Manx Marine Environmental Assessment

Infrastructure

Energy, Mines and Minerals

Hard Rock quarry in the Isle of Man. Photo: Department of Infrastructure.

MMEA Chapter 6.3

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Manx Marine Environmental Assessment

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Disclaimer:
The Isle of Man Government has facilitated the compilation of this document, to provide baseline information on the Manx marine environment. Information has been provided by various Government Officers, marine experts, local organisations and industry, often in a voluntary capacity or outside their usual work remit. Advice should always be sought from relevant contacts where queries arise.

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Energy, Mines and Minerals

Introduction

Energy and minerals are essential to the island's prosperity, quality of life and help to create and develop sustainable communities. Energy is vital for a modern economy being required for transport, powering businesses and heating homes. An adequate and steady supply of minerals is essential to provide infrastructure and buildings.

This section discusses past and future development of marine renewable energy, hydrocarbon and aggregate extraction.

Although the nature, scope, scale nor location of future development in Manx waters is currently unknown, generic information on the potential effects of a range of developments is also provided, with initial suggestions for mitigation which can later be reviewed with marine stakeholders.

Strategic Overview

The role of Government with regard to energy and mines and minerals is to oversee the use and potential use of our natural resources in a way which contributes to the development of a diverse and vibrant economy and high quality place to live and work, but at the same time conserve the environment.

Isle of Man Government Priorities

An overview of current Isle of Man Government priorities is provided in MMEA Chapter 1.1 (Introduction).

See also the Programme for Government:
https://www.gov.im/media/1353685/framework-for-a-programme-for-government-final.pdf

Vision 2020:
http://www.whereyoucan.com/ibweb/res/pdf/pdf/Vision2020-Leaflet.pdf

Current Energy Policy

Energy policy approved by Tynwald has several aims which include:

- maintaining the security of energy supply,

- securing the efficient use of affordable energy, and
- minimising the impact of our energy use on the environment.

In April 2014, Tynwald supported the strategy for offshore energy production: https://www.gov.im/media/1347624/offshore-energy-report.pdf

Energy Demand

Energy is vital to a modern economy, with requirements for heating and lighting of homes, travel and for powering businesses and economic development. Energy policies across the world are evolving in response to rising fossil fuel prices, issues over security of supply and the need to reduce carbon emissions to combat climate change.

Currently the Isle of Man is heavily reliant on imported primary energy supplies derived from burning fossil fuels that have a finite supply. The Island is entirely dependent on external markets and all energy supplies of gas and oil are imported from the UK, Europe and beyond. The Island also imports secondary energy supplies in the form of electricity when economically beneficial. Due to this dependence on importing energy, it is important to consider the Isle of Man in the wider context of energy policy in the UK and Europe.

Elsewhere, European fossil fuel production continues to decline and Europe is heavily dependent on imports, meeting greater than 50% of its energy needs. Future dependency on imported energy is considered a potential risk for security of supply, particularly in the context of rising global demand and finite fossil fuel reserves.

The plateau of fossil fuel supply and subsequent decline means the global economy will have to make do with less oil than is currently available, a situation that will be exacerbated by a steadily increasing demand from developing countries. This situation is highly likely to lead to substantial price spikes in oil prices and, due to tight linkage in prices, to gas also. These spikes will be superimposed on a long term trend of rising prices which may have serious economic and social consequences.

Energy Targets and Carbon Emissions

Europe has energy objectives of sustainability, competitiveness and security of supply, by reducing greenhouse gas emissions by 20%, increasing the share of renewable energy to 20% and improving energy efficiency by 20%, all by 2020.

These are the first steps in the transition to a high-efficiency, low-carbon energy system. The fundamental technological shifts involved in decarbonising the EU electricity supply, the ending of oil dependence in transport, low energy buildings, and smart interconnected electricity networks will only happen with a coordinated agenda for research and technological development, regulation, investment and infrastructure development.

The EU has implemented a strategy to generate 20% of energy requirements from renewable sources by 2020:
https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2020-energy-strategy

The UK has a strategy for a transition to a low carbon economy and aims to, "Lead the move to a low carbon economy in a coordinated drive to tackle climate change. The Low Carbon Business Team is working to help businesses overcome the challenges and grasp the opportunities from the move to a low carbon economy".

Recognising the economic necessity for change, the UK has through the Climate Change Act 2008 become the first country in the world to adopt a legally binding target to reduce carbon emissions below 1990 levels by at least 34% by 2020 and by 80% by 2050: http://www.opsi.gov.uk/acts/acts2008/ukpga_20080027_en_1

The current contribution from renewable energy sources can be viewed at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/633782/Chapter_6.pdf

The burning of fossil fuels adds greenhouse gases to the atmosphere and is a major contributor to climate change: http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

Following a request by the Isle of Man Government, the UK has extended the coverage of the Kyoto Protocol ratification to include the Isle of Man as a Crown Dependency:
https://unfccc.int/process/the-kyoto-protocol

The Isle of Man reports annual greenhouse gas emissions figures for all sectors of the economy to the UK for collation as part of the UK's annual greenhouse gas emissions inventory. Under the Kyoto Protocol the Isle of Man has agreed to put in place plans and policies to manage greenhouse gas emissions. The Department responsible for the collation of data for onward submission to the UK is the Department of Environment, Food and Agriculture.

In July 2011, the Council of Ministers reported on the reduction of carbon emissions by the Isle of Man Government:
https://www.gov.im/media/626201/20110623cominreportrecarbonem.pdf

In May 2013, Tynwald received the Council of Ministers' Report on Environment and Infrastructure Policy and agreed that the key objectives detailed in the report be the general framework for the development of Environment and Infrastructure policy:
https://www.gov.im/media/1349308/report-by-comin-on-environment-and-infrastructure-policy.pdf

The key objectives include the following which relate specifically to climate challenge mitigation and sustainable development:

- Government will adopt a greenhouse gas emissions target for the Isle of Man of 80% reduction of 1990 levels by 2050.
- Government will develop policies and strategies that will lead to reductions in greenhouse gas emissions to meet that target.
- Government will formulate a long term strategy for sustainable development which meets the needs of the present generation without compromising the ability of future generations to meet their needs.

In May 2015**,** the following policies on sustainability and climate challenges were approved by Tynwald:
https://www.gov.im/media/1349306/policy-on-sustainable-development-and-mitigating-climate-challenges-comin-report.pdf

- Sustainability will be central to Government's policy and decision making to ensure we balance the long term needs of society with the needs of the economy and the environment.
- To deliver the agreed scale of emissions reduction it will be necessary to ensure that total greenhouse gas emissions from electricity generated on Island will be close to zero by 2050.
- To deliver the agreed scale of emissions reduction it will be necessary to ensure that net emissions of greenhouse gasses from buildings will be close to zero by 2050.
- To deliver the agreed scale of emissions reduction it will be necessary to ensure that all surface transport will be powered by ultra-low greenhouse gas emission technology by 2050, with the exception of machines of cultural importance such as those used on the heritage railways and for motor racing events.
- To deliver the agreed scale of emissions reduction it will be necessary to ensure that all land use practices will adhere to the principles of sustainable development by 2050 to minimise greenhouse gas emissions.
- Government will assess how greenhouse gas emissions from the Island can be reduced and review this assessment, and progress against it, every 5 years.
- To reduce risks and maximise benefits Government will both promote and undertake appropriate proactive adaptation to the current and projected climate.

In June 2016, Tynwald approved the Climate Challenge Mitigation Strategy for the Isle of Man and a series of 5 year action plans to deliver Tynwald's 2050 target of reducing greenhouse gas emissions per person by 80%, compared to 1990 levels:
https://www.gov.im/media/1354417/a-climate-challenge-mitigation-strategy-2016-2020.pdf

More recently in December 2017 the Minister for the Department of Environment, Food and Agriculture announced the establishment of a Future Energy Group consisting of representatives from several government departments to focus on the options and implications to reduce the carbon emissions and develop a plan to deliver the changes we need for the Isle of Man.

Power Generation

In terms of power generation, the Isle of Man has one statutory electricity generator and network operator for the Isle of Man population of approximately 85,000 people, equating to over 42,000 domestic connections (figures provided by the MUA in 2016).

The Manx Utility Authority (MUA) is Government owned and operated. The MUA has a modern generating portfolio of a Combined Cycle Gas Turbine power station for the majority of island demand, which averages 50MW, plus smaller contributions from Diesel generating sets, Energy from Waste and Hydro-electric. Furthermore, the MUA also has a 67MW interconnector linking the Isle of Man electricity network to the UK in the North-West of England. The MUA currently exports to the UK approximately 25% of the electricity generated on the Island and scope exists for further exports using the existing interconnector.

For further information about current power generation on the IOM and the role of MUA please refer to MMEA Chapter 6.1 (Cables and Pipelines).

Trans-national Partnerships

The Isle of Man continues to develop plans and policies to manage our greenhouse gas emissions and as an internationally responsible jurisdiction is keen to play its role in addressing climate change and energy security issues. This includes working closely with neighbouring jurisdictions such as the British Irish Council (BIC).

