Adapting to Climate Change
II.

Milford Haven Port Authority
Second Report to the Secretary of State.

Milford Haven Port Authority

June 2015

Adapting to Climate Change

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1. Introduction

Under the Climate Change Act 2008, section 63(5), the Defra Secretary of State has powers to direct certain Reporting Authorities to report on the anticipated impacts of climate change, and on their proposals for adaptation and embedding into their strategic business planning.

In England and Wales, Harbour Authorities with a throughput of more than 10 million tonnes of commercial cargo annually are required to report. Twelve Harbour authorities were included on the list of priority reporting authorities in the first reporting round (2009-2011).

Milford Haven Port Authority received the Climate Change Adaptation Reporting Direction from the Secretary of State's Authority on 10th March 2010. The report was be prepared and submitted in March 2011.

In summary, In order to establish how climate change could affect MHPA's functions, activities and interests, MHPA ran a facilitated workshop for key port personnel. This workshop used the projections of the UK Climate Projections 09 (UKCP09) for the 2080s under the medium emissions scenario as a starting point.

Based on these projections, workshop participants used expert judgement to identify the potential risks associated with a number of relevant climate change parameters, and to indicate their likelihood and consequence for the Authority's functions and activities.

The highest priority climate-related risks identified (i.e. those with potentially significant consequences and requiring some kind of action within ten years) are associated with:

- increased flood risk around Milford Docks, Milford Ship Repairers and Quayside at Port of Pembroke; increased freshwater flow causing back-up flooding around the Fishermen's' Compound area and Cedar Court;
- any increase in the frequency of high winds leading to more frequent disruption to the boarding or landing of pilots or to escort tug connections at sea, with potentially significant implications for port operations; and
- extreme events resulting in other forms of disruption to business continuity with potentially significant financial and/or safety implications.

In most cases, however, the risks identified are long term i.e. they are not likely to become significant for many years, typically decades. Nonetheless, if the Authority is to make informed decisions about timely and cost-effective adaptation responses, preparatory actions will be needed. Amongst the actions thus identified are the following:

- installation of a water level monitor at Hubberston Pill
- installation of a new beacon and notification of an increased flood risk at Hakin Jetty
- requirement for those applying for a marine works licence and capital dredging licences to demonstrate that their proposals are climate-proof; and
- increased attention to the ongoing monitoring and review of data on sea levels, high wind frequency, sea state, etc. to enable early identification of the need for changes in working practices or any further adaptation measures.

The second reporting cycle has been conducted on a voluntary basis and the Port of Milford Haven agreed that a summary report on progress in meeting the commitments described in March 2011 would be submitted in 2015. This report provides a summary of what has been achieved to date.

2. Proposed actions from the 2011 report

2.1 Adaptation actions for high priority risks

The highest priority climate-related risks are those associated with:

- increased flooding
- any increase in the frequency of high winds, and
- business continuity issues associated with extreme events.

Most such risks thus highlighted are, however, long term i.e. they are not likely to become significant for many years, typically decades. The actions identified as being useful within the next ten years are therefore preparatory in nature. In particular, data collection and monitoring actions are required to ensure that future decisions (e.g. on when adaptation responses are required, the level of threat faced and the most appropriate response option) are well-informed.

Box 2.1 MHPA Meteorological Stations

MHPA maintains Meteorological Stations located at five sites distributed along the length of the Waterway at Lawrenny, Port of Pembroke Ferry Terminal, and Milford Docks. A tide gauge is located at the Port Authority Jetty adjacent to a Proudman tide gauge and there is fourth Met Station installed on the Mid-Channel Rocks beacon in the entrance to the Milford Haven Waterway. A fifth Met. Station has been installed at the Liddeston Ridge photovoltaic solar park.

Continuous monitoring and recording of the Rainfall, Solar radiation, Wind strength and direction, Air temperature, Humidity, Sea Level (including wave height and swell) occurs.

This information is publically available through the MHPA website as a summary graphic display and monthly summary data. Internally the meteorological information is used operationally for vessel management and shipping movement programming purposes.

As a consequence of the Climate Change Adaptation Reporting and the outcome of the internal risk assessment workshop a requirement has been identified for the collation of meteorological data and monitoring of trends, particularly those emerging as a consequence of climate change. ie., the risk of :

- increased flooding
- increase in the frequency of high winds, and
- business continuity issues associated with extreme events.

Further refinement of the data processing and presentation software will be a required to generate summary information that is suitable for the longer-term tracking and identification of trends. The meteorological trends, plus the information distilled from the Marine Operations Imap database concerning weather related shipping delays, will provide early warning for operational limitations, flood risk management and stakeholder notifications.

In this regard, it is of note that much of the monitoring required to inform such decisions already takes place or can easily be modified or supplemented to provide the required information. Boxes 2.1 and 2.2 discuss some of the ongoing monitoring activity already undertaken by the Authority and explain its relevance to the climate change risks.

