Dorset Low Carbon Energy Route Map and Evidence Base

Energy opportunities for decarbonising Dorset

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1. Executive summary

Energy is at the heart of the UK's net zero challenge, which means the sector is also at the heart of the opportunities this transition will bring. This document sets out where Dorset is now, and the level of decarbonisation that is needed over the next three decades if Dorset is to play its part in delivering the UK's net zero carbon 2050 ambition.

This route map builds on the 2019 South West Energy Strategy to document the opportunities and natural advantages which could place Dorset at the forefront of the net zero transition, while at the same time driving a local green economy, creating new jobs, and supporting the area's economic and industrial strategy.

A potential leader...

Dorset is a unique microcosm of future energy opportunities, boasting significant potential in all key low carbon energy sectors, from solar PV and offshore wind to hydrogen and energy storage, as well as having potential for onshore wind, marine energy, nuclear and bioresource. The historic onshore oil and gas production in the region, and salt caverns underlying Portland, offer opportunities for hydrogen, carbon and energy storage that are unique in the South of England. These important natural advantages mean that the area has real potential to be a leader in a net zero energy system.

In addition, the area has many of the key sectors that can both benefit from, and help drive, the transition. This includes two international ports, an airport, a defence cluster with marine engineering expertise, universities leading on net zero innovation and skills, agriculture for bioenergy and sustainable food and more. Dorset has the opportunity to be an exemplar area demonstrating the possibilities of a healthy, green, sustainable economy to the many millions of visitors arriving each year.

...with a long way to go

As well as unique opportunities, Dorset faces the same significant challenges as the rest of the UK in decarbonising heat and transport. Heating of homes and businesses is dominated by natural gas and almost all vehicles are fuelled by petrol and diesel. Over the next thirty years, every building will need to be heated by a clean, low carbon heat source and nearly every vehicle, including marine and agricultural vehicles, will need to become low carbon.

Despite excellent renewable resources, only solar PV has seen any significant uptake in the area. As of 2019, Dorset met only 5% of its energy demand through local low carbon energy generation (in comparison, Cornwall met almost 10%), and by 2050 a much higher proportion of Dorset's impressive resources will need to be harnessed, in order for the UK to achieve net zero by 2050.

The key challenge for the LEP and councils will be to help develop the right infrastructure to support the area's energy potential. Dorset currently faces almost universal electrical network constraints which need to be addressed urgently to avoid impacting both the speed of decarbonisation and associated green growth economy.

Dorset's route to Net Zero

Opportunities unique to Dorset

Generation and storage

2020

- No diesel generation by 2025
- Dorset generates 500 GWh of low carbon electricity, of which 80% is solar PV. This is 5% of Dorset total energy demand.
- 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
- No unabated gas-fired power stations.
- 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.

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

2. Where Dorset is now

Much of Dorset's energy use is typical of the UK and is heavily dominated by fossil fuels. Energy efficiency has made an impact over the last decade, somewhat reducing usage of gas and electricity in buildings, but transport energy demand remains largely unchanged.

Total energy demand per person in Dorset is 23 MWh. 74% of this demand is met through fossil fuels, predominantly natural gas for heating and petroleum for vehicles.

As of 2018, Dorset met approximately 5% of its total energy demand (and 22% of just electricity demand) through local low carbon energy generation, mostly in the form of solar PV and bioenergy.

In a net zero world, all of Dorset's energy demand will either need to be avoided, or met using low carbon electricity, low carbon hydrogen or biofuels. As a result, seismic shifts are required in how much energy is consumed, and how that energy is produced.

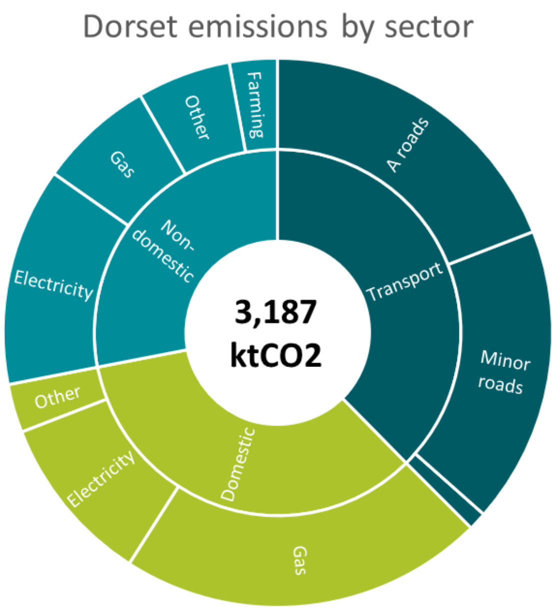
Through significant changes to energy efficiency of homes and businesses and shifting to highly efficient electric vehicles and electric heat pumps, combined with utilisation of Dorset's high levels of renewable energy resources such as offshore wind, it is possible for the area to contribute more low carbon energy than it consumes (see section 4.1).

2.1. Overall energy use

Using the latest available data from 2018, Dorset's energy use totalled 13,803 GWh, including 4,782 GWh from gas, 3,103 GWh from electricity, and 5,328 GWh from petroleum, mainly for transport. Energy consumption has decreased steadily over the last decade, with total demand over 7% lower than in 2010.

Prior to the Covid-19 pandemic, there had been no significant change in domestic electricity, gas or transport energy use over the last few years, but non-domestic gas consumption decreased significantly in Dorset, with a 9% drop in 2018 alone. The impact of Covid-19 is as yet uncertain, but it is likely that usage will return to pre-pandemic levels in the absence of any significant government policy to avoid this.

