Technical Study

MSP as a tool to support Blue Growth

Roundtable discussion paper: Marine Aggregates and Marine Mining, 11/12 October 2017

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Marine Aggregates and Marine Mining

1 Introduction

Overall size of the sector and industry structure

Mature ☒ For Marine Aggregates Growing ☒ For Marine Mining Emerging ☒ For Deep-Sea Mining

The marine aggregates sector considers the exploration, exploitation, extraction and dredging of sand and gravel from the seabed, primarily for the purpose of construction and beach nourishment. The marine minerals sector considers the exploration, exploitation and extraction of marine minerals, such as iron ore, tin, copper, manganese and cobalt (oil and gas extraction is dealt at another factsheet). Deep-Sea Mining is the type of marine mining that occurs in waters depths from 800-6000m where mineral deposits of polymetallic nodules, manganese crust and sulfide deposits might be found[1] (Table 1)

The European sea basins contain several economically valuable aggregate resources, as well as many minerals[2].

Table 1: Minerals and Related depths

Type of mineral deposit	Average Depth	Resources found
Polymetallic nodules	4,000 – 6,000 m	Nickel, copper, cobalt, and manganese
Manganese crusts	800 – 2,400 m	Mainly cobalt, some vanadium, molybdenum and platinum
Sulfide deposits	1,400 – 3,700 m	Copper, lead and zinc some gold and silver

Over the past three decades, the marine aggregates sector has seen extensive development, with an estimated GVA of 625 million Euros in Europe in 2015 alone1.The sector is projected to grow significantly, as a result of the expected increase of the global population and the interrelated need for more construction and infrastructure. Currently, already 50% of all ready-made concrete contains marine aggregates.

Marine mining, however, is still in a nascent stage, with deep-sea mining even in the exploratory phase. It is expected that the marine mining sector will see continued growth in the coming years, in an effort to meet the demands of high-tech industries[1].

Marine Aggregates & Marine Mining Value Chain

(with * those steps with marine spatial

[1] Ahnert, A.; Borowski, C., 2000
[2] EEA, 2015, State of Europe's Seas, Technical report No. 2/2015, European Environment Agency, Copenhagen

Time horizons			Spatial characteristics		
Seasonal	Yes and No	Due to the presence of ice the activity might be seasonal	Place based	Yes and No	Place based while extraction (mining, dredging, etc.) and non-place based while transport.
Planning horizon	For marine aggregates the planning horizon is 2030 while for deep-sea mining the planning horizon is 2020-21[3]		Linear	Yes	
Development time	From planning to the actual use of the aggregates for construction it may take up to 20 years. Deep-sea mining takes around 4 years (only for the exploration phase at depths around 1600-5000m).		Distance to shore	Marine aggregates and mining resources can be extracted from shallow waters as well as from more offshore areas.	
Lifetime of installation	30-40 years	Operationally activity lasts between 30-40 years depending on maintenance.	Water depth	Covers the entire range from shallow to deep-sea waters. Occurring mostly at shallow depths around 45-50 m.	
			Moving	Yes	
			Land Sea interaction	Yes and No	Interaction is important for marine aggregates. Not so important for mining.

[3] Interview with Blue Mining Project coordinators (http://www.bluemining.eu/). 02nd August 2017.

2 Relevance

Status in each Sea Basin (Table 2[4])

Sea Basin	Presence	Potential	Comments
Atlantic	◆◆◆	➡➡	Potential for deep-sea mining for cobalt-rich ferromanganese crusts.
Baltic Sea	◆◆	➡➡	The marine aggregate extraction industry is well established in the Baltic Sea. Potential for increasing demand of aggregates for coastal defence works to safeguard dunes, beaches and even whole islands for the future.
Black Sea	◆	➡	Potential for increasing demand of aggregates for coastal defence.
East Med	◆	➡➡	Potential for increasing demand of aggregates for coastal defence and construction.
North Sea	◆◆	➡	The marine aggregate extraction industry is well established in several countries around the North Sea, contributing up to 15% of some nations' demands for sand and gravel. Potential for increasing demand of aggregates for coastal defence works to safeguard dunes, beaches and even whole islands for the future.
West Med	◆◆◆	➡➡	Potential for increasing demand of aggregates for coastal defence.

