Call for evidence on shore power: Implementing maritime commitments in the Transport Decarbonisation Plan, response form

This response is made on behalf of the British Ports Association. The responses do not prejudice any individual responses made by our members.

Mark Simmonds
Director of Policy & External Affairs
British Ports Association

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1. Can you provide any evidence to quantify the current level of GHG and air pollutant emissions from vessels at berth in UK ports? Please disaggregate this information as much as possible (e.g. to cover different ports and vessel types and operational and idle vessels).

Modelling for the BPA by Arkevista suggest that vessels at berth in the UK used over 641GWh of energy in 2019. Removing vessels that were at berth for less than two hours, that number falls to around 500GWh. The data from this work and details of the methodology is supplied alongside this response in confidence.

Using Government fuel conversion factors for MGO, we estimate this to correspond to around **176,000 tonnes of CO_2e at berth in 2019**, accounting for around **0.03% of UK $CO2_e$ emissions** that year. Given the critical role shipping plays to the UK economy, this is a very small volume of emissions to focus on, especially as shore power would realistically only be a suitable abatement option for a portion of those emissions.

The Government's Maritime 2050 strategy forecasts port volumes to rise to around 600m tonnes in 2050, a 23% increase on 2019 volumes. In the absence of detailed modelling, if we assume that power usage at berth rises by 23% in the same period, that would be 788GWh in 2051. We would expect engine efficiencies, abatement technologies and cleaner fuels to significantly reduce the amount of potential demand by 2050.

We believe that the vast bulk of emissions from cargo vessels and ferries are at sea from main propulsion engines, although this will vary from vessel to vessel depending on a variety of factors. In the context of greenhouse gas emissions, it is important to focus investment and effort at the areas for greatest reduction and we are not convinced that at-berth emissions meet this definition. For other air pollutant emissions, the location of emissions is more important and effort should be focussed on locations close to population centres that have existing air quality issues.

Our view therefore is that whilst shore power will be a valuable tool for reducing emissions at berth for *some* ports, it is not a feasible solution for all ports (and certainly not for every terminal or berth at every port).

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2. In your opinion, which technologies and fuels can contribute to reducing vessel emissions at berth and what are their costs, benefits and level of technology readiness? Please include both on-board and land side technologies (e.g. storage) where relevant.

See table in annex.

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3. In your opinion, what impact would shore power have in reducing emissions at berth for (a) different vessel types and (b) different locations in the UK? Could shore power have any other positive or negative environmental impacts (e.g. any impacts on marine pollution)? Please quantify and disaggregate your responses as much as possible.

Our view is that shore power would have the biggest positive impact in locations where vessels:

- call regularly
- are, or may be, at berth for long durations
- are berthed close to population centres [for air pollutants]
- have high hotel loads [for greenhouse gases]

The benefits of shore power for a busy city-centre cruise terminal will therefore be stronger than for a rural terminal handling coastal bulk carriers.

The more of these requirements that are met, the stronger the case might be, although even in cases where all of these conditions apply there can be prohibitive barriers such as reluctance from port users to connect, a lack of available power and high capital costs.

Other positive environmental impacts

Shore power can also reduce noise and vibrations from ships' engines.

Other negative environmental impacts

The BPA is considering the impact of embedded emissions in infrastructure – the CO_2e and other pollutants emitted when creating the steel and concrete and other materials used during construction. For some infrastructure projects, a significant volume of the overall lifetime emissions generated from its use can is 'embedded' in the construction. This is not a major concern for shore power projects unless the installations are heavily under-utilised, as would be likely in a mandate scenario.

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4. In your opinion, what are the key (a) barriers and (b) incentives for ship owner, ship operators and ports to invest in shore power?

The BPA has examined the key barriers for ports to invest in shore power. Our report on this is submitted alongside this response. The barriers are:

High Capital Costs

The costs of installing shore power vary considerably. The capital costs can be split between portside infrastructure (such as groundwork, cabling and cable management etc), which can generally be anywhere between £300k and £10m per connection and network capacity upgrades and reinforcement which can vary between £2m and £25m for a 16MVA connection. Reported costs for shore power projects in European and US ports vary widely (€2.2m for 8MW connection in Dunkirk, 2019 and €15m for a 12.8MW connection in Kiel, 2020, for example).