British-Irish Council (BIC)

The BIC was created under the Agreement reached in the Multi-Party negotiations in Belfast in 1998, to promote positive, practical relationships among its Members. Its Members are the governments of Ireland, Britain and the Devolved Administrations of Northern Ireland, Scotland and Wales, and the Crown Dependencies of the Isle of Man, Jersey and Guernsey.

In 2009, the BIC agreed to establish an energy work stream for marine renewables and electricity grid issues. The work stream comprises of senior officials from all members of the BIC and the meetings provide an excellent forum within which the various Administrations can update each other on work stream activity, plans and progress.

The electricity grid sub group has developed a programme focussing on interconnection, market integration, planning, consents and market coupling policy areas. An, "All Islands Approach," has been proposed by the UK to develop energy resources across the British Isles which encourages and enables developers to exploit commercial opportunities for generation and transmission, facilitates the cost-effective exploitation of the renewable energy sources available, increases integration of markets and improves security of supply. The BIC Energy Ministers have agreed to cooperate to deliver offshore renewable energy for use within the British Isles and for export to Europe:

http://www.britishirishcouncil.org/sites/default/files/16%20-%20Sixteenth%20Summit%20-%20London%20-%2020%20Jun%202011_3.pdf.

The energy marine renewables sub group was created to share best practice around research and development, policy support and marine environment activities. This has included the BIC Energy Ministers jointly writing to the EU Energy Commissioner to encourage the EU to support further development in this sector and increase the profile of marine renewables with the European Commission and adoption with the Strategic Energy Technology Plan:
http://www.britishirishcouncil.org/news/bic-calls-eu-back-ocean-energy-resource.

In 2016 these two sub-groups came together in one group following consideration by ministers at the London Summit. It was agreed that the group would be jointly chaired by the Scottish and UK Governments.

Opportunities for the Isle of Man

The Isle of Man owns its territorial waters out to the 12 nautical mile limit, and as such has responsibility for marine spatial planning and zoning over a significant proportion of the Irish Sea. Due to the central location in the Irish Sea the Isle of Man has an opportunity to contribute to the generation of renewable energy and also the grid infrastructure to meet our own future needs and export renewable energy to our neighbouring jurisdictions.

The EU funded ISLES study assessed the feasibility of creating an offshore interconnected transmission network and subsea electricity grid based on renewable energy sources off the coast of western Scotland and in the Irish Sea/North Channel area:
http://www.islesproject.eu/

Technically the ISLES project is feasible and the Isle of Man could offer a similar interconnector hub solution for connecting renewable energy projects in the central region of the Irish Sea.

Analysis has been completed by AEA Technologies Limited in 2010 investigating the impacts and opportunities for the Isle of Man from renewable energy:
https://www.gov.im/media/624407/aeaexecutivesummary.pdf
https://www.gov.im/media/624419/aeamainreport.pdf
https://www.gov.im/media/624413/aeareportappendices.pdf

For an overview of Manx territorial waters please see: MMEA Chapter 2.1 (Introduction); and MMEA Chapter 2.2 (The Legislative System).

Climate Change

There is widespread agreement among the world's leading scientists that our climate is changing due to man-made emissions of greenhouse gases in addition to natural climate variability. The evidence for climate change is now overwhelming and worldwide, the oceans are showing a recent rapid and accelerating rise in temperature with pronounced effects on marine ecosystems (Reid and Beaugrand 2012). Changes will also have far-reaching impacts on societies and economies.

For a local perspective including changes being observed in Manx waters please see:

- MMEA Chapter 2.2 (Climate Change in Manx waters); and
- MMEA Chapter 2.1 (Hydrology, Weather and Climate, Climatology).

For further information on climate change in a local, UK and global context see:

- the United Kingdom Climate Impact Programme (UKCIP): www.ukcip.org.uk,
- the Intergovernmental Panel on Climate Change: www.ipcc.ch/
- for the Isle of Man - https://www.gov.im/about-the-government/departments/environment-food-and-agriculture/environment-safety-and-health-directorate/climate-change/

Offshore Renewable Energy

Offshore Wind

The British Isles has one of the largest offshore wind resources in the world, with relatively shallow waters and strong winds extending far into the North Sea. Offshore wind is expected to make the single biggest contribution towards the UK Government's target of 15 per cent of energy from renewable sources by 2020.

An opportunity exists to develop joint projects in an "All Islands Approach" to generation of renewable energy as previously agreed by the Energy Ministers in the British Irish Council. The shallow waters in the Isle of Man territorial seas would allow potential developers to construct turbines at a cheaper cost than deeper offshore sites.

The Irish Sea has a substantial wind resource and developers predict that turbines in this location will have a load factor of up to 40%. Again, the large yield of extractable wind energy will reduce the cost and risk for investment for developers locating turbines in the Isle of Man territorial seas.

The Isle of Man is in close proximity to the UK and is separated by only 17 miles at its nearest point to the UK mainland. The cost of interconnectors is proportional to the distance

travelled and the close proximity to a connection point in the North-West of England would minimise interconnector investment.

The UK is currently developing offshore wind farms in close proximity to the Isle of Man including the Walney Extension development that will stop close to our 12 nautical mile territorial sea limit.

The shallow Isle of Man territorial waters, served with significant wind resource in close proximity to the UK would be a cost effective approach to supply renewable energy to the UK electricity market assisting the UK Government meet its National renewable energy targets. In order for this to be achieved it would be necessary for the UK to extend the renewable energy incentives to the Isle of Man for electricity supplied to the UK market from renewable energy sources and discussions between the Isle of Man and UK Governments continue to resolve this issue.

In November 2015, an Agreement for Lease was signed with DONG Energy to explore the possibility of developing an offshore wind farm in Manx waters off the north east coast of the Island.
https://www.gov.im/news/2015/nov/30/agreement-signed-to-explore-potential-for-offshore-wind-farm-development/.

Marine Renewables - including tidal stream, tidal range and wave

The UK is currently seen as the world leader in wave and tidal stream energy. Devices up to 1MW have been successfully deployed. Marine energy could provide 20% of UK electricity consumption, from a practically extractable resource of 36,000 MW.

The Isle of Man has significant tidal and wave resource however, in view of the relatively early stage of technological development it will be a number of years before significant generation capacity is possible in our territorial seas.

In October 2015, the Isle of Man Government granted a survey licence to Manx Tidal Energy Ltd to explore the possibility of developing a tidal array on an area of the seabed off the Point of Ayre:
https://www.gov.im/news/2015/oct/12/licence-granted-to-explore-potential-for-offshore-tidal-energy/.

Development Stages for Offshore Renewable Energy

Any offshore wind farm or marine renewable energy development would involve the following stages:

1. Site prospecting/selection including collection of site specific environmental data, and seabed information by geophysical and geotechnical survey.
2. Planning and consenting.

3. Development, including construction of foundations and any scour protection, turbine or device installation, cable laying including shoreline crossings and armouring, installation of gathering stations/substations and connection to the onshore national electricity transmission system.
4. Generation operations.
5. Maintenance.
6. Decommissioning, including removal of facilities.

Grid Interconnection

European electricity grids must be upgraded and modernised to meet increasing demand due to a major shift in the overall energy value chain and mix but also because of the multiplication of applications and technologies relying on electricity as an energy source (heat pumps, electric vehicles, hydrogen and fuel cells, information and communication devices etc.). The grids must also be urgently extended and upgraded to foster market integration and maintain the existing levels of system's security, but especially to transport and balance electricity generated from renewable sources, which is expected to more than double in the period 2007-2020. A significant share of generation capacities will be concentrated in locations further away from the major centres of consumption or storage. Up to 12% of renewable generation in 2020 is expected to come from offshore installations, notably in the Northern Seas.

The exploitation of Europe's offshore wind potential brings new challenges and opportunities for power transmission in Europe. Offshore wind capacity in Europe is expected to reach 150 GW in 2030. The majority of the sites currently being considered for offshore wind projects are situated close to the European coast, not further than 100 km from shore. This is in part due to the high cost of grid connection and limited grid availability. Challenges for Offshore Electricity Infrastructure in Europe can be viewed at:
https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/offshoregrid_offshore_electricity_grid_infrastructure_in_europe_en.pdf

Recently the EU funded ISLES study assessed the feasibility of creating an offshore interconnected transmission network and subsea electricity grid based on renewable energy sources off the coast of western Scotland and in the Irish Sea/North Channel area (http://www.islesproject.eu/). Technically the ISLES project is feasible and the Isle of Man could offer a similar interconnector hub solution for connecting renewable energy projects in the central region of the Irish Sea.

For information about the current grid infrastructure please see MMEA Chapter 6.1 (Cables and Pipelines).

Hydrocarbons

Oil and Gas

Ownership of all petroleum and natural gas existing on the Isle of Man and beneath the Island's territorial waters, is vested in the Department of Infrastructure (DOI) under the terms of the Petroleum Act 1986.

This section contains information provided in the Mineral Resources Plan 2010, produced by Wardell Armstrong for the Department of Environment, Food and Agriculture as a reference. A full version is available on request to the Department.