[4] Table based on expert judgment and assessment of the sources quoted throughout the document.

Legend: = low presence = medium presence = high presence
= none / limited potential = medium potential = high potential

Status in each EU Country (Table 3[5])

Sea Basin	Country	Presence	Potential	Comments
Atlantic	Ireland	◆	➡	Land-based sources of materials are likely to remain the main supply option for the coming years[6].
Atlantic / North Sea	United Kingdom	◆◆◆	➡➡➡	The UK has one of the world's most developed marine aggregate industries, extracting 15 to 20 million tons of marine aggregates from the seabed annually. Much of this is used for building houses, transport infrastructure, replenishing beaches and improving coastal defenses. It is an industry which will be further developed in the forthcoming 40 years[7][8].
Atlantic / West Med	France	◆◆◆	➡➡	Potential for deep-sea mining for sea-floor polymetallic sulphides at the mid-Atlantic ridge[9].
Baltic Sea	Poland	◆◆◆	➡➡	Marine aggregate extraction is very important as a source of materials for coastal protection.
Black Sea	Bulgaria	◆	➡	Mineral resources exploiting, meaning gravel and sands are extremely reduced in Bulgaria, with some exception.
Black Sea	Romania	◆◆	➡	The exploitation of sand and gravel resources is extremely reduced in Romania with some exceptions. During 2016-2017 sands nourishing

Legend: = low presence = medium presence = high presence
= none / limited potential = medium potential = high potential

[5] Table based on expert judgment and assessment of the sources quoted throughout the document. **Note: No information was found for the status of marine aggregates and marine mining at the following countries: Portugal; Spain; Estonia; Finland; Latvia; Lithuania; Sweden; Denmark; Germany; Croatia; Cyprus; Slovenia; Italy; Malta.**

[6] Irish Sea Marine Aggregate Initiative (IMAGIN) Technical Synthesis Report

[7] Marine aggregates: Capability & Portfolio 2015 report. The Crown State. UK

[8] http://www.bmapa.org/documents/BMAPA_16th_Annual_Report.pdf

[9] UNEP 2014 Bulletin

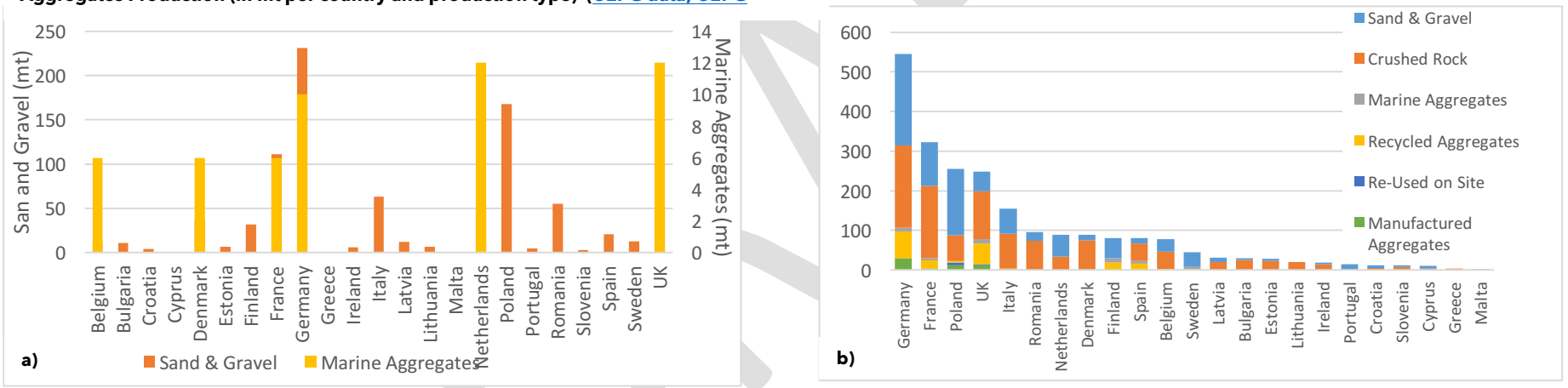
				activities and works have taken place for enlarging beaches on the areas with strong coastal erosion effects.
East Med	Greece	◆	➡➡	Present demand of Greek industry for marine aggregates. Its potential is being researched through projects such as MARE (see section 5)
North Sea	Belgium	◆◆◆	➡➡	Well established aggregate extraction sites mostly for beach nourishment. Potential to continue in the forthcoming years for coastal protection.
North Sea	Netherlands	◆◆	➡	Well established aggregate extraction sites.