The BPA infrastructure tracker shows that UK ports invested £1bn of private capital into infrastructure projects in 2021. UK ports are used to long-term investment in infrastructure but this is done on a commercial basis. A lack of a commercial business case combined with very high costs is the primary barrier cited by most UK ports.

BPA research found that no shore power project anywhere in the world has been undertaken on a commercial basis. We have tracked over 100 worldwide projects and are supplying data on 75 of them alongside this submission (the data for the remainder is not complete).

Our view is that shore power is not viable without some kind of public support to bridge the gap in business case that exists in every example we have been told of. Research for the BPA by polling company Savanta found political support for this in Parliament. We believe that as well as making shore power projects viable for some ports, this co-investment could support innovation and wider electrification and decarbonisation in ports and harbours; shore power could be an important precursor to vessel charging, for example.

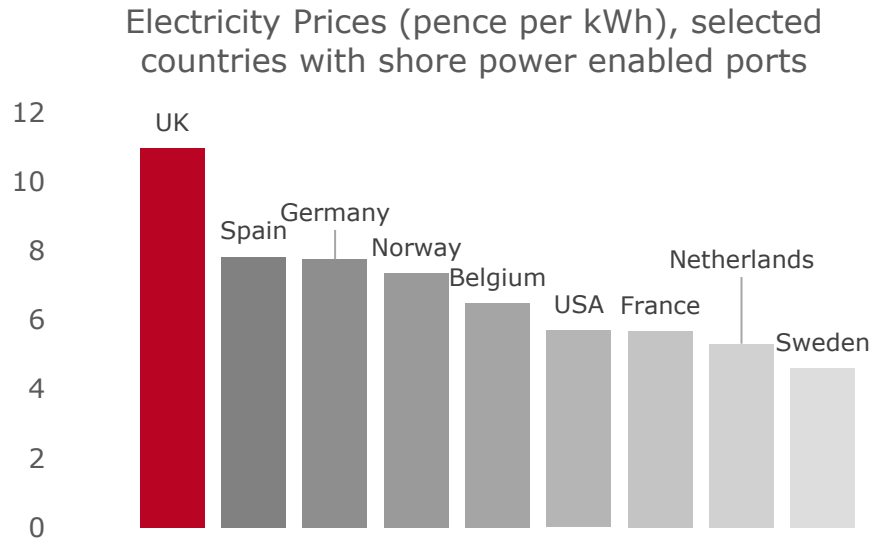
Lack of Network Capacity

BPA research found that seven of the top ten UK ports by throughput in England are power constrained – that means they are at or near the ceiling of power available to them. Given the high peak loads that shore power often demands, network upgrades are often necessary. For large connections, reinforcement is usually needed. This process can be expensive (see above) but also time consuming and complex. Energy networks are generally reluctant to undertake this kind of work on a regular basis so ports will usually need to future-proof their upgrades. Given the lack of demand or regulation, it is difficult for ports to predict when the best time to undertake this work would be, even if cost difficulties can be overcome.

The BPA supported the development of a tool for National Grid by Siemens to help ports estimate their future demand. We believe there is a need for an in-depth study by Government to understand the future power needs of ports to ensure that this is properly planned for.

High Energy Prices

Data on electricity prices for UK industrial users compared to countries with shore power at their ports (from 2020 BPA report) shows that prices are significantly higher in the UK. This is a disincentive for users to plug in and undermines the business case for shore power.



Several European countries have taken action to make electricity more competitive against the costs of marine fuel by lowering taxes on electricity used in shore power.

We strongly believe that electricity when used as shore power for vessels at berth or as a renewable marine fuel (or for the generation of such fuel) should be exempt from taxes to help improve its competitiveness.

A lack of consistent demand

Demand for shore power varies by ship type and size. Large cruise and container ships are the most likely to be shore power ready, according to figures we compiled as part of our 2020 shore power report. Whilst those segments are the 'most ready', demand is still relatively low: only 15% of container ships were shore power ready in 2020 according to our best estimates, although this was skewed towards larger vessels. Data from Clarksons in 2020 showed that only 1.5% of vessels on the orderbook will have shore connections.

