Dorset Low Carbon Investment Opportunities

Decarbonising Dorset

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Dorset's route to Net Zero

Opportunities unique to Dorset

Generation and storage

2020

Dorset generates 500 GWh of low carbon electricity, of which 80% is solar PV.

This is 5% of Dorset total energy demand.

No diesel generation by 2025

Salt caverns in Portland may be developed for gas or hydrogen storage.

Subsidy-free solar farms take off, with 200 MW developed in the 2020s.

2030

Offshore wind decision before 2030

1 GW of offshore wind off the coast of Dorset could generate 4,800 GWh, c. 50% of total energy demand by 2040.

Solar and onshore wind farms continue to develop, many co-located with batteries and hydrogen electrolysers. Onshore renewable generation exceeds 1,300 GWh by 2040.

No unabated gas-fired power stations.

2040

Opportunity for a small modular nuclear reactor at Winfrith dependent on technological progress.

High levels of hydrogen electrolysis and energy storage provide flexibility to energy networks.

Bioenergy feedstocks exported for power generation with CCS, to generate negative emissions.

2050

All power generation from solar, wind, and nuclear.

Energy demand

2020

Total energy demand of c. 14,000 GWh, split between gas, electricity and petroleum.

Total demand has decreased 7% since 2010.

Electric vehicle registrations continue to accelerate, with over 200,000 in the 2020s.

Heat pumps installed in off-gas and new-build homes. No gas boiler connections in new homes after 2025.

Decision making process on local heat zones

2030

UK ban on sales of new fossil fuel vehicles

In the Net Zero - Electrification scenario, heat pump uptake rates hit over 10,000 per year.

In the Net Zero - Hydrogen scenario, 40% of on-gas homes are heated by hydrogen by 2040.

Investment in local heat zones - Hydrogen, heat pumps, and heat networks.

EPC C minimum for all possible buildings by 2035

Wytch Farm Oil Field planning expires in 2037

2040

Hard-to-decarbonise HGVs, agricultural machinery and shipping switch to low carbon fuels, such as hydrogen, biofuels and electricity.

Over 80% of vehicles are electric vehicles

Remaining gas boilers are replaced by hydrogen boilers, heat pumps or biofuels.

Total energy demand falls as low as 7,500 GWh by 2050.

2050

Only low-carbon heating and transport remain

1. Executive summary

This energy investment opportunities document details ten project areas where significant investment could be attracted to Dorset in the near future, as the energy system transforms to achieve net zero carbon emissions by 2050.

Dorset has a long way to go to achieve net zero and will be facing significant opportunities and challenges along the journey. Key decision points are outlined in the Route Map (above) and the Decarbonising Dorset Evidence Base document which also covers:

- Where Dorset is now, in terms of current energy use and energy generation.
- Dorset's low carbon resources and energy infrastructure.
- Two net zero 2050 scenarios setting out potential implications for Dorset's energy generation, heat, transport and buildings in the future.

This document builds on the Evidence Base as well as existing strategic documents relevant to decarbonisation in the county including:

- Joint LEP Energy Strategy (produced January 2019)
- Dorset LEP local industrial strategy
- Dorset Council's climate and ecological emergency strategy and action plan
- BCP Council's climate and ecological emergency declaration

To produce this report, we also consulted with a number of key local stakeholders including:

- Dorset Council
- BCP Council
- Dorset Community Energy
- Portland Port
- MOD representative
- Bournemouth University
- Suttles Quarries
- Scottish and Southern Electricity Networks
- South West Energy Hub

Taking a whole system approach

The net zero transition is not just a series of projects; it is a fundamental system change, building a whole new green economy. Therefore, in order to maximise the benefits and returns from each of these opportunity areas, it will be crucial to consider the implications for all elements of the energy system and for Dorset's energy infrastructure and economy.

For example, the salt cavern opportunity for hydrogen storage in Portland also provides the potential to develop hydrogen production in the area from electrolysis. Installing local renewable energy could help power this process. The stored hydrogen or ammonia could be used for decarbonising bunker fuels and the marine sector. These projects will also trigger investment in the local energy network which, if including some strategic investment, could be used to reduce the network cost of other decarbonisation plans, including decarbonisation of heat and transport in the Portland and Weymouth area.

Each section of the report covers a critical area for decarbonisation and includes recommendations on where Dorset could focus its efforts and investment in the near term.

The prioritised opportunity areas have been identified using the following criteria:

- Presenting a significant net zero challenge.
- Presenting the most immediate opportunities for Dorset in terms of investment or jobs.
- Having important whole system and infrastructure implications in Dorset for the net zero transition.
- Subject to challenges which are delaying progress in Dorset and where the private sector, acting alone, cannot unlock a solution.

The plan also notes where there are opportunities that could be viable in the medium term that are not currently priorities, including those that require UK government policy change or have narrow implications for decarbonisation.

Jobs and economic opportunities

A key element of the Energy Investment Opportunity document is identifying where Dorset can benefit economically from the significant system shifts that are already underway. For solar, offshore wind and building retrofit opportunities, Regen has used the existing research and data to estimate how much investment is likely to be required and the associated local jobs and Gross Value Added to indicate the total economic benefits of such investment.

Numbers of full-time equivalent (FTE) jobs referenced in the report are estimates of total jobs related to activities that could be within Dorset. Job numbers are estimated over the lifetime of the project: in the near-term, job numbers may be higher; for example, in offshore wind, much of the employment related to the project occurs during construction. To note, there are a wide variety of estimates related to the economic impact of these sectors, the numbers quoted in this report should be seen as approximate, based on recent studies where available.

Summary of investment priorities

Of the low carbon generation resource in the area, solar and offshore wind present the biggest and most immediate opportunity for Dorset, with other technologies having some good potential in the medium term.

Supporting 1 GW of solar generation

A number of actions are recommended to help deliver an additional 1 GW of solar generation capacity within Dorset, which could bring:

- £500m of investment into Dorset and £1 billion of GVA.
- An estimated 1,200 potential local, high-skilled jobs in electrical engineering, construction and maintenance of sites.
- Opportunity to diversify farm incomes and reduce energy costs for homes and businesses.

A 1 GW offshore wind farm

As a critical part of the UK's decarbonisation plan, an offshore wind project in the area could be a hub around which to build a new green economy in Dorset and bring in:

- C. £1.5bn inward investment into Dorset and surrounding areas, with a GVA of £3.3bn.
- 2,300 new high-skilled jobs in electrical engineering, marine construction and maintenance of sites.
- Investment into both Portland and Poole Ports to support the installation and maintenance of the project.
- A significant community benefit fund over the life of the project to support local charities and schemes.

In addition, the network investment required for the project could be used to unlock areas of constrained network and other generation opportunities within Dorset.

Developing hydrogen innovation clusters

The natural capital of both Portland's salt caverns, along with a potential excess of low carbon generation from wind and solar, goes hand-in-hand with the opportunity for future development of 'green' hydrogen by electrolysis in Dorset. This is expected to be a critical fuel for decarbonisation of heavy transport, industry and the marine sector. The hydrogen sector also provides a transition pathway for Dorset's existing oil and gas infrastructure.

Strategic Network Investment

The energy infrastructure in Dorset has significant constraints, stifling growth in the county and presenting a barrier to achieving net zero. The solution is both more investment in network capacity, as well as digital and smart systems to utilise existing capacity more efficiently.

Strategic conversations need to be started between local authorities and the networks to identify the strategic sites for low carbon projects and agree the processes required to develop the right energy infrastructure to support growth and net zero in Dorset.

Smart, local and flexible systems

Dorset has a number of key industrial areas or business parks with network constraints. At these sites, there is an opportunity to explore the potential for smart solutions and flexibility to reduce peak demand and release headroom for future network demand, as well as to explore the potential for co-location with or private wires to low carbon generation and/or storage. This will:

- Provide a boost for new low carbon generation.
- Unlock growth opportunities for Dorset businesses in the short-term ahead of significant network investment.
- Provide high-skilled jobs in digital and smart energy, as well as electrical engineering and construction.

Sending the retrofit demand signal

One of the biggest challenges for Dorset, and any other region looking at delivering net zero, is energy efficiency. Minimising the energy needed for heating buildings reduces network and infrastructure costs to electrify heat, significantly reducing the system costs of achieving net zero.

An estimated 370,000 homes in Dorset have an EPC of D or below. Upgrading these dwellings to an EPC of C would create:

- Investment into Dorset buildings of around £3.3bn, resulting in a total GVA of £10bn.
- Nearly 9,000 jobs created in sector, the majority of which have the potential to be local to Dorset.

Local authorities could be playing a significant role in stimulating the sector, by giving a demand signal on retrofit through their own procurement processes and through convening the rest of the public sector demand in this area.

Marine Source Heat Demonstrator

And Net Zero Village

New heating technologies will be needed in over 80% of Dorset buildings to achieve net zero, and there are likely to be different solutions in urban areas compared to the rural and off-gas parts of the county.

It is important that Dorset starts on this journey now, as there is a long way to go. These pilot demonstration projects could be used to develop solutions that can then be replicated across Dorset, positioning Dorset businesses to expand on these opportunities when the UK heat strategy becomes clearer.

Filling the gaps in public EV charging

The electric vehicle is now certain to be commonplace in Dorset by 2030, and it is important that the county has the charging infrastructure to support the sector and ensure a fair transition for all drivers, in terms of charging costs and access to electric vehicle charging.

Working together with the private sector, local authorities can develop a public EV charging offering and specifically identify and fill gaps in provision to support local needs.

Bus decarbonisation strategy

A coordinated approach to bus electrification could be an important Dorset-wide project on the path to net zero, both reducing emissions and encouraging uptake of public transport.

Local authorities should work on a bus decarbonisation strategy in conjunction with the Dorset bus operators, including making a commitment on phasing out diesel and petrol vehicles by a specified date. They will also need to work together on the significant energy infrastructure challenges that accompany the transition from fossil fuels, including the space and electrical capacity to provide rapid chargers at electrified depots.

Case study: Bristol City Leap

Bristol – selecting private sector partners

Bristol City Council describes a City Leap as a "series of energy and infrastructure investment opportunities that represent a big step towards a cleaner, greener" city. The Bristol project plans to develop, construct and finance up to £1 billion of investment, detailed in a prospectus that pulls together opportunities from multiple sectors. The largest investment areas are heat networks and domestic energy efficiency, each allocated around £300 million of potential investment by 2027.