Requirements for Hydrocarbon Potential

For economically significant hydrocarbon accumulations to occur there are four key prerequisites:

- A hydrocarbon source rock;
- Strata with good porosity and permeability to act as a reservoir;
- A structural or stratigraphic trap to hold the accumulation;
- A seal mechanism to prevent escape of hydrocarbons.

Source Rock

A source rock contains naturally occurring organic material which, given appropriate compaction conditions, is chemically altered and mobilised. The majority of the hydrocarbons formed then migrate out of the source rock, through permeable strata or along fractures to areas of lower pressure, to be trapped in a reservoir structure or to escape to surface.

Organic material in source rocks may originate as marine organisms such as aquatic plankton incorporated in fine grained sediments, or in the form of decayed plant matter which is preserved as coal. When subject to an increase in temperatures and pressures, usually due to burial, marine shales produce both liquid oil and natural gas (predominantly methane). Coal usually gives rise to natural gas, as in the gas fields of the southern North Sea.

In Isle of Man waters the most likely source rocks are shales of Namurian and Dinantian age, though there is some potential from Westphalian Coal Measures.

A source rock must experience temperatures and pressures sufficient for organic material to break down into hydrocarbons. For normally buried strata this would be, for oil, maturation temperatures of 60-65^{o}C, (approximate depths of 1500-2000m) and for gas, maturation temperatures of 100-150^{o}C (approximate depths of 2000-2500m). Peak oil generation in Isle of Man Waters probably occurred around the late Triassic (approximately 180 million years

ago) and peak gas generation around the late Jurassic (approximately 135 million years ago). Cessation of maturation occurred with regional uplift during the Tertiary (approximately 40 million years ago).

Reservoir
Reservoir rocks are permeable strata in which migrating fluid hydrocarbons accumulate. Well-sorted sandstones with high porosity and permeability make probably the best reservoirs, though limestone with dissolution porosity and fractured formations also provide reservoirs.

In Isle of Man waters the most probable reservoir strata are the Permo-Triassic Sherwood and Collyhurst Sandstone Formations. Dinantian Limestone conglomerates and shales are a possible secondary reservoir, though this has not yet been proven in surrounding basins.

Trap
For hydrocarbons to accumulate in economically viable quantities some form of structure is necessary. These are often domed or faulted strata but more subtle traps such as lithological changes horizontally along formations are now identified and exploited. In the Isle of Man basins the most probable trap types are those related to faults. Carboniferous folding may provide structure for early Dinantian/Namurian reservoirs, and isolated Carboniferous limestone reefs may form stratigraphic traps.

Seal
The impermeable seal formation which helps prevent escape of hydrocarbons from the reservoir rock to the surface is as important as a porous, permeable reservoir. The seal is usually fine grained strata such as shale or mudstone, although in the Southern North Sea sandstone reservoirs are sealed by evaporates (rock salt or anhydride). The most likely sealing formations in the Isle of Man basins are the Permo-Triassic marls and mudstones of the Manchester Marl and Mercia Mudstone Groups. Carboniferous reservoirs would be sealed by shales and mudstones.

For a broad overview of the offshore geology of Manx waters and the wider Irish Sea please refer to British Geographic Society (BGS) reports listed therein.

Please refer to MMEA Chapter 2.3 (Coastal Geology) for further information and local resources.

Oil and Gas Exploration and Production Activities

Various offshore activities are associated with exploration for and eventual production of oil and gas. The principal activities are outlined below.

Seismic Surveys
Seismic surveys are carried out by a specialist vessel employing equipment which is trailed. The vessel follows a grid pattern for a number of days across its survey area. This operation

can affect a variety of marine biodiversity (notably fish and marine mammals), commercial fishing and shipping activities.

Exploration Drilling

A drillship or jack-up drilling rig would take about one month to drill an exploration well and an exclusion limit or safety zone is usually imposed around a rig whilst it is active which would affect fishing/shipping activities. Exploration drilling has potential to affect the marine environment by discharge of wastes from the rig, including waste waters, refuse, drilling mud or rock cuttings from the well. Such discharges would be subject to stringent control by regulation and conditions may be imposed on licences restricting such discharges. There are also underwater noise effects to marine biodiversity including fish, cephalopods and marine mammals.

Following completion of drilling, an unsuccessful exploration well would be plugged below sea bed level and abandoned with no other structures being left in place. Exploration drilling rigs are provided with advanced equipment to control pressure within the well and thus to prevent the occurrence of a "blow-out" or uncontrolled release of fluids, including hydrocarbons, from the well. Such events are extremely uncommon.

Use and Handling of Hazardous Substances

The nature of the hydrocarbons which are targeted by drilling means that strict legislative controls are imposed on offshore activities. There are numerous potentially environmentally hazardous substances which may be used on a rig, such as oil based drilling muds and acids for fracturing formations to enhance flow rates. Pollution would need to be carefully controlled and monitored and the disposal of unwanted gases such as hydrogen sulphide controlled by provision of appropriate environmental management systems to industry guidelines.

Gas Flaring

If an exploration well makes a discovery, the well is tested for the flow rate of oil or gas to assess the quantity, accessibility and nature of the hydrocarbon discovered. Gas produced in these short tests is flared. Regulations are necessary to control flaring for the safety of rig crews as well as wildlife, such as migrating birds which can be attracted to the flame.

Transportation

Oil and gas can be transported by tanker or pipeline although gas is almost invariably transported by pipeline. It is generally at the point of loading and unloading that pollution risks occur. Shipping codes of practice (e.g. under international conventions to which the Island is signatory), regular pipeline inspections and monitoring of loading and unloading activities (under environmental management systems) and contingency planning are all essential requirements.

Production Facilities

A semi-permanent structure is necessary off shore when a field is developed. As a long term feature, its environmental impact may be significant. There is however a degree of flexibility

in siting a production platform. During the initial planning stages involved in siting a platform there must be a financial commitment and procedures documented by the operator for the later removal of the structure, and to improve the site at the end of production.

Hydrocarbon Infrastructure

To maximise benefit from an active hydrocarbon industry in its offshore waters, the Isle of Man will need to consider the provision of an efficient infrastructure on the Island. East Irish Sea activity is currently serviced from the UK, for example, the Morecambe Fields are serviced from Fleetwood and Heysham with airport facilities at Blackpool. If the Isle of Man could provide a site for activities such as crew accommodation, transportation, equipment maintenance and storage, there could be benefits of local employment and the use of local facilities.

There is limited accessible infrastructure around the Isle of Man for production of oil and gas. The South Morecambe Gas Field has been in production since January 1988 and North Morecambe came on stream in the 1990s. Gas is transported via pipeline to a terminal at Barrow-in-Furness on the southern Cumbrian coast. A new gas processing terminal has been built in Clwyd, North Wales, for the Hamilton discoveries. For any Gas discoveries in Isle of Man waters the following development scenarios could be considered:

- Gas could be piped in its raw state from a production platform to the Morecambe Field infrastructure for processing and onward transmission.
- Construction of onshore Isle of Man processing facilities for use of gas on the Isle of Man or for transmission via the existing UK - Ireland pipelines.
- Processing facilities at platform site and piping onshore.

Oil production is more easily dealt with and could be transported by pipeline or by tanker from the production platform.

Isle of Man System for Hydrocarbon Exploration

The Continental Shelf of north-west Europe is divided into the territorial waters of the Isle of Man, the UK, Eire, Norway, Netherlands, Denmark, Germany and France, all of which employ similar systems of exploration for and exploitation of hydrocarbons.
The Isle of Man system was instituted for the 1994 Hydrocarbon Licensing Round and revised for the more recent 2017 Hydrocarbon Licensing Round.

Quadrants Blocks
The Isle of Man, the UK and Eire divide their territorial waters into quadrants measuring 1º Latitude by 1º Longitude. Each quadrant is given a unique number and subdivided into 30 blocks with an average size of 250 square kilometres. Quadrant 110, block 23 would be written 110/23. Where blocks fall within the Isle of Man territorial seas, they are identified by the prefix IOM, for example IOM112/26. Some blocks fall in both Isle of Man and UK

territorial seas and in such cases, the part of the block which is within Isle of Man waters is given the IOM prefix and the remainder, within UK waters, has no prefix, for example block IOM109/4 and block 109/4. If a well is drilled in a block it is named after the block, for example the first well in block IOM112/29 was called well IOM112/29-1 and if a second well were to be drilled in this block it would be called IOM112/29- 2. Letter suffixes are also used for well names, for example IOM112/19A.

The quadrant blocks around the Isle of Man are illustrated in Figure 1.