Box 2.2 Ongoing hydrographic monitoring

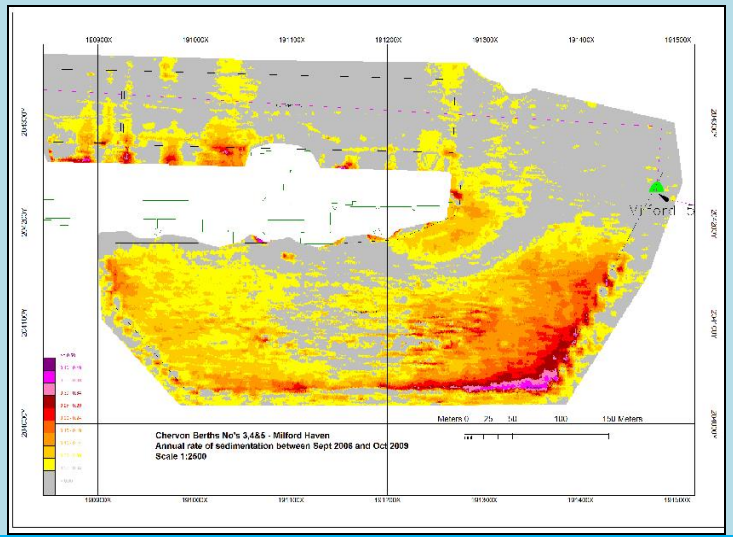
The necessity for maintenance dredging at locations throughout the Waterway is determined by sedimentation rates. There is suggestion that climate change related variations in seasonal precipitation could significantly increase seasonal freshwater input with attendant suspended sediment loading of the water column. This, in combination with increased sediment loading and transportation resulting from increased frequency and severity of storm events, calls for accurate information on the rate of sedimentation in key areas as an important component of the Maintenance Dredging Strategy for the Port. It is also possible that changes may occur over time in the pattern of accretion and erosion due to changes in the overall hydrodynamic environment as a result of climate change. Hydrographic surveys of the Haven will provide information on any changes that take place.

MHPA have carried out bathymetric surveys of Milford Haven at regular intervals since 1970. The method of survey has recently been upgraded in the main navigational areas from single beam survey to multibeam survey, enabling near total seabed isonification. This improvement in seabed coverage has greatly improved the quantity and quality of information available for assessing sedimentation rates within the Haven.

Surveys of the whole Haven, from St Ann's Head to the Cleddau Bridge, are carried out every 4-5years. Since 2009 MHPA have also started a program to survey all of the main sedimentation areas annually. The purpose being to provide regular information on sedimentation rates within the areas that require maintenance dredging, such as the berth boxes and the navigation channels. This will enable more accurate predictions to be carried out with regard to available water depth and expected dredging requirements.

The detailed analysis of the bathymetric information obtained from the regular surveys will enable any progressive changes in sedimentation rates with key areas to be monitored over time. Should the sedimentation rate increase or decrease as a result of climate change the pattern be evident and can be accommodated within the dredging strategy framework.

The following figure is an example of the analysis of annual sediment accretion rates in the vicinity of one of the terminals that will inform the maintenance dredging strategy and forward planning for maintenance dredging programming.



In addition to ongoing monitoring activities, it is proposed to install a new automatic water level sensor in the Hubberston Pill. this can be considered to be a 'no regrets' adaptation measure insofar as it will enable the Authority to deal more effectively with an existing problem, thus reducing the likelihood of a significant incident irrespective of the rate of change under a scenario of increased winter rainfall and more frequent extreme events. This measure is discussed further in Box 2.3 below.

Box 2.3 Installation of an automatic water level monitor in Hubberston Pill

Located to the north of Milford Docks, and flowing through a culvert into Milford Docks, Hubberston Pill is a lake extending to an area of over 2 acres of varying depths of water. It lies in a valley and is filled from a large catchment area along its length.

There have been occasions in the past when the culvert has blocked and the water level has risen to the point of flooding the village of Priory at the head of the Pill.

There is currently no warning system for the rising water level and hence for the risk of flooding. This risk will increase in the future with the predicted Climate Change related increases in extreme weather events and higher winter rainfall.

It is proposed to install a water level monitor which will supply live information and will also be able to relate the level to the weather conditions, particularly rainfall.
The monitor will also include an alarm which will trigger messages on mobile phones of various operational personnel in order that action can be taken prior to flooding occurring.

The benefits will be the ability to provide an advanced warning of flooding, improved management, reduced flooding incidents and fewer complaints from residents.

Another area of increased flood risk identified (associated with sea level rise rather than increased winter rainfall) is in the area around Milford Docks – in particular, Hakin Jetty may be submerged more frequently and problems might also be anticipated at Mackerel Quay and the Fisherman's Pontoon. Whilst the continuation of existing monitoring will enable the Authority to monitor flood frequency and raise awareness of any problems, future adaptation measures could include the installation of a beacon at the end of the jetty to prevent vessels hitting the structure when it becomes submerged on future high spring tides; the issue of warnings to ensure that the jetty is not used for storage; and possible changes to working procedures/ensuring users are aware of any increased risk.

Other potentially significant implications for the Port are associated with any increase in frequency, strength and/or intensity of high winds. Given the nature of vessels into Milford Haven – particularly the high windage LNG gas carriers – this possible aspect of climate change has the potential to cause problems. However, it is recognised that the UKCP09 projections of wind events are described as being extremely uncertain. Whilst there could be a future need to change pilots' working practices, berthing procedures, etc., the focus in the short to medium term will be on continuing the collection of data so as to ensure that well-informed decisions can be made if and when action is required.

The direct and indirect implications for the Port Authority of any increase in the frequency of extreme events (snow, ice, heat, storm, etc.) are also recognised as being potentially significant in terms of their potential to cause business disruption or physical damage.

However, the existing Port Risk Register and Contingency Plans already make provision to deal adequately with such risks.

Finally, related in part to the high priority risks insofar as reducing flood risk is concerned, another preparatory action identified as being necessary concerns awareness-raising of potential climate change adaptation requirements amongst the Authority's various third party stakeholders, notably those applying to the Authority for a Marine Works Licence or Capital dredging Licence. In order to promote such consideration, the Authority intends to add a section to its **Marine Works Licence** application form. This new item will require applicants to demonstrate that any measures necessary to 'future-proof' their proposed activity or development with respect to climate change risk have been considered and incorporated.

2.2 Implementation of adaptation actions

Most of the actions identified as being required in the short-term relate to monitoring and trend analysis. The measures required to meet these objectives are described in the following table.