In the city centre, for example, they are utilising their harbour and river access to consider multiple water source heat pumps to supply green heat to heat networks, in combination with other technologies. Smart energy systems, commercial energy efficiency and renewable energy are also allocated an estimated £125m, £100m, and £40m respectively. In addition, £10 million of investment has been earmarked for effective monitoring, evaluation and dissemination of knowledge and data from the projects, in order to develop a system of continuous improvement.

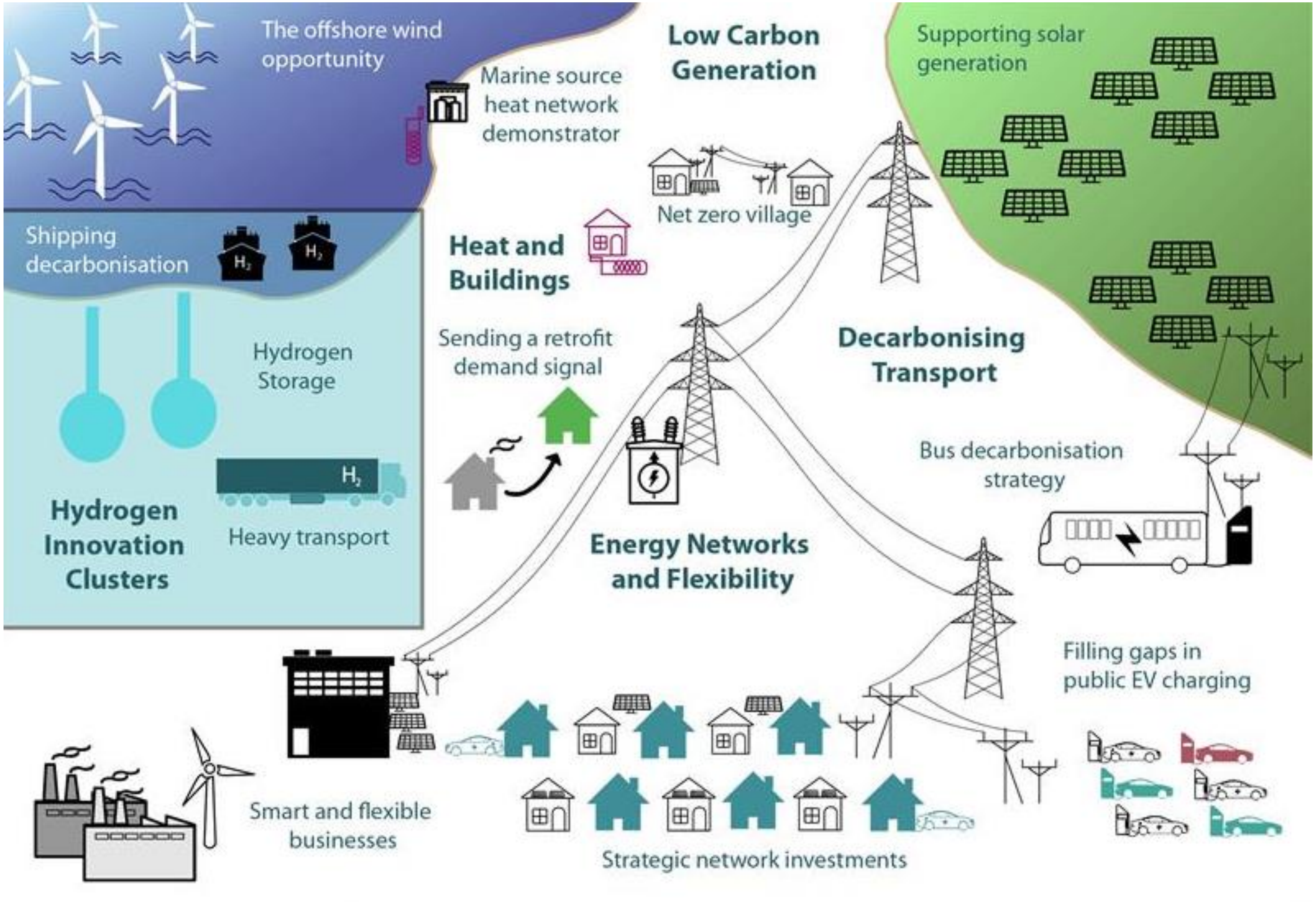


Figure 1. Visualisation of the Opportunities to Decarbonise in Dorset

2. Low carbon generation

With the electrification of heat, transport and industrial processes a core part of a net zero future, demand for electricity in Dorset is expect to more than double by 2050. To meet this additional demand for electricity using low carbon and renewable sources, the Committee on Climate Change has estimated that renewable generation capacity needs to quadruple.

The UK currently relies upon imports for the majority of our energy needs, and therefore a key opportunity at the core of the net zero transition is the ability to generate high levels of low carbon power within the UK. This means retaining both the benefit from the energy resource within the UK in terms of jobs and investment, as well as ensuring security of supply.

By 2050, the net zero Dorset scenarios suggest there is the potential to increase local renewable and low carbon generation capacity from 480 MW in 2020 up to 2,600 MW by 2050, a fivefold increase. The net zero scenarios suggest around 1,000 MW of new renewable capacity could be from solar power, with an offshore windfarm providing a further 1,000 MW.

2.1. Supporting solar generation

Dorset has both large areas of developable, lower grade agricultural land, along with high levels of solar irradiance, which makes it a very attractive area for solar generation, as has been seen over the past decade. Dorset Council's action plan identifies council-owned land that could host solar PV sites.

The county already hosts a number of large solar farms, including a 48 MW site installed near Christchurch, with nearly 200 MW of solar sites currently in planning and development.

Case Study: Solar Farms in Dorset

South Farm, Spetisbury – in construction
Stockbridge, Longburton – planning submitted

The under-construction solar farm at Spetisbury will install 40 MW of solar panels and is exploring adding 10 MW of battery storage capacity to provide flexibility. The project has signed a power purchase agreement with The City of London Corporation Solar to help the project manage their exposure to the risk of fluctuations in the market price for electricity.

Another large solar site is being planning in Stockbridge. The project is aiming to install 35 MW of solar PV and potentially 10 MW of battery storage. Both sites are being developed by Voltalia and will also be providing ecological enhancement.

There are many facets to the opportunities around solar generation in Dorset. As well as decarbonising electricity generation, solar projects can provide investment opportunities for communities and local businesses, or possibly reduce their energy costs. For agriculture, the revenue from these sites can support and help diversify farm incomes. Solar sites are regularly used to provide livestock grazing or to enhance and restore local biodiversity. In terms of local jobs, there is potential for businesses to provide construction and maintenance services.

Many sites can offer further system value using battery storage to provide flexibility to the constrained network. In the future, excess solar generation in the area could be turned into hydrogen to decarbonise other sectors or captured through energy storage.

2.1.2. Investment and jobs

The net zero Dorset scenarios suggest around 1,000 MW of new solar capacity could be developed in Dorset by 2050, of which around a quarter would be expected to be rooftop solar panels. Large ground mounted solar has less than half the cost per kW than small-scale rooftop due to economies of scale. The investment required for this would be around just over £500 million. With operations and maintenance investment expected of around an additional £100 million to 2050Jobs relating to solar energy that are likely to be based in the UK are sales, installation and services, which are all demand led[i]. An estimated total of 12,00 FTE jobs could be supported and provided by local businesses within Dorset, capturing around half of the total employment related to this amount of new solar capacity. To realise these benefits fully, it is important that the skills to deliver these projects are developed within Dorset businesses.

Table 1. *Cost, GVA and Jobs for new large and small-scale solar PV in Dorset.*

Added Capacity	Investment Required	Gross Value Added	Local Jobs (FTE)
Small-scale solar			
246 MW	£263.4 million	£271 million	295
Large-scale solar			
787 MW	£254.8 million	£865 million	944
Total			
1,033 MW	**£518.2 million**	**£1.14 billion**	**1,239**

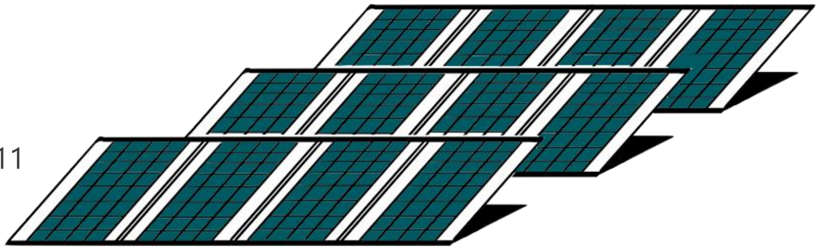
2.1.3. Challenges

Although new solar generation is now being built subsidy-free, financing for new solar sites is a key challenge for the sector.

The key issue is the variability of the electricity market price, which means that future revenues are uncertain. As a result, projects are increasingly looking to secure corporate Power Purchase Agreements (PPAs) to provide a level of certainty around the price of power over the lifetime of the project and allow financing to be raised. The case study solar site in Spetisbury has secured a PPA from the City of London, however good PPAs can be difficult to arrange.

The second key challenge is network constraints. Dorset's electricity network is heavily constrained with many areas operating at or near capacity. This means that new connections often face high costs where they trigger upgrades to the network, which can make projects unviable.

For many subsidy-free solar sites the solution to both financing and network costs is to reduce the relative costs of the project through economies of scale. As a result, solar sites are becoming increasingly large, which can cause separate issues in gaining planning permission.



2.1.4. Recommendations

There are a number of areas where Dorset councils and the LEP can help remove barriers to further solar projects in the area:

- **Leading by procurement.** Procuring electricity for council sites and properties through local PPAs. These sleeving structures, such as the one used by the City of London, can be used to procure electricity from sites such as community energy projects that need to secure financing.
- **Network investment.** Critical for this and other opportunities will be working with National Grid, SSEN and WPD to understand network constraints and identify opportunities for strategic investment in good areas for solar generation.
- **Local jobs**. Working with local solar firms and colleges to emphasise electrical engineering, solar jobs and opportunities in the sector, as well as encouraging developers to prioritise local jobs and apprenticeships within project planning.
- **Planning guidance.** Developing guidance for developers and communities in Dorset about solar generation and best practice in terms of benefit to communities and the natural environment.
- **Using council land and estates.** BCP and Dorset both have considerable council land and buildings which could host solar projects. Dorset Council have committed in their net zero action plan to scope their properties for renewable energy potential.

2.2. The offshore wind opportunity

Offshore wind is at the heart of the UK government's decarbonisation plans, and in 2020 they announced the intention to quadruple the generation capacity of offshore wind sector in the UK by 2030. The energy minister noted that expanding the offshore wind supply chain is seen to be key to rebuilding the UK's economy after the pandemic[ii].