The carbon emissions associated with energy use from all sectors amounted to 3,187ktCO2 including 729 ktCO_2 from electricity, 900 ktCO_2 from gas, and 1,197 ktCO_2 from Transport. There is a small net reduction in emissions of 115 ktCO2 from land use and forestry. Regenerative agricultural and nature-based solutions could significantly increase this contribution. Annual average emissions per person in 2018 were 4.0 tonnes of CO_2, which is lower than the UK average of 5.8 tonnes.



2.2. Current energy use in buildings

Around 15% of Dorset homes are connected to a low carbon heating source, though mainly in the form of resistive electric heating, which can be an expensive form of heating. 80% of homes are heated by natural gas, and 5% are heated by oil, LPG or solid fossil fuels. In non-domestic properties, around half are on-gas and the remainder are predominantly heated via resistive electric heating.

Regen's analysis suggests that around 34% of Dorset homes have an Energy Performance Certificate (EPC) rating of A, B, or C, compared to 55 % for non-domestic properties. Only 5% of homes have an EPC rating of a B or better. This is broadly in line with the UK average and highlights the scale of the energy efficiency challenge.

By the mid-2030s, it is likely that all homes will be required to achieve an EPC C or above where practicable, which would therefore require improvements to the majority of the 66% of homes that currently fail to meet this standard. According to the Climate Change Committee's 6th Carbon Budget, non-domestic properties may be expected to achieve this even sooner, by 2030 or 2032.

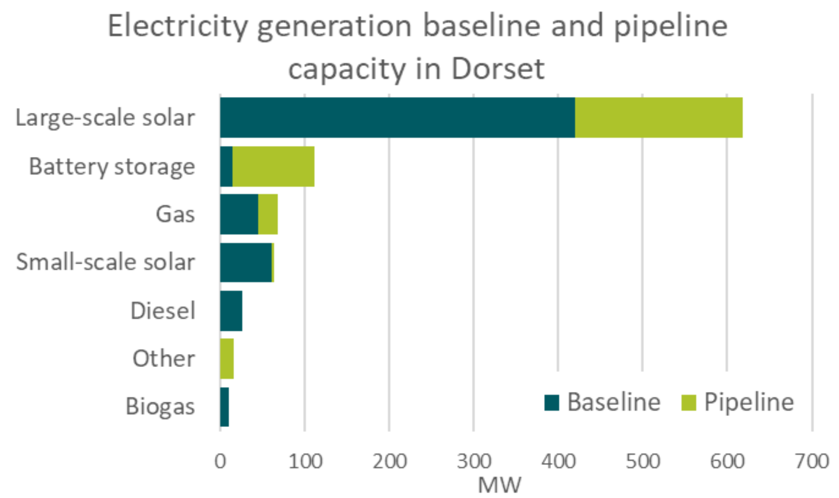
2.3. Current generation and storage

Installed renewable capacity is dominated by solar PV, with a total capacity of 480 MW, including 420 MW of ground-mounted solar and 60 MW of rooftop solar. This accounts for 98% of low carbon generation capacity in Dorset. In comparison to comparable regions of the UK: Cornwall has a combined solar capacity of 534 MW, while in Devon, solar capacity amounts to 236 MW.

Despite having substantial onshore and offshore wind resource, there is no large-scale wind energy currently in Dorset. Other significant generation includes the 45 MW gas-fired Chickerell Power Station, and 26 MW of diesel generation. The Wytch Farm oil field produces approximately 14,000 Barrels of Oil Equivalent per day, which is equivalent to 6.1 kt of CO_2e daily, or 2,226.5 kt CO_2e per year. This is equivalent to 73% of Dorset's total carbon emissions in 2018.

Assuming typical load factors, renewable energy generation in Dorset currently totals around 685 GWh per year, including 512 GWh of electricity and 173 GWh of heat. This equates to around 22% of electricity consumption, but only 5% of total energy consumption.

According to connection registers from the area's electricity network operators, 197.2 MW of solar PV capacity has been accepted to connect to the distribution networks in the next few years, alongside 111 MW of battery storage, 23 MW of gas peaking plant and 16 MW of other generation, most notable as proposed energy from waste facility. Not all pipeline projects will be built, but the current pipeline shows a move towards large-scale, subsidy-free solar farms and battery storage, either co-located with solar generation or as standalone projects.

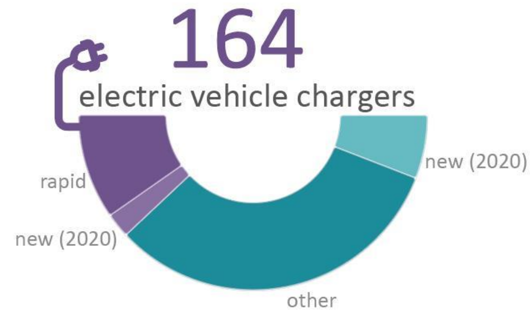


2.4. Current energy use for transport

In total, road vehicles covered 3,912 million miles across Dorset, this included cars (81%), light goods vehicles (16%), heavy goods vehicles (2%) and buses (0.3%). On average, each person travelled 126 bus miles in 2019/2020 compared to 4,096 car miles. This means that passenger bus journeys account for 3.6% of all personal road transport.

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, this is consistent with EV uptake increasing across the UK.

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.