3 Status and evolution Analysis

Current Status

Between 2000 and 2006, the marine aggregates industry in Europe experienced a continuous increase in annual turnover[10], which started to decline as a result of the difficulties the construction sector was facing after 2006. At the same time, during the 2006-2013 period, the European aggregates industry declined by 30% its production, until the sector showed a stability of production in 2014.
Most national production of aggregates came from EU countries like Germany, Poland, UK or France, however, it remains challenging to assemble exact data for an industry that is comprised predominantly of SMEs.

Figure 1: a) 2015 Sand & Gravel and Marine Aggregates production; b) 2015 National Aggregates Production (in mt per country and production type) (UEPG data; UEPG



Drivers

✓ Limited access to terrestrial raw materials (due to unstable social-political relations) and search for more quality materials (mining industry facing declining ore grades), was the main reason for increasing interest in shallow-water mining (offshore to avoid conflicts with other users).

[10] Blue Growth, Scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts

- ✓ Raw material's consumption demand ought to increase in the coming years (i.e. population growth, protection against climatic effects needed, mineral needs…).
- ✓ A more advanced level in technology which currently allows for extraction up to about 150 meters water depth.
- ✓ Climate change driven: These industries (and particularly activities such as land reclamation and beach nourishment) are likely to become increasingly relevant because of climate change and rising sea levels, which will increase the need for replenishing beaches and improving coastal defenses.
- ✓ Increased demand for high-tech metals is driven by technological developments that require precious metals.

Barriers & Bottlenecks

Note: *Direct spatial implications* would be those which already hold a spatial characteristic (i.e displacements, re-routings, etc.); *Indirect spatial implications* would be those which might occur or not depending if we solve the barrier/bottleneck or not (i.e. efficiency improvements might bring more efficient developments and less new developments might be needed in the future which would create less spatial implications in terms of less space required)

Barriers & Bottlenecks	Direct spatial implications	Indirect spatial implications	Comments
Society / Jobs			These sectors need for the availability of skilled labour force which is not currently present at EU and needs to be enhanced by showcasing the industry as an attractive career choice for young people. At the same time, in the case of deep-sea mining, benefits to local populations are still unclear[11]. This might affect existing /new developments and their spatial implications.
Bad press / Opposition			Most stakeholders thought that dredging for sand and gravel was less damaging to the environment than oil and gas extraction[12].However, as with all mining operations, marine and deep-sea mining raises questions about its potential environmental impact to seabed and pollution by heavy metal laden plumes and increasing turbidity due to suspended particles. Thus, mostly environmental groups are in favor of reducing current extraction activities, preventing new ones and increasing recycling as a response to the

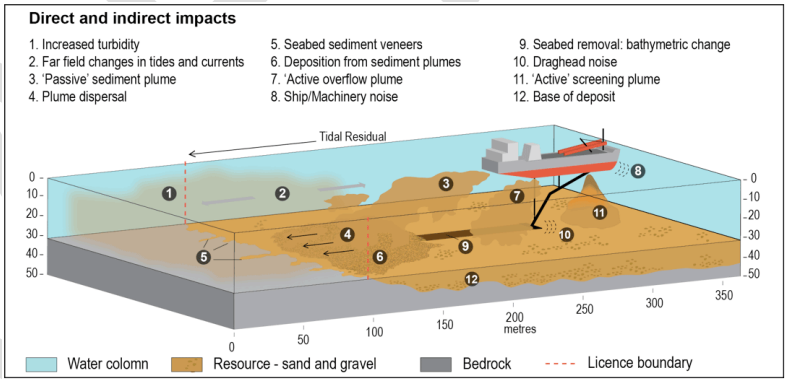
[11] COMMISSION STAFF WORKING DOCUMENT- EU stakeholder survey on seabed mining: summary of responses- SWD(2015) 119 final
[12] Marine aggregates: Capability & Portfolio 2015 report. The Crown State. UK