The primary issue with a lack of demand for shore power is the missed revenue opportunities from selling power to vessels. This would be the only method of recovering costs for shore power installations for ports and terminals. Therefore a lack of consistent usage of available shore power would mean that the port or terminal is unable to recover the capital costs. In addition to this risk, there are a number of fixed costs associated with shore connections, regardless of whether or not they are used.

Therefore, any Government that wants to see shore power play a significant role in emissions reduction – as seems reasonable for certain sectors at least – must make tackling the lack of demand a central pillar in any policy considerations. Tackling lack of demand might focus on certain sectors but must not do so in a way that confers a competitive advantage on any particular one of them.

5. Can you provide estimates of the costs and benefits for any current or future shore power projects in the UK, including emission savings, costs of infrastructure at ports and costs of any upgrades to existing network connections and any reinforcements required to the electricity network? If possible, please provide estimates of cost recovery periods for these projects and estimates of the associated increases in electricity demand?

Below are broad BPA estimates made as part of our research in 2020. We have also attached our global shore power knowledge bank to this submission which details all of the costs we know of associated with 75 shore power projects.

BPA estimates of costs of shore power project elements

Project Element	Estimated Cost Ranges
Feasibility Studies; Surveys, Pre-Project work etc.	£5k to £70k
Network capacity upgrades, reinforcement etc.	£2m to £25m for a 16MW connection
Off-grid generation	Up to £6m
Infrastructure inside port or terminal, including groundwork etc.	£0.3m to £10m
Retrofitting vessels	Up to £1m

Off-Grid Generation

BPA Cost Estimates of Terrestrial Wind Turbine Project

Maximum Power Output	Project Cost
Single 100kW turbine	£345k
Single 1MW turbine	£1.03m
Single 3MW turbine	£1.25m
Single 3.5MW turbine	£3.13m
Note: If the turbine is connected to the grid to export energy, then there will be related costs that could significantly increase overall project costs	

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6. Can you provide estimates of the total overall costs and benefits if shore power is taken-up commercially at scale across the UK, including the overall emission savings and electricity demand? Please disaggregate these estimates across different locations, if possible?

We cannot see a scenario where shore power is taken up commercially at scale across the UK.

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7. Are you aware of any shore power installation projects underway in the UK? If so, please provide as much detail as possible?

ABP Southampton has installed two shore connections at its cruise terminals, with public support from the Solent LEP.

Orkney is installing an intermediate voltage shore power connection for the MV Hamnavoe. This was made possible thanks to public support from climate change and enterprise funds.

Fraserburgh has installed shore power for fishing vessels at several berths, utilising public grants.

We are aware of several ports that are or have been exploring the feasibility of shore power. Most we have spoken to have said that public funding would be necessary to make it worthwhile. It is well known in the ports industry that there are no shore power installations that have been undertaken without public support anywhere in the world and that is for good reason.

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8. Do you think government coordinated guidance would be a helpful tool for ports and other operators to navigate the complexity of shore power projects? If so, which topics should be included to maximise the value of such a document?

Possibly.

Ports have often reported difficulties in dealing with energy networks and the process of securing more electrical capacity. Some support or guidance in that area might be welcome.

Some signposting and support for obtaining funding for shore power could be useful in the absence of a dedicated fund.

Whilst the sheer complexity of projects can itself be a barrier, we are not convinced that guidance on the actual engineering or construction would be helpful as many of the challenges will be site or project specific.

Wider guidance on issues like standards might be helpful, but we think it likely that suppliers and consultants will be the main users of this and will likely be familiar already.

9. In your opinion, how could government's coordinating function be deployed to accelerate collaboration across the maritime sector to facilitate shore power projects? Can you please provide examples?

Government could have a role in bringing together and supporting groups of ports and port users in voluntary coalitions similar to the MOU signed by the 'Northern Range' ports on shore power or Operation Zero.

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10. In your opinion, does future revenue uncertainty represent a significant barrier to investment in infrastructure for shore power? Please explain your answer.

Yes.