The area of the English Channel off the Dorset coast continues to offer significant potential for an offshore wind project. The investment and associated local economic benefits could be hugely significant for Dorset and their role in the new green economy.

2.2.1. The opportunity

The offshore wind resource area is valuable locally and nationally for a number of reasons including:

- **Close to centres of population.** The electricity from an offshore project will be generated near big centres of population in Bournemouth, Christchurch and Poole and southern England more broadly. This makes the site more valuable than generation in areas of the North Sea and Scotland as it reduces the power losses associated with transportation of electricity across the country.
- **Significant energy system benefits.** The only offshore site in the south of England at present is the Rampion windfarm off Brighton, with the vast majority of offshore wind installed along the eastern coast of the UK, in the North Sea. As weather and wind patterns vary across the UK, there are significant energy system benefits to developing offshore wind away from existing sites, increasing diversity of offshore wind generation. The Dorset coast is one of the best and windiest locations for offshore wind in England.
- **Enabling Dorset to be a net exporter of low carbon power.** A 1 GW offshore site would typically be expected to generate over 4 GWh per year, which represents over 100% of the area's electricity use in 2018 and c. 30% of total 2018 energy use. By 2050, the site could provide around 50% of Dorset's total energy use and is key to making the county a power exporter. At present, low carbon generation in Dorset is predominantly from solar and is equivalent to only 5% of total energy demand.
- **Energy infrastructure and network.** The network infrastructure from an offshore project could also unlock other net zero opportunities in the area, and investment could be expanded to relieve some of the electricity constraints facing Dorset. The network investment could also unlock other generation opportunities such as tidal stream electricity generation. and support hydrogen production through electrolysis.

2.2.2. Jobs and investment

The investment required to construct and operate an offshore wind farm of 1,000 MW capacity would be approximately £1.4 billion, based on current project costs. This is a significant reduction from the earlier Navitus Bay project and is due to recent advancements and record-low costs in the industry[iii].

The associated jobs would amount to approximately 2,300 FTEs. This estimate includes installation, manufacturing, operation and maintenance, all of which could be localised in Dorset or neighbouring areas. For example, Vestas on the Isle of Wight provide manufacturing of offshore wind blades and currently employ around 600 staff[iv]. The total GVA of the project would be approximately £2 billion. The operation and maintenance costs up until 2050, assuming a year of commissioning in 2030, would be around £500m million.

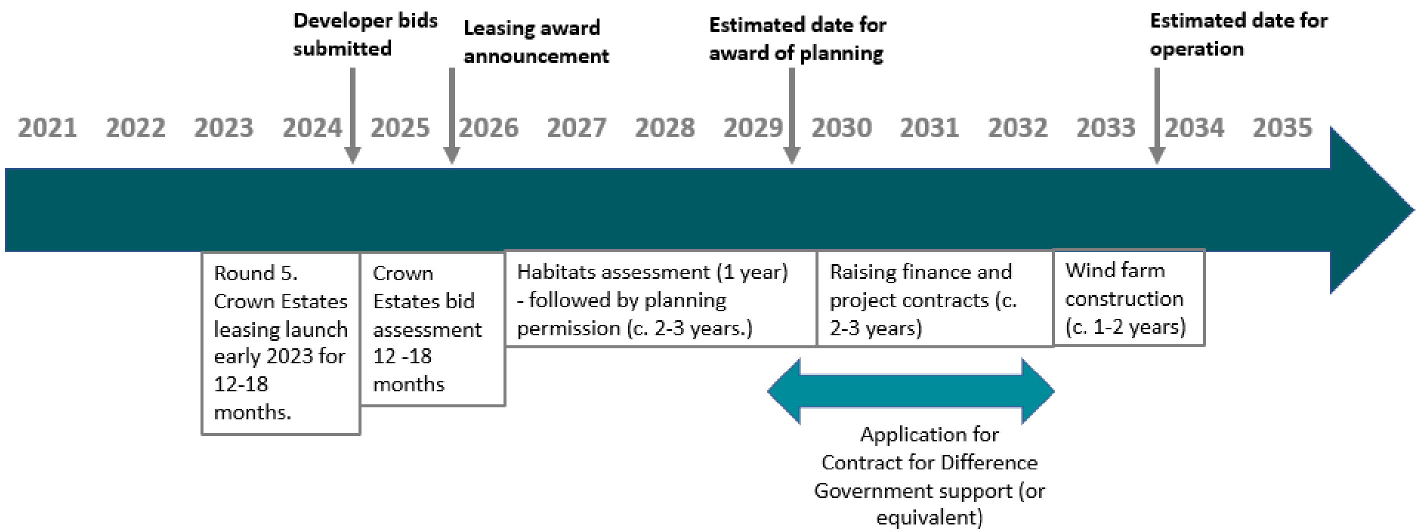
Table 2. *Cost, GVA and Jobs 1,000 MW of offshore wind in Dorset.*

Project	Cost	GVA	Jobs (FTE)
1 GW Offshore Wind	**£1.43 billion**	**£2 billion**	**2,300**

2.2.3. The challenges

With the current timescales for development of offshore wind, the earliest an offshore wind site could be operational would be in the early 2030s. The process outlined below shows that a developer has to take to develop a viable offshore wind farm project. Each stage has considerable costs and risks.

Local opposition to the earlier project in the area and late-stage refusal of planning meant considerable losses were incurred by the previous developer. This will be a significant deterrent to new interest in the area by offshore wind developers.



2.2.4. Recommendations

If Dorset LEP and councils decide that an offshore wind farm is right for the area, it will be important to actively work to attract developer interest in the site. The first step will be engagement with the Crown Estate and prospective developers, with the objective for the site to be opened up in Leasing Round 5 (expected in early 2023).

It will then be critical over the next two years for the LEP and councils, as well as civil society in Dorset, to address the negative perception that developers have of the area. In addition, the public sector will need to work to address public and political climate and wind scepticism in Dorset, making a strong economic and environmental case for an offshore project to local businesses and residents.

Offshore wind learning programme.

Many communities across the UK now host an offshore wind farm, which means there is an opportunity to undertake a programme of learning from existing sites, including Rampion in Brighton and other equivalent sites. These learning events could include:

- Site tours to assess the visual impacts from different distances from shore and perception of offshore wind in the local areas currently hosting wind farms.

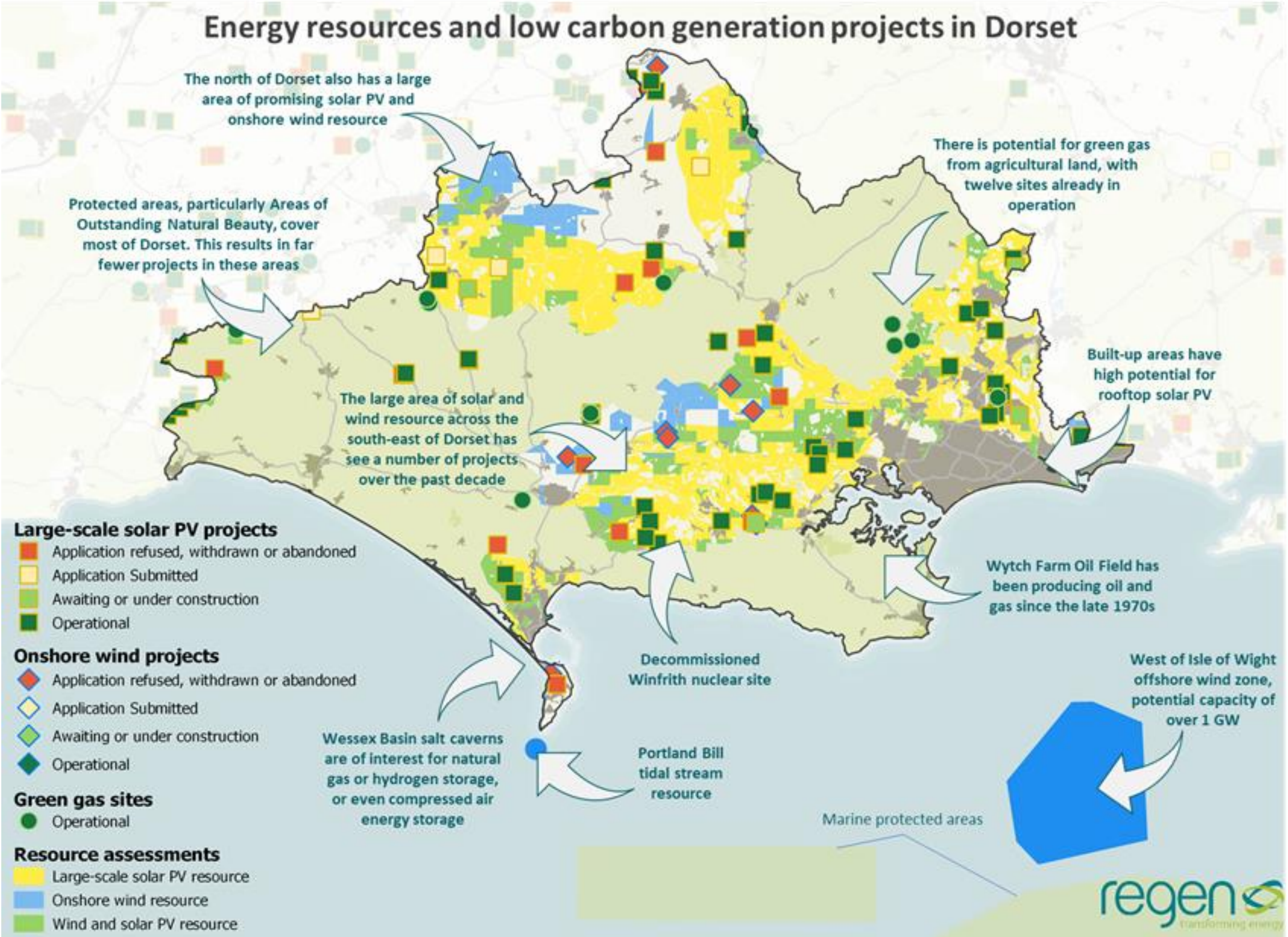
- Assessing impact on tourism. For example, a number of local companies in Brighton now offer boat tours to the Rampion windfarm.

- Jobs and economy. A review of the considerable jobs and economic opportunities from the project, including regeneration of Poole and Portland Ports as well as high-skilled jobs and apprenticeships relevant to net zero and the green economy.

- Community benefit opportunities. The Rampion community fund offers local projects grants and is currently managing investments of £3.1 million.

The learning events can be used to set out a **prospectus detailing locally led conditions of development** under which the LEP and councils might support a project in the area. This should be done in coordination with the Isle of Wight council.

