal reuse of urban waste water resources, end-users should receive training so that they use water of the appropriate reclaimed water quality class.¹⁴²
- Permit the production / supply of reclaimed water for agricultural irrigation on the basis of a permit. In order to ensure a harmonised approach of traceability of reclaimed water the substantive rules for such permits should be laid down by the EU.¹⁴³
- Not preclude the use of reclaimed water for other purposes, provided a high level of protection of the environment is ensured.¹⁴⁴
- Provide up to date information to the public to increase confidence in water reuse, including via awareness raising campaigns in MS where reclaimed water is used for agricultural irrigation. Increased transparency / traceability could also be of particular use to other relevant authorities for whom the specific water reuse has implications.¹⁴⁵

¹³⁹ The policies listed here are repeated in **COM 2018/337: Minimum requirements for water reuse** and minimally in **COM(2015) 614 final: An EU action plan for the Circular Economy**.

¹⁴⁰ **REGULATION (EU) 2020/741: on minimum requirements for water reuse,**

¹⁴¹ Ibid, p. 2-3:

¹⁴² Ibid, p. 4.

¹⁴³ Ibid, p. 4.

¹⁴⁴ Ibid, p. 5.

¹⁴⁵ Ibid, p. 6.

- Provide end-user education / training as components of implementing and maintaining preventive measures. Specific human exposure preventive measures should be considered in the water reuse risk management plan.¹⁴⁶
- Lay down rules on penalties applicable to infringements of this Regulation and ensure their implementation.¹⁴⁷

Directive 2000/60/EC: Water Framework directive, which advises the EC and MS to:

- Protect and improve the quality of the environment in utilisation of natural resources, based on the precautionary principle and that the polluter should pay.¹⁴⁸
- Promote sustainable water use based on a long-term protection of water resources.¹⁴⁹
- Ensure that water-pricing policies provide adequate incentives for users to use water resources efficiently, providing an adequate contribution of the different water uses, and take into account the polluter pays principle.¹⁵⁰

{SWD(2021) 140 final} - {SWD(2021) 141 final}: “Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil states that the:

- EC will aim to ensure that MS promotes sustainable and efficient water consumption... present a socially fair water bill to all water users and polluters, including industry, agriculture and household consumers, making best use of the revenues for sustainable investments.¹⁵¹

SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) final amending Directive 2010/75/EU of the European Parliament on industrial emissions (integrated pollution prevention and control) notes that:

¹⁴⁶ Ibid, p. 6.

¹⁴⁷ Ibid, p. 7

¹⁴⁸ **Directive 2000/60/EC: Water Framework Directive**, p. 2. :

¹⁴⁹ Ibid, p.. 5.

¹⁵⁰ Ibid, p. 13.

¹⁵¹ **{SWD(2021) 140 final} - {SWD(2021) 141 final}: “Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil** which states that the EC, p. 9.

- Increased coherence will also be created by clarifying the rules that apply to the indirect release of polluting substances into water from UWWT.¹⁵²

Directive 86/278/EEC: Sewage sludge directive enjoins the MSs to use sludge:

- Under conditions which ensure that the soil and the surface and ground water are protected¹⁵³
- Such that account is taken of the nutrient needs of the plants and that the quality of the soil and of the surface and groundwater is not impaired.¹⁵⁴

Directive 91/676/EEC: Nitrates Directive advises the MS to:

- Designate, within a two -year period, as vulnerable zones, all known areas of land in their territories which drain into the waters, which contribute to pollution.¹⁵⁵
- Establish codes of good agricultural practice, to be implemented by farmers, voluntarily¹⁵⁶
- Provide training to farmers, promoting the application of codes of good agricultural practice¹⁵⁷
- Monitor the nitrate content of their waters.¹⁵⁸
- Limit the land application of :fertilisers, while taking into account the characteristics of the vulnerable zone concerned; additionally, for each farm, the amount of manure applied annually, including by the animals themselves, shall not exceed a specified amount¹⁵⁹

EU Policies supporting Urban-Mining Objective 3:

Objective 3: To recover and valorise waste material from urban wastewater treatment into useful resources. [Note: materials are phosphorus, kaumera, salts]

OJ, 14.6.2018, L 150: Revised Waste Legislative Framework suggests to the MSs that:

¹⁵² SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) final amending Directive 2010/75/EU of the European Parliament on industrial emissions (integrated pollution prevention and control), p. 8.