As per UK Government policy, ports operate in a competitive market and are required by their enabling statutes (in the case of trust ports) or investors/owners (in the case of privatised ports) to operate their harbours in a commercial manner.

Given the high capital costs of shore power and the lack of competitiveness in price between electricity and diesel or MGO, it is difficult to generate a business case for shore power, even if every customer agreed to use it.

As infrastructure owners and operators, ports are used to making long-term investments. In some cases, ports have told us that the costs of shore power meant that they would not recoup their investment for 100 years. In other cases there is uncertainty as to whether zero-emission fuels may replace shore power as a preferred power source at berth before the investment has paid off.

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11. Can you provide examples of innovative commercial finance models that might help de-risk port investment in shore power infrastructure? Please include as much detail as possible.

From conversations we have had with European ports we understand that there are examples of 'build, own, operate and transfer' (BOOT) or 'build, own, and operate' models (or similar) in Europe where external companies have installed and operated shore power connections in a port but we are not familiar with them. Given the high cost of electricity in the UK and the general lack of consistent demand from shipping, we think it unlikely that such a model would be attractive in UK ports without Government intervention.

12. Do you have any other views on the potential of government's coordinating function in supporting the uptake of shore power?

The successful launch of Operation Zero at COP26 demonstrates that Government can bring together industry in a voluntary coalition. Given the significant barriers to the installation of shore power however, this might only go so far.

Despite the Government's reluctance so far to launch a dedicated shore power funding scheme, there are public funds available for shore power as demonstrated by Fraserburgh, Orkney and Southampton's schemes. We believe that shore power for fishing vessels may be eligible for support from the new UK Seafood Fund's £65m infrastructure scheme. Signposting and guidance from DfT on the myriad of national, sub-national and local funding schemes would be useful for many ports who are not used to looking for or applying for public funding.

We also believe there is a role for government in energy planning to ensure that ports' decarbonisation ambitions are not stymied by network capacity.

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13. In your view, what would the impacts of a mandate on vessels to use shore power while at berth be on (a) ship owners (b) ship operators (c) UK ports and (d) the wider UK economy?

The BPA identified a lack of consistent demand as a primary barrier to the provision of shore power from ports in the UK. A mandate on vessels to use shore power at berth would clearly go some way to removing this barrier and create some certainty for ports. The other barriers and challenges identified in our report, particularly the high capital costs and high cost of energy in the UK, would still be prohibitive to the widespread installation of shore power without government support.

As our report concluded, all barriers to shore power must be tackled at once.

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14. Do you think that any mandate on vessels to use shore power while at berth in the UK should be accompanied by a mandate on ports to install the related shore power infrastructure? Please explain your answer.

We support the polluter pays principle, but we recognise that ports have an important role to play in supporting shipping's emissions reduction journey. We support an equitable and fair approach to regulation.

We do not think an infrastructure mandate for ports is feasible or even technically possible in many cases. The negative impacts of a mandate on ports would be significantly greater than the impact of a mandate on shipping.

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15. In your view, what would the impacts of a mandate on port operators to install shore power infrastructure be on (a) ship owners (b) ship operators (c) UK ports, (d) energy network operators, and (e) the wider UK economy?

Impact on UK ports

Shore power is one way of reducing emissions at berth and should be viewed as a means and not an end in itself. Any kind of infrastructure mandate is unworkable and at odds with decades of UK government ports policy that supports a market-led, commercially operated industry. It would put hundreds of millions of pounds of investment at risk without relatively minor benefits.

In its broadest sense, a shore power mandate would need to cover every berth rather than every port, which typically have multiple terminals and berths. The level of berth utilisation differs widely by port and vessel type and many berths are multi-purpose, making planning shore power needs incredibly difficult. The costs of providing shore power at every berth would run into many billions of pounds and would not be technically possible for many with constrained power networks. The decarbonisation benefits to shipping would be marginal.

Many ports do not have air quality issues that justify this level of intervention. A shore power mandate could have serious consequences for wider port infrastructure investment, which in 2021 stood at over £1bn.

Ports and shipping are part of the solution, not part of the problem, when it comes to reducing GHG emissions. Shipping is by far the most efficient way to move freight and Government policy should support and encourage more freight to move by water and not damage the competitiveness of shipping.