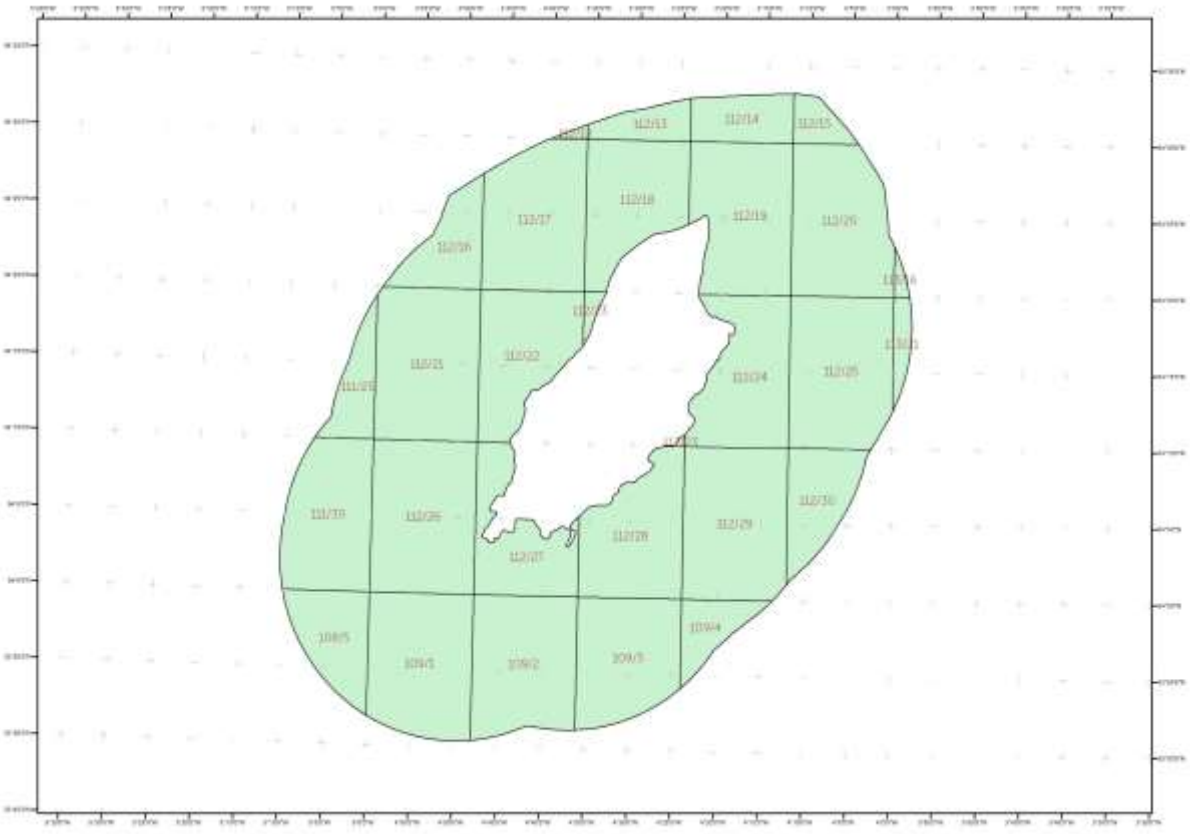

Figure 1. IOM Hydrocarbon Blocks.

The Isle of Man Government issues two forms of offshore licence:

- Prospecting Licences, entitling the licensee to prospect for hydrocarbons using generally non-intrusive methods;
- Petroleum Production Licences (three terms) which give the licensee exclusive rights to explore for hydrocarbons in a defined area and, subject to further authorisations from the Government, permission to drill exploration, appraisal and production wells.

Prospecting Licence

Prospecting Licences are usually granted for the acquisition of Speculative Data ("spec. data"). This may be aeromagnetic, gravity or more often seismic reflection data, usually acquired by geophysical prospecting companies who acquire data for sale to oil companies. Prospecting Licences are issued for a fixed fee and for a fixed period. A number of such

licences were issued by the Government in 1994. Further details can be sought by contacting The Department of Infrastructure.

Petroleum Production Licence

An offshore Petroleum Production Licence is usually issued during a licensing round but may exceptionally be issued at other times (an "out of round" licence). Such a licence is granted to a company or group of companies which can satisfy conditions of technical competence and financial stability and provide an adequate work programme to explore the acreage. A Petroleum Production Licence is held on a rental basis and entitles the operator to explore and drill for hydrocarbons within the licence area.

Applications are made via a prescribed process and will address three Terms:

Initial Term – Exploration
The Initial Term (which may last up to 9 years) will incorporate:
Phase A – Studies and reprocessing
Phase B – Shoot Seismic
Phase C – Drill Exploration and Appraisal Wells

Second Term – Appraisal and Field Development Planning
If the operator of a Petroleum Production Licence makes a discovery it can submit plans and documents to request approval to appraise and develop that find and extend the licence for up to 6 years.

Third Term - Development and Production
Finally the operator of a Petroleum Production Licence can bring the field onto production. This term may last up to 18 years and may be extendable.

Isle of Man Petroleum Production Licences include strict conditions on any operations, including conditions on the following:

- Pollution and safety contingency planning
- Fishing
- Navigation and aviation
- Rigs and pipelines
- Use of drilling muds and chemicals
- Discharges from rigs
- Environmental protection
- Notifications and consultations
- Cables and pipelines
- Abandonment of structures.

Environmental conditions require that any drilling activity and seismic surveys in Manx waters are to be subject to appropriate Environmental Impact Assessment, following industry best practice guidelines, in consultation with relevant Departments, and dependant on the nature and scope of the development.

Applicants for Licences are required to demonstrate that they have a detailed understanding of the requirements, together with established policies and practices on health and safety, staff and management training and environmental management. There are also requirements for appropriate and early engagement with the relevant Government Departments (notably DOI, DEFA together with MNH and the MUA).

Manx waters were initially subject to an assessment which has identified areas where exploration activity may be constrained by fisheries or environmental factors, navigation or seabed structures in 1994 and based on the best available and accessible information at the time (consultants employed to assist were Wardell Armstrong). Subsequently the initial Manx Marine Environmental Assessment (2012) assisted with updates, to underpin marine management decisions with improved and robust locally available information.

All licence block areas are the subject of existing draft block-specific conditions which would form the basis for future detailed licence conditions to ensure that any activity carried out under the licence would conform to the Government's requirements in respect of the strict protection of the marine and coastal environment, the interests of the fishing industry and other sea users. All exploration and production activity would be subject to strict licence conditions, including requirements to carry our appropriate environmental impact assessments for all drilling and production activity and for seismic exploration activity in certain areas following industry best practice guidelines, in consultation with relevant Departments, and dependant on the nature and scope of the development.

Exploration and Development Drilling

Once a Petroleum Production Licence has been awarded and a company has carried out a detailed seismic survey and identified suitable structures, wells may be drilled. Exploration or "wildcat" wells, the latter drilled in previously undrilled territory, are drilled in unproven structures called "leads". If a first well is successful, or due to successful drilling of similar structures nearby the accumulation is confidently predicted, the structure is termed a "prospect". Once the structure is under appraisal or development it is termed a Field. For example a well drilled in the Solway or Peel Basin of the Isle of Man would be wildcat well drilled on a lead.

Approval has to be obtained from the Department of Infrastructure as the petroleum and seabed owner before development of a field. Whilst appraisal wells and seismic surveys provide information on the Prospect, detailing its shape and size, "development" drilling is more concerned with detailed reservoir analysis for production purposes. For example, a medium size gas field in the North Sea with recoverable reserves of around 200 billion cubic feet of gas would have possibly one discovery well, four appraisal wells and one platform from which six or more development wells would be drilled.

Brief History of Exploration Activity

Past exploration activity in and around Isle of Man waters has been concentrated in the four prospective sedimentary basins which lie partially in Isle of Man waters. These are:

Lagman Basin
Eubonia Basin } Sub Basins of the East Irish Sea Basin
Solway Basin
Peel Basin

The East Irish Sea Basin has been considered to be the most attractive hydrocarbon region on the UK continental shelf outside the North Sea.

The South Morecambe Gas Field, which lies 35 miles south east of the Isle of Man, was discovered in 1974. It was brought on stream in 1988 with recoverable resources of 150 billion cubic metres of natural gas. North Morecambe, separated from South Morecambe by a *graben* structure was discovered in 1976 with recoverable reserves of 35 billion cubic metres. Oil was discovered in November 1990 by Hamilton Oil and Gas in Block 110/13.

The two northernmost sub-basins of the East Irish Sea Basin, the Lagman and Eubonia Basins, lie partially within the Isle of Man territorial seas. The only well drilled within Isle of Man waters prior to the First Isle of Man Licensing Round was drilled by BP in 1982 in the Lagman Basin. This well encountered minor gas shows, though later interpretation suggested that this well may have missed its targeted structure.

After 1982 and in the period before the First Isle of Man Licensing Round, exploration activity in Isle of Man waters was limited to seismic reflection surveys. Jebco Seismic Limited acquired surveys in 1988 and 1992 for purchase by oil companies. The 1992 survey was acquired with the future Isle of Man licensing round in mind.

The Solway Basin's south west termination, partly formed by a fault, is onshore around the Point of Ayre. This Basin was originally identified by aeromagnetic and Bouguer Gravity Anomaly data. It was traditionally considered a simple sag basin with little structure and therefore no potential for hydrocarbon traps but Esso acquired operatorship of several blocks adjacent to the Isle of Man waters for detailed exploration under the UK 14th Round of Licensing.