	Adaptation Action	Departmental responsibility	Cost	Implementation
1	Hubberston Pill water level sensor	Engineering - Infrastructure Environmental – data / monitoring	£5-7.5k.	Within 3 years
2	Hakin Jetty – Beacon and Notification of Flood Risk	Engineering - Infrastructure Marine Ops - notifications	£5k	Within 2 years
3	Marine Works Licence	Marine Operations Harbourmaster	nominal	Within 1 year
4	Sea level Monitoring Annex 1 Table CC Effects 5-10	IT and Engineering – Infrastructure Environmental – data / monitoring IT – database software development	£2.5k	Within 1 year
5	Extreme Events, High Winds, Sea State. Annex 1 Table CC Effects 16-17	Marine Ops – Imaps Database reports Environmental –Data Collation and Monitoring of trends.	£2k	Within 1 year

2.3 Opportunities presented or enhanced by Climate Change:

The 2011 ARP report not only lists the significance of risk presented by climate change, but also indicates where potential positive benefit could emerge, viz:-

Climate Change Effect 9 - rising sea level, could have beneficial advantage in reducing the port dredging requirement.

CCE.17 - increasing wind speed and frequency of high wind presents the opportunity to further investigate wind powered renewable energy projects. There could also be positive benefits with respect to renewable energy opportunities with solar panels

and photovoltaic installations benefiting from increased solar radiation. The latter is expended upon in Box 4.5 below.

CCE.18 - reduction of days of fog has positive marine operational implications.

CCE.19 - increasing air temperature and sunshine could lead to increased tourism and recreational use of the waterway leading to pressure on infrastructure and possible water use management and capacity issues. The positive benefit if managed sensitively could benefit the MHPA Milford Marina operations. Similar to above there could be positive benefits with respect to renewable energy opportunities with solar panels and photovoltaic installations benefiting from increased solar radiation. The latter is expended upon in Box 2.4 below.

Box 2.4 Photo Voltaic renewable energy business opportunities and initiatives.

The combination of our geographical location of South West Wales, the present subsidies in the form of Feed-In Tariffs presented by the political climate and the Government encouragement for installation of renewable energy power generation schemes, plus the climate change influence of increasing solar radiation all present opportunities for solar power renewable energy schemes.

Two initiatives, both still in their early stages, are being progressed by MHPA.

1. Installation of PV panels on appropriately orientated roofs within the MHPA estate, particularly on buildings within Pembroke Port and Milford Docks.

2. The installation PV panels on the roofs of suitable Community Halls and Schools within the South Pembrokeshire area. MHPA is investigating the financial options and practicability of leading such a scheme. This project has the additional benefit, in that it aligns with the MHPA Trust Port remit of local community and local economic interaction and benefit.

3. Achievements to Date, (June 2015).

3.1	**Hubberston Pill and Goose Pill water level sensors**

Flood Risk – Automatic monitoring of water levels in Hubberston and Goose Pills.

2014 saw the completion of the installation of an automated system to monitor water levels within the two Pills in order to provide an early indication of flood risk. The telemetry system, data storage and internal monitoring procedures were completed mid 2014. The system will allow for flood risk email notifications to be sent out both internally and externally as required once we are happy with the data feed accuracy. Sampling of this data is carried out at one minute intervals with download of data from each logger at twenty minute intervals. The systems are completely self-sustained and powered by solar panels with small batteries to keep them operating during hours of darkness. Information from these two systems is currently displayed graphically for internal use, although over time it is anticipated this information could be provided externally also.

The results from the water level monitoring to date show two effects:

1. An out of phase relationship of the water level in the Pill when compared with tide levels
2. A more sudden and larger change of water levels with a relationship to rainfall events

It should be noted that a water level sensor has been installed in Goose Pill and is yielding similar results.

The relationship of the water level with the tide has led to further investigations which are ongoing. This is aimed at determining whether the observed phenomenon is related to groundwater flow or backflow along the culvert but which ever is the case the effect is small compared to the fluvial flow from inland. In this case we are investigating whether there have been changes in the upstream characteristics such as the effect of a local housing development or the partial removal of dams related to a local refinery. These investigations are ongoing.

3.2	**Hakin Jetty – Beacon and Notification of Flood Risk**

Public warning notices of risk of flooding during periods of extreme high water spring tides were installed in late 2012 on the approach to the stem of the jetty and at the top of the seaward landing steps.

3.3	**Marine Works Licence**

Completed 2011. An additional paragraph relating to provision for any climate change related mitigation has been inserted in the Marine Works Licence Application Pack.

3.4	**Meteorological Data Analysis and Monitoring**

3.4.1 Meteorological stations.

In 2014 meteorological data recording capability was enhanced with the installation of a weather station at the Liddeston Ridge Solar Array, and the completion of the installation of monitoring equipment on Mid Channel Rock's Beacon. The latter weather station, in the extremely exposed location at the entrance the Port, has (amongst other sensors) a Vega water level sensor installed at the top of the structure. This downward firing radar sensor provides information to the datalogger four times per second. The information is run through several calculation routines to provide water level, average wave height (over a fifteen minute period), peak wave height, and wave period.

With a recent upgrade of the datalogger early in 2015, the Port now has sufficient confidence in this system that notice was given to the Met Office early in June 2015 to cease the information feed from the ODAS buoy at Turbot Bank (62303) at the end of the current contract. The Met Office anticipates that this service will be removed from station shortly after the contract ends, most likely during the Autumn of 2015.

In total there are now 5 weather stations distributed across the Milford Haven Waterway. The prime purpose is to inform port operational requirements such as live

information on wind speed, direction, tidal height etc. In addition, live weather information is presented on the Port website and is regularly used to inform local leisure activity.