			scarcity of raw materials[11].This bad press and NGO opposition could act as a potential development barrier with its spatial implications.
Presence of underwater heritage			In the UK, if underwater heritage is found, no activity is usually allowed at the Archaeological Exclusion Zone. This might affect existing /new developments and their spatial implications. At the same time, still insufficient measures are in place to document and protect underwater cultural heritage artefacts discovered during offshore activity in shallow waters. These artefacts are unlikely to recover following their disturbance.
Fisheries			Clear opposition from other users of the sea, such as fishermen, is one of the main factors limiting growth of offshore aggregate extraction. This might affect existing /new developments and their spatial implications.
Need for research and knowledge			Need for more research, modeling, data, and knowledge over the uncertainty of impacts over longer period of time as well as knowledge of whereabouts of deposits in order to provide better location maps of marine raw material resource sites. This might affect existing /new developments and their spatial implications.
New deep-water explorations / New technologies			The increasing scarcity over the supply of raw and non-living material, tends to push some countries (i.e. UK, Belgium, Netherlands and France) out into deeper waters further offshore to look for new material´s supply zones. This pushes the technological capacity of boats that will have to operate at deeper waters (larger boats) with more powerful equipment. Important technological challenges still exist for marine mining in deeper waters. This might affect existing /new developments and their spatial implications.
Efficiency improvements			Although the quantity of sand and gravel potentially available from marine sources seem to be vast, these resources should be exploited in the most efficient and effective manner possible. The industry's focus has also turned towards delivering efficiency improvements, building on cost reductions (lower unit costs per extraction). This might affect existing /new developments and their spatial implications.
Investments for explorations and licensing			Many investors are still unable to access the finance they require to develop offshore assets and to increase the rate of exploration drilling. This might affect existing /new developments and their spatial implications.

Commodity prices instability			Prices per material are affected by many drivers of supply and demand (geopolitical uncertainty, etc.). This instability and volatility on the commodity prices makes it hard to establish business trends and limits investments when risks are thought to be high. This might affect existing /new developments and their spatial implications.
Uncertainty in economic benefits			For private businesses, the downside may be strongly limited compared to society – at worst, total loss of investment – while the upside may be strongly skewed with scope for quite disproportionate benefit from higher than expected returns (depending on how royalties are calculated)[13].This might affect existing /new developments and their spatial implications.
High taxation schemes			Taxation over the extraction of raw materials is thought to be a potential market-based incentive for natural resource management, which could also limit the sector´s development and might affect existing /new developments and their spatial implications. Aggregates taxes already exist in the Czech Republic, Italy, Sweden and the United Kingdom where adopting an environmental taxation schemes is helping to improve the quality and reliability of extraction data, which can then be used to encourage changes in quarry management activities[14]. In the United Kingdom, for example, the tax on raw construction materials gives the sector added confidence when purchasing materials, since part of the levy revenues have been used to support the development of quality standards for recycled aggregates.
Higher costs for offshore explorations			Sector´s movement of more offshore areas will increase the cost of exploitation and mining which will have to be overcompensated with high concentrations of the material than at other sites or an increase in the efficiency of extraction (operating costs of dredging are generally high and increase with the distance from the landing ports and the depth of the deposits). This might affect existing /new developments and their spatial implications.

[13] Median Sustainability S.L. (2016). MIDAS. Report on policy options and associated valuation and appraisal needs and methods.