The vast majority of pollutant air emissions from ships that are harmful to human health are at sea. It is important to tackle the relatively small amounts in coastal areas, ports and at-berth but the situation in different ports varies considerably and a blanket regulation is not the most efficient way to tackle this issue.

The business and environmental case for shore power, as well as the costs of implementing it, varies considerably from port to port. Government should recognise this and take a technology-neutral, goal-based approach to driving down emissions from ships at berth.

Impact on wider UK economy

We believe that a mandate, in its broadest sense, would add significant costs to ports and their users, increasing the cost of trading goods. These inflationary pressures would be unwelcome and are unnecessary.

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16. In your view, what would the impacts of a mandate that all vessels are "shore power capable" by design be on (a) ship owners (b) ship operators (c) UK ports and (d) the wider UK economy?

Assuming this was for all vessels built in the UK, this would have little impact for UK ports as the vast majority of vessels calling in UK ports are not built in the UK.

If the mandate was somehow achievable for all ships calling in UK ports, which we doubt realistic, this on its own would still not compel vessels to use shore connections.

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17. Do you have any other views on the potential implications of government mandates, or any other regulatory intervention, to support the take-up of shore power? Please include evidence where possible, including references to international case studies where relevant.

California

California is the only administration we are aware of to have a mandate on the use of shore power in place and has provided *at least* $300m to the state's seven ports for the infrastructure, including $180m to the Port of Long Beach. California's port volumes are around 20% of the UK's tonnage.

The California Air Resources Board (CARB) has been regulating at-berth emissions since 2007 at the ports of Los Angeles, Long Beach, Oakland, San Diego, San Francisco, and Hueneme. The 2007 regulation required fleet operators of certain types of vessels to reduce at-berth emissions from its vessels' auxiliary engines at berth by 80 percent by 2020. From 2020, 80% of a fleet's visits to a port must meet the regulatory requirements to plug in or reduce the auxiliary engine power generated by a fleet by 80% each quarter. They can use alternative control techniques to achieve these requirements. Container, cruise and reefer vessels are currently in scope if their fleets make a certain number of annual visits to a port. This is being extended in stages from 2023 to more vessel types, including tankers from 2027.

We that the California model is an interesting case study but the regulation has been designed to reflect US port policy and their unique situation. Lessons from their approach are included in our working paper attached to this response.

Innovation

We believe that public funding support for shore power is critical to making it viable in the UK, as it has proved everywhere else in the world. The UK's unusual (and successful) ports policy and setup does not alter the barriers and challenges to shore power.

Whilst shore connections are proven and demonstrated we believe that they will act as a precursor for further innovation in the electrification and decarbonisation of ports and shipping in the UK. Investment in shore power connections can drive innovation and investment in smart grids, vessel charging, and storage. Government co-investment can also help drive more innovative delivery and storage solutions.

18. Are you aware of economic instruments deployed internationally to address emissions at berth? If so, please provide details, including their cost and environmental impacts.

The BPA co-authored a working paper examining how other countries and administrations have sought to address emissions at-berth. This is appended to this submission. Some of the common themes from these approaches are summarised below.

Public funding

Research by the BPA finds that there are no shore power projects anywhere in the world that have gone ahead without an element of public funding. The BPA looked at nearly 100 shore power projects, covering every significant scheme we are aware of around the world. The EU, California and China have all provided significant funds for shore power infrastructure. Several EU member states with large ports have also removed taxes on electricity when used as a marine fuel – something the BPA has been calling for in the UK for several years given the relatively high cost of business electricity. This may soon put UK ports at a competitive disadvantage. Any public funding must be allocated fairly.

Goal-based approach

All of the emission regulations we looked at allowed vessels to take alternative approaches to achieving the same result – effectively a goal-based approach – to a greater or lesser degree. It is our strongly held view that shore power is a means not an end and, whilst it is likely to play a significant role in at-berth emissions reduction, any regulatory approach should be flexible enough to allow and encourage alternative means of reducing emissions. It should also take an equitable approach to these common goals, ensuring that costs are shared fairly.