¹⁵³ Sewage sludge directive, p. 7, Article 1

¹⁵⁴ Ibid, p. 8, Article 8

¹⁵⁵ Directive 91/676/EEC: Nitrates Directive, p. 4

¹⁵⁶ Ibid, p. 4

¹⁵⁷ Ibid, p. 4

¹⁵⁸ Ibid, p. 5

¹⁵⁹ Ibid, p. 10

- Progressively reducing landfilling...to ensure that economically valuable waste materials are recovered. That reduction should avoid the development of excessive capacity for the treatment of residual waste facilities, as this could result in undermining re-use targets.¹⁶⁰
- The aim of this Directive is to ensure a progressive reduction of landfilling of waste, in particular of waste that is suitable for recovery, and, to provide for measures, to prevent or reduce as far as possible negative effects on the environment from landfilling of waste.¹⁶¹
- A definition of material recovery should be introduced to cover forms of recovery other than energy recovery and the reprocessing of waste into materials to generate energy. It includes preparing for re-use.¹⁶²
- Materials that cease to be waste through recovery are to be counted for the attainment of the respective recovery set in those Directives in line with the applicable calculation methods.¹⁶³
- By 2030, all waste suitable for recovery shall not be accepted in a landfill with the exception of waste for which landfilling delivers the best environmental outcome.¹⁶⁴
- Take measures to ensure that waste that has undergone recovery is considered to have ceased to be waste via the establishment of material and application-specific end-of-waste criteria based on EU harmonised conditions.¹⁶⁵
- Take measures to achieve the best possible management of waste containing significant amounts of CRMs.¹⁶⁶ (*This applies specifically to phosphorus*)
- Take measures, before / during recovery, to remove hazardous substances.¹⁶⁷
- In order to provide operators in markets for SRMs with more certainty as to the waste or non- waste status of substance, it is important that MS take measures to ensure that waste that has undergone recovery is considered to have ceased to be waste if it complies with the conditions laid down in this Directive. Such measures may include:
 - Adopting legislation transposing those conditions supported by procedures for their implementation, such as the establishment of material and end-of-waste criteria, guidance documents, case-by-case decisions and procedures for the ad hoc application of the harmonised conditions established at the EU level.
 - Enforcement provisions to verify that waste that is considered to have ceased to be waste as a result of a recovery complies with EU law on waste, chemicals and

¹⁶⁰ OJ, 14.6.2018, L 150: “Revised Waste Legislative Framework, p. 103

¹⁶¹ OJ, 14.6.2018, L 150: “Revised Waste Legislative Framework, p. 104

¹⁶² Ibid, p. 113

¹⁶³ Ibid, p. 119

¹⁶⁴ Ibid, p. 105.

¹⁶⁵ Ibid, p. 105

¹⁶⁶ Ibid, p. 117

¹⁶⁷ Ibid, p. 130

products, in particular prioritising waste streams that pose higher risk to human health and the environment due to the nature and volume of those waste streams, waste that is subject to innovative recovery processes or waste that is recovered for subsequent further use in other MS.

- Setting requirements on operators recovering waste or holders of recovered waste materials to demonstrate compliance with the conditions of this Directive.¹⁶⁸

Directive 2008/98/EC: Waste Framework Directive advises the MSs that:

- The recovery of waste and the use of recovered materials should be encouraged.¹⁶⁹
- to take measures, to promote the re-use of products and prepare for re-use by encouraging establishment and support of re-use networks, the use of economic instruments, and procurement criteria.¹⁷⁰
- certain specified waste shall cease to be waste when it has undergone a recovery and complies with specific criteria.¹⁷¹

COM (2020) 98 A new Circular Economy Action Plan for a cleaner and more competitive Europe proposes that the EC:

- Develop an *Integrated Nutrient Management Plan*, with a view to ensuring more sustainable application of nutrients and stimulating the markets for recovered nutrients.¹⁷²
- Assess the scope to develop further EU-wide end-of-waste criteria for certain waste streams based on monitoring MS' application of the revised rules on end-of-waste status and support cross-border initiatives for cooperation to harmonise national end-of-waste criteria.¹⁷³

COM(2015) 614 final: An EU action plan for the Circular Economy which instructs the EC to:

- Develop quality standards for SRMs where they are needed, while proposing improvements to the rules on 'end-of-waste'; as part of this process the EC is developing the Raw Materials Information System (RMIS) and supporting research on raw materials flows.¹⁷⁴

¹⁶⁸ Ibid, p. 113

¹⁶⁹ **Directive 2008/98/EC: Waste Framework Directive**, p. 2, par 8

¹⁷⁰ Ibid, p. 2, par 8

¹⁷¹ Ibid, p.11, art.6

¹⁷² **COM (2020) 98 A new Circular Economy Action Plan for a cleaner and more competitive Europe**, p. 12

¹⁷³ Ibid, p. 13.

¹⁷⁴ **COM(2015) 614 final: An EU action plan for the Circular Economy**, p. 13

{SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: “Chemicals Strategy for Sustainability Towards a Toxic-Free Environment” deals with chemicals, including “materials of concern” and advises the EC:

- To minimise substances of concern in recycled materials: ¹⁷⁵:
 - Introduce requirements, giving priority to those product categories that affect vulnerable populations as well as those with the highest potential for circularity.
 - Ensure availability of information on chemical content and safe use, by introducing information requirements in the context of the *Sustainable Product Policy Initiative* and tracking the presence of substances of concern through the life cycle of materials.
 - Ensure that authorisations and derogations from restrictions for recycled materials under REACH are exceptional and justified.
 - support investments in sustainable innovations that can decontaminate waste streams, increase safe recycling, develop methodologies for chemical risk assessment that take into account the whole life cycle of substances,
- Develop an open data platform on chemicals to facilitate the sharing, access and re-use of information on chemicals coming from all sources. ¹⁷⁶

COM(2016) 157: Regulation proposal for CE market fertilising products advises the EC and MS that:

- An environmental goal of the EU is to incentivise large scale fertiliser production from domestic organic or secondary raw materials. The proposal will provide a regulatory framework radically easing access to the internal market for such fertilisers, while allowing valorisation of secondary raw materials. ¹⁷⁷
- There is a need to make use of recycled or organic materials for fertilising purposes. Harmonised conditions for making fertilisers from recycled or organic materials, available on the entire internal market, should be established. ¹⁷⁸