Elf Enterprise Caledonia had also acquired licences over acreage in the Peel Basin west of Isle of Man waters. The Peel Basin was previously assumed from gravity/magnetic and limited seismic data to lack younger sediments from which the major reservoir formations of the East Irish Sea Basin are derived. Data acquired in 1992 by Jebco however, identifies a possible coverage of younger strata with thicker sections on the down throw sides of faults.
Two geophysical exploration companies approached the Isle of Man Government in the latter part of 1993 for permission to collect aeromagnetic data in Isle of Man airspace and Prospecting Licences were was granted.

A map on activities and infrastructure outside of Manx waters is available at: https://www.ogauthority.co.uk/data-centre/

The First Isle of Man Round of Hydrocarbon Licensing

The Isle of Man Government previously issued Prospecting Licences to geophysical companies acquiring aeromagnetic spec. data. Most of the seismic spec. data was acquired by Jebco in 1992, though Geco-Prakla and Jebco were active before the extension of the Territorial Seas. Jebco held approximately 2,500km of seismic data in and around Isle of Man seas which was sold and interpreted by oil companies interested in the Isle of Man's First Licensing Round.

The Isle of Man Council of Ministers approved the necessary preparation for the Isle of Man First Hydrocarbon Licensing Round in January 1994 and licence applications were invited in December 1994.

Following the First Isle of Man Licensing Round in December 1994, Petroleum Production Licences were awarded to Elf and Marathon, as follows:

Company	Blocks
Elf	IOM112/13, IOM112/14, IOM112/15, IOM112/19 and IOM112/20
Marathon	IOM112/29

The terms of these licences required the operators to implement programmes of seismic exploration and to drill at least one exploration well. Wells were subsequently drilled as follows:

Company	Well
Elf	IOM112/19A
Marathon	IOM112/29-1

Following the award of licences under the First Hydrocarbon Licensing Round, an application was submitted by BP for an "out of round" licence on an area which had not been the subject of licence awards in the Round. Marathon also applied for an "out of round" licence for an area adjacent to the block it had been awarded in the Round in order to undertake and extended seismic survey programme. The Government awarded "out of round" licences in 1996 as follows:

Company	Blocks
BP	IOM112/25, IOM112/30, IOM113/16 and IOM113/21
Marathon	IOM112/24

The blocks awarded following the Round and the "out of round" licences awarded are shown in Figure 2.

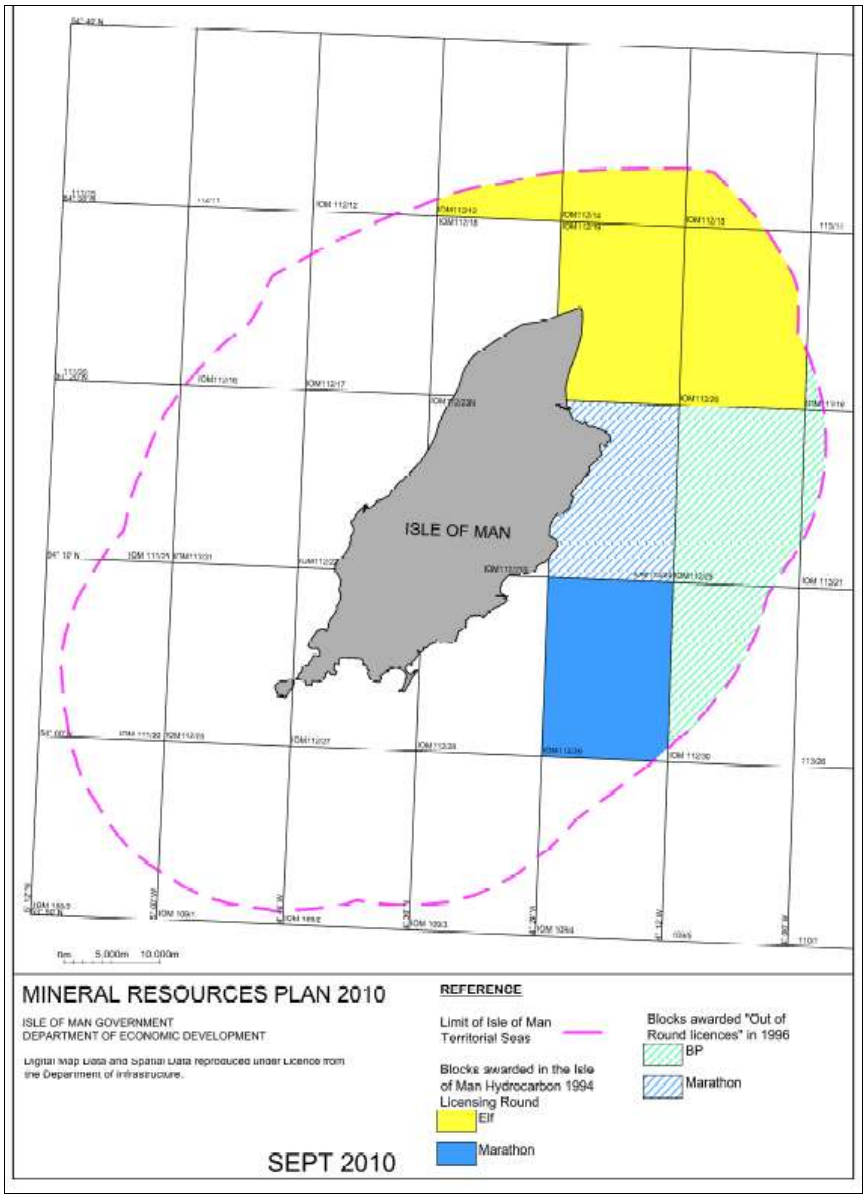

Figure 2. Petroleum Production Licences: Licences Granted 1994-1996. Digital borehole data is available at http://www.tgsnopec.com/data.aspx

Future Licensing in Manx Territorial Waters

A second licensing round was held during 2017. Any decision to award a licence will be made by the Department of Infrastructure during 2018.

Coal

This section contains information provided in the Mineral Resources Plan 2010, produced by Wardell Armstrong for the Department of Environment, Food and Agriculture as a reference. A full version is available on request to the Department.

Coal Exploration

Coal exploration has occasionally taken place in the Isle of Man since 1669 when the ruling Lord of Mann ordered a search for coal. Early attempts to find coal were however carried out in strata older than the Coal Measures and were therefore unsuccessful. Attention directed in the 19th Century to the Carboniferous strata of the north and south of the Island, when most of the exploration was undertaken by the Isle of Man Coal Company who drilled a borehole in the Ballasalla area which found no coal.

In 1891, Messrs. Craine Bros of Liverpool commenced the systematic exploration of the northern extremity of the Island in search of coal. Several boreholes were drilled through the considerable depth of drift and into the underlying solid rock. No significant coal was found.

Between 1985 and 1987 three boreholes were drilled on the eastern part of the Ayres by Riofinex North in an attempt to determine whether a coalfield similar to the Workington Coalfield might exist beneath the eastern shore of Ayres. Boreholes were drilled to depths ranging between 128 metres and 483 metres. All of the boreholes intersected the Carboniferous strata but coal-bearing strata were not encountered. The report on the drilling programme suggested that coal was unlikely to be found in significant quantity, but that prospects might be better offshore.

The Riofinex North report also concluded that in order to determine the presence of coal, it would be necessary to drill a deep (550 to 650 metre) borehole near to the Point of Ayre. This would have a high financial risk since the evidence suggests coal is unlikely to be present in significant amounts. If coal-bearing strata were encountered then the depth would be such that it would probably have little or no economic potential.

Future Exploration and Exploitation of Coal Resources

In consideration of the negative exploration results obtained to date it is very unlikely that any further coal exploration activity will take place in the Isle of Man in the foreseeable future. The only possibility of any future coal exploration would be a continuation of the exploration programme at either the Point of Ayre or offshore.

Unconventional Coal Gasification (UCG)

British Geological Survey (BGS) data indicates that productive (Westphalian) coal measures may exist in Isle of Man territorial waters at a significant depth below the seabed. Using unconventional coal gasification (UCG) technology it is possible for the partial in-situ combustion of a deep underground coal seam to produce a gas for use as an energy source. It is achieved by drilling two boreholes from the surface, one to supply oxygen and water/steam, the other to bring the product gas to the surface. This combustible gas can be used for industrial heating, power generation or the manufacture of hydrogen, synthetic natural gas or other chemicals. The gas can be processed to remove carbon dioxide (CO_2) before it is passed on to end users, thereby providing a source of clean energy with minimal greenhouse gas emissions.

UCG is both an extraction process (like coal mining) and a conversion process (gasification) in one step, producing a synthetic gas (Syngas). Large scale operations were developed in the Soviet Union during the 1970's.