3.4.2 Analysis of MHPA Meteorological Data.

The Port has been recording a wide range of meteorological parameters at is met. stations for several years. The primary use of this live data is to inform day to day operational activities, particularly shipping movements within the port. In addition, a summary of live information is provided on the Port's web pages to inform leisure and recreational boating activities within, and in the vicinity of, the Port.
The historical data set amounts to a significant quantity of data and it was felt that an attempt at investigating these data to identify any trends which may be of value for the longer term identification and monitoring of climate related change.
Consequently a collaborative research project was initiated between the Port and Bangor University under the SEACAMS initiative, one of the projects within the European Convergence Programme.

Project Name: Determination of appropriate methodologies and protocols for the collection and analysis of meteorological data in Milford Haven with respect to the development of climate change mitigation strategies

Aim: To determine best practice methodologies and protocols in utilising and analysing long-term data sets in order to better understand medium-long term and seasonal trends in meteorological conditions and sea-state and potential impacts of specific conditions at various locations within and adjacent to the Haven. This would facilitate the development and implementation of a mechanism designed to identify and monitor, potential impacts of climate change in Milford Haven Port.

Objectives:

- Milford Port to provide SEACAMS research staff in Bangor University with access (via an SQL login) to its meteorological data set.
- Examine the data and conduct desk based literature review and research to ascertain how best over the medium-long term these data can be best collected, analysed and presented by Milford Port.
- Utilise the findings to identify and/or facilitate the development and implementation of mechanisms/protocols designed to identify and monitor, potential impacts of climate change in Milford Haven Port.

This project is due to be completed and reported at the end of June 2015.

3.5	Extreme Events, High Winds, Sea State. (Risk)

3.5.1 Climate Change monitoring

Risk presented by climate change has been included within the environmental section of the Port's Corporate Risk Register where currently the risk presented by sea level rise has a low risk level. The process of conducting the Climate Change Adaptation Reporting risk assessment and reporting to Defra in 2011 has further informed the Climate Change Risk section of the Risk Register.

3.5.2 Extreme Weather Events

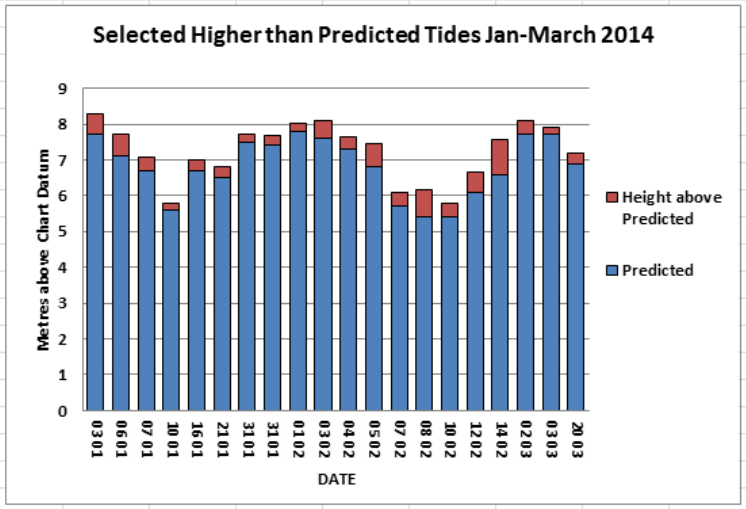
During early 2014 the Port, along with other south-western UK and western Wales coastal communities, experienced extensive periods of high rainfall and extreme weather, particularly low pressure systems generating a succession of gales and storms.

There were several incidents of the combination of low atmospheric pressure and south-westerly winds which generated tidal surges, some of which were significantly above predicted tidal heights:

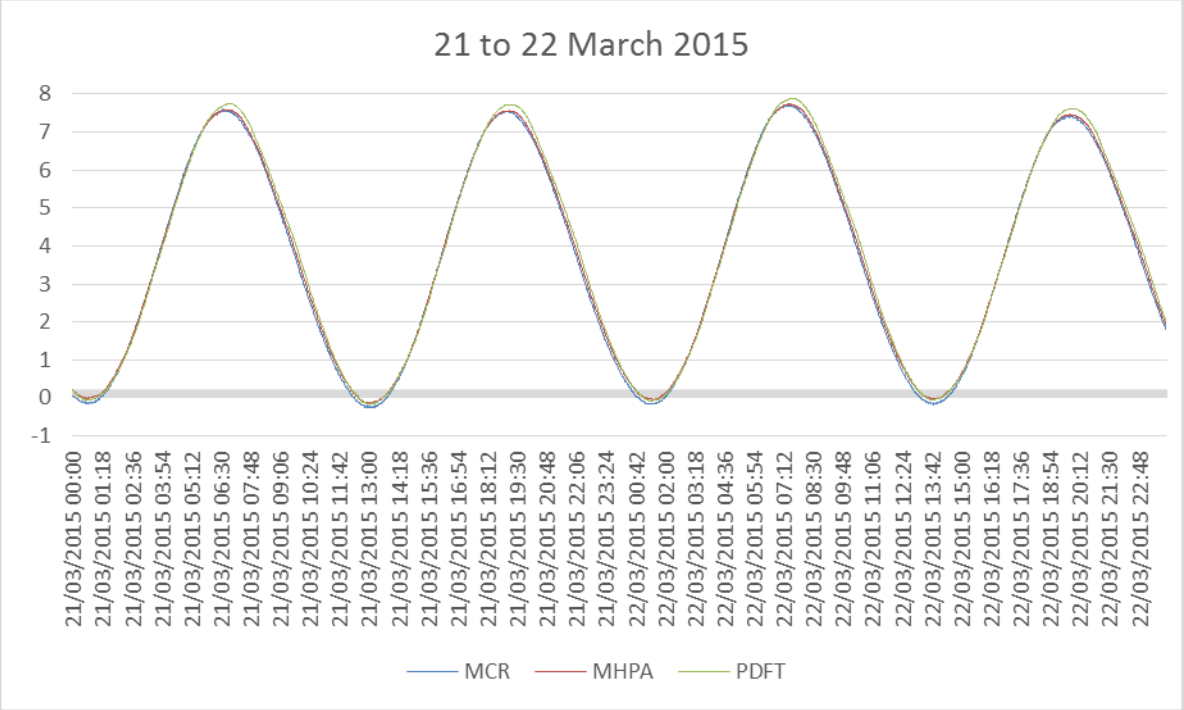
- Several incidents of Highwater Spring Tides exceeding +8.0m above CD, which have never previously been recorded within the Port, the highest of 8.27 above CD (7.7m predicted) on 3rd January 2014 leading to extensive local flooding.
- Wednesday 12th February 2014 - a predicted HW of 6.1m (actual 6.65m) combined with an extreme south westerly storm. Gusts of 93.6mph were recorded on the Cleddau Bridge and 65kts (74.9mph) at the Pembroke Dock weather station (which is located in a more sheltered location than the bridge).
- Friday 14th February 2014 - the actual height above CD was recorded as 7.58 compared to the predicted 6.6. This is the highest variance ever recorded in the Port. Fortunately this did not occur on a spring tide and no overtopping or flooding was reported, although the falling barometric pressure reached 961mb, the lowest recorded by the Port to date.