¹⁷⁵ {SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: Chemicals Strategy for Sustainability Towards a Toxic-Free Environment, p. 5-6

¹⁷⁶ Ibid, p. 17. This is also mentioned in **COM(2019) 190: “Implementation of the Circular Economy Plan”**

¹⁷⁷ **COM(2016) 157: Regulation proposal for CE market fertilising products**, p. 3-4

¹⁷⁸ Ibid, p. 11. This is also mentioned in **COM(2015) 614 final: An EU action plan for the Circular Economy**

- In the interest of easing market access, it is crucial that notified bodies apply the conformity assessment procedures¹⁷⁹ without creating unnecessary burdens for economic operators.¹⁸⁰
- CE-marked fertilising products should be placed on the market only if they are effective and do not present unacceptable risks. Requirements for safety and quality, as well as appropriate control mechanisms, should be established.¹⁸¹
- It should be possible for products containing **phosphorus** recycled from sewage to access the internal market. For that purpose, the power to adopt acts in accordance with Article 290 of the *Treaty on the Functioning of the European Union*¹⁸² should be delegated to the EC in respect of defining additional categories of CE marked fertilising component materials eligible for use in the production of such products.¹⁸³
- Manufacturers who believe that a CE marked fertilising product which they have placed on the market is not in conformity with this Regulation shall take corrective measures to bring that product into conformity, or to recall it, if appropriate.¹⁸⁴

Regulation (EC) No 1907/2006: REACH regulation states that:

- A high level of human health and environmental protection should be ensured in the approximation of legislation on substances, with the goal of achieving sustainable development. That legislation should be applied in a non-discriminatory manner whether substances are traded on the internal market.¹⁸⁵
- To encourage innovation, product and process oriented research and development should be exempted from the obligation to register for a certain time period where a substance is not yet intended to be placed on the market to an indefinite number of customers because its application in preparations or articles still requires further research and development

¹⁷⁹ Conformity assessment is the process carried out by a manufacturer to demonstrate whether specific requirements relating to a product have been fulfilled. In the EU legislation, conformity assessment procedures cover design and production phases. See [HERE](#).

¹⁸⁰ Ibid, p. 18.

¹⁸¹ Ibid, p. 18.

¹⁸² [Article 290](#) of the TFEU allows the EU legislator to delegate to the Commission the power to adopt **non-legislative acts of general application** that supplement or amend certain non-essential elements of a legislative act. The legislator can thus concentrate on policy direction and objectives without entering into overly detailed and often highly technical debates.

¹⁸³ Ibid, p. 19.

¹⁸⁴ Ibid, p. 20.

¹⁸⁵ **Regulation (EC) No 1907/2006: REACH**, p.2, par. 3.

performed by the potential registrant himself or in cooperation with a limited number of known customers.¹⁸⁶

EU Policies supporting Urban-Mining Objective 4:

Urban-Mining Objective 4: To recover energy from waste water treatment, as well as using alternative sources of energy, in order to close the loop in urban wastewater treatment plants. [Note: energy recovery via biogas and alternative sources are solar]

DIRECTIVE (EU) 2018/ 2001: on the promotion of the use of energy from renewable sources (recast) advises the EC and MS that:

- When applying administrative rules, or planning structures and legislation which are designed for licensing renewable energy installations, the MS should take into account the contribution of **energy from renewable sources**. This will benefit the rapid deployment of energy from renewable sources.¹⁸⁷
- **Biofuels**¹⁸⁸ should be required to fulfil sustainability / greenhouse gas emissions saving criteria when being produced. The harmonisation of those criteria is essential for achieving EU policy objectives. Such harmonisation obligates the MS not to refuse to take into account, on other sustainability grounds, **biofuels** obtained in accordance with this Directive, trade between Member States in compliant biofuels.¹⁸⁹
- Provision should be made for schemes that set standards for the production of **sustainable biofuels**, and that certify that the production of biofuels meets those standards. To ensure that compliance with the sustainability and greenhouse gas emissions saving criteria is verified in a harmonised manner the EC should be empowered to adopt implementing rules, including standards of reliability and independent auditing.¹⁹⁰
- EC should facilitate the exchange of best practices between the competent national authorities to find a common approach to promote a higher uptake of cost-efficient renewable energy projects. The Commission should also encourage investments in new, flexible and clean technologies.¹⁹¹

¹⁸⁶ Ibid, p. p. 11, par. 28

¹⁸⁷ **DIRECTIVE (EU) 2018/ 2001: on the promotion of the use of energy from renewable sources (recast)**, p. 88, par. 44.

¹⁸⁸ Biogas is a form of biofuel.

¹⁸⁹ Ibid, p. 96, par. 94.

¹⁹⁰ Ibid, p. 98., par. 108.

¹⁹¹ Ibid, p. 84, par 14.