[14] EEA- European Environmental Agency. (2008). Environmental taxes on aggregate materials in the EU: towards sustainable construction. Report.

Environmental protection			Marine mining potentially causes environmental damage to the biological diversity and ecosystems in mining areas. Damage may arise from a range of pressures, including contamination of ecosystems by hazardous substances, changes in siltation at the seabed, underwater noise and the extraction of species[15]. Little is known about recovery times of these ecosystems and more research is needed. At the same time, marine extraction may exacerbate the erosion that generates the need for nourishment in the first place, that the deposited material might be of a different granularity than the original material and that biological communities are disturbed in the places where sand is deposited. This might affect existing /new developments and their spatial implications.  **Figure 2: Sand dredging potential direct and indirect impacts**
Drilling production elements			Chemicals / Fluids / Re-suspension of particles / Nutrients / Other substances (metal ions…[16]). This might affect existing /new developments and their spatial implications.

[15] Koss, R.S., Knights, A.M., Eriksson, A. and L.A. Robinson. 2011. ODEMM Linkage Framework User guide ODEMM Guidance Document Series No.1. EC FP7 project (244273) 'Options for Delivering Ecosystem-based Marine Management'. University of Liverpool, ISBN: 978-0-906370-66-7.

[16] "There is a risk that the mining process will release metal ions into the water column, either in the benthic plume created by mining vehicles or, following dewatering on the surface vessel, in a mid-water plume. Such plumes can potentially travel hundreds of kilometers, carrying potential toxicants with them. Mid-water plumes may impact photosynthetic microalgae or animals within the water column" (http://www.maritime-executive.com/article/scientists-fear-deepsea-mining)

Safety and spills			Maximizing the safe exploration will remain an important focus for the industry especially for deep-sea mining development in other to avoid potential spills. This might affect existing /new developments and their spatial implications.
Implementation and Regulatory Enforcement			Aggregates producers in many European countries are facing the negative consequences of unfair competition. This includes: illegal extraction, extraction as part of civil works, illegal landfilling, illegal backfilling and dumping of waste, poor environmental performance, unsafe and unhealthy working conditions, grey/black/informal markets and employment, late payments, non-compliance with accounting, overloading and exceeding working times and low quality aggregates[17].
More harmonization amongst legislative measures around marine aggregates and mining needed			Despite legislative measures for mining in waters subject to EU environmental rules are thought to be adequate [18], there is still scope for better enforcement and more harmonization especially with other EU legislations (oil & gas extraction; fisheries; aquaculture; conservation; etc.). This harmonization and co- evolvement of the legislation at the same pace of the technological development would help minimizing the potential effects that marine aggregates extraction and marine mining might have over other existing or planned marine uses. This might affect existing /new developments and their spatial implications.
More flexible licensing			Licensing is considered as over-stringent, over-bureaucratic and costly. There is a need to have more flexible licensing schemes including timing devoted to those licensing. This will encourage new investments in explorations. This might affect existing /new developments and their spatial implications.

[17] COMMISSION STAFF WORKING DOCUMENT- EU stakeholder survey on seabed mining: summary of responses- SWD(2015) 119 final

[18] Marine aggregates: Capability & Portfolio 2015 report. The Crown State. UK

Trends

According to the most recent study by the "Union Européenne des Producteurs de Granulats" (European Aggregates Association), the number of countries predicting some aggregates tonnages growth exceeds those predicting a decline, but with very modest growth projections (0.9% of aggregates tonnages growth by 2016).

For marine mining, by 2020, 5% of the world's minerals, including cobalt, copper and zinc could come from the ocean floors. This could rise to 10% by 2030. Global annual turnover of marine mineral mining can be expected to grow from virtually nothing to €5 billion in the next 10 years and up to €10 billion by 2030[19]. Whereas civil society respondents believed that the emphasis would be on rare earths, most stakeholders believed that phosphates offered the best prospects. However, the feasibility of extracting phosphates and iron sands is being investigated[20].