Other

Shale Gas

Extraction of shale gas uses hydraulic fracturing (commonly known as fracking). This process involves the propagation of fractures in a rock layer caused by the presence of a pressurised fluid. Hydraulic fractures form naturally, as in the case of veins or dykes, and is one means by which gas and petroleum from source rocks may migrate to reservoir rocks. For further details refer to:
http://www.decc.gov.uk/en/content/cms/meeting_energy/oil_gas/shale_gas/shale_gas.aspx

Carbon Capture and Storage (CCS)

Carbon capture and storage (CCS) captures CO_2 from fossil fuel power stations. The CO_2 is then transported via pipelines and stored offshore in deep underground structures such as depleted oil and gas reservoirs. For further details refer to:
https://www.gov.uk/government/collections/carbon-capture-and-storage-knowledge-sharing

Carbon dioxide may be stored in a range of geological formations including depleted hydrocarbon reservoirs and coal seams. Depleted hydrocarbon reservoirs will coincide with existing coal seams extractable by UCG methods.

Ownership of Manx Mines and Minerals

Mines and Minerals Division – Department of Environment, Food and Agriculture

Ownership of all non-hydrocarbon minerals existing on the Isle of Man is vested in the Department for Environment, Food and Agriculture under the terms of the Minerals Act 1986 and as amended by the Minerals (Amendment) Act 2006 ("the Minerals Acts").The Department permits operators/developers to extract minerals via mining leases, mining licences and mining permissions and the Minerals Acts broadly set out the circumstances and procedures by which these Agreements are granted.

For further information see MMEA Chapter 2.1 (The Legislative System). See also:

The Minerals Act 1986 – http://www.gov.im/lib/docs/ded/mineralsact1986.pdf

The Minerals (Amendment) Act 2006 - http://www.gov.im/lib/docs/ded/commercialDev/leg20080602mineralsamendmentact.pdf

The DEFA has a duty to ensure that the finite mineral resources on the Island are exploited as required and in a controlled manner. Any mineral operator/developer wishing to extract minerals has to apply to the DEFA to obtain the necessary rights to work minerals which are granted by virtue of a Mining Agreement in the form of a Lease, Licence or Permission issued in accordance with the Minerals Acts. Permission is also required from DOI, as owner of the seabed and Territorial Seas Committee (Territorial Seas (Consequential Provisions) Act 1991).

The system of mineral ownership on the Isle of Man differs significantly from that in the UK, as mineral ownership in the UK is generally linked to the ownership of the surface of the land. The Minerals Acts was introduced to clarify the position and vested all mines and minerals in the then Department of Industry, with minor exceptions. Individuals or businesses are required to obtain working rights from the Department.

Quarry operators wishing to apply to extract minerals or any developers (where minerals need to be extracted incidental to development) in the Isle of Man may make an application for a:

- **mining lease** - intended for extracting significant quantities of mineral over a specified period of time;
- **mining licence** - intended for extracting mineral over a short period of time e.g. 6 - 12 months;
- **mining permission** - for a very short period of time e.g. 3 months or where the amount of mineral extracted is very small;
- **prospecting licence** - for prospecting on a specific piece of land over a short period of time; and

- **mining facilities permit** - to permit a specified piece of land to be used in accordance with an acquired ancillary right to facilitate the working of mines and minerals.

Quarry operators/developers are expected to have, or have applied for, planning permission for land which is the subject of a minerals extraction application or an application for development which involves ancillary mineral extraction.

Please Note: Mining leases have only been issued for land based mineral extraction on the Isle of Man. Whilst there has been some prospecting of marine aggregate, the need to issue a lease has not yet arisen.

The processes involved regarding the issue of a marine aggregate lease have not been agreed, however to understand how the application **may** be treated, an overview of how leases are issued for terrestrial quarries provides a reasonable benchmark.

It is envisaged that a stringent consenting regime will be implemented as part of marine spatial planning through the Marine Infrastructure Management Act 2016. In the interim however, decisions for lease agreements will be handled by the cross-departmental Marine Spatial Planning Officers Group with decisions by the Territorial Seas Committee.

Mineral Extraction Application Process (Terrestrial Minerals)

Before an application for mineral extraction can be considered planning permission has to have been granted through the Department of Environment, Food & Agriculture's (DEFA) Planning and Building Control Division. To avoid the conflict of interest which may be perceived because the Department is the mineral owner and planning authority, planning applications concerning minerals developments will normally be determined by an independent planning inspector. In addition the right to access and disturb the surface for the working of minerals has to have been obtained from the landowner or controller, and a reasonable sum for such rights of access and disturbance agreed.

Application

An application for a prospecting licence, lease, licence or permission is made to the DEFA using an application form which can be found on the DEFA website's minerals section - https://www.gov.im/categories/business-and-industries/mines-and-minerals/

The application, once received by the Department, and depending on the type, be it a lease, licence or permission, is processed accordingly.

Processing application

Each type of application is considered appropriately, resulting in the issue of a licence or lease issued by the Department of Environment, Food & Agriculture. A mining permission usually is issued in the form of a letter from the same Department.

Heads of Terms
Following receipt of the application, if the DEFA is satisfied that all relevant information has been provided, Heads of Terms are drawn up.

Heads of Terms contain conditions such as

- Period of the Agreement;
- Permitted Annual Extraction Limit;
- Royalty rates (payable to the Department of Environment, Food & Agriculture);
- 1st Retail Price (RPI) review;
- 1st Market review; and,
- Certain Rent (minimum royalty payable).

The draft Heads of Terms are sent to the applicant for agreement, prior to seeking Departmental approval and Treasury concurrence.

Statutory Notice
In the case of a mining lease, Section 2, Subsection (3) of the Minerals Acts require the DEFA to issue a Statutory Notice to every Department, Statutory board or other public body, which in the opinion of the DEFA will be effected by the mining activity, as well as every local authority within whose land the activity falls as well as the landowner and applicant.
The period of notice for the statutory letter is set at four weeks, after which, and subject to resolving any issues which may arise, the Department can issue a mining lease.

Licence or Lease
A licence is granted for an extraction which is likely to be no longer than 12 months to completion, whereas a lease is issued for extracting a significant quantity of mineral over a prolonged period.

The licence/lease ("the Agreement") contains the conditions under which the mineral extraction can take place and includes the agreed Head of Terms and any conditions set by the planning authority.

The Agreement will include the minimum amount payable ("Certain Rent") should mineral extraction not exceed 40% of the annual permitted extraction.

Royalties
During the course of each year (or part year) the Agreement is operational the Department issues royalty return forms at the end of May and at the end of November. The forms are issued to establish the amount and type of mineral produced in the preceding six months and from that determine the amount payable to the Department in royalty fees or Certain Rent.

Reasonable Sum
Any Mining Agreement will make reference to a Reasonable Sum. This is an additional arrangement made between the surface landowner / controller and the mineral developer

for the rights to access and disturb the surface for the working of minerals. The Reasonable Sum can be in the form of a lump sum or periodic payment. The Department of Environment, Food & Agriculture will have no involvement in the negotiations of a Reasonable Sum, but only need to be satisfied that a Reasonable Sum is in place. In some instances the rights to access and disturb the surface may require a further agreement to be made between the landowner / controller and mineral developer.

Marine aggregates

Ownership of marine aggregates is vested in the Department of Infrastructure by virtue of section 2(1) and (4) of the Territorial Sea (Consequential Provisions) (3) Act 1991 (minerals and petroleum). Under the Act, the DOI may issue various permissions to prospect for, or extract on a commercial basis, aggregates and hydrocarbons.

Applications for Prospecting Licences and Mining Leases should be presented to the Department of Infrastructure for processing. The application would be considered by the Territorial Seas and Environment and Infrastructure Committee prior to approval being granted by the Department of Infrastructure.

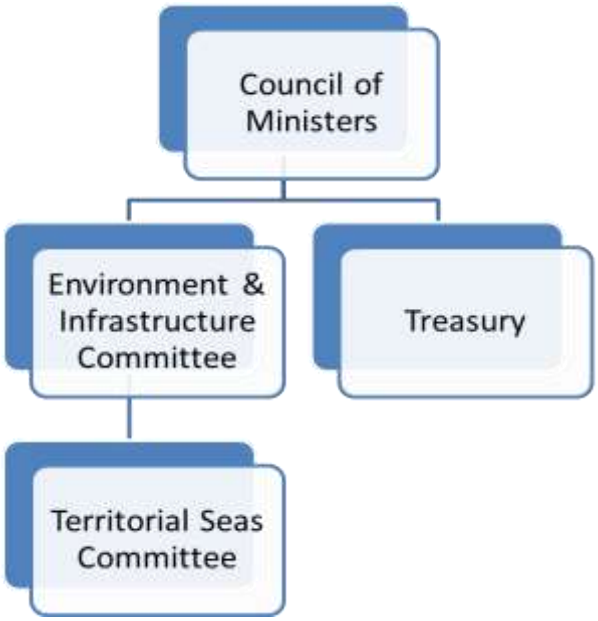

Figure 3. Organisational Chart of Government Administrative Committees.

Wardell Armstrong LLP has provided consultancy services in respect of Mines and Minerals management to the Isle of Man Government for over thirty years.

The services provided includes:

- Advice on minerals planning and operations,
- Liaison with the Department's legal consultants on aspects of mines and minerals,

- Provision of advice and guidance with regard to abandoned mines workings,
- Preparing valuations and recommendations on reviews of royalty,
- Attending minerals related meetings and undertaking monitoring activity.