Being proactive with these conditions provides an opportunity for the area to create a strategic and locally led project that supports Dorset's objectives for net zero and the green economy. These conditions can be used as a basis for early conversations with developers and the Crown Estate.


Energy resources and low carbon generation projects in Dorset
The north of Dorset also has a large area of promising solar PV and onshore wind resource
Protected areas, particularly Areas of Outstanding Natural Beauty, cover most of Dorset. This results in far fewer projects in these areas
There is potential for green gas from agricultural land, with twelve sites already in operation
Built-up areas have high potential for rooftop solar PV
The large area of solar and wind resource across the south-east of Dorset has see a number of projects over the past decade
Wytch Farm Oil Field has been producing oil and gas since the late 1970s
Decommissioned Winfrith nuclear site
West of Isle of Wight offshore wind zone, potential capacity of over 1 GW
Wessex Basin salt caverns are of interest for natural gas or hydrogen storage, or even compressed air energy storage
Portland Bill tidal stream resource
Marine protected areas
Large-scale solar PV projects
Application refused, withdrawn or abandoned
Application Submitted
Awaiting or under construction
Operational
Onshore wind projects
Application refused, withdrawn or abandoned
Application Submitted
Awaiting or under construction
Operational
Green gas sites
Operational
Resource assessments
Large-scale solar PV resource
Onshore wind resource
Wind and solar PV resource

2.3. Other opportunities

In addition to key opportunities within solar and wind, there are other opportunities in the area which could provide low carbon generation now or in the future.

2.3.1. Onshore wind

Despite onshore wind being the cheapest renewable energy technology, since 2015 the planning system in England has placed significant barriers in the way of new onshore wind development, in particular requiring them to be in areas allocated in a Local Plan. However, with Dorset Council's new Local Plan including wind allocations, there is now potential for sites to be developed in the county.

Dorset has areas of potential resource for onshore wind, avoiding key landscape designations, but at present no large-scale sites are operational, due to historical local opposition. However, one larger project, the 9.2 MW Alaska wind farm, is expected to be installed in East Stoke in the next few years.

With limited national policy support for the technology, there are only a few actions that can be taken at a local level. Dorset Council has already designated onshore wind areas in the recent draft Local Plan and should continue to be positive about the technology where the opportunity arises. If a project does come forward, similar to the community development at Lawrence Weston in Bristol, council electricity procurement through a PPA could be used to financially support the development.

2.3.2. Anaerobic digestion, biomass and biofuel

Dorset has considerable agricultural land that could have potential for growing biomass for energy. The sustainability of large-scale biomass for energy is questionable given competing uses for land, but small-scale projects, particularly where heat is used as well as electricity, could offer a low carbon energy solution for some specific sites.

Biomass could also be suitable for combined heat and power applications linked to Dorset's network constrained business parks. The rural location of the Dorset Innovation Park, for example, presents a particular opportunity for an off-grid energy solution like biomass.

Dorset already has a number of anaerobic digestion sites and the technology may provide future small-scale opportunities to decarbonise agricultural vehicles. There are opportunities with Dorset Council in particular to use the county farms as hubs to develop anaerobic digestion and/or biofuel projects.

2.3.3. Tidal energy

Marine energy from tidal or wave is not yet commercially viable, although investment is continuing at demonstration sites such as Orkney. Dorset has a potential site for tidal stream energy off Portland and this should be considered a medium-term opportunity once the technology is proven elsewhere.

2.3.4. Small Modular Reactors

The presence of the defence sector and previous Winfrith nuclear reactor site means that Dorset has potential for future nuclear technologies. An Arup study mentioned the Winfrith site specifically as having potential for a Small Modular Reactor. These reactor types may prove feasible for investment in the future, though bringing back a nuclear industry into the area could prove challenging. However, the site could be considered as having potential for medium-term development if projects are proven viable elsewhere.

2.3.5. Hydropower

There are some small-scale hydropower opportunities across Dorset, but currently the UK government subsidy regime does not support hydropower investment, and most are unable to obtain funding for the large upfront costs.

Small hydropower can still be an important area for landowners or community projects where resources allow. A national policy on upfront support for sites would be able to unlock the potential of remaining sites in Dorset.

However, these will need to be considered locally in conjunction with improvements to biodiversity and water quality. Hydropower projects which include fish passes and other improvements to existing weirs can be an important part of wider improvement of water sources.

3. Focus on hydrogen

Hydrogen is set to play a critical role in enabling the UK economy to achieve net zero carbon. As well as providing a low carbon energy source for hard to decarbonise sectors such as heavy transport, aviation and various industrial processes, hydrogen could also play an important role in energy system balancing as a multi-vector fuel by using very low-cost electricity during times of over-supply to convert, store and transport energy in the form of hydrogen for applications across the energy system.

3.1. Hydrogen supply and production

Most hydrogen is currently produced through steam methane or auto thermal reforming of natural gas, resulting in what is known as **grey hydrogen**. The UK already has an established grey hydrogen market, currently generating c. 27 TWh of grey hydrogen each year[v] primarily used in the production of ammonia for fertiliser. Grey hydrogen is not consistent with net zero. However grey hydrogen could be combined with carbon capture and storage (CCS) to produce **blue hydrogen**. Current CCS technology achieves savings of 60-85% relative to natural gas use[vi]. The Climate Change Committee has argued that blue hydrogen is not a fully clean source of hydrogen unless CCS technology is able to achieve 95% capture efficiency rates[vii]. At present, there is no commercially viable CCS technology, though this may develop in the medium term.

Green hydrogen is produced via electrolysis, the process of using electricity to split water into hydrogen and oxygen, and is considered zero carbon, if the input energy is renewable. Low-cost renewable electricity, available when supply exceeds demand, can be used for hydrogen production. Electrolysis technology is readily available but expensive, though innovation is being undertaken to drive down the cost. Currently, only 5% of hydrogen gas produced worldwide is from electrolysis, mainly due to the high cost of the renewable electricity required.

In addition to producing hydrogen, electrolysers can facilitate increased market penetration of wind and solar generation without adding to electricity oversupply by operating at times of surplus energy. This can help to optimise renewable energy assets, reduce curtailed energy generation, and provide balancing services to the local networks and grid by shifting oversupply of electrical energy temporally and/or geographically.

In the future, hydrogen could also be used for electricity generation. With much unabated fossil fuel generation expected to close over the next decade, there is a potential for hydrogen peaking plants to replace natural gas plants and provide power when renewable generation is low.

UK government is currently pursuing both green and blue hydrogen in a twin track-approach. A proposed target of 5 GW of low carbon hydrogen capacity by 2030, with an associated production target of 42 TWh, was introduced in the Prime Minister's Ten Point Plan in November 2020 and reiterated in the Energy White Paper[viii].

A further £240 million Net-Zero Hydrogen fund has been created to help achieve these aims. The upcoming Hydrogen Strategy paper is expected to announce policy measures to develop the hydrogen economy. This may include details of the revenue mechanism to support business models for low carbon hydrogen projects.

Costs associated with future hydrogen production are a source of debate. A study by Wood Mackenzie predicts that **green hydrogen** could become cost competitive by 2040, with costs falling by 64%, while blue hydrogen costs rise by 59%[ix]. A more recent study by BloombergNEF suggest this has narrowed to being competitive by 2030[x]. This implies that green hydrogen will outperform blue hydrogen in the longer-term.

3.2. Hydrogen demand sectors

There are some key sectors expected to be leading on hydrogen as their low carbon solution. In particular, hydrogen is expected to be an important element in the decarbonisation of industrial processes and high-grade heat requirements across the UK, such as in steel and cement production, where processes cannot easily be electrified. It is projected that one in ten steel and chemical plants in Europe will be using low carbon hydrogen by 2030, with c. 12% of global industrial energy demand met by hydrogen by 2050[xi].

Shipping and aviation have limited low carbon fuel options available, which makes hydrogen or associated fuels such as ammonia an important area of innovation.

Hydrogen is increasingly considered as one of the most promising zero emission technologies for future aircraft, however there are many challenges that still need to be addressed before hydrogen aircrafts become common place. The UK Government is one party supporting ZeroAvia, a collaboration looking to develop hydrogen aircraft solutions.

The UK government's Maritime 2050 strategy[xii] aims to have zero emission ships commonplace globally by 2050, with all new vessels operating in UK waters by 2025 to be designed with zero emission propulsion capability. The plan envisages that by 2035, low or zero emission fuel bunkering options are readily available across the UK. In this spirit, a £20 million Clean Maritime Demonstration Competition has been launched which will support the design and development of clean maritime technology, including hydrogen.

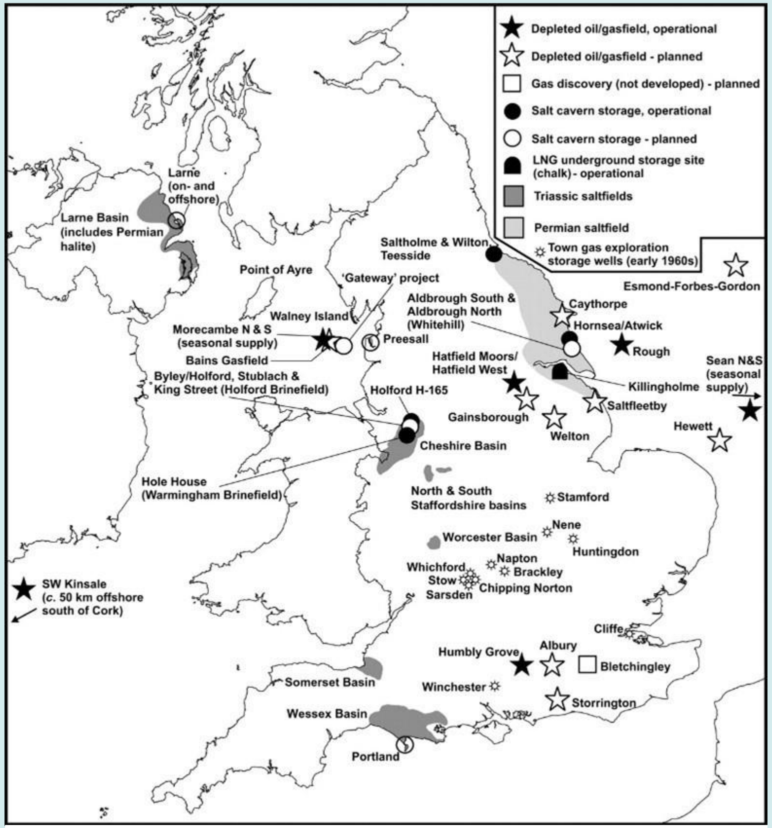


Figure 2. UK energy storage opportunities

There are also a number of projects exploring the potential for hydrogen to be used for heating. However, there remains considerable uncertainty about the potential use of hydrogen for building heat, due to the cost of the fuel for the end user and infrastructure required to supply this sector.