For deep-sea minerals, the future remains uncertain regarding to what extent the seabed will be tapped of its resources on a commercial scale. Industry players active in the field are generally confident that it is a matter of time before mining will begin as current technology already allows for extraction up to about 150 meters water depths. However, since the costs are known to be very high while the benefits are still uncertain for some deposits (e.g. seabed massive sulphides), the business case is not always there, there are no commercial activities to date and prospects have been delayed repeatedly.

All these development trends might bring marine spatial implications due to the existing/new development´s spatial needs and the need to co-exist with other already existing/new marine uses.

4 Spatial Consequences of Future Trends

Marine aggregates extraction and marine mining sectors are showing trends for growing and becoming potentially economically relevant for EU´s Blue Growth Strategy. Thus, their further development entails several spatial implications that are of high relevance to MSP and, therefore, should be included in national MSP processes.
In a world where most beach and coastal areas are suffering from an increase in erosion due to morphological changes of their environments together with unprecedented sea level rises and climate change impacts, the need for beach nourishment, erosion and sea-level rise protection and coastal restoration

[19] EC, 2012. European Commission. Communication from the Commission to the European Parliament, the Council, the European Economic and social Committee and the Committee of the Regions: Blue Growth– opportunities from the marine and maritime sustainable growth. COM(2012) 494. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0494:FIN:EN:PDF.
[20] European Commission (2015). EU stakeholder survey on seabed mining: summary of responses.

has increased. This increasing trend of demands for aggregates would lead to new potential marine aggregates extraction sites for obtaining them and would require from land reclamation. New land reclaimed sites will bring spatial implications with other marine uses that where occurring or thought to be occurring in those areas (see conflicts with other coastal marine uses such as small-scale fisheries, tourism, recreational activities, conservation measures and aquaculture activities as an example[21]).

In search of a way to minimize or avoid this coastal space conflict between uses, marine aggregates and marine mining sectors are further moving offshore in the UK, Belgium, Netherlands and France where trans-boundary cooperation between EU MS would be essential. At the same time, for those activities still happening in more shallow waters, and in order to minimize space conflicts, nature-based solutions to beach nourishment are being researched such as sandscaping - a potential solution as it is an innovative coastal management concept which is designed to use naturel processes (wind, waves and tide) to distribute marine aggregates to nourish and create new beaches (e.g. Netherlands).

However, societal trust and support for these type of marine uses is still scarce as their potential impacts onto environmental, biological and archaeological resources are still unclear. These need to be understood if Europe pursues further developments of these sectors. Thus, working in partnership with industry, regulators and stakeholders to improve the sustainability of the sector should be encouraged. An example of this can be seen in 2002 UK´s Aggregates Levy Sustainability Fund (ALSF)[22], where all the aggregates levies are derived to improve the sustainability of the sector.

Relationship with other sectors

The matrix below indicates the potential Marine Aggregates Sector compatibility (synergies and conflicts) with other marine sectors. (Note: red = potential conflicts; green = potential synergies; grey = not applicable).

		Shipping	Ports	Tourism & Recreation	Oil & Gas Extraction	Pipelines & Cables	Fishing	Aquaculture	Marine Renewables	Marine Aggregates	Conservation
	Synergies										

[21] http://www.bmapa.org/issues/other_sea_users.php

[22] The Aggregates Levy Sustainability Fund is a scheme developed that uses some of money generated by the Aggregates Levy to reduce the environmental impacts of the extraction of aggregates, both on land and from the sea, and to deliver benefits to areas subject to these impacts. http://www.bmapa.org/issues/aggregates_levy.php

Marine Aggregates	Conflicts/Risks										

Recommendations in MSP

(After the conference)