Segment-specific approach

Each approach we looked at differentiated its rules by type and size of vessel as well. This is sensible. BPA research suggests that large container ships and large cruise ships are both more likely to be shore power ready and it tends to be ports and terminals catering to these sectors that have installed shore power connections. These vessels do however draw significant loads at berth, meaning capital costs and technical challenges are higher.

Sensible Exemptions, Timelines and De Minimis Rules

All regulatory regimes have reasonable exemptions, for example for emergencies or where shore power is not available or where a port is not connected to the grid. All approaches allow a two- or three-hour time at berth before regulations apply, which is sensible as connecting and disconnecting can take time in some instances. All three frameworks also built-in sensible lead-times: an initial 12 year “escalator” in California, nine years in the EU and grandfather rights in China.

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19. In your view, how could similar economic instruments be used in the UK to address emissions at berth? What would the impacts be on (a) ship owners (b) ship operators (c) UK ports and (d) the wider UK economy?

Our view is that the most successful approaches to reducing emissions at berth combine public funding support with a technology neutral, goal-based approach.

We note also that the most successful approaches to incentivising shore power include taking steps to support it through the tax and energy planning frameworks as well. We strongly believe that regulation for ships and ports must be equitable and should address both supply and demand, including risk bearing.

Whilst shore power is likely to play an important role in reducing emissions from ships at berth, it is not the only solution to reducing emissions and may not be the most viable option in the medium or long-term. The regulatory framework should support that and encourage innovative approaches.

Our views on how an at-berth emissions regulatory framework might work are summarised in the table below. These are supported by the UK Chamber of Shipping and the UK Major Ports Group.

BPA position on a UK at-berth emissions framework

Element	UK Industry Position
Public funding?	Critical. We are not aware of any commercial shore power projects that have been undertaken without public support, given costs, demand uncertainty and infrastructure availability. Public funding must be allocated on a competitive and transparent basis
Goal or technology based?	A goal-based approach will encourage innovation and is at the heart of any successful at-berth emission regulation to some extent
Applicability	It is important that both ships and ports are treated equitably. Government should consider the role of terminals early in the process and the burden of risk
Segments	It is best to begin with shipping segments that have characteristics and interest conducive to adopting shore power before regulating other segments, as is the case everywhere else that at-berth emissions are regulated
Sensible Exemptions	The UK should consider exemptions for some ports or circumstances such as those not connected to the grid, and not penalise ships when infrastructure is not available
Fleet-based?	Taking a “fleet”-based approach, whether by port or nationally, could stimulate innovative new approaches to reducing emissions and is worth exploring if it can be done in a way that is not overly burdensome
Protecting competitiveness	A holistic, cross-modal approach is important to avoid unintentionally increasing GHG emissions through reverse modal shift

Planning support	Given the timelines and costs associated with securing new energy capacity, Government should consider some accelerated process if shore power (and other energy-intensive emission reduction technologies) is to be required in the short term
Energy market rules	Some parts of current energy market regulation present barriers to roll out. Energy market regulation should be examined alongside the development of any at-berth regulations likely to result in a significant increase in shore power
Timeframe	There should be a sensible lead-in time for at-berth regulations, reflecting the significant costs and planning involved. A stepped approach would be appropriate and encourage innovation as ports are not forced quickly into existing solutions in a short timeframe

20. In your view, which alternative levers, including economic instruments, would support the commercial take-up of shore power in the UK? Please provide as much detail as possible, including on potential impacts.

An international carbon price or similar mechanism would create demand for shore power and alternative emissions abatement technologies and/or alternative fuels.

The lack of demand for shore power as a significant barrier to uptake in the UK. The Government has sought to encourage a move to electric vehicles through a mixture of financial incentives and regulation in the form of the planned prohibition of combustion engines from 2035. A similar two-pronged approach might support emissions reductions from shipping in ports.

We would support the development of a *limited pilot scheme* to test the viability of a goal-based regulatory approach to create or grow the demand for emissions abatement solutions, of which shore power is likely to be a significant option. A goal-based regulatory approach would essentially be a zero-emission berth standard and should meet consider the principles set out in the response to question 19. We believe such a scheme would not negate the need for public support, at the very least in the form of a fund to be recouped from polluters.