3.3. Hydrogen infrastructure and storage

A key question for the future of hydrogen is not just the demand and supply for the fuel, but what hydrogen infrastructure will be needed to facilitate its use and storage, the cost of that infrastructure and how and where that will be provided. In particular, producing hydrogen at scale goes hand-in-hand with the need for long-term hydrogen storage. Opportunities include salt caverns and old gas storage facilities. **Figure 2** shows that Dorset has potential salt cavern storage at Portland and has Triassic salt fields covering much of the county[xiii].

The location of hydrogen assets is therefore likely to be heavily influenced by infrastructure costs and the ability to locate supply near demand in order to avoid transporting the fuel over large distances. This includes:

- Proximity to large sources of demand, e.g. transport (marine, aviation, HGV) or power generation.

- Proximity to hydrogen storage facilities (such as salt caverns).
- For green hydrogen, local network availability and constraints, the latter providing a revenue stream for network services.
- For green hydrogen, proximity to low-cost and low carbon or renewable generation.
- For blue and green hydrogen, the location of existing gas infrastructure.
- For blue hydrogen, proximity to areas with potential for transport and storage of captured carbon emissions (such as old oil fields)

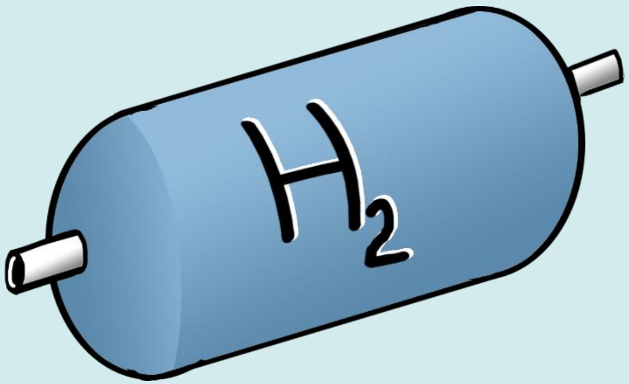
At present, most hydrogen is produced next to demand and this is a trend that is expected to continue well into the next decade until the infrastructure implications for the sector become clearer.

3.4. Jobs and GVA in hydrogen

Hydrogen is a growing sector with many moving parts, and projections on costs, jobs and GVA are at an early stage. Nonetheless, insights can be drawn from the existing literature to make some initial estimates.

According to the Hydrogen Roadmap Europe, approximately 1 million people in Europe will be employed in the hydrogen sector by 2030, 500,000 of which are in manufacturing production and distribution equipment and 350,000 associated with fuel cells. Another study by Navigant focusing on upstream hydrogen production shows that 1-1.5 million green hydrogen jobs could be created in the EU by 2050, a third of which would be direct jobs.

A UK-level study by Element Energy models an investment of £160 billion to decarbonise the entire UK economy (including hydrogen domestic heating) between 2020 and 2050. This translates to 110,600 direct jobs in hydrogen and a GVA of nearly £16 billion[xiv]. Under their industry-only hydrogen scenario, investment of £38.2 billion would be needed by 2050. 43,000 direct jobs would be created, with GVA at £4 bn.



3.5. Hydrogen in Dorset

Given the importance of infrastructure and storage to the success of hydrogen, Dorset has a number of unique existing resources as well as key sources of potential future demand that could place the area at the forefront of the emerging sector. In the short term, there should be action taken to explore these opportunities.

3.5.1. Hydrogen storage and infrastructure

There are two big opportunities for hydrogen infrastructure in Dorset which could benefit from further exploration and feasibility studies. Firstly, the location of potential hydrogen storage facilities in Portland salt caverns, which could make it a prime location for future hydrogen production facilities, serving both Dorset and international maritime demand.

A second opportunity for hydrogen, other energy storage or carbon capture is the existing and redundant oil and gas fields around Poole Harbour and Purbeck. In addition, there is also infrastructure and an oil pipeline between Purbeck and Southampton which could potentially be repurposed and linked to a hydrogen hub at Southampton Port.

There are no gas terminals in Dorset, but the area does have a high-pressure gas network crossing the north of the county, which could be useful for the transportation of hydrogen into or out of the county in the medium and long term.

Case study: Solar powered hydrogen

Canford Resource Park – planning submitted

Canford Renewable Energy have submitted plans for a 1 MW hydrogen production facility linked to a 5 MW solar farm on an existing landfill gas generation site. If approved, it would be a first of its kind with surplus solar energy producing 150,000 kg of green hydrogen fuel a year. The project is currently awaiting approval by BCP Council and hopes to be fully operational in early 2022.

3.5.2. Hydrogen production

As well as infrastructure, key for green hydrogen production is the availability of excess renewable generation along with associated network and grid capacity.

As explored in the energy route map, Dorset has excellent resources for both solar and wind power. In their renewable energy technical paper, Dorset Council have identified the opportunity to combine large-scale renewable energy resources with hydrogen generation to make Dorset a net exporter of energy[xv]. The Net Zero – Electrification scenario suggests that Dorset could be a net exporter of low carbon energy by 2050.

3.6. Hydrogen demand clusters

In the short and medium term, hydrogen is likely to be focused on clusters, where innovation spending can be focused and where production and demand can be matched with local infrastructure.

For Dorset, there are two key areas which could form a coordinated source of demand and potential for innovation, whilst the hydrogen sector looks to commercialise and overcome the many hurdles that come with bringing forward a new sector.

3.6.1. Heavy transport hydrogen cluster

Most private vehicles are expected to be electrified but hydrogen technologies are being considered for some “heavy” road transport, marine transport and aviation. At present, there is no commercial availability of hydrogen-ready versions of many heavy vehicles, but a number of companies have these in development. Opportunities for developing a heavy transport demand cluster in Dorset could include:

- HGVs using Poole Port
- Heavy machinery and vehicles in the quarrying sector
- Defence vehicles
- Utilities specialist vehicles, excavators, dump trucks, road gritters, and construction vehicles.

3.6.2. Marine hydrogen cluster

Dorset has a large marine sector with two ports and three harbours providing links to mainland Europe, as well as a number of local and international ferries. As a result, there is big opportunity for innovation around hydrogen and ammonia for shipping within Dorset.

As identified in section 3.3, there is potential for storage of hydrogen near Portland Port. Hydrogen for shipping remains a possibility, with main costs associated with hydrogen being for fuel ($4,000/ton for hydrogen compared to $620/ton for LNG[xvi]. However, costs of hydrogen are expected to fall dramatically, related to the falling price of electricity from renewables and LNG may rise as carbon price and taxation increase[xvii].

Dorset is part of Maritime UK South West[xviii], which has a decarbonisation programme encouraging policymakers to support the marine sector. The existing marine industries within Dorset could be encouraged to incorporate hydrogen into their operations. For example, Sunseeker International, based in Poole harbour, could be an early adopter of hydrogen in shipping through retrofitting and designing new hydrogen-powered vessels for wealthy clients. There is an opportunity for using local waters for both developing and testing hydrogen equipment and vessels. Other partners could include:

- The Marine & STEM centre at Bournemouth & Poole College
- Royal Fleet Auxiliary Military in Poole
- Portland port as an off-taker or producer of hydrogen or ammonia for bunkering fuels.
- Ferries including Sandbanks (due for replacement in 2032)

Case study: Southampton plans a hydrogen super-hub

Port of Southampton - feasibility stage

It is estimated that Southampton's industrial activities emit 2.6 million tonnes of CO_2 per year. However, the clustering of industrial premises and marine transport makes it a feasible location for a centre of hydrogen and/or carbon capture utilization and storage (CCUS), and it is one of six areas identified by the government for this purpose.

A feasibility study is currently being carried out by WSP to develop a decarbonisation pathway for the Southampton's transport and industrial sectors. The project is funded by Macquarie's Green Investment Group and gas network company SGN.

3.7. Other opportunities

There are other medium- and long-term opportunities for hydrogen in Dorset, which should be given a 'watching brief' in terms of development in the sectors.

3.7.1. Power

There is potential that gas-fired power stations like Chickerell in Weymouth could switch towards hydrogen to provide peaking and network services as they transition away from fossil gas. The cost and volume of hydrogen required for peaking means that this is an opportunity that may become viable only in the long term.

3.7.2. Aviation

All aircraft will need to transition towards low carbon fuel before 2050 and hydrogen could be a good option. Bournemouth International Airport is therefore a potential source of future demand.

In the short term (the next 10 years), hydrogen fuelled aircraft capable of short haul flights such as to the Channel Islands are likely to be developed. Bournemouth airport offers medium-haul flights which could transition to hydrogen or electricity in the medium term.

4. Energy networks and flexibility

The UK's energy infrastructure transports energy from where it is generated to where it is needed, and the energy system managed by National Grid works within that to balance demand and supply, keeping the lights on and the system stable. The current system was built to support a centralised 'controllable' system with slow evolution of demand and supply.

This 'old world' system is now facing increasing challenges and there is now considerable focus on developing the processes and infrastructure to support a decentralised, smart and high renewables system.

The solution is two-fold: both more investment in network capacity and at the same time using technology and smart systems to utilise existing capacity more efficiently. At present, generation is expected to respond to varying demand. In a net zero world, demand and generation will both need to be increasingly flexible, and demand will be incentivised to respond to available supply, linked together through smart digital platforms.

4.1. Strategic network investment

4.1.1. The opportunity

The network infrastructure at both low and high voltages needs to evolve quickly to allow all areas of the UK to cost-efficiently develop renewable energy opportunities and achieve net zero objectives. At household and commercial level, the network will also need to absorb the extra demand related to the electrification of transport and heat, that is currently met by fossil fuels.

It will be of critical importance for achieving net zero that Dorset has the right infrastructure in the right places, to transport energy from new and decentralised generation sources to new sources of demand. This should go hand in hand with significant investment in the digital and smart systems needed to utilise flexibility and storage to balance demand and supply.

4.1.2. The challenge

Dorset has a highly constrained electricity network across many areas for both demand and generation. This means that new connections on either side are likely to trigger reinforcements higher up the network, which can be very costly, potentially stifling growth and opportunities in the area.

The situation in Dorset is the result of networks having a regulatory barrier to strategically investing in the network to alleviate constraints 'ahead of need'. Instead, the networks only invest in response to specific projects that have triggered issues and are able to pay for network upgrades. In many situations, projects facing these costs do not progress.