2.5. Energy Infrastructure

Figure 1 shows the main energy infrastructure in Dorset including the gas, electricity, and oil networks. Much of the electrical infrastructure in the area is constrained, this means that new connections, generation or demand can incur high costs.

At present on the distribution network, new connections are required to pay part of the cost for network reinforcement 'triggered' by a new connection. This is not the case at the higher voltage transmission network. Ofgem are currently reviewing this 'connection boundary' and changes may be announced this year that will reduce or remove this requirement.

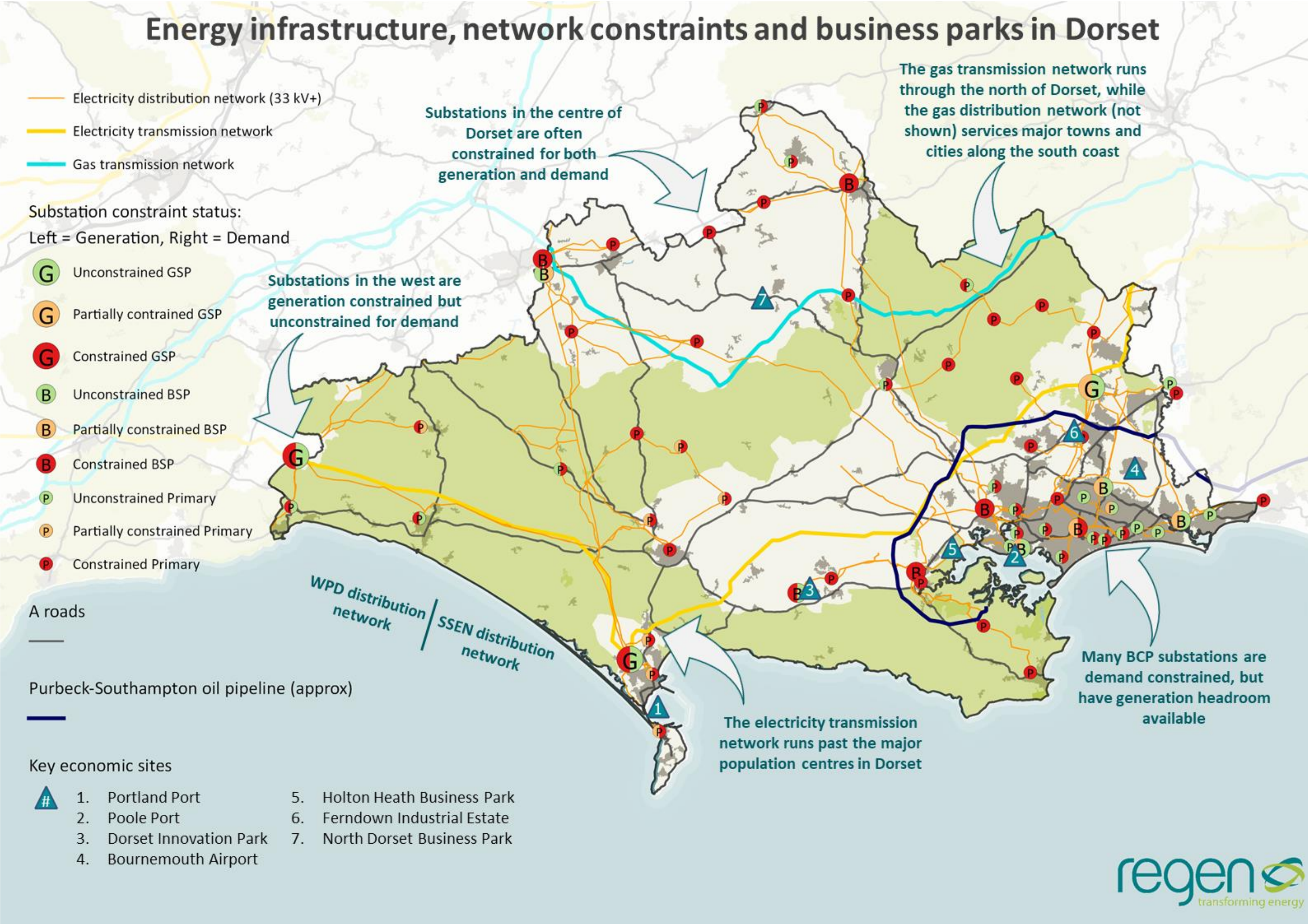


Figure 1 - Summary map of Dorset's energy infrastructure, highlighting the level of constraint on the electricity network.

3. Dorset's low carbon resources

Dorset's impressive natural resources means it has significant potential for low carbon energy production through solar, wind, marine, nuclear and bioenergy. While current low carbon energy generation is predominantly solar PV, there is clear scope for Dorset to host a wide variety of renewable and low-carbon technologies. The key areas of low carbon resources and existing projects are illustrated on the summary map in Figure 2. Section 4 uses the resource assessment from this section to produce net zero scenario projections.

3.1. Solar resources

The vast majority of Dorset's existing 491 MW of low carbon generation is from solar PV, both rooftop solar on homes and businesses, and larger ground-mounted solar farms. The area has strong irradiance and land area and therefore would be expected to host large amounts of solar PV in any future net zero scenario.

3.1.1. Ground-mounted solar PV

Dorset has high levels of solar irradiance compared to the rest of the UK, as well as a large amount of developable low grade agricultural land and therefore is very attractive for solar farm developers, where network and planning considerations are not restrictive.