Marine Sand & Gravel

Since the 12-mile territorial seas limit was established (September 1991), the possibility of extracting aggregates, and in particular sand and gravel, from IOM waters has been raised on several occasions. Elsewhere such commercial extraction is licensed and practiced in the territorial waters of both the UK and Republic of Ireland, in some cases in waters near to the Isle of Man's territorial limit (http://www.bmapa.org/).

The following information is taken from the Mineral Resources Plan 2010, produced by Wardell Armstrong as a reference. A full version is available on request to the Department of Environment, Food & Agriculture.

Subtidal Sediments
Following the expansion of the territorial sea limits the a preliminary offshore geological mapping programme of the Irish Sea was undertaken by the British Geological Survey (BGS) and identified areas in the Irish Sea where sand and gravel occur (Jackson et al. 1995).

During preparation of the Mineral Resources Plan 1994, the BGS was commissioned to assess the distribution of marine sand and gravel off the coast of the Isle of Man. The report, based on geological and geophysical surveys held on their database was sufficient enough to appraise the marine aggregates resource potential; however it could not prove the quality and quantity of the deposits.

Sand
The report identified a number of extensive sandbanks lying off the north-east of the Island; the Bahama, Ballacash and King William banks. A smaller bank was found off the Calf of Man in the south – The Wart Bank.

Gravel
Large areas of the sea floor north and south of the Island are covered by gravel deposits, upon which an overburden of no more than 0.2m thick exists. The BGS report concluded that some of the gravel deposits close to the northern and southern margins of the Island may be thin, but thicker deposits are probable in the north of the Island and in an area offshore in Douglas Bay. In addition there are known to be thick deposits of gravel on shore at the northern end of the Island, which may extend into the sea.

The report recommended that due to the inadequacies of the available geological database to support a satisfactory resource appraisal, further investigative work was needed. The BGS recommended concentrating on areas where sand and gravel resources were anticipated from the reconnaissance geological data. These areas would need to be surveyed by

geophysical techniques to determine the thickness of the deposits followed by a programme of grab and core sampling to calibrate the geophysical results.

Further Subtidal Information

In recent years, much more information has become available about Manx marine habitats of conservation importance. The main findings of recent habitat surveys are presented in the MMEA Chapter 3.3 (Subtidal Ecology).

In 2008, Bangor University carried out a systematic benthic survey of the whole of Manx territorial waters for both Fisheries and Biodiversity purposes, as part of their fisheries research contract with the Isle of Man Government. This survey produced a large quantity of useful data which has been presented in a number of published scientific reports.

The survey work provides the first interpolated overview of habitats in Manx waters with biotope habitat classification derived from subtidal sediment information from surface grabs and photo analysis from images from drop-down camera and video survey work. The three main habitats of international conservation interest identified during the survey were horse mussel reefs, maerl beds and Ross worm reef habitats (*Sabellaria spinulosa*), which are all OSPAR priority habitats.

Further information regarding bathymetry and surface sediments is provided in MMEA Chapter 2.1 (Physical Environment – Hydrology).

Marine Aggregate Prospecting

To date no commercial marine sand and gravel dredging has taken place in Manx waters.

Preliminary mapping of the Irish Sea bed by the British Geological Survey identified several areas where sand and gravel occur through a number of extensive sand bodies situated off the north east tip of the Island known as the Bahama, Ballacash and King William Banks. Large expanses of the sea floor to the north and south of the Island are also known to be mantled by gravel deposits.

The former Department of Trade & Industry in 2005 made provisions for the issue of non-exclusive prospecting licences to companies who may wish to carry out surveys to assess the potential of for commercially viable deposits of marine aggregates.

The Isle of Man Government granted two prospecting licences in 2007, to search for deposits of sand, gravel and shingle within Manx territorial waters to Westminster Gravels Limited (https://westminster.boskalis.com/) and CEMEX UK Marine Limited (www.cemex.co.uk/aa/aa_ma.asp).

Prior to granting these Prospecting Licences in 2007, an Environmental Sensitivity Assessment (ESA) was conducted by Wardell Armstrong to establish areas where mineral extraction was to be avoided based on the most accessible information supplied from other

marine users of the sea bed and water column at that time. The ESA was effectively an update to the plan provided by the Company in 1994 when an ESA was required for the Hydrocarbon Licensing round. The ESA merely provides indicative information regarding the nature of the environmental sensitivities within an area of search – the onus should be with the mineral developer to fully research and address the environmental sensitivities as part of a Prospecting Licence / Mining Lease application.

Expressions of interest have since been received from other marine dredging operators but to date, no further applications for prospecting licences have been received.

It is envisaged that future Environmental Sensitivity Assessments will take account of updated information being compiled and identified as part of this Manx Marine Environmental Assessment. In particular, the recent marine habitat surveys by Bangor University, DEFA and Seasearch have identified the locations of sensitive marine habitats (see MMEA Chapter 3.3 (Subtidal Ecology)). Recent research into the use of Manx waters by marine mammals and basking sharks will also be key in future assessments. It should be noted that this MMEA report does not replace requirements for appropriate site specific information to be brought together, to ensure marine management decisions are based on the best available local information. For examples of Environmental Characterisation Assessments in UK and industry best practice, see: www.bmapa.org.

Commercial Extraction

The Isle of Man has no formal policy for the issue of a Mining Lease for the working of marine sand and gravel. However, a series of protocols for the issue of Prospecting Licences and eventually Production Mining Leases was introduced by the former Department of Trade & Industry in 2005.

The following general steps are likely to be needed in bringing forward the licensing of marine aggregate extraction:

- Introduction of amended or new legislation and regulations as necessary, and the making of the necessary administrative preparations;
- Assessment of the sensitivity of the Territorial Seas to inform consideration of which areas may in principle be acceptable for future extraction. This work was completed by the Department in 2005 in consultation with other key Government Departments;
- Inviting the marine aggregate industry to apply for non-exclusive prospecting licences to allow operators to conduct limited surveys and sampling as a basis for future applications for extraction licences or leases;
- Through a formal competitive "tender round", inviting operators to bid for defined areas;
- Successful bidders under a tender round would be awarded an exclusive licence or lease for detailed exploration of the defined area for which bids have been accepted and for extraction of aggregates, subject to satisfactory compliance with a range of requirements, such as the completion of an EIA. The exclusive licence or lease would

include an initial period, within which the operator would be able to confirm the details of the resource and prepare its detailed technical proposals and would have to satisfy the Department that its operations would meet all technical and environmental requirements. Following this, the DEFA would be able to authorise the commencement of extraction.

If sand and gravel deposits are proven and the likely quantity of sand and gravel determined a number of policy issues will need to be raised, one being to decide whether minerals extracted should be for use on the Isle of Man only or whether the aggregates can be exported to serve the UK demand for marine aggregates. Where the intention is to land sand and gravel on the Island, appropriate wharf facilities will need to be provided. Douglas and Ramsey appear to be nearest ports to the offshore prospecting areas. Thus feasibility of developing such wharf facilities at these or other Manx ports would have to be addressed.

Coastal Quarries

The Point of Ayre – Sand

Pooil Vaaish – Limestone

Costal Quarries are mineral operations that lie immediately adjacent to the sea, usually in the form of a linear excavation running parallel to the coast or a bay like feature. The concept of a costal quarry conjures up images of a type of "super-quarry" whereby large volumes of aggregates are extracted and transported over long distances by sea.

For the current mineral operation which lies immediately adjacent to the Manx coastline, it is important to understand that neither one of these operations are of a super-quarry status. These operations are briefly described below.

Point of Ayre
Operated by Island Aggregates Ltd, the site is located approximately 3km north of the village of Bride in the north-eastern most point of the Island. The site lies approximately 250m to the south of the high water mark along the coast and extracts sand and gravel from the Point of Ayre formation to produce concrete sand and various grades of aggregate. In terms of annual output and lateral extent, this is by far the largest mineral operation on the Island.

Pooil Vaaish
Operated by *Pooil Vaaish* Quarry Ltd on the eastern shore of *Baie ny Carrickey*, approximately 2km to the west of Castletown. *Pooil Vaaish* produces largely dimensional, ornamental and building stone. It is a very small scale quarry which produces low tonnages.

Locations are listed in the **Mineral Resources Plan.**

Please see MMEA Chapter 2.3 for information about Coastal Geology at key locations around the Manx coast.

The Point of Ayre Quarry is in proximity to Areas of Special Scientific Interest (ASSI). For further information please refer to MMEA Chapter 3.7 (Marine and coastal conservation).

Mines

Historically, the Isle of Man is one of the more intensely mined areas in the British Isles and records show there are numerous abandoned mines throughout the Island. Manx mines produced a significant proportion of the lead, zinc and copper produced from the British Isles at one time.

The Isle of Man has a long metalliferous mining tradition, with activity reaching a peak in the latter half of the 19th century. Most of the mines on the Isle of Man were abandoned between 1880 and 1900 and only the Foxdale, Snaefell and Great Laxey mines survived into the 20th Century. The period of intense exploration was then over, and since 1919, when Great Laxey mine finally closed, there has been no recorded underground mining on the Isle of Man.