There were numerous incidents of coastal erosion and flooding in western coastal areas, including erosion of the seawall at Milford Haven's Smokehouse Quay and at Warehouse Jetty seawall adjacent to Pembroke Port, (see illustration).

DATE	Bar Press	Actual HW above CD	Predicted HW above CD	Difference
03 01	984.3	8.27	7.7	0.57
06 01	985.2	7.71	7.1	0.61
07 01	993.2	7.06	6.7	0.36
10 01	1009	5.78	5.6	0.18
16 01	984	7	6.7	0.30
21 01	999	6.81	6.5	0.31
31 01	979	7.7	7.5	0.20
31 01	979.5	7.69	7.4	0.29
01 02	983	8.02	7.8	0.22
03 02	992	8.1	7.6	0.50
04 02	970.2	7.63	7.3	0.33
05 02	961.9	7.47	6.8	0.67
07 02	972	6.09	5.7	0.39
08 02	965	6.16	5.4	0.76
10 02	982.8	5.78	5.4	0.38
12 02	974.9	6.65	6.1	0.55
14 02	963	7.58	6.6	0.98
02 03	991	8.08	7.7	0.38
03 03	976.3	7.9	7.7	0.20
20 03	1006	7.18	6.9	0.28



Selected tidal records, January - March 2014, Pembroke Dock Ferry terminal

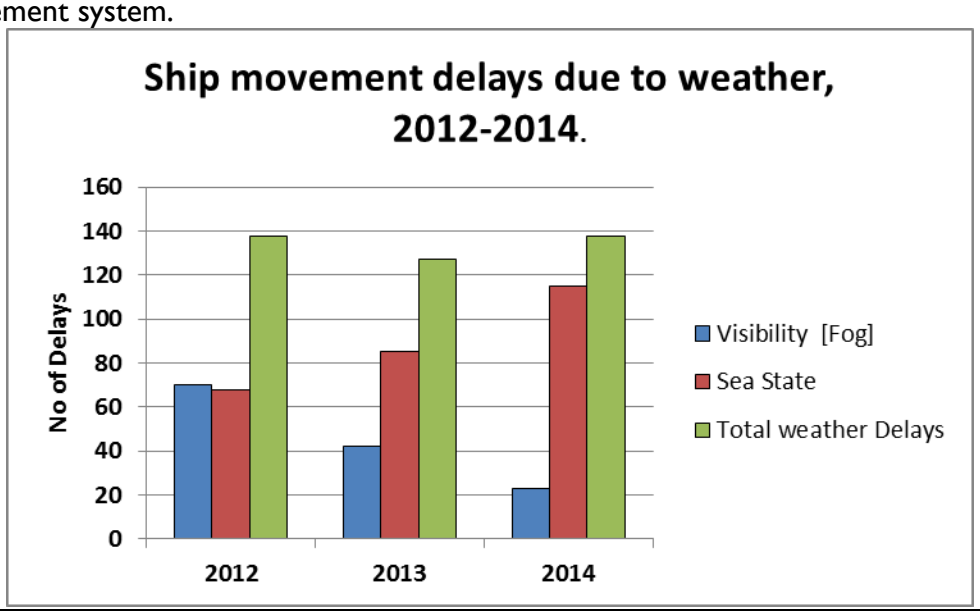


Water level records from the Port's Met Stations at Mid Channel Rock, Port Authority Jetty and Pembroke Dock Ferry Terminal over the week-end of exceptional tides 21st-22nd March 2015.

During early 2015 in contrast the opposite tidal extreme occurred – the lowest astronomical tide ever was recorded on the Port's tide and weather stations. On Saturday 21st March 2015 the tidal gauges at Mid Channel Rock and at the Port Authority Jetty recorded an extreme low water level of between 20cm to 25cm below Chart Datum. This was due to calm conditions and a high barometric pressure of 1028mbars. The opportunity to observe the partial eclipse of the sun also occurred, due to the particular celestial alignments, the previous day.

3.5.3 Delays to shipping and pilotage due to sea state or poor visibility

The climate change prediction of increased frequency of extreme weather events also has implications for the efficiency of marine operations within the Port. The monitoring of delays to shipping movements was felt to be an effective mechanism for tracking and identifying any trends linked to this aspect of climate change. The number of delays due to excessive sea state preventing pilot access to vessels entering the Port, or delays to shipping movements due to poor visibility (fog), are monitored through the marine data management system.