Ofgem has started to recognise the barrier that this has caused in the transition to low carbon and the distortion it has caused as the costs are not levied onto customers on the transmission network. Changes are being discussed to remove some of the reinforcement costs from new connections at distribution level from 2023[xix].

4.1.3. Recommendations

Dorset councils or the LEP should engage proactively with the energy networks, in particular Scottish and Southern Electricity Networks (SSEN) along with Western Power Distribution (WPD) and Southern Gas Networks (SGN) to understand the constraints in the area and what investment by network or public funds might be required to unlock these issues.

Within this, it will be important to **develop and share information with the networks about strategic growth areas** where new electrical infrastructure is likely to be required to support net zero energy assets, generation or electrification. For example, the opportunity for hydrogen storage and electrolysis at Portland Port.

There is also a role to **explore how the coordination of projects in one area of the network could be used to unlock future capacity.** For example, the new network infrastructure related to offshore wind or significant solar sites could be built on to alleviate other issues in the area and unlock further sites.

4.2. Smart, local and flexible systems

4.2.1. The opportunity

When operating within constrained areas of the network there is an opportunity, particularly for large energy users, to provide flexibility services to the network, capturing revenues by providing services both to the National Grid and distribution networks to manage their networks within system limits.

These flexible and smart system solutions could help to remove or reduce the cost of network upgrades, in specific areas.

In Dorset, there is an opportunity to work strategically with high energy using industrial sites to identify future requirements (including for decarbonisation and electrification) and to develop whole energy system solutions to unlock the potential of the sites and businesses within them. For example, there may be opportunities to co-locate low carbon generation and storage within the sites and to invest in smart systems, energy efficiency and flexibility to provide additional headroom for growth.

4.2.2. The challenge

The general electricity constraints across the county means that Dorset has a number of key business locations and parks which are currently constrained for additional demand and generation, leading to high costs for new or increased connections.

As businesses expand or move to an area, there are incremental changes to the energy demand which can be costly for individual businesses. There is an opportunity to coordinate the future energy needs of businesses within these industrial sites and use this aggregated demand to work with networks and develop innovative, smart system solutions to help provide the additional energy capacity needed at a lower cost.

Case study: Zero Carbon Rugeley

Rugeley Staffordshire – design stage

Zero Carbon Rugeley is a project to produce an innovative design for a town-wide Smart Local Energy System (SLES). The £3 million Innovate UK-funded project will deliver a detailed design of a smart local energy system for Rugeley, including the 2,300 houses being built in the former ENGIE coal-fired power station and two local business parks.

The project will assess the options for a smart local energy system, using proven digital, smart and low carbon technologies at scale. The user-centric solutions are also aiming to reduce the impact of the development on the local

4.2.3. Recommendations

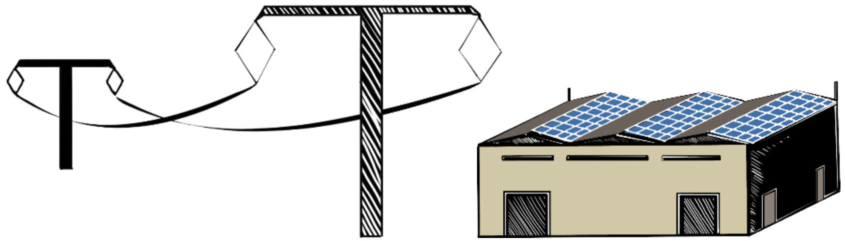
Identify key industrial areas or parks with constraints and explore existing requirements as well as future electrification or decarbonisation of heat, transport and processes.

These solutions should explore:

- **Potential for smart solutions and flexibility in loads** across the area to reduce peak demands.
- Scope the potential total **future electrical loads** through expansion or electrification.
- **Co-location or private wire to low carbon generation** opportunities such as solar, wind, biomass and anaerobic digestion.
- Battery storage or other energy storage solutions to reduce capacity needs.

Examples include:

- **Dorset Innovation Park.** Given the rural location there is an opportunity to invest in biomass generation along with CHP to decarbonise energy and heat for businesses on site as well as alleviate local electricity constraints.
- **Bournemouth Airport.** Constraints could be alleviated with generation on-site, for example installing solar along with battery storage. In the longer term, there would be potential to use solar powered electrolysis to provide green hydrogen to the aviation industry.



4.3. Other opportunities

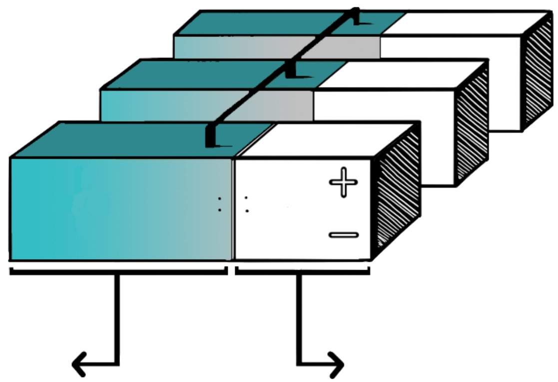
4.3.1. Battery storage

The UK has over 1 GW of operational battery storage, and a huge pipeline of well over 10 GW in various stages of planning. While Dorset has only one significant battery storage project currently in operation, the 15 MW Holes Bay grid flexibility project in Poole, a pipeline of four projects totalling 96 MW have received network connection agreements and could connect in the near future.

The battery storage business model relies on different sources of revenue including co-location with renewable sites, benefitting from electricity price arbitrage, and responding to network and flexibility services. Developing further storage sites is dependent on a combination of network and UK government policy with little input needed at a local or regional level at this stage.

4.3.2. Local flexibility services

SSEN currently have not yet introduced active network management areas in Dorset where they procure services to manage local constraints. It will be important to understand SSEN and WPD's plans in the future and whether there are opportunities for local businesses (including council and public sector assets) to engage in flexibility markets.



4.3.3. New technologies for energy storage

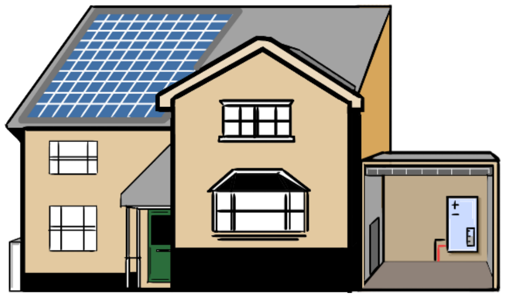
There are a number of emerging technologies for energy storage that could feature in Dorset, most of which are still at demonstration stage.

A particular opportunity that may be relevant for Dorset in the medium and longer term is Compressed Air Energy Storage (CAES), which could use either salt caverns or infrastructure at redundant gas fields[xx].

5. Energy efficiency of buildings

The UK government has ambitions for as many homes as possible to be improved to an EPC C or above by 2035, "where practical, cost-effective and affordable"[xxi]. Energy efficiency is a crucial step to making net zero affordable, as it both reduces energy costs to householders but also significantly reduces the amount of renewable energy required nationally to decarbonise the economy. Energy efficiency is critical for both scenarios calculated for Dorset.

Regen's energy efficiency analysis for SSEN, which covers the majority of homes in the Dorset area, suggests that over 60% of homes would need to install significant energy efficiency measures to achieve the UK government target. These measures would include retrofitting insulation to roofs, walls and floors to ensure that minimal energy is needed to heat (and cool) our buildings.



5.1. Sending a retrofit signal

5.1.1. The opportunity

As well as reducing the cost of energy and heating for residents and businesses over the long term, there are significant co-benefits from energy efficiency improvements. Warmer, healthier homes should mean fewer excess winter deaths, helping address fuel poverty. The jobs and economic activity related to the retrofit challenge could offer a significant new market for large and small businesses across Dorset.

At present, 54% of dwellings in Dorset have an EPC below the C rating category, and thus will need retrofits in the future. With a total housing stock in 2020 of 367,500 households, this means approximately 200,000 will need retrofits.

Following the recommendations listed on EPC certificates for houses with a D rating or lower, it is possible to estimate the total investment that will be required to hit the 2035 target. For all households in BCP the cost of upgrading all properties to C is estimated at £1.5 bn. In Dorset this is £1.8bn, making the total cost across Dorset County £3.3bn. This results in an average of £14,000 worth of energy efficiency improvements in each home.

Using previous studies for the average jobs created per million household retrofits, an estimated 8,900 FTE jobs would be created as a result of these energy efficiency upgrades. There is potential for these jobs to be local, as installation and retrofit work is conducted on-site, however at present many opportunities go to large UK-wide firms.

The total cost of retrofit in Dorset is estimated at £3.3 billion, and the added value from the investment is estimated at £10 billion as a result of the significant savings to the householder.

Table 3. *Cost, GVA and Jobs for retrofits of buildings with an EPC rating lower than C*

	Cost	Gross Value Added	Jobs (FTE)
Building Retrofits	**£3.34 billion**	**£10.02 billion**	**8,922**

5.1.2. The challenge

At present there is a lack of funding and imperative to upgrade homes and commercial premises, both in terms of regulation and the relative price of gas and electricity. This may be starting to change with the upcoming Heat and Buildings Strategy and requirement for all rented properties to be EPC level E or higher.

The lack of consistent demand for energy efficiency measures means that building firms and general builders are not getting a signal to upskill in this area or to invest in accreditation to provide guaranteed services. This has led to a lack of certified skills within the sector to provide insulation and energy efficiency services.

In addition, a lot of the work requires a high level of cost and disruption to householders. There is no current policy from UK government to address the funding challenges following the closure of the domestic green homes grant. However, some of the costs can be mitigated by providing the services at scale and using economies of scale to provide the services across a community or district at lower cost.

In the future, it is expected that whole house retrofit approaches where energy efficiency and low carbon heating are installed across a whole property will become the norm, avoiding more costly, incremental changes. It is likely that the next stage of ECO4 (Energy Company Obligation) funding from 2022 will be more focused on this whole-dwelling approach.

5.1.3. Recommendations

In the absence of UK-wide policy, local authorities could play a significant role in providing the supply chain a demand signal on retrofit through their own procurement processes.

This would include a **combined signal about plans for council-owned buildings**, including council housing retrofitting plans. This signal would need to set clear standards about what is expected in terms of delivery, such as using new PAS 2035 standards and using retrofit coordinators in planning.

There is also an opportunity for the councils to **coordinate the Dorset demand signal for retrofitting services with town councils and other public sector organisations** such as schools, hospitals, and housing associations.