- EC shall monitor the origin of biofuels consumed in the EU and the impact of their production, including the impact as a result of displacement, on land use in the EU.¹⁹²
- MS shall ensure that their authorities include provisions for the integration of **renewable energy**, when planning and renovating.... Industrial areas and energy infrastructure. MS shall encourage administrative bodies to include heating / cooling from renewable sources in the planning of city infrastructure.¹⁹³

{SWD(2021) 140 final} - {SWD(2021) 141 final}: Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil focuses on emissions and pollution control which could act as an enabler towards (greater) biogas harvesting and the adoption of renewable energy in UWWT plants. It advises the EC to:

- To propose that its **air quality standards** be aligned more closely with the upcoming WHO recommendations and that provisions on monitoring, modelling and air quality plans be strengthened to help local authorities, while improving the overall enforceability of the regulations.¹⁹⁴
- Introduce stricter requirements to tackle **air pollution** at source, such as from agriculture, industry....¹⁹⁵

SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) final amending Directive 2010/75/EU of the European Parliament on industrial emissions (integrated pollution prevention and control) promotes energy efficiency in the EU. Its policy suggest that:

- Energy efficiency minimum levels will be introduced, to maximise energy efficiency and minimise energy consumption, resulting in decarbonization.¹⁹⁶
- An industrial installation operator must establish and implement an environmental management system (EMS) in accordance with relevant BATs, with a view to the continuous

¹⁹² Ibid, p. 138, article 33.

¹⁹³ Ibid, p. 114, article 15:

¹⁹⁴ **{SWD(2021) 140 final} - {SWD(2021) 141 final}: Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil**, p. 6

¹⁹⁵ Ibid, p. 6.

¹⁹⁶ **SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) final amending Directive 2010/75/EU of the European Parliament on industrial emissions (integrated pollution prevention and control)**, p.14. A similar energy efficiency policy is also mentioned in **COM(2019) 640 final: "EU Green Deal**, p. 6.

improvement of the environmental and energy efficient performance and safety of the installation.¹⁹⁷

- It is appropriate to submit industrial installations to energy efficiency requirements in respect of combustion units or other units emitting carbon dioxide on the site.¹⁹⁸

Reference Document on Best Available Techniques (BAT) for Energy Efficiency focuses on the BAT for improving energy efficiency which could affect the operations of alternative energy systems in a UWWT. The BATs that are connected to this UWWT plants include:

- Implementing and adhering to an energy efficiency management system¹⁹⁹
- Using tools / methodologies to assist with identifying / quantifying energy optimization.²⁰⁰
- Systematic comparisons with sector, national or regional benchmarks.²⁰¹
- Optimising energy efficiency when planning a new installation / unit / significant upgrade.²⁰²
- Establishing/ maintaining procedures to monitor / measure key operation characteristics with a significant impact on energy efficiency.²⁰³

¹⁹⁷ Ibid, p. 19.

¹⁹⁸ Ibid, p. 26.

¹⁹⁹ **Reference Document on Best Available Techniques (BAT) for Energy Efficiency**, p. 273: Bat 1.

²⁰⁰ Ibid, p. 276: BAT 5.

²⁰¹ Ibid, p. 278: BAT 9.

²⁰² Ibid, p. 281: BAT 10.

²⁰³ Ibid, p. 282: BAT 16.

9.3 Citations from EU policy supporting the Industrial-Mining Objectives

Note: There are five (5) Industrial-Mining Objectives

EU Policies supporting Industrial-Mining Objective 1:

Industrial-Mining Objective 1: Promote industrial collaboration along the value chain in order to minimise the use of raw materials (water) and energy. [Note: Two resources: raw materials and energy. Also, energy here refers to waste heat recovery.]

REGULATION (EU) 2020/741: on minimum requirements for water reuse which argues that:

- The Union's ability to respond to the increasing pressures on water resources could be improved by...promoting water savings through multiple uses for urban waste water. Directive 2000/60/EC (*Water Framework Directive*)²⁰⁴ mentions water reuse, combined with the promotion of the use of **water- efficient technologies in industry and water-saving irrigation techniques**, as one of the measures MS may choose to apply to achieve the Directive's objectives of good qualitative and quantitative water status for water bodies.²⁰⁵

DIRECTIVE (EU) 2018/ 2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources (recast). It enjoins the MS to:

- Carry out an assessment of the potential for developing renewable heating / cooling schemes based on waste energy potential to promote....efficient infrastructure.²⁰⁶
- Take steps to develop district heating and cooling infrastructure to accommodate the development of heating and cooling from.... waste heat and cold.²⁰⁷
- To count waste heat subject to a limit of 40 % of the average annual increase, when calculating its share of renewable energy in the heating and cooling sector.²⁰⁸

²⁰⁴ Directive 2000/60/EC: Water Framework Directive, P. 64

²⁰⁵ **REGULATION (EU) 2020/741: on minimum requirements for water reuse**, p. 1. Note that this idea of water savings is also referenced, briefly in **COM 2018/337: Minimum requirements for water reuse**.

²⁰⁶ **DIRECTIVE (EU) 2018/ 2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources (recast)**, p. 89., par 49.

²⁰⁷ Ibid, p. 119, Article 20.

²⁰⁸ Ibid, p. 122, Article 23.

- Ensure that their authorities include provisions for the integration and deployment of...waste heat when planning, urban infrastructure, industrial....and energy infrastructure.²⁰⁹

{SWD(2021) 140 final} - {SWD(2021) 141 final}: Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil. It advises the EC to:

- Propose that its **air quality standards** be aligned more closely with the upcoming WHO recommendations and that provisions on monitoring, modelling and air quality plans be strengthened to help local authorities, while improving the overall enforceability of the regulations.²¹⁰
- Introduce stricter requirements to tackle **air pollution** at source, such as from agriculture, industry....²¹¹

SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) final amending Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control). It notes to the MS that:

- Energy efficiency minimum levels will be introduced, to maximise energy efficiency and minimise energy consumption, resulting in decarbonization.²¹²
- An industrial installation operator must establish and implement an environmental management system (EMS) in accordance with relevant BATs, with a view to the continuous improvement of the energy efficient performance of the installation.²¹³
- it is appropriate to submit industrial installations to energy efficiency requirements in respect of combustion units or other units emitting carbon dioxide on the site.²¹⁴

Reference Document on Best Available Techniques (BAT) for Energy Efficiency proposes the following BATs for industrial systems:

²⁰⁹ Ibid, p. 114, article 15.