The above data show an increasing number of delays, year-on-year due to the sea state preventing pilot transfers, and the opposite in delays due to poor visibility (fog). The three year data set is too short a period to place any confidence in the emergence of a clear trend. Any influence attributable to climate change is likely to be of a small incremental nature detectable on a decadal rather than immediate time scale, but the continual monitoring of these delays will provide evidential data should this become an operational issue.

3.6	**Business opportunities and initiatives.**

3.6.1 Renewable Energy – Photvoltaics

The Port continues to invest in renewable energy projects. The Liddeston Ridge 5MW terrestrial photo voltaic array was successfully switched on and operating at fully capacity from April 2014 Further progress within solar, wind, wave & tidal sectors is a focus as the port pursues its diversification strategy.

Power generated by the roof-mounted photo voltaic arrays across the Port's property, together with that generated by Liddeston Ridge array, totalled 5,185.82 MWhr compared to 598.37 MWhr in 2013. In terms of emissions equivalent offset, this represents 342.52% of total emissions due to electricity consumption, and the equivalent saving of 102.27% equivalent of total greenhouse gas emissions from all of our operations. Further detail is included in the following section.

3.6.2 Carbon Footprint Calculations

2014, the year that the Port can declare '*We are Carbon Neutral*'

As in previous years, the consumption of utilities is carefully monitored and the equivalent CO_2 emissions, using Defra July 2014 conversion factors, is calculated. Emissions generated by the consumption of the following utilities have been used to calculate the total emissions generated, which amount to 2,506.24 tonnes CO_2 equivalents.

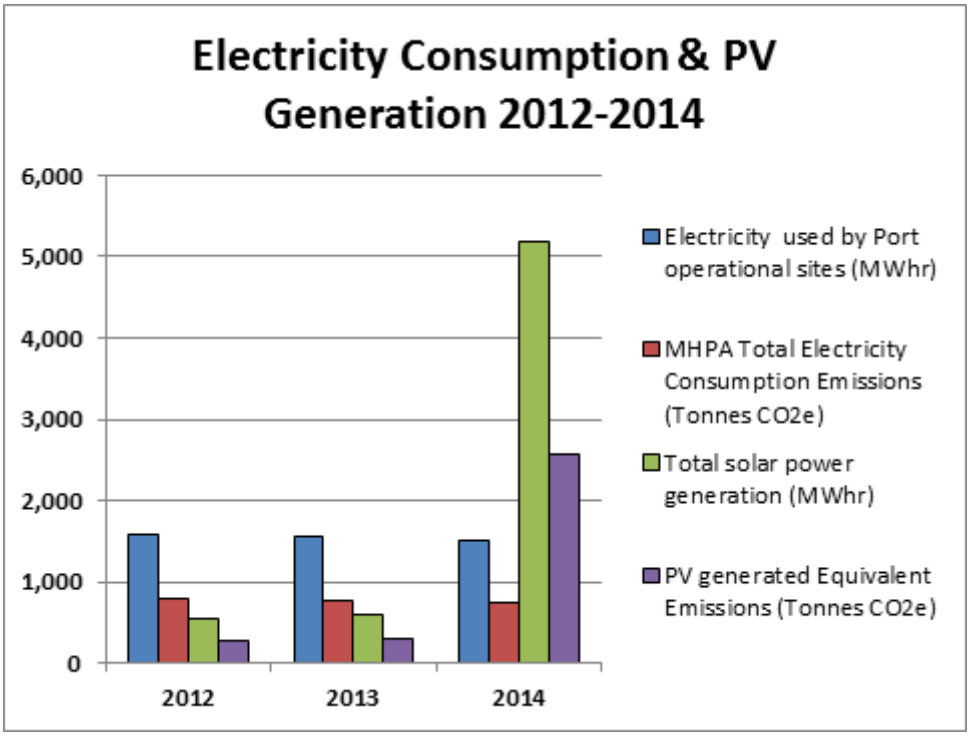
- **Electricity indirect emissions**
- **Gas emissions**
- **Marine craft emissions**
- **Water Ranger emissions**
- **Red diesel Pembroke Port plant emissions**
- **White diesel Pembroke Port road plant emissions**

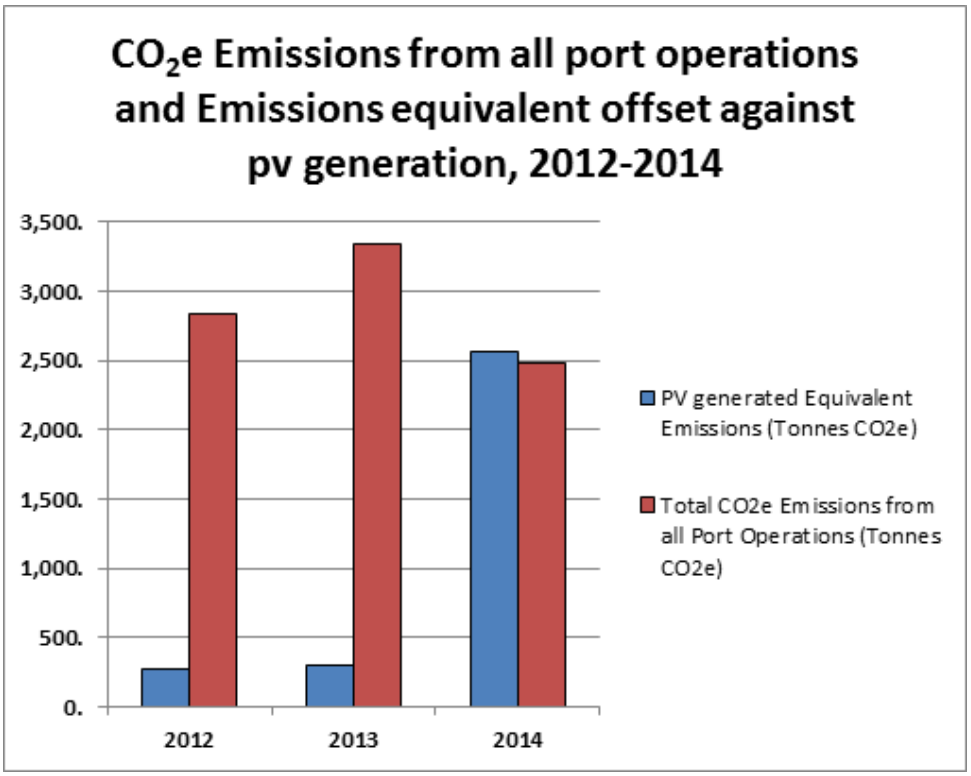
- **Milford Fish Docks emissions**
- **Milford Marina red diesel emissions**
- **Heating fuel emissions**
- **Company car emissions**
- **Private car usage for company business emissions.**