Resource is greatest in the south-east and north of the area, which are rural areas that are not within the Dorset or Cranborne Chase AONBs. This is reflected in the distribution of existing sites, which are mostly in the band of resource in the south-east of Dorset.

It should be noted, however, that there are a number of existing sites located within the AONB boundaries, and AONB status should not be considered as a hard constraint on solar project development.

Regen's resource assessment, which accounts for key technical, network and planning considerations, identifies 62,000 ha of land area that could potentially be suitable for large-scale solar PV – only 4% of this would be needed to meet the net zero scenario projections of 1200 MW.

3.1.2. Rooftop solar PV

Analysis of Ordnance Survey data suggests there is over 2000 ha of potential roof area for rooftop solar in Dorset area, with almost 700 ha on domestic houses alone. Between 7% and 11% of existing roof area would be needed to meet the net zero scenario projections. Even if small-scale solar were restricted to domestic houses and bungalows, only 25%-35% of suitable roof area would be needed in the net zero scenarios.

3.2. Wind resources

3.2.1. Onshore wind

Onshore wind has historically seen minimal development in the area, with no large-scale sites, though the 9.2 MW Alaska Windfarm in East Stoke is expected to be built shortly. The presence of protected areas across Dorset and a need to avoid built-up areas for larger turbines, means that onshore resource is limited to select areas of higher windspeeds. The majority of opportunity is located between Bournemouth and Dorchester, and east of Yeovil. The area around Portland has high wind speeds, but potential is limited by the presence of buildings and protected areas. The AONBs that make up a large part of the land area in Dorset are considered hard constraints on onshore wind development.

Regen's resource assessment, which accounts for key technical and planning considerations, has identified 25,000 ha of land area that could potentially be suitable for onshore wind, representing a total potential of 1.3 GW – local scenario projections suggest an installed capacity of up to 100 MW would be in line with the UK's net zero ambitions, given the lack of existing onshore wind projects in the area. A similar GIS-based study for Dorset Council found a total capacity potential of 1.1 GW in the Dorset County area alone.

3.2.2. Offshore wind

There is significant resource available for offshore wind off the coast of Dorset and the Isle of Wight. Previous plans from 2010-2012 suggest an opportunity of around 1,000 MW to the west of the Isle of Wight.

Offshore wind technology have advanced dramatically in the last few years with significant decreases in cost. This may mitigate some of the issues with the earlier proposal in this area. The resource area presents an important opportunity for Dorset in the future and with the opportunity to use deeper water technology to locate projects further offshore, mitigating visual impact. However, the presence of a Marine Protection Zone to the south of the resource area could limit the potential to take advantage of these improvements.

3.3. Low carbon gas resources

3.3.1. Green gas

There are currently 12 green gas projects in the area, ten of which produce electricity and heat on site using CHP, and two also injecting biomethane into the gas distribution network. These projects represent less than 1% of UK green gas production and are mainly fed by crops such a maize/beet (39%), food waste (29%) and manure (19%). Overall bioenergy production across all feedstocks and uses is difficult to quantify, but a reasonable estimate for Dorset would be around 1,000 TWh per year, 1% of UK indigenous bioenergy production.

Green gas can be produced from arable crops, livestock waste and residential/commercial sewage. The Dorset area contains around 2.4% of UK cattle, 1.5% of UK farmed area and 1.2% of UK population. The presence of these feedstocks suggests there is some further potential for new sites which may be developed as negative-emission bioenergy with carbon capture and storage. Scenarios by the CCC suggest the UK's indigenous bioenergy production could increase to 1.5-2 times current levels by 2050.

3.3.2. Hydrogen

Future low carbon hydrogen production in the UK could occur in two forms: 'blue hydrogen', produced through reformation of natural gas along with carbon capture and storage, or 'green hydrogen' produced via electrolysis using low carbon electricity. There is also potential for the UK to import hydrogen from overseas, similar to gas imports today.

The potential for green hydrogen in Dorset is directly related to the potential for low carbon electricity generation such as solar PV and wind. Green hydrogen production could become attractive to solar and wind developers in the future either to avoid constrained areas of the electricity network and/or to provide an alternative revenue stream for projects. A recent planning application from Canford Renewables Energy is proposing a first-of-its-kind solar PV and hydrogen electrolysis project.

Blue hydrogen production is dependent on suitable carbon capture and storage facilities in the vicinity of the hydrogen production. Typically, offshore oil and gas fields in the North Sea and Irish Sea are seen as most favourable for carbon storage. However, the Wytch Farm oil field, has been identified as one of the only onshore oil fields that may be suitable for carbon storage and there may also be potential to reuse oil infrastructure for hydrogen or carbon capture in the future, such as the Purbeck-Southampton oil pipeline.

3.4. Other low carbon resources

3.4.1. Marine energy

There is no wave or tidal range resource in the area, but a zone of potential tidal stream generation has been identified off Portland Bill – a 30 MW site was proposed in 2014 but so far marine energy has not developed to be commercially viable. The site is stated as 'in development' by developer Simec Atlantis.

3.4.2. Nuclear

The recently decommissioned Winfrith Atomic Energy Establishment hosted testing for nuclear reactor designs between 1959 and 1990, with a reactor providing 100 MW of power to the National Grid. Some future energy scenarios feature up to 25 small modular nuclear reactors of around 500 MW capacity located around the country. Currently small modular reactors are not yet a commercially viable proposition, and no decisions have been made on where the most suitable sites may be located.