²¹⁰ **{SWD(2021) 140 final} - {SWD(2021) 141 final}: Pathway to a Healthy Planet for All EU Action Plan: Towards Zero Pollution for Air, Water and Soil**, p. 6

²¹¹ Ibid, p. 6.

²¹² **SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) final amending Directive 2010/75/EU of the European Parliament on industrial emissions (integrated pollution prevention and control)**, p.14. A similar energy efficiency policy is also mentioned in **COM(2019) 640 final: "EU Green Deal**, p. 6.

²¹³ Ibid, p. 19. The EMS BAT is mentioned in the next section.

²¹⁴ Ibid, p. 26.

- Implementing and adhering to an energy efficiency management system²¹⁵
- Identifying the aspects of an installation that influence energy efficiency by carrying out an audit. It is important that an audit is coherent with a systems approach.²¹⁶
- Using tools / methodologies to assist with identifying / quantifying energy optimization.²¹⁷
- Establish energy efficiency indicators.²¹⁸
- Systematic comparisons with sector, national or regional benchmarks.²¹⁹
- Optimising energy efficiency when planning a new installation / unit / significant upgrade.²²⁰
- Carrying out maintenance at installations to optimise energy efficiency.²²¹
- Establishing/ maintaining procedures to monitor / measure key operation characteristics with a significant impact on energy efficiency.²²²

EU Policies supporting Industrial-Mining Objective 2:

Industrial Objective 2: Enable the continuous reuse of water within a closed-loop system to reduce the use of freshwater.

The primary document affecting objective 2 is **REGULATION (EU) 2020/741: on minimum requirements for water reuse**²²³ orders the EC and MS to take action on the following issues:

- Council Directive 91/271/EEC(5) (concerning *urban waste water treatment*) requires that treated wastewater be reused in order to decrease water pressure, while reducing the impact of discharge of treated wastewater into water bodies.²²⁴
- Create an instrument to regulate standards for water reuse to remove the obstacles to its reuse.²²⁵
- Compliance with minimum requirements for water reuse should be consistent with EU water policy and contribute to the achievement of the SDG 6 & SDG 12.²²⁶

²¹⁵ Reference Document on Best Available Techniques (BAT) for Energy Efficiency, p. 273: BAT 1.

²¹⁶ Ibid, p. 275: BAT 3.

²¹⁷ Ibid, p. 276: BAT 5.

²¹⁸ Ibid, p. 277: BAT 8.

²¹⁹ Ibid, p. 278: BAT 9.

²²⁰ Ibid, p. 281: BAT 10.

²²¹ Ibid, p. 281: BAT 15.

²²² Ibid, p. 282: BAT 16.

²²³ The policies listed here are repeated in **COM 2018/337: “Minimum requirements for water reuse**

²²⁴ **REGULATION (EU) 2020/741: on minimum requirements for water reuse. 1.**

²²⁵ Ibid, p. 1

²²⁶ Ibid, p. 3

- Water reuse risk management plans should ensure that reclaimed water is safely used and managed. To develop risk management plans, existing international guidance/ plans could be used.²²⁷
- Take measures to ensure that water reuse does not lead to a deterioration in water quality; thus, water reuse risk management plans should pay attention to protecting water bodies.²²⁸
- Reclamation operators should be responsible for the quality of reclaimed water at the point of compliance. For this purpose, reclamation facility operators should monitor the quality of reclaimed water.²²⁹
- Reclamation facility operators and end-users should cooperate to ensure that reclaimed water produced is in accordance with the minimum quality requirements regarding crop categories. In cases where this is not the case, water quality requirements could be met by using, at a subsequent stage, several water treatment options alone or in combination with the multi-barrier approach.²³⁰
- Production / supply of reclaimed water for agricultural irrigation should be allowed on the basis of a permit. In order to ensure a harmonised approach of traceability of reclaimed water the substantive rules for such permits should be laid down by the EU.²³¹
- Competent authorities should verify compliance of reclaimed water with the conditions of a permit. In cases of non-compliance responsible parties must take measures to ensure compliance.²³²
- The reclamation facility operator shall ensure that, at the point of compliance, reclaimed water intended for agriculture complies with minimum requirements for water quality.²³³
- The authorities verify whether compliance meets with the conditions set out in the permit. Compliance is determined by: (a) on-the-spot checks; (b) monitoring data; (c) any other adequate means.²³⁴

SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) final amending Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) states that:

²²⁷ Ibid, p. 3

²²⁸ Ibid, p. 3

²²⁹ Ibid, p. 3. Also reflected in **COM 2018/337: Minimum requirements for water reuse**, p.15, par. 9.

²³⁰ Ibid, p. 4.

²³¹ Ibid, p. 4. Also reflected in **COM 2018/337: Minimum requirements for water reuse**, p.16, par. 11.

²³² Ibid, p. 4. Also reflected in **COM 2018/337: Minimum requirements for water reuse**, p.16, par. 11.