5 Resources / Actors / References

Actors

Name of Actor	Type of Actor	LINK	Short explanation
European Aggregates Association (UEPG)	Association	http://www.uepg.eu/	UEPG stands for "Union Européenne des Producteurs de Granulats" (European Aggregates Association, Europäischer Gesteinsverband). Aggregates are sand, gravel (including marine aggregates), crushed rock, recycled and manufactured aggregates. UEPG represents the European Aggregates Industry in Brussels, now with Members in 27 countries. On behalf of its Members, UEPG actively lobbies the European institutions and other stakeholders on issues key to the industry.
European Dredging Association (EuDA)	Association	https://www.european-dredging.eu/	The European Dredging Association ("EuDA") was founded in 1993 as a non-profit industry organisation for European dredging companies and related organisations to interface with the various European Union's ("EU") Institutions and also some International Organizations (such as IMO, HELCOM or ILO). EuDA members employ approximately 25,000 European employees directly "on land and on board of the vessels" and more than 48,300 people indirectly (through the suppliers and services companies). The

			combined fleet of EuDA's members counts approximately 750 seaworthy EU-flagged vessels.
European Association of Mining Industries, Metal Ores & Industrial Minerals _ EUROMINES	Association	http://www.euromines.org/mining-europe/main-mineral-deposits-europe	Euromines is the recognised representative of the European metals and minerals mining industry. The association's main objective is to promote the industry and to maintain its relations with European institutions at all levels. Euromines provides services to its members with regard to EU policy and serves as a network for cooperation and for the exchange of information throughout the sector within Europe. The association also fosters contacts with the mining community throughout the world. Euromines represents large and small companies and subsidiaries in Europe and in other parts of the world which provide jobs to more than 350,000 people. Through the activities and operations of these members, more than 42 different metals and minerals are produced. For some metals and minerals, Europe is the world's leading producer.
European Innovation Partnership on raw materials (EIP)		https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en	Please complete this part.
British Marine Aggregate Producers Association (BMAPA)	Association	http://www.bmapa.org/	The representative trade body for the British marine aggregate industry. BMAPA is a constituent body of the wider Mineral Products Association, the trade association for the aggregates, cement and concrete industries

Projects

Name	Type of Project	Duration	LINK	Short explanation
ERA-MIN (Network on the industrial handling of raw materials for European industries) & ERA-MIN 2	European FP7 Programme Call Horizons2020 Programme Call	Project Calls each year	https://www.era-min.eu/system/files/call_text_era-min_joint_call_2017_0.pdf	ERA-MIN 2 aims to support the European Innovation Partnership on Raw Materials, the EU Raw Materials Initiative and further develop the raw materials sector in Europe through funding of transnational research and innovation (R&I) activities. This will be achieved through one co-funded call in 2017, as well as two additional calls in 2018 and in 2019, designed and developed specifically for the non-energy, non-agricultural raw materials sector.
Sustainable Intelligent Mining Systems - SIMS	Horizons2020 Programme	May 2017 – May 2020	http://www.simsmining.eu/	Our vision is to create a long lasting impact on the way we test and demonstrate new technology and solutions for the mining industry. With a selected consortium ranging from mining companies, equipment and system suppliers to top-class universities, the SIMS project will boost development and innovation through joint activities aiming at creating a Sustainable Intelligent Mining Systems.
Viable Alternative Marine Operating Systems - VAMOS	Horizons2020 Programme	January 2017 – June 2021	http://vamos-project.eu/	To enable the exploitation and rehabilitation of underexploited and abandoned European deposits of mineral raw materials
Marine Aggregates Prospecting and	Research Funding Program: THALES	January 2017 – June 2021	http://excellence.minedu.gov.gr/thales/en/thalesprojects/375655	The proposed research project aims to investigate the Greek continental shelf, including the Cyclades Plateau, in terms of MA identification, prospecting, dredging, and usage.

Exploitation - MARE	(Investing in Knowledge Society through the European Social Fund)			

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- http://www.jpi-oceans.eu/imis?insid=7138#pro (JPI Oceans Marine Information System)
- https://ec.europa.eu/maritimeaffairs/policy/seabed_mining
- Irish Sea Marine Aggregate Initiative (IMAGIN) Technical Synthesis Report
- http://www.bmapa.org/documents/BMAPA_16th_Annual_Report.pdf
- http://www.bmapa.org/issues/other_sea_users.php & http://www.bmapa.org/issues/aggregates_levy.php