3.4.3. Large-scale energy storage

Dorset sits within the Wessex Basin, a geological area that contains underground salt caverns. These salt caverns were close to being developed as natural gas storage by Portland Gas Storage Ltd. in the early 2010s, after being granted planning permission in 2008, but failed to secure funding. More recently, the Wessex Basin salt caverns were identified by Element Energy as potential hydrogen storage in a report for BEIS, with an estimated potential storage capacity of 227,000 GWh. Salt caverns have also been identified for potential large-scale, long-term energy storage through Compressed Air Energy Storage (CAES).

3.4.4. Geothermal heat

The geology of the underlying Wessex Basin hosts deep aquifers that can be accessed to provide low grade heat for heat networks. This has been accomplished in Southampton, where the Southampton District Energy Scheme supplies heat to over 1,000 domestic and commercial properties. Depending on more in-depth study of the strata underlying major population centres in Dorset, the geothermal resource of the area may be exploitable in a similar fashion.

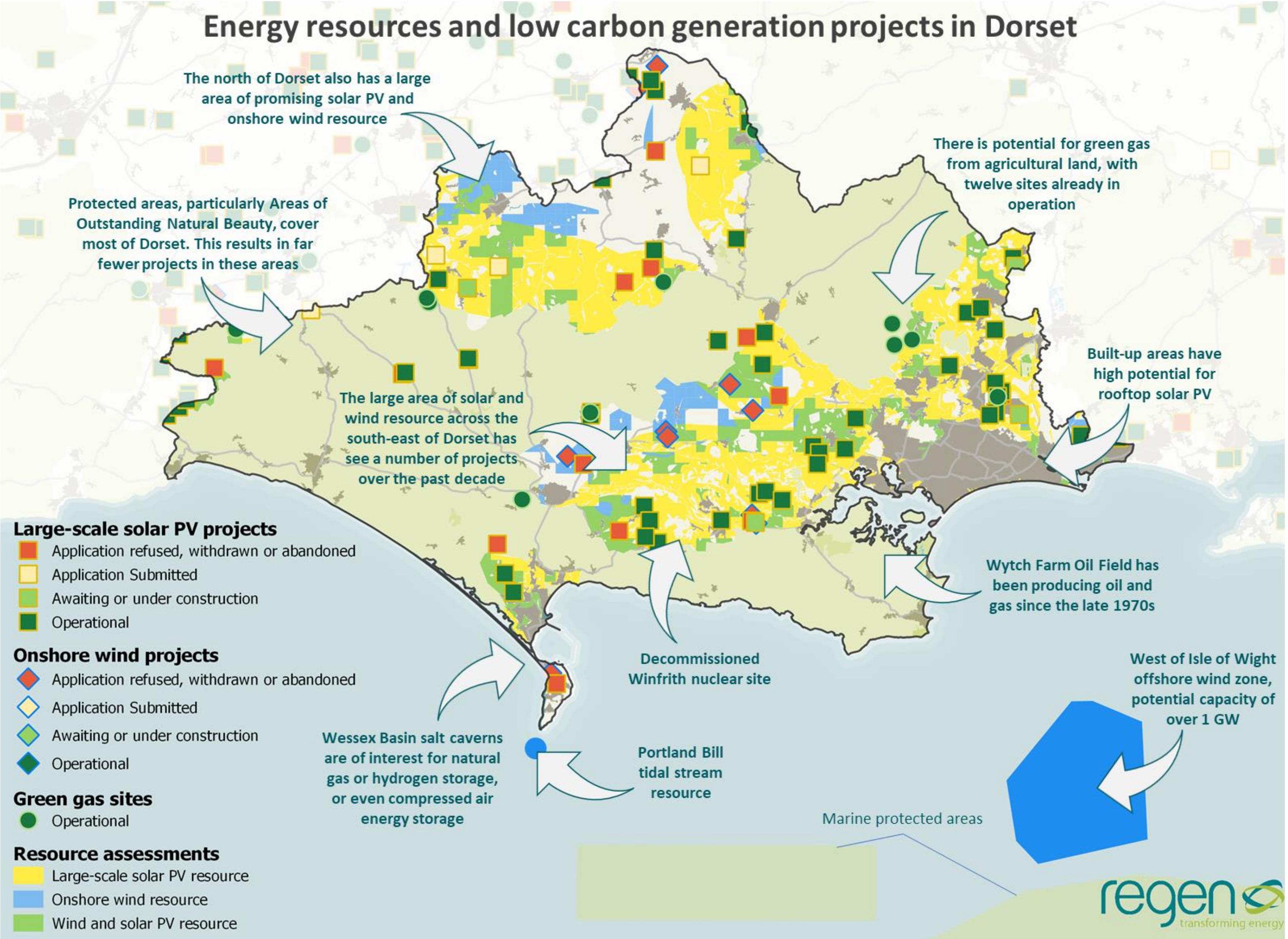


Figure 2 - Summary map of Dorset's energy resources, highlighting existing and proposed projects and key resource areas and constraints.

4. Where Dorset needs to get to

The UK Government has committed to achieving net zero carbon emissions by 2050 and in April 2021 to reducing emissions by 78% from 1990 levels by 2035. The UK reduction is currently 45%. In response to this, the Committee on Climate Change (CCC) and National Grid have both set out clear pathways for how the UK could be able to decarbonise by 2050.

Dorset Council and Bournemouth, Christchurch and Poole Council, which make up the Dorset LEP area, have both announced ambitions to decarbonise their operations and wider areas of influence ahead of the UK 2050 target.