²³³ Ibid, p. 9 - Article 4. Also reflected in **COM 2018/337: Minimum requirements for water reuse**, p.16, par. 10.

²³⁴ Ibid, p. 11, Article 7.

- The IED proposal complements these initiatives by, among others, widening the Directive's scope....improving resource and energy efficiency, **promoting water reuse**, and introducing a mandatory environmental management system.²³⁵

Reference Document on Best Available Techniques (BAT) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector proposes the following BATs in the chemical sector:

- Reduce the volume and/or pollutant load of wastewater streams, to enhance the reuse of waste water within the production process and to recover and reuse raw materials.²³⁶

Although (technically) **not** policy, **{COM(2021) 400 final} - {SWD(2021) 141 final}: COMMISSION STAFF WORKING DOCUMENT Digital Solutions for Zero Pollution** provides support for Industrial Mining objective 2, as it advises that:

- Most industries produce wastewater. Digital systems have been fundamental in the design and operation of Decision Support Systems (DSS) that allow for enhanced effluent control through reuse of wastewater at precisely defined, fit-for-purpose quality levels in heavy industry operations. The system compares these data with the requirements of the intended water reuse application and activates the adequate treatment process accordingly. By closing this loop, such approaches can indirectly reduce the amount of treated wastewater reaching the environment. Various projects under the ICT4Water cluster²³⁷ have targeted precisely these integrated digital systems. These projects have aimed at reducing abstraction and point-source pollution pressures by setting up small loops within water networks to open the accessibility of the reuse or recycle of otherwise wasted resources like waste, process water, and other materials.²³⁸

EU Policies supporting Industrial-Mining Objective 3:

²³⁵ **{SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) final amending Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control)}**, p. 8.

²³⁶ **Reference Document on Best Available Techniques (BAT) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector**, p. 546, BAT 7.

²³⁷ ICT4Water cluster: a community of 61 EU-funded research and innovation projects on digital innovations for water. See: <https://ict4water.eu/>

²³⁸ **{COM(2021) 400 final} - {SWD(2021) 141 final}: COMMISSION STAFF WORKING DOCUMENT Digital Solutions for Zero Pollution**, p. 33.

Industrial-Mining Objective 3: Ensuring sustainable production and consumption by adopting innovative business models such as chemical leasing. [Note: Could be other innovative BMs aside from chemical leasing]

{SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: **Chemicals Strategy for Sustainability Towards a Toxic-Free Environment** guides the EC toward supporting innovative business models:

- The EC will support, through its financial instruments and research and innovation programmes: R & D of innovative business models such as performance-based business models²³⁹ to ensure a more efficient use of chemicals and other resources²⁴⁰

OJ, 14.6.2018, L 150: Revised Waste Legislative Framework briefly mentions innovative business models:

Waste prevention is the most efficient way to improve resource efficiency and to reduce the environmental impact of waste. It is important therefore that Member States take appropriate measures to prevent waste generation and monitor and assess progress in the implementation of such measures. As part of such measures, Member States should facilitate innovative production, **business and consumption models** that reduce the presence of hazardous substances in materials and products that encourage the increase of the lifespan of products and that **promote re- use**.²⁴¹

EU Policies supporting Industrial-Mining Objective 4:

Objective 4: Reduce wastewater and waste (brine, organic, sludge) some of which is normally disposed of via incineration or landfill.

²³⁹ “Performance based business models” incorporate the concept of chemical leasing.

²⁴⁰ {SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: **Chemicals Strategy for Sustainability Towards a Toxic-Free Environment**, p. 7.

²⁴¹ **OJ, 14.6.2018, L 150: Revised Waste Legislative Framework**, p. 115.

Reference Document on Best Available Techniques (BAT) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector provides techniques for reducing sludge and wastewater:

- Maintain an inventory of waste water and waste gas streams, as part of the environmental management system In order to facilitate the reduction of emissions to water²⁴²
- Monitor key process parameters (including waste water flow) at key locations (e.g. influent to pre-treatment and influent to final treatment) for relevant emissions to water.²⁴³
- Monitor emissions to water in accordance with EN or ISO or other international standards that ensure the provision of data of an equivalent scientific quality.²⁴⁴
- Reduce the volume and/or pollutant load of wastewater streams, to enhance the reuse of waste water within the production process and to recover and reuse raw materials.²⁴⁵
- Use an integrated waste water management and treatment strategy in order to reduce emissions to water.²⁴⁶
- Pre-treat wastewater that contains pollutants that cannot be dealt with adequately during final wastewater treatment by using appropriate techniques In order to reduce emissions to water.²⁴⁷
- Use an appropriate combination of final wastewater treatment techniques.²⁴⁸
- Use one or a combination of techniques in order to reduce the volume of wastewater sludge requiring further treatment²⁴⁹ (BAT 14 also lists a series of techniques on p. 730-731).

²⁴² **Reference Document on Best Available Techniques (BAT) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector**, p. 543, BAT 2.

²⁴³ Ibid, p. 544, BAT 3

²⁴⁴ Ibid, p. 544, BAT 4

²⁴⁵ Ibid, p. 546, BAT 7.

²⁴⁶ Ibid, p. 546, BAT 10.

²⁴⁷ Ibid, p. 547, BAT 11.

²⁴⁸ Ibid, p. 547, BAT 12.

²⁴⁹ Ibid, p. 551, BAT 14.