This demand signal should be focused on **procurement processes that prioritise local and SME organisations** to deliver the work. This both supports the local economy and encourages upskilling in the area. In order for this to be successful, there needs to be significant effort put into making the procurement process open to SMEs, potentially targeting the sector in pre-procurement exercises to flag the opportunity and skills that might be needed.

5.2. Other projects

5.2.1. Homeowner or renter guidance

Given the importance of energy efficiency to achieving net zero, it is important to raise awareness of the Domestic Energy Performance Certificates (EPC) and their uses and implications.

Local authorities could be being more proactive about communications in this space to help explain the basic information contained within the certificates, and rights as a tenant to renting a property rated at an E and above.

5.2.2. Local retrofit skills and training

The industry has developed new standards around energy efficiency, including new energy efficiency roles such as a retrofit coordinator. It will be important to signpost local SMEs and building firms to these standards, as well as to training provision such as with the retrofit academy.

6. Decarbonising heat

The future of heat is another key challenge for net zero, with strong links to energy efficiency and minimising the amount of energy we need for heat (and cooling) in the future.

At present, 80% of properties are fuelled by fossil gas and there are few choices for low carbon heating other than heat pumps (either air, ground, water or marine source). Heat pumps are highly efficient, typically using less than a third of the energy of conventional fossil fuelled technologies. Other low carbon options include biomass, biofuels or, in small and efficient buildings, resistive electrical heat.

Hydrogen for domestic and commercial heat is at the stage of feasibility assessment and is likely not to be a viable option until the 2030s and likely after 2035. However, there is also a real risk that the delivered cost of hydrogen will be too high for heat usage, and instead its use will be better focused on harder to electrify sectors, such as heavy transport or industrial processes. Also, unlike heat pumps, hydrogen cannot provide a corresponding cooling solution, which in the face of climate change is an increasing consideration for urban locations and commercial properties.

Costs, jobs and GVA of heating installations were not calculated for this section because many jobs would be for existing heating engineers and are likely to overlap with the overall cost and jobs of building retrofits.

The future progress on heat relies to some extent on a national heat strategy. But in the absence of this national policy direction, there are also some low-risk opportunities for Dorset which are outlined below.

Case study: Shoreham Marine Source Heat

Shoreham Harbour 'Eco Port' - installed 2021

A marine source heat pump services the Maritime House business centre. By designing the system to provide a high temperature flow, the new heat pump connects to the original heating system and installation could be carried out with little disruption.

Erosion from the corrosive sea water and propensity for biological growths can be problematic for marine source heat pumps, but ICAX developed the pump with an abstraction and rejection system to ensure the pump is durable in the marine conditions. The project contributes to Shoreham's EcoPort status.

6.1. Marine Source Heat Demonstrator

6.1.1. The opportunity

A 2015 DECC study identified the Dorset coastal areas as providing a significant opportunity for marine source heat, with the water temperature significantly higher than other areas of the UK during the winter[xxii]. With many urban areas in Dorset situated by the coast, marine source heat could provide an efficient, low carbon solution for heating and heat networks for the county.

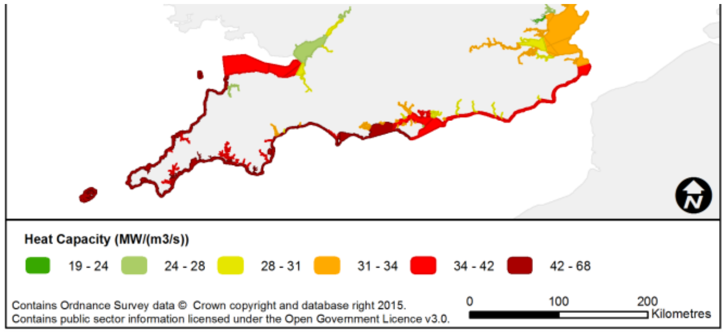


Figure 19 Heat capacity per unit abstraction for coastal and transitional waterbodies

A number of projects have already identified this heat source as an opportunity, including in Shoreham[xxiii], an earlier (though failed) project at Poole Harbour[xxiv] and more recently in the Sydenham's Yard redevelopment (see case study in Section 6.1.3).

Dorset should look to identify and develop a project to demonstrate the potential for marine source heat to decarbonise heating in coastal areas and communities.

Developing an innovative marine source heat project could help Dorset become a hub for this technology and capitalise on the natural advantage of Bournemouth being a 'city by the sea'.

6.1.2. The challenge

As with many low carbon heat solutions, the upfront costs of heat networks and innovative technologies such as marine source heating is often high. Although the running costs will be significantly lower and more efficient than existing fossil fuel systems, payback times for investment can be long. This funding challenge is one where councils could play an important role.

Another challenge will be the multi-stakeholder engagement with the project and the need to coordinate with a wide number of stakeholders and heat users.

6.1.3. Recommendations

In order to take forward this project, it will be important to:

- **Identify potential areas** with both new and existing buildings, which could be related to existing redevelopment activities, such as Poole Harbour Holes Bay or the Town's Fund application in Boscombe. The project should look to serve a number of different heat users in order to maximise learnings and aim for customers in both new and existing buildings.
- **Widen sustainability objectives** in addition to heat decarbonisation, including fuel poverty alleviation, improving air quality and retrofit energy efficiency should help secure government funding sources and grants.
- **Encourage local businesses to be part of the delivery** and supply chain for the project. There are a number of **marine businesses situated in Dorset** that could have existing skills to provide the marine-based planning and infrastructure.
- **Cooperate with the local finance sector hub** in Bournemouth to explore innovative funding models, covering upfront cost and utility heat provision to support further roll out of a marine heat source in other communities.

Case study: Marine source heat at Sydenham's Yard, Poole

Project under construction

A marine source heat source was scoped as a heating solution for the Sydenham's Yard redevelopment. By tapping into the stable sea temperature, an open loop marine source heat pump will be providing heating to the mixed use development Poole, including 350 dwellings over eight buildings.

The new development received planning permission in 2018 and according to BSE3D consulting engineers, who completed the heat pump feasibility study, the scheme is expected to be the largest scale marine source district heating scheme in the UK.

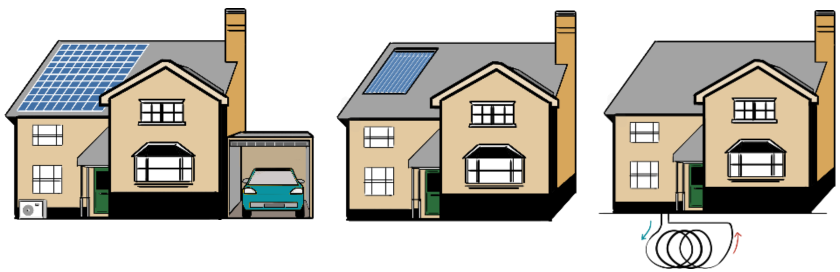
6.2. The Net Zero Village

6.2.1. The opportunity

Dorset has around 18% of homes in off-gas areas and in Dorset Council area this is nearly a quarter (23%). The UK Government is aiming for these homes to be the first to shift to low carbon heating solutions within the 2020s.

In small communities, there is an opportunity to develop a more efficient low carbon solution for heat by taking a 'whole community' approach. This allows both the community and utilities to develop infrastructure to support the whole area, rather than shifting individual properties one-by-one.

An example of this is Swaffham Prior[xxv], a 300-home off-gas community in Cambridgeshire. A heat network run by heat pumps is being installed in 2021 after a three-year development and is providing an opportunity for the residents to switch away from delivered oil and bottled gas. The network will provide low carbon heat at an equivalent price to existing systems.



6.2.2. The challenge

Coordinating a whole community approach to net zero is a significant stakeholder challenge that requires committed communities and individuals within them to drive the project, as well as supportive councils and likely some dedicated paid resources.

A whole system approach to a heating shift could also involve investment in energy efficiency, smart flexible systems such as batteries and renewable generation where possible, which can together work to alleviate fuel poverty and electricity network constraints.

6.2.3. Recommendations

Dorset should look to identify potential off-gas village communities willing to be involved in a project. One community could be chosen for the first stage, to demonstrate the potential for the approach, and then further areas could feature in further stages of a wider roll out.

Next steps would involve:

- Exploring existing schemes to learn from approaches taken in other areas.
- Identify interested off-gas communities, potentially through an application process.

- Fund a feasibility and options process and local stakeholder engagement in a chosen community.
- Explore finance and access to upfront grants and funding.
- Coordinate with the local finance sector in Bournemouth to explore innovative funding models, covering upfront cost and utility heat provision to support further roll out to similar communities.

6.3. Other opportunities

6.3.1. Heat pumps in new homes and developments

From 2025 the Future Homes Standard is expected to stop new build homes from installing natural gas boilers in favour of heat pump technology. Heat pumps are likely to provide the best low carbon heat solution for the majority of new dwellings as they should already be highly efficient.

Even before 2025, however, local authorities can specify heat pumps for new homes through the planning process. This demand for installations will help to build local demand and associated skills for this key low carbon technology.

7. Decarbonising transport

Net zero transport is a two-part challenge. The first part is the technology that will decarbonise existing diesel and petrol fuelled vehicles, and the second is the equally important reduction in mileage through increases in active travel (walking and cycling) and encouraging uptake of public transport.

The second part of this is crucial for net zero and also has the potential to achieve significant co-benefits, including healthy lifestyles, improved air quality, reduced congestion and creating more liveable spaces.

Electric vehicles make up just 0.3% of total cars registered in Dorset. However, 9.5% of new vehicles registered in the 2019 were electric, which is consistent with EV uptake increasing across the UK. This rapid shift is expected to continue, prompted by the UK government ban on sales of new petrol and diesel vehicles from 2030. By 2040, over 80% of vehicles will be electrified.

The jobs and GVA involved in this shift are difficult to calculate but it is expected in result in retraining of mechanics and garages, and a shift in business models for vehicle refuelling from petrol station to electric charging stations.

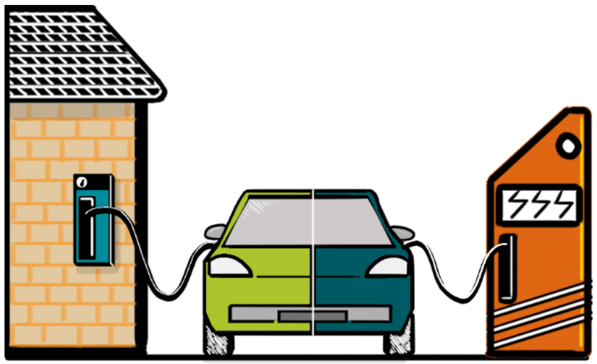
7.1. Filling gaps in public charging

7.1.1. The opportunity

There are 164 public electric vehicle chargers installed in Dorset, of which 38 are rapid chargers. 32 new chargers, including 9 rapid chargers, were installed in 2020. Proportionally, there are 21 chargers for every 100,000 residents, which is less than the national average of 32 chargers for every 100,000 residents.