In 2014 carbon emission savings, as a result of investment in solar power, were greater than emissions generated by the Port's own operations. It is important to note that these figures reflect all the operational activities of the business and do not include the independent third party operators and tenants within the boundaries of the port.

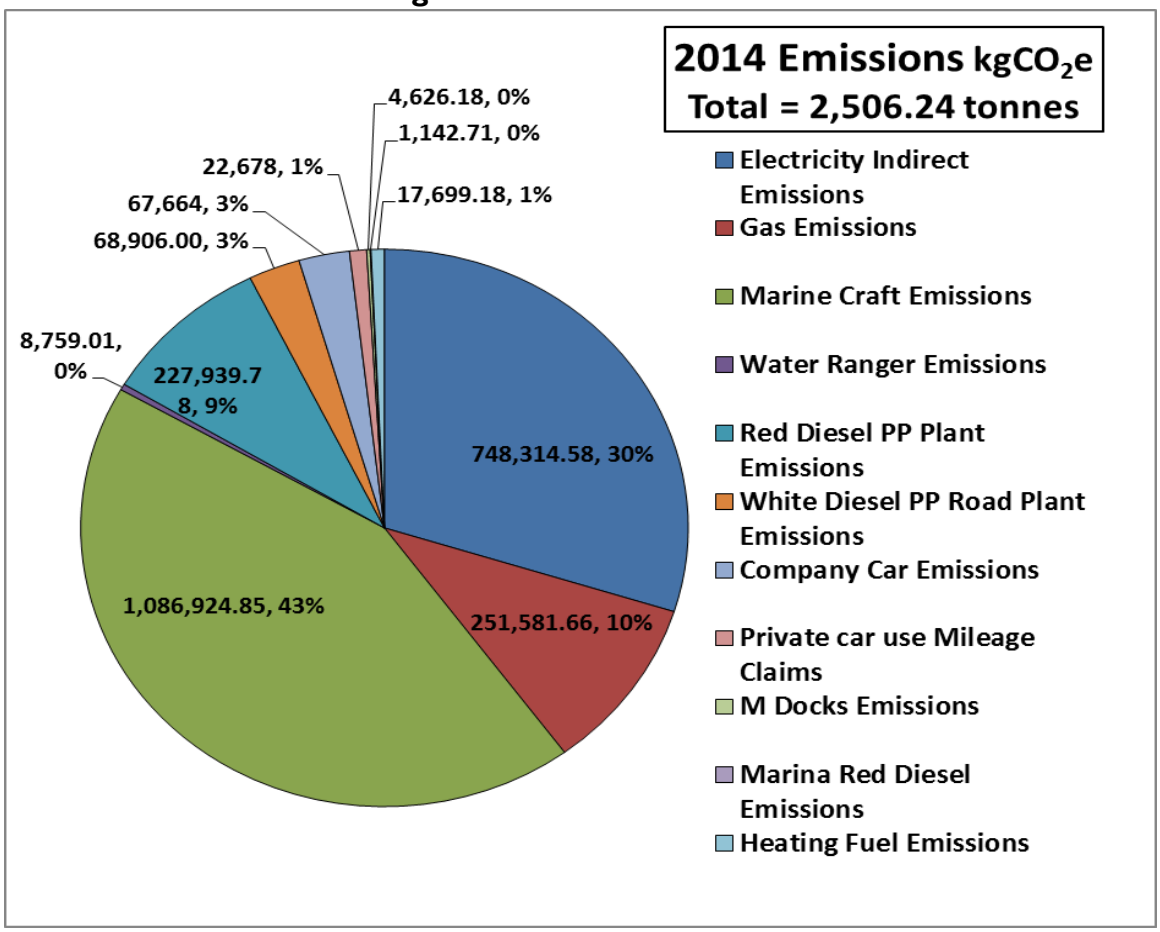
	Electricity used by Port operational sites (MWhr)	MHPA Total Electricity Consumption Emissions (Tonnes CO_2e)	Total solar power generation (MWhr)	PV generated Equivalent Emissions (Tonnes CO_2e)	% PV emissions equivalent offset for electricity consumption.	Total CO_2e Emissions from all Port Operations (Tonnes CO_2e)	% PV emissions equivalent offset for all port operations
2012	1,588.54	785.15	541.77	267.71	34.10	2,834.18	9.45
2013	1,564.18	773.11	598.37	295.72	38.25	3,332.93	8.87
2014	1,514.01	748.31	5,185.82	2,563.14	342.52	2,506.24	102.27
Note	Conversion factor of **0.49426** for kWh to $kgCO_2e$ per unit.						

The following histograms show the contribution that photovoltaic generated electricity has made over the last three years. The Port has generated almost three and a half times as much electrical power than it consumed in 2014 (342.52%). The step-change in productivity has occurred since the Liddeston Ridge array came on stream in April 2014.