Decision C(2013) 8589 regarding the BREF on Chlor-alkali production provides practical techniques for reducing wastewater and brine specifically in chlor-alkali synthesis operations:

- In order to reduce the generation of waste water, BAT is to use a combination of the following techniques: brine recirculation; recycling of other process streams; recycling of salt-containing waste water from other production processes; use of waste water for solution mining; concentration of brine filtration sludges; nanofiltration; techniques to reduce chlorate emissions.²⁵⁰

Directive 91/271/EEC: Urban Waste Water Treatment Directive advises the MS that:

- Sludge arising from waste water treatment shall be re-used whenever appropriate. Disposal routes shall minimise the adverse effects on the environment.²⁵¹

The policies in **OJ, 14.6.2018, L 150: Revised Waste Legislative Framework** states that:

- Progressively reducing landfilling...to ensure that economically valuable waste materials are recovered. That reduction should avoid the development of excessive capacity for the treatment of residual waste facilities, as this could result in undermining re-use targets.²⁵²
- Targets setting landfill restrictions should be strengthened by gradually reducing landfilling to a minimum level; this reduction should fit into an integrated policy based on the waste hierarchy, while enhancing a shift towards prevention.²⁵³
- The EC reviews the targets for landfilling (by 31 December 2024) , while introducing quantitative targets per capita on landfilling and to introducing restrictions to the landfilling of non-hazardous waste other than municipal waste.²⁵⁴

²⁵⁰ **Decision C(2013) 8589 regarding the BREF on Chlor-alkali production**, p. 41-42

²⁵¹ **Directive 91/271/EEC: Urban Waste Water Treatment Directive**, p. 5, Article 14.

²⁵² **OJ, 14.6.2018, L 150: Revised Waste Legislative Framework**, p. 103

²⁵³ *Ibid*, p. 102

²⁵⁴ *Ibid*, p.106

- By 2030, all waste suitable for recovery shall not be accepted in a landfill with the exception of waste for which landfilling delivers the best environmental outcome.²⁵⁵
- the aim of this Directive is to ensure a progressive reduction of landfilling of waste, in particular of waste that is suitable for recycling or other recovery, and, by way of stringent operational and technical requirements on the waste and landfills, to provide for measures, procedures and guidance to prevent or reduce as far as possible negative effects on the environment,²⁵⁶

{SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: Chemicals Strategy for Sustainability Towards a Toxic-Free Environment advises the EC to:

- Develop a framework of indicators to monitor drivers / impacts of chemical pollution and to measure the effectiveness of chemicals legislation.²⁵⁷

Directive 2000/60/EC: Water Framework Directive proposes that:

- An MS may adopt measures applicable to all river basin districts and/or the portions of international river basin districts falling within its territory: (thus) for point source discharges liable to cause pollution, a requirement for prior regulation, such as a prohibition on the entry of pollutants into water, or for prior authorisation, or registration based on general binding rules, laying down emission controls for the pollutants concerned, including controls.²⁵⁸

²⁵⁵ *ibid*, p. 105.

²⁵⁶ *ibid*, p. 106.

²⁵⁷ **{SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: Chemicals Strategy for Sustainability Towards a Toxic-Free Environment**, p. 21.

²⁵⁸ **Directive 2000/60/EC: Water Framework Directive**, p. 14, par 3g.

SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) 111 “final amending Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) suggest to the MS that:

- It is necessary to specify further the conditions under which the competent authority, when setting emission limit values applicable to pollutant releases to water in a permit granted under Directive 2010/75/EU, may take account of the downstream treatment processes in a wastewater treatment plant, in order to ensure that such releases do not lead to an increased load of pollutants in receiving waters when compared to a situation where the installation applies BAT and meets emission levels associated with the best available techniques for direct releases.²⁵⁹

Directive 2008/98/EC: Waste Framework Directive states that:

- In order to improve the way in which waste prevention actions are taken forward in the MS and to facilitate the circulation of best practice in this area, it is necessary to strengthen the provisions relating to waste prevention and to introduce a requirement for the MS to develop waste prevention programmes concentrating on the key environmental impacts.²⁶⁰
- The costs of waste management shall be borne by the original waste producer or by the current or previous waste holders (based on the polluter-pays principle).²⁶¹

EU Policies supporting Industrial-Mining Objective 5:

Industrial Objective 5: Enable the sustainable recovery of materials (such as Na and CL streams as well as NaCl) from industrial water mining operations. [Note: different products obtained].

OJ, 14.6.2018, L 150: Revised Waste Legislative Framework suggests to the MS that:

²⁵⁹ SEC(2022) 169 final} - {SWD(2022) 110 final} - {SWD(2022) 111 “final amending Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control), p. 27

²⁶⁰ Directive 2008/98/EC: Waste Framework Directive, p. 7 par. 40.

²⁶¹ Ibid, p. 14, art. 14.