The last phase of base metal production commenced in 1952, when Metalliferous Holdings Ltd. was formed for the purpose of re-working waste tips at Snaefell mine and possibly re-opening the mine. The company's attempt to re-open the mine failed, although by 1958 when the project was abandoned, 2,440 tonnes of mixed concentrate had been extracted from the waste tips.

Occurrence
All of the main metalliferous ore-bearing veins of the Isle of Man occur in the Manx Group and associated granites. The main mineralisation took place after the intrusion of the Caledonian granites during periods of orogenic movement and occurred along fault planes produced by movement in the Earth's crust. The main ores were sulphides of lead, zinc, and copper, with small amounts of silver and traces of gold.

Exploration
Since 1958 exploration work on the Island has been very limited but in 1991 a prospecting licence was issued by the Department of Trade and Industry in respect of terrestrial land in the Sulby Dhoo area. The licence was for a reconnaissance geochemical survey of that area. Field work started in January 1991 and continued for a further two months.

An extensive sampling programme was undertaken which involved:-

- Review of old records and past work
- Prospecting around all old trials and workings
- Stream Sediment Panning
- Soil and Till Sampling

Samples were tested, principally for gold, although also for zinc, lead, copper, arsenic and barium.

Some initial indications of gold came from the sediments found in streams draining a particular zone of high ground between *Slieau Freoghane* and *Slieau Dhoo*. However, further prospecting for gold appears to have been generally unsuccessful. Zinc, lead, copper, arsenic and barium results in those samples were low.

The conclusions from the exploratory work were that the presence of gold in panned concentrates from stream sediments was confirmed although little or no gold was found in samples of soils, tills or rock. To date no further work has been undertaken.

There have also been proposals for base metal (lead and zinc) exploration in the Carboniferous Limestone around Castletown, following exploration work undertaken during the 1970s. The work undertaken in the 1970s included soil sampling and drilling of 13 inclined boreholes to depths of between 19 and 77 metres. Sporadic base metal mineralisation was present in several of the boreholes.

Future Exploration of Metalliferous Resources

Levels of interest in metalliferous exploration work on the Isle of Man are generally low.

Prospecting for gold appears to have been generally unsuccessful.

The probability of significant quantities of base metals being found is considered to be small and it is difficult at this early stage to suggest policies in relation to underground Metalliferous mining on the Island. Each exploration project should be assessed on its merits and monitored as the project progresses.

Exploration programmes should in principle be encouraged, subject to the necessary statutory permissions being granted. They can provide valuable geological information for the Isle of Man, especially where boreholes are drilled.

Health and Safety

Legislation

These industrial activities demand complex Health and Safety Legislation. The Isle of Man has based its legislation on that of the UK, as implemented by the UK Health and Safety Executive.

The Isle of Man Health and Safety at Work Inspectorate

The first annual report of the Health and Safety at Work Inspectorate has been published, covering the period April 2010 - March 2011. The report explains the role of the

Inspectorate and also covers the work undertaken by the Inspectorate, in addition to setting out statistical information on accidents and injuries and the resulting time lost from the workplace.

Contact:
Health and Safety at Work Inspectorate
Department of Environment, Food & Agriculture
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Best practice guidelines from specific industries are also available including:
http://www.hse.gov.uk/offshore/

Environmental Implications

Activities from all of the industry activities featured in this chapter have their own suite of potential effects which are dependent on the nature, scope, site and spatial extent of any future proposed development.

Assessment of each potential effect and the most appropriate associated mitigation requirements require their own review (therefore beyond the scope of this generic report) but would likely be a requirement as part of any environmental impact assessment process.

However, summary information is offered as an initial broad scale view to assist future marine management discussion and future requirements for consideration of marine spatial planning for Manx waters.

Potential Effects and Environmental Risk

Potential sources of environmental effects from anthropogenic activities include the following. The list is not comprehensive but serves as an initial guide to assist future discussions between developers, marine stakeholders and Government Departments.

- Noise (impulsive) from seismic survey and piling during installation and decommissioning activities (see below)
- Noise (semi-continuous or continuous) from turbines, drilling rigs, (e.g. intertidal and subtidal percussive workings), rock placement, production facilities or vessels (see below)
- Physical damage (acute) to seabed features, biota and features of archaeological interest from anchoring, pipeline construction and cable laying
- Physical damage (non-acute) from particulate smothering

- Physical presence of structures, colonisation of structures by organisms, avoidance of wind farm areas e.g. by birds, animal collisions with structures and turbine blades and barriers to movement of birds, fish and marine mammals
- Physical presence of structures, interference with other users of the sea
- Physical presence of structures, visual intrusion
- Post-decommissioning (legacy) effects
- Change to sedimentation and hydrography regime
- Energy removal downstream of wet renewable devices
- Chemical contamination (routine) from drilling and other discharges, antifouling coatings
- Chemical contamination (accidental) from spills
- Atmospheric emissions from fuel combustion, venting
- Contribution or reduction in net greenhouse gas emissions
- Electromagnetic Fields, possible effects on electrically or magnetically sensitive species from subsea power cables. In Manx waters, particular consideration should be taken of impacts on basking sharks
- Physical damage to submerged heritage/archaeology from infrastructure construction and impact on the setting of coastal historical sites
- Visual impacts and seascape effects including change to character

What impacts can seismic surveys have on marine mammals?

Unlike humans and other terrestrial animals, marine mammals rely on sound instead of sight as their primary sense. Dolphins, whales and seals use their sense of hearing to locate prey, avoid predators, choose migration routes, and to communicate across long distances. The noise associated with seismic surveys can affect the ability of these animals to detect natural underwater sounds, thereby disrupting these critical activities. For further information on marine mammals and impacts please refer to MMEA Chapter 3.4a (Marine Mammals - Seals) and MMEA Chapter 3.4b (Marine Mammals - Cetaceans).

What impacts can seismic surveys have on fish?

The powerful sound waves generated by seismic surveys can have a variety of harmful effects on fish particularly if at close range (adult fish as well as larvae and fish eggs). Scientific studies have also shown that air gun blasts can cause a variety of sub lethal impacts on fish such as damaging orientation systems and reducing their ability to find food. Researchers have noted disturbances in the migration routes of salmon and other anadromous species as a result of seismic operations.

Seismic surveys can cause physical damage to fish ears and other tissues and organs such as swim bladders. Although such effects may not kill fish immediately, they may lead to reduced fitness, which increases their susceptibility to predation and decreases their ability to carry out important life processes. Furthermore, if important prey species in the food web such as squid and zooplankton are harmed by seismic testing, the fish dependent on these creatures may also be negatively affected. See MMEA Chapter 4.1 (Commercial Fisheries and Sea Angling) and MMEA Chapter 3.5 (Basking Shark).

What impacts can surveys have on commercial fishing and shipping
All industry activities in Manx waters can potentially interfere with fishing operations and shipping routes. Please also refer to MMEA Chapter 6.2 (Shipping and Navigation).

The effect that one potential development could have on another - threats (potential conflicts) and opportunities (dual-location).

- Clean coal could result in seabed settling and hence would not be suitable for co-location with surface developments e.g. offshore wind, tidal, hydrocarbon platforms.
- Infrastructure developments including cables, pipelines, wind farms would not be suitable for co-location with fishing activities due to possible physical damage from dredging.
- Infrastructure developments such as wind turbines and platforms are possible nursery areas for fish due to restrictions on fishing.

Cumulative effects
An environmental impact assessment for one development will need to assess combined and cumulative impacts from other developments in place or underway.

Consent for Marine Infrastructure Development

The Marine Infrastructure Management Act 2016 provides a single application and consenting regime for a number of controlled marine activities including offshore energy projects. Currently secondary legislation is being drafted. Until all the required secondary legislation is in place, the extant legislation will continue to apply.

https://www.gov.im/about-the-government/departments/infrastructure/harbours-information/territorial-seas/primary-marine-legislation/

Initial Considerations for Future Marine Development

Please note: This list is not comprehensive. Projects should be assessed on a case by case basis and specialist advice sort from the relevant Departments and local organisations.

Best Practice and Standards
As best practice, recommendations may be made that guidelines from appropriate responsible authorities elsewhere with experience of the relevant industries are applied in liaison with the Isle of Man's Department of Environment, Food and Agriculture and Manx National Heritage who have responsibility for biodiversity and natural heritage.

For example:

JNCC: guidelines for offshore industry including: http://jncc.defra.gov.uk/page-4273.

Stakeholder Liaison

Early involvement with local non-governmental organisations together with existing industry including shipping, fishing and marine tourism in Manx waters would also be best practice.

Confidence and knowledge gaps

This is the first time such marine information has been compiled for Manx waters and further resources may be identified during and following the consultation phase on the first working documents.

Many research projects are ongoing and information will become outdated as new research becomes available.

It is therefore important that developers contact the relevant Government Departments and Manx research organisations to ensure they have the most up to date information.

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