This section details two pathways to net zero emissions for Dorset: The Net Zero – Electrification scenario, in which decarbonisation of heat, transport and industry is dominated by electrification and a 1 GW offshore wind farm is built, making Dorset a net energy exporter, and the Net Zero – Hydrogen scenario, in which hydrogen has a more significant role in decarbonisation, especially for domestic heat and Dorset relies on energy imports for c. 50% of demand. The key differences and similarities are summarised in Table 1.

These scenarios are aligned to national pathways from National Grid and the CCC and are presented against a contrasting 'non-compliant' scenario that fails to achieve climate obligations. The scenarios outline the key shifts that could occur over the next three decades, as well as some of the major uncertainties.

Both net zero scenarios culminate in the eradication of unabated fossil fuel consumption for buildings, transport and electricity generation across the area.

Table 1 - Key differences and similarities between the Dorset net zero scenarios.

<table>
<tr><th>Sector</th><th>Net Zero - Electrification</th><th>Net Zero - Hydrogen</th></tr>
<tr><td rowspan="3">Power</td><td colspan="2">High levels of solar PV capacity, both ground-mounted solar farms and rooftop solar arrays.</td></tr>
<tr><td>Dorset's offshore wind resource is developed, helping to mitigate the additional electricity demand for heat.</td><td>Dorset's offshore wind resource is not developed, as a higher proportion of energy consumption is met by hydrogen.</td></tr>
<tr><td colspan="2">Gas and diesel generation decommissioned over time.</td></tr>
<tr><td rowspan="3">Buildings</td><td>Currently on-gas buildings decarbonised through electric heat pumps</td><td>Most on-gas building heat decarbonised through hydrogen.</td></tr>
<tr><td colspan="2">Most off-gas buildings decarbonised through heat pumps</td></tr>
<tr><td colspan="2">High levels of energy efficiency required</td></tr>
<tr><td rowspan="2">Transport</td><td colspan="2">Almost all cars, LGVs and buses powered by electricity by 2040, with the remainder fuelled by hydrogen.</td></tr>
<tr><td>55% of HGVs electrified</td><td>30% of HGVs electrified</td></tr>
<tr><td>Industrial</td><td>Industrial gas, oil and coal consumption electrified where possible, hydrogen and biofuel used where electrification is unsuitable.</td><td>Industrial fossil fuel consumption mainly replaced by hydrogen, with some electrification and biofuel.</td></tr>
<tr><td rowspan="2">Agriculture</td><td colspan="2">Agricultural machinery fuelled by hydrogen, electricity and biofuels by 2050.</td></tr>
<tr><td colspan="2">Increasing afforestation and land restoration to improve carbon sequestration.</td></tr>
</table>