- The aim of this Directive is to ensure a progressive reduction of landfilling of waste, in particular of waste that is suitable for recovery, and, to provide for measures, to prevent or reduce as far as possible negative effects on the environment from landfilling of waste.²⁶²
- A definition of material recovery should be introduced to cover forms of recovery other than energy recovery and the reprocessing of waste into materials to generate energy. It includes preparing for re-use.²⁶³.
- Materials that cease to be waste through recovery are to be counted for the attainment of the respective recovery set in those Directives in line with the applicable calculation methods.²⁶⁴
- By 2030, all waste suitable for recovery shall not be accepted in a landfill with the exception of waste for which landfilling delivers the best environmental outcome.²⁶⁵
- Take measures to ensure that waste that has undergone recovery is considered to have ceased to be waste via the establishment of material and application-specific end-of-waste criteria based on EU harmonised conditions.²⁶⁶
- Take measures to achieve the best possible management of waste containing significant amounts of CRMs.²⁶⁷
- Take measures, before / during recovery, to remove hazardous substances.²⁶⁸.
- In order to provide operators in markets for Secondary Raw Materials (**SRMs**) with more certainty as to the waste or non- waste status of substance, it is important that MS take measures to ensure that waste that has undergone recovery is considered to have ceased to be waste if it complies with the conditions laid down in this Directive. Such measures may include:
 - Adopting legislation transposing those conditions supported by procedures for their implementation, such as the establishment of material and end-of-waste criteria, guidance documents, case-by-case decisions and procedures for the ad hoc application of the harmonised conditions established at the EU level.
 - Enforcement provisions to verify that waste that is considered to have ceased to be waste as a result of a recovery complies with EU law on waste, chemicals and products, in particular prioritising waste streams that pose higher risk to human health and the environment due to the nature and volume of those waste streams,

²⁶² OJ, 14.6.2018, L 150: “Revised Waste Legislative Framework, p. 104

²⁶³ Ibid, p. 113

²⁶⁴ Ibid, p. 119

²⁶⁵ Ibid, p. 105.

²⁶⁶ Ibid, p. 105

²⁶⁷ Ibid, p. 117

²⁶⁸ Ibid, p. 130

waste that is subject to innovative recovery processes or waste that is recovered for subsequent further use in other MS.

- Setting requirements on operators recovering waste or holders of recovered waste materials to demonstrate compliance with the conditions of this Directive.²⁶⁹

Regulation (EC) No 1907/2006: REACH advises that:

- A high level of human health and environmental protection should be ensured in the approximation of legislation on substances, with the goal of achieving sustainable development. That legislation should be applied in a non-discriminatory manner whether substances are traded on the internal market.²⁷⁰
- To encourage innovation, product and process oriented research and development should be exempted from the obligation to register for a certain time period where a substance is not yet intended to be placed on the market to an indefinite number of customers because its application in preparations or articles still requires further research and development performed by the potential registrant himself or in cooperation with a limited number of known customers.²⁷¹

SWD(2018) 36 final: Report on Critical Raw Material Part 1 counsels the MS to:

- Take measures to achieve the best management of waste containing significant amounts of CRMs, and include in their waste management plans appropriate measures regarding waste collection and recovery.²⁷² Again, this measure does not necessarily impact the materials mined in CS6 but could act as an enabler of industrial-mining of CRMs in general.

SWD(2018) 36 final: Report on Critical Raw Material Part 3 advises the EC to:

- (possibly) Support the development of new or optimisation of existing chemical processes and/or technologies that enable/enhance the safe recycling and/or reuse of CRMs.²⁷³

²⁶⁹ Ibid, p. 113

²⁷⁰ Regulation (EC) No 1907/2006: REACH, p.2, par. 3.

²⁷¹ Ibid, p. p. 11, par. 28

²⁷² SWD(2018) 36 final: “Report on Critical Raw Material” Part 1, p. 11

²⁷³ SWD(2018) 36 final: “Report on Critical Raw Material” Part 3, p. 62

{SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: “Chemicals Strategy for Sustainability Towards a Toxic-Free Environment” enjoins the EC:

- To minimise substances of concern in recycled materials: ²⁷⁴:
 - Introduce requirements, giving priority to those product categories that affect vulnerable populations as well as those with the highest potential for circularity.
 - Ensure availability of information on chemical content and safe use, by introducing information requirements in the context of the *Sustainable Product Policy Initiative* and tracking the presence of substances of concern through the life cycle of materials.
 - Ensure that authorisations and derogations from restrictions for recycled materials under REACH are exceptional and justified.
 - support investments in sustainable innovations that can decontaminate waste streams, increase safe recycling, develop methodologies for chemical risk assessment that take into account the whole life cycle of substances,
- Develop an open data platform on chemicals to facilitate the sharing, access and re-use of information on chemicals coming from all sources.²⁷⁵ This measure promotes the tracking of valuable materials, which could potentially be obtained from an industrial-mining operation.

Reference Document on Best Available Techniques (BAT) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector provides best practice for industries in the chemical sector that could affect an industrial wastewater operation:

- Reduce the volume and/or pollutant load of wastewater streams, to enhance the reuse of waste water within the production process and to recover and reuse raw materials.²⁷⁶

Set up and implement a waste management plan as part of the environmental management system (EMS) that, in order of priority, ensures that waste is prevented, prepared for reuse, recycled or otherwise recovered.²⁷⁷

²⁷⁴ {SWD(2020) 225 final} - {SWD(2020) 247 final} - {SWD(2020) 248 final} - {SWD(2020) 249 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}: **Chemicals Strategy for Sustainability Towards a Toxic-Free Environment**, p. 5-6

²⁷⁵ Ibid, p. 17. This is also mentioned in **COM(2019) 190: “Implementation of the Circular Economy Plan”**

²⁷⁶ **Reference Document on Best Available Techniques (BAT) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector**, p. 546, BAT 7.

²⁷⁷ Ibid, p. 551, BAT 13..



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