21. In your opinion, what uptake of shore power do you expect in the UK between now and 2050, in the absence of further government intervention?

We think it likely that there will be some limited take up for some segments where public funding support can be found but not necessarily in the short term and not likely to be widespread.

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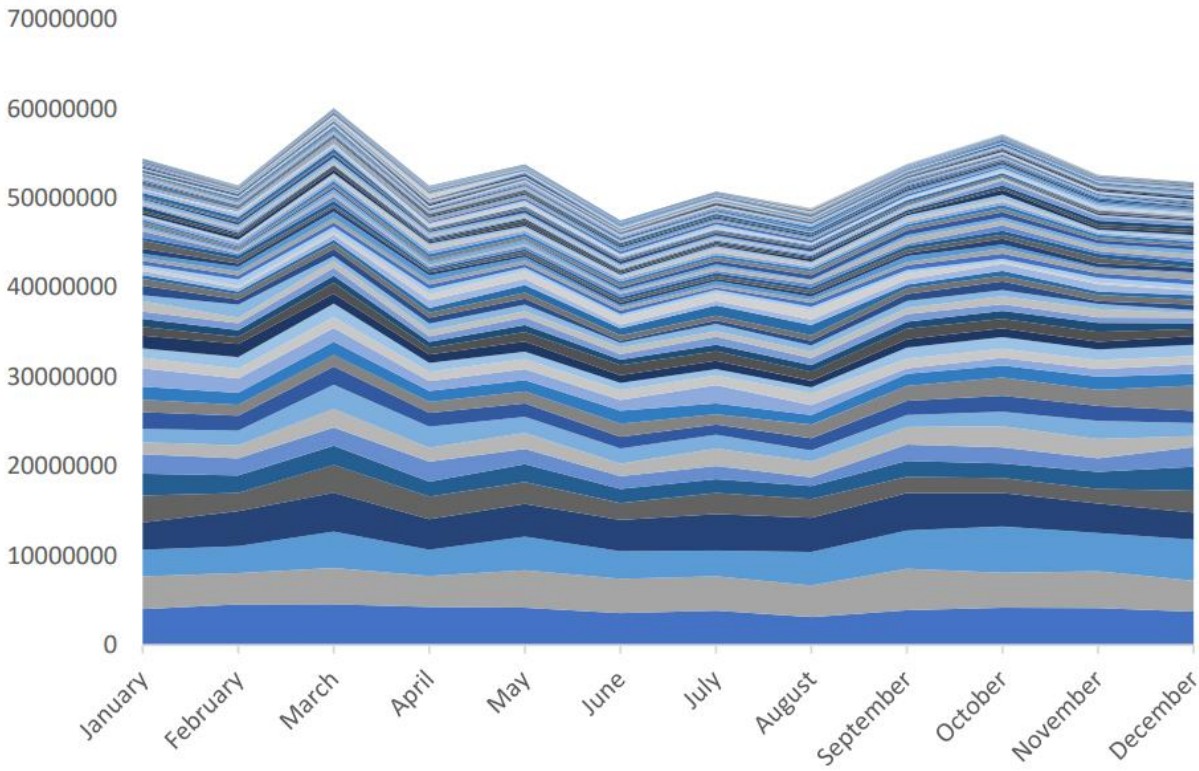
22. Do you have any other information or evidence that you would like to submit as part of your consultation response?

Global shore power connections database

The BPA has collected data on 100+ shore power installations around the world. We are sharing 75 of these as part of this call for evidence – the remaining data is not of sufficient quality to share.