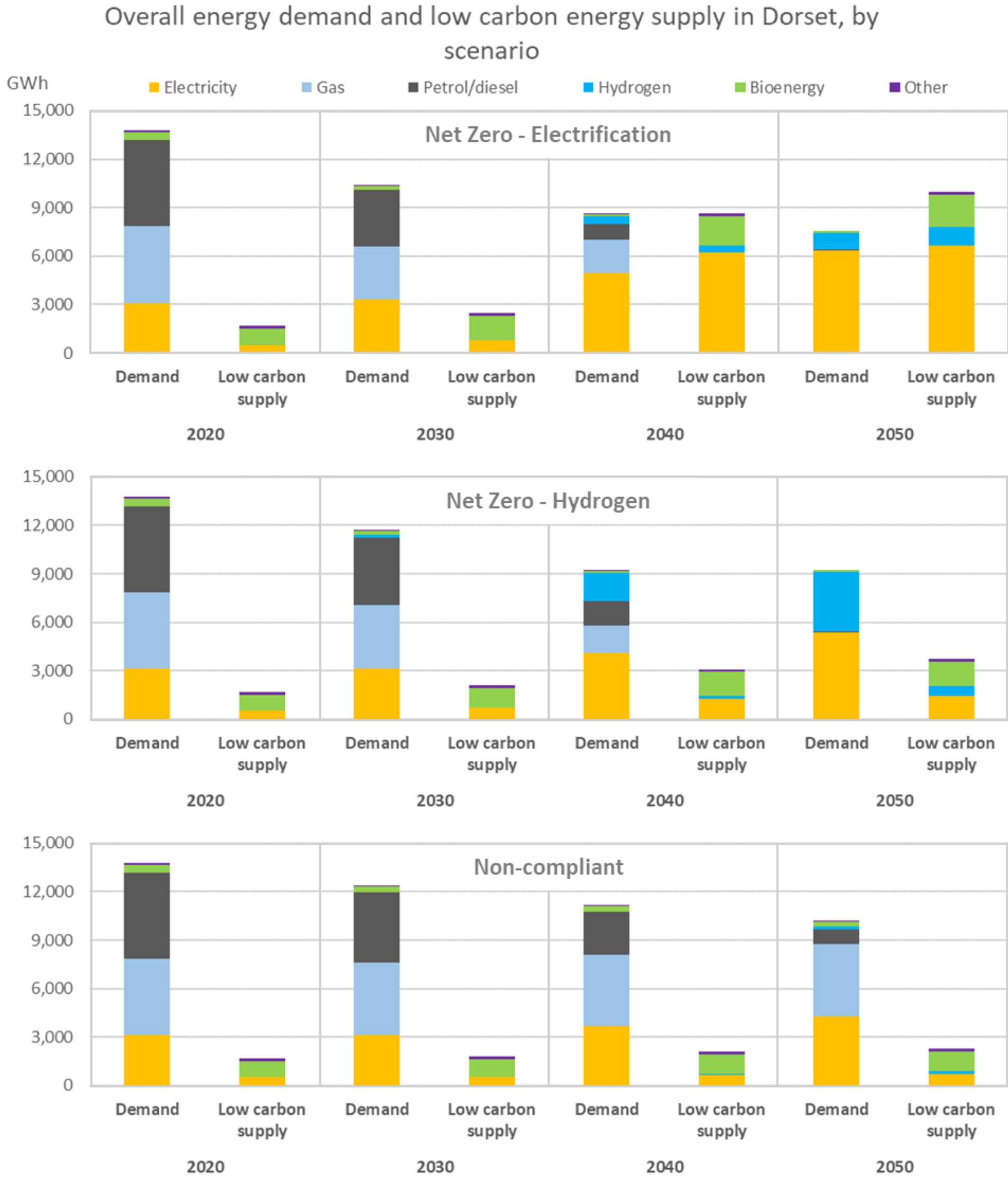
4.1. Future energy use

Total energy demand across Dorset currently totals 13,800 GWh, with low carbon generation providing less than 700 GWh – just 5% of current demand. In net zero future energy scenarios, demand and supply change dramatically as Dorset and the rest of the UK become net zero carbon by 2050. Currently, 73% of energy demand is met through fossil fuels.

In the net zero scenarios, this fossil fuel demand is either avoided through energy efficiency measures or met through alternative low carbon fuels such as electricity, hydrogen and bioenergy.

Importantly, electric vehicles and electric heat pumps are around four times as efficient compared to their petroleum vehicle and gas boiler counterparts. As a result, when combined with high ambitions for domestic and non-domestic energy efficiency, both net zero scenarios see much lower total energy consumption over the coming decades. By 2050, overall energy demand in the scenarios is between 55% and 67% lower than the existing baseline.

In all scenarios, electricity demand and generation increase, while petrol/diesel consumption reduces to almost zero. Total energy demand delivered through natural gas reduces to zero in Dorset in both net zero scenarios. In the Net Zero – Hydrogen scenario, 69% of current natural gas demand is replaced by hydrogen.



As Dorset is not an energy island, low carbon supply does not have to match demand in order for net zero to be achieved. However, comparing total demand with low carbon generation can be a useful metric when considering Dorset's 'contribution' to the UK's overall net zero energy system.

In the Net Zero – Electrification, Dorset's total energy demand is matched by low carbon generation by 2040, with c.50% of this energy provided by a 1 GW offshore wind farm. By 2050 in this scenario, Dorset is a net exporter of power.

In the Net Zero – Hydrogen scenario, Dorset does not manage to match its energy demand with low carbon generation, instead achieving around 40%. This is predominantly due to the lack of offshore wind in this scenario, but is also impacted by the reliance on hydrogen boilers for most domestic heating, which use approximately four times as much energy as an electric heat pump. However, if some of the more ambitious technology advances were made, such as commercialisation of small modular reactors, this could change.

4.2. Future energy in buildings

4.2.1. Heating technologies

Around 80% of Dorset buildings are currently heated by natural gas; by 2050, all these properties will have to switch to an alternative heat source to deliver the net zero scenarios. Furthermore, any off-gas homes heated by fossil fuels, such as oil, LPG or coal, will have to switch to a low carbon alternative.

The two net zero scenarios illustrate the key current uncertainty across energy scenarios, which is whether the decarbonisation of domestic heat is achieved through electric heat pumps or replacing natural gas with low carbon hydrogen. Within this, however, there are some clear routes including for off-gas and new homes.

4.2.2. Challenging heat pump targets

The UK government has set some high targets for heat pump rollout in the coming decade, aiming for 600,000 installations per year by 2028. If achieved, this should result in the majority of off-gas properties being electrically heated by the early 2030s, and a significant number of on-gas properties converting to a heat pump. 5% of homes in Dorset are heated by oil, LPG or solid fuel, and switching to a heat pump would likely provide long-term benefits to both carbon emissions and heating bills in these properties.

In addition, new build homes will no longer be able to install natural gas boilers from 2025 onwards in all scenarios. New homes are likely to be fuelled by heat pumps, either individually in each home, or connected to a wider heat pump-driven heat network. Based on local plans and historic build rates, the scenarios assume over 20,000 new homes in the area by 2030, and almost 30,000 by 2040, the vast majority of which are projected to be electrically heated in all scenarios.

In the Net Zero – Electrification scenario, the heat pump installation rate in Dorset reaches over 10,000 per year from 2030 onwards, in order to achieve no fossil fuelled domestic heating by 2050.