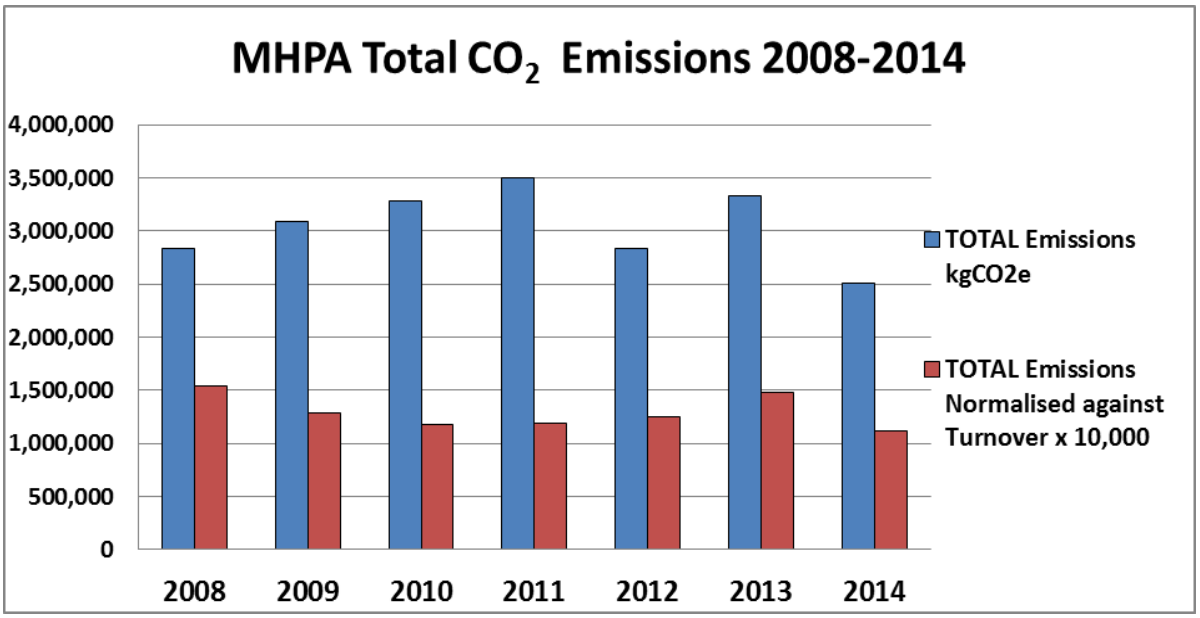




Greenhouse gas emissions in 2014 are shown below:



Electricity consumption accounts for 30% of all (indirect) emissions, but the largest contributor remains the emissions from the combustion of marine gas oil from the marine craft (43%) compared to 42% last year.



Total estimated emissions for 2014 amounted to 2,506.24 equivalent tonnes of CO_2. This represents a 24.8% decrease on the previous year high of 3,332.93 equivalent tonnes of CO_2.

When normalised against the annual turnover for the business, which itself is down by 0.12%, then total emissions decreased by a 24.71%.
There has been a decrease of 22.79% in emissions from marine craft in 2014 compared to the previous year. This was directly related to a reduction of 16.85% in shipping movements reflecting the reduced hours marine craft were involved in Pilot transfers and patrols.

Over the last 5 years the emissions generated by diesel engined road plant has been relatively stable and has ranged from a high of 74.8 tonnes in 2010 to 64.4 tonnes in 2012. Senior staff car emissions have decreased year-on-year from 157.7 tonnes in 2010 to 67.6 tonnes last year. The decrease is essentially a direct result of a reduction in the number of staff with a company car. This year, for the first time, we have been able to record the emissions associated with the business use of personal vehicles.

Off-road diesel engined vehicles, which primarily consists of the Tugmasters used for the transfer of unaccompanied freight trailers on and off the Irish Ferry, and the haulage vehicles used for the transfer of bulk animal feed from the quayside to the storage warehouses within Pembroke Port, generated 227.9 tonnes of CO2 equivalents which represents a 8.54% decrease since 2013.

4. References

- Milford Haven Port Authority, 2011, Adapting to Climate Change: A Report to the Secretary of State pp.38. March 2011.
- Port of Milford Haven. Annual Business Review. 2013, 2014. http://www.mhpa.co.uk/uploads/news_downloads/PoMH_Business_Review_2013.pdf
- Port of Milford Haven. Environmental Performance Reports, 2012, 2013, 2014. http://www.mhpa.co.uk/environmental/

5. Summary

	2011 Adaptation Action	Departmental responsibility	Status
1	Hubberston Pill water level sensor	Engineering - Infrastructure Environmental – data / monitoring	**Installation Completed** **Monitoring On going**
2	Hakin Jetty – Beacon and Notification of Flood Risk	Engineering - Infrastructure - notifications	**Completed**
3	Marine Works Licence	Marine Operations Harbourmaster	**Completed**
4	Sea level Monitoring Annex 1 Table CC Effects 5-10	IT and Engineering – Infrastructure Environmental – data / monitoring IT – database software development	**SEACAMS Project Initiated** **Monitoring Ongoing**
5	Extreme Events, High Winds, Sea State. Annex 1 Table CC Effects 16-17	Deep Sea – Imaps Database reports Environmental –Data Collation and Monitoring of trends.	**Monitoring Ongoing**
6	Photo Voltaic renewable energy business opportunities and initiatives.	Engineering , Short Sea.	**PV Solar Park Operational** **Marine Renewables logistic support ongoing**

Pilot Boat *Picton* in heavy seas passing the Mid Channel Rocks Beacon and Meteorological Station at the entrance to Milford Haven, January 2015.