It is important that Dorset helps to accelerate EV transition in the county, while benefitting from associated reductions in air pollution.

In Dorset, the public infrastructure also needs to support seasonal tourism and tourist destinations that might experience peak charger usage rates in the summer months.



7.1.2. The challenge

Many EV owners are expected to mainly charge vehicles at home, but those travelling long distances and those without off-road parking such in urban centres will rely on public EV charging infrastructure.

Although the private sector is likely to develop business models that deliver the majority of these solutions, it is likely that there could be gaps in provision in low income areas or areas with seasonal tourists, where the market is not consistent enough to initially support private investment.

7.1.3. Recommendations

Working together with the private sector, local authorities can develop a public EV charging offering and particularly identify and fill gaps in provision to support local needs.

Another key area would be in working with tourist destinations to help ensure there is EV charging infrastructure to support sector with highly seasonal demand.

Electric vehicles, although around four times more energy efficient than existing internal combustion engine vehicles, are still expected to put pressure on the electricity networks in some areas. There will be a need to work with networks to identify the best locations for charging solutions.

Case study: Eco charging hub

Blanford Hill – construction planned for 2023

Combining a 15 MW solar PV project and 3 MW of battery storage with EV charging, the Eco charging hub plans to host 12 rapid electric vehicle chargers. It will also have a small café and shop for use whilst charging. The project will also carry out landscape and ecological enhancement to the site. The hub will connect to the local electricity network 2 km from the site. The site is off the A356, 5km from the A35. The project notes the high solar irradiance within Dorset as a factor in its location.

The plans, developed by Naturalis, if approved, would be built and operated by Falck Renewables.

7.2. Bus decarbonisation strategy

7.2.1. The opportunity

Decarbonising buses will have an important role in net zero, both to reduce carbon emissions and air pollution from the sector as well as encouraging a shift towards public transport. The Dorset area has a number of operating bus networks, including First Bus, More Bus and Yellow Bus.

Electric buses are already in production and usage across the UK. Dorset operator First Bus have, for example, committed to a net zero fleet by 2035 and purchasing no further diesel buses after 2022. For operators, electric buses have lower operating costs than diesel in terms of fuel, and the buses also lower maintenance costs. For passengers, the technology offers a quieter and smoother journey.

Within Dorset, there is an opportunity to encourage this sector to decarbonise and to coordinate energy infrastructure to support this shift. There will be economies of scale by combining approaches across the county and coordinating charging infrastructure.

7.2.2. The challenge

At present electrification is looking to be the best solution for buses, though other low carbon options are available, including biofuel and potentially hydrogen.

However, the issue for bus companies is not just the technology within the vehicles, which are more costly upfront despite lower operating costs, but importantly the infrastructure challenges for moving to a low carbon fuel, including the space and electrical capacity to provide rapid chargers at electrified depots.

7.2.3. Recommendations

A coordinated approach to bus electrification could be an important Dorset-wide project for net zero, and could include:

- Work on a bus decarbonisation strategy in conjunction with the Dorset bus operators, including making a commitment to the date for phasing out diesel and petrol vehicles.
- Support bus companies with energy infrastructure to facilitate decarbonisation change by coordinating with network operators.
- Use the decarbonisation of the sector to support bus transport as a mode choice for the public.

7.3. Other opportunities

7.3.1. Supporting active travel

Promoting walking and cycling over local car journeys is key to reducing the energy used in transport.

Local areas should continue to invest in street layouts that encourage walking and low-traffic neighbourhoods as well as investing in off-road cycling infrastructure to encourage a modal shift.

7.3.2. Agriculture

Agriculture has long shaped Dorset's landscape, with c. 77% of the land being farmed. This also poses a decarbonisation challenge as agricultural vehicles and machinery are large emitters of carbon dioxide and greenhouse gases. Although hydrogen could be an opportunity for this sector, nearer term opportunities for decarbonisation remain with biofuels and on-farm anaerobic digestion.

7.3.3. Rail

National Rail is considering three main ways of decarbonising rail traction – overhead electrification, batteries, and hydrogen fuel cells. Hydrogen can potentially offer a better value for money than electrification in areas of the network where fewer trains run.

The main London-Weymouth route is already electrified and at present the National Grid decarbonisation plan[16] have provisionally labelled the diesel service from Weymouth to Bristol for battery provision, potentially a hybrid system, so trains can run on electrified track where available. This is still open to consultation and there is an opportunity for hydrogen trains in Dorset in the longer term.

Battery hybrid trains may also be an option for the Wareham – Swanage heritage line which may allow current electrified services to run directly from London to the popular tourist destinations along the heritage line, removing some seasonal road traffic.

Dairy farm biomethane production

Cornwall – pilot project with 1 of 6 pilot sites under construction

As part of Cornwall Council's Climate Action Plan, captured biogas produced by small off-grid dairy farms is to be regularly collected from the sites, processed and sold locally. It is envisioned that it will be used to power all 77 of Cornwall Council's road maintenance trucks and is also being trialled in tractors. Waste is also used to make soil conditioner which replaces the need for artificial fertilizer and stores carbon in the soil. The pilot is run by Bennamann.

Appendix note on costs, jobs and GVA: methodology and assumptions

Regen has used existing multipliers and data to estimate how much investment is likely to be required and the associated local jobs and Gross Value Added for each technology, as an indicator of the total economic benefits of an investment. The technologies with sufficient data for these calculations were: Large-scale and small-scale solar PV, offshore wind and housing retrofits. There was not sufficient information to confidently estimate these numbers for low carbon transport, hydrogen and low carbon heating.

- **Estimated costs**

Costs for low carbon sources of generation were estimated based on future prices under a medium price reduction scenario. Data on costs by electricity source was provided by the BEIS Electricity Generation Costs 2020. Installation costs were considered, as well as operations and maintenance costs for solar and wind estimates. Operational and maintenance costs were excluded from the buildings cost estimates, as these are less understood and minimal. Pre-development costs for offshore wind were included as they form a significant part of the total project costs. Pre-development costs were however not included for building retrofit, heating and solar calculations, as these are minimal.

- **Jobs**

To calculate the approximate Full Time Equivalent (FTE) jobs associated with an investment, an average 'jobs per MW' multiplier was used from a number of data sources. Sources with unusually high or low estimates of jobs/MW of installed capacity were excluded to remove outliers. The study only calculated direct jobs such as those related to maintenance and installation, as these are the jobs that are could be local to Dorset. While some manufacturing jobs will be in the UK, the majority of these will be located in the north of England and the Midlands, and therefore these have been excluded from the estimate for jobs local to Dorset.

The FTE multipliers used in this analysis refer to the number of jobs that are created over the lifetime of the project. In reality, many of the years of employment associated with a project would occur in the near-term, when the project is developed and constructed.

- **GVA**

For the GVA calculations, a similar multiplier approach was taken by analysing several sources to understand the typical GVA per £ of investment. To calculate the GVA of building retrofits, an assumption of £3 GVA for every £1 invested was used, based on current studies. A multiplier of £1.1 million for every MW of added capacity has been used to calculate the GVA for solar projects.

- **Sources for jobs and GVA calculations**

To derive the multipliers used to derive employment and GVA figures for each technology, an average of the most reliable and relevant sources was taken. Some representative examples are presented here:

- Okkonen, L.; Lehtonen, O. *Socio-economic impacts of community wind power projects in Northern Scotland.* https://daneshyari.com/article/preview/6766901.pdf
- Solar Power Europe 2017, *PV Jobs & Value Added in Europe* https://www.solarpowereurope.org/wp-content/uploads/2018/08/Solar-PV-Jobs-Value-Added-in-Europe-November-2017.pdf
- The Energy Efficiency Infrastructure Group 2020, *Energy efficiency's offer for a net zero compatible stimulus and recovery* https://www.theeeig.co.uk/media/1096/eeig_report_rebuilding_for_resilience_pages_01.pdf

Endnotes

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[i] Ecuity, 2020 *Local green jobs accelerating a sustainable recovery*
[ii] https://www.renewableuk.com/news/534792/Energy-Minister-says-expanding-UK-offshore-wind-supply-chain-is-key-to-economic-growth-.htm
[iii] The Carbon Brief, 2019 *Analysis: Record-low price for UK offshore wind cheaper than existing gas plants by 2023*
[iv] BEIS, *2019* *Offshore wind: a global industry investing in the Isle of Wight*
[v] Carbon Brief, 'Hydrogen 'required' to meet UK net zero goals, says National Grid', July 2020_
[vi] Committee on Climate Change, Hydrogen in a low carbon economy, November 2018
[vii] Committee on Climate Change, Net Zero Technical Report, May 2019.
[viii] HM Government, UK Energy White Paper, December 2020
[ix] Wood Mackenzie *Hydrogen production costs to 2040: Is a tipping point on the horizon?*
[x] https://ieefa.org/green-hydrogen-to-be-cost-competitive-by-2030-bloombergnef/#:~:text=Green%20hydrogen%20to%20be%20cost%2Dcompetitive%20by%202030%E2%80%94BloombergNEF,-Facebook%20Twitter%20LinkedIn&text=A%20new%20report%20is%20raising,types%20in%20the%20next%20decade.
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[xiii] D.J. Evans and S. Holloway, A review of onshore UK salt deposits and their potential for underground gas storage, 2009
[xiv] Element Energy, 2019 *Hy-Impact Series Study 1: Hydrogen for economic growth Unlocking jobs and GVA whilst reducing emissions in the UK*
[xv] Dorset Council, Renewable energy technical paper
[xvi] Argonne National Laboratory & US Department of Energy, 2019 *Total Cost of Ownership (TCO) Analysis for Hydrogen Fuel Cells in Maritime Applications – Preliminary Results*
[xvii] https://www.greencarcongress.com/2021/04/20210407-bnef.html
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[xx] https://www.researchgate.net/publication/330484190_Reusing_Abandoned_Natural_Gas_Storage_Sites_for_Compressed_Air_Energy_Storage
[xxi] https://publications.parliament.uk/pa/cm201719/cmselect/cmbeis/1730/173005.htm
[xxii] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/416660/water_source_heat_map.PDF
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[xxiv] http://www.ptep.co.uk/
[xxv] https://heatingswaffhamprior.co.uk/