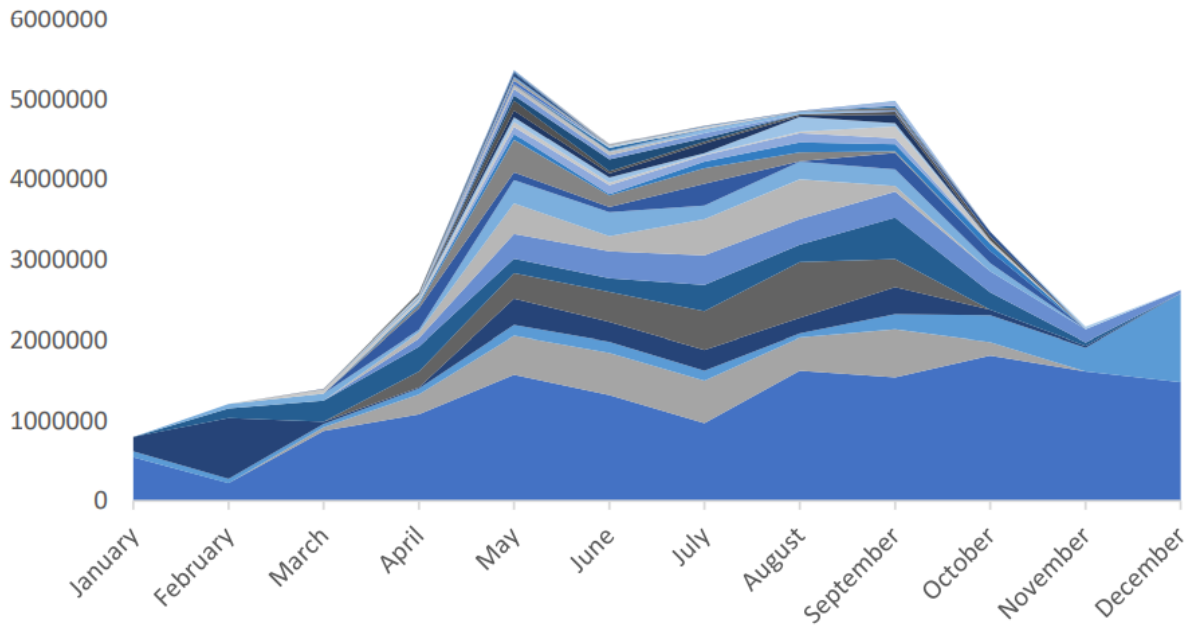
Total Power Usage of Vessels at Berth in individual UK Ports in 2019, monthly totals in kWh

This chart was produced from data supplied by Arkevista to the BPA. It shows peaks in potential power demand from vessels at berth.



Total Power Usage of Cruise Vessels at Berth in individual UK Ports in 2019, monthly totals in kWh

The chart below was produced from the same data and shows the large seasonal peaks for potential demand for power for cruise ships calling in the UK. A similar chart for container ships is available in our report on page 72.



Distances to substations

On average, English ports handling commercial cargoes are 13.2 km or 8.2 miles from their nearest 400kV substation. We commissioned this data as it can have a bearing on the cost of a shore power installation.

Research commissioned for the BPA in 2020 listed the distances of every English port and marine terminal to its nearest 275kV and 400kV substation. Data for other UK nations was not available to us. The distances were measured as straight line distances. The dataset is included in our submission.

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Question Two			
Technology	**Costs**	**Benefits**	**Technology readiness (TRL)**
Technologies that prevent emissions entirely or move them upstream			
Batteries and fuel cells		Low or zero tailpipe emissions and low upstream emissions depending on the energy source/fuel.	7-9
Shoreside power from grid or off-grid generation	Varies widely. See question 5	Abatement of almost all GHG and air pollutant emissions, noise and vibrations	9
Alternative fuels		Low or zero tailpipe emissions and low upstream emissions depending on the energy source/fuel.	3-9
LNG		Reduction in NOx and SOx	9
Technologies that treat or capture downstream emissions			
Scrubbers Exhaust gas treatment systems typically fitted to a ships exhaust to capture a particular emission, such as sulphur dioxide.	Anywhere between $1m and £8m depending on the ship	Abatement of certain emissions	9
Emissions capture 'Sock on a stack' systems such as the 'Marine Exhaust Treatment System' in use at the Port of Los Angeles and other similar technology typically placing a cap over a ships exhaust to capture	Unknown	According to the manufacturer of the 'Advanced Maritime Emissions Control System'[1], between 94.5% and 99.5% of air pollutant emissions captured.	8/9

[1] https://calports.senate.ca.gov/sites/calports.senate.ca.gov/files/advanced_maritime_emissions_control_system_050815.pdf

and treat the emissions, either from a barge or shoreside.			