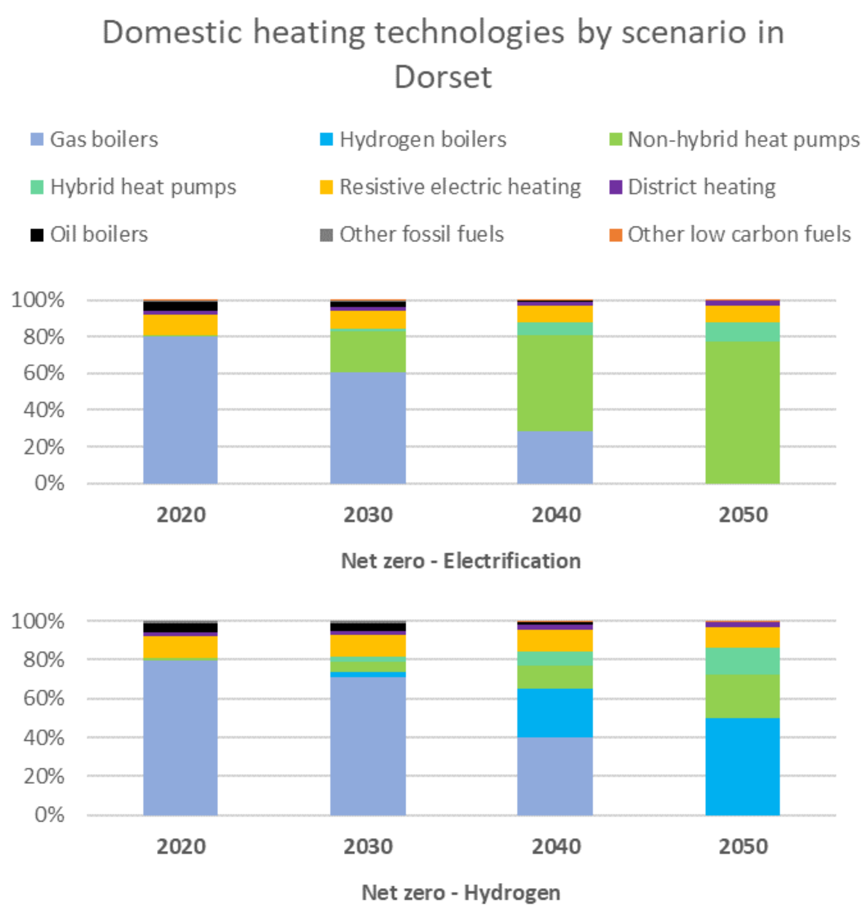
As heating technologies such as gas boilers have an average lifetime of 15 years or more, it is important that low-carbon heating is installed in all building types by the early 2030s in order to avoid removing heating technologies before the end of their operational life in the late 2040s.

4.2.3. Uncertainty around hydrogen for heating

There is currently significant interest from some policy makers and industry in using hydrogen for heating, utilising the existing gas network and replacing natural gas with hydrogen, with an intended minimal impact on the end consumer. However, there are big uncertainties in the Net Zero - Hydrogen scenario

Hydrogen is an immature technology which, if it develops as hoped, will still not be viable for heating until after 2030. Significant changes to domestic heating will need to be made before this date to be on track to achieve net zero. As well as technological and infrastructure challenges with the technology, there are also uncertainties around the cost of hydrogen to the end consumer compared to current mains gas prices. It is clear that any rollout of hydrogen for domestic heating would need to be accompanied by high levels of energy efficiency to avoid substantially increased consumer bills.

In the Net Zero – Hydrogen scenario, hydrogen boilers replace the majority of gas boilers over time, at the natural replacement rate. Hydrogen-ready gas boilers are expected to come to market in the 2020s, easing the switch to hydrogen in this scenario. Alongside this, heat pump installation rates reach over 4,000 per year from 2030 onwards, across off-gas homes, new builds and some on-gas homes.



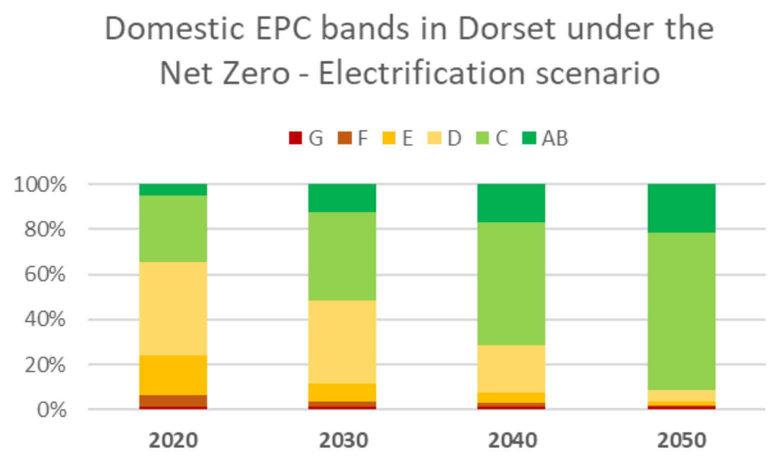
4.2.4. High levels of energy efficiency

Whether hydrogen or electric dominates the pathway for decarbonising heat, both require significant investment in energy efficiency. Heat pumps, while operational in poorly insulated buildings, are much more efficient in well insulated buildings, providing benefits to both reducing consumer bills and impacts on the electricity network.

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". 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 this target. As a result, combined with consumer behaviour change. the average heat demand per home in the area falls by c. 20% under both Net Zero scenarios by 2050, compared to only 13% in the non-compliant scenario.

Additionally, increasing product standards and consumer preferences result in energy demand for domestic appliances, electronics and lighting falling by 26-30% in the net zero scenarios by 2050, compared to only 7% in the non-compliant scenario.

Non-domestic properties are subject to stricter targets, requiring a minimum EPC B by 2030 under the net zero scenarios, as per recent CCC guidance and government consultation. Non-domestic energy demand reduces by over 20% in the net zero scenarios by 2050, with over half this reduction occurring by 2030.



4.3. Future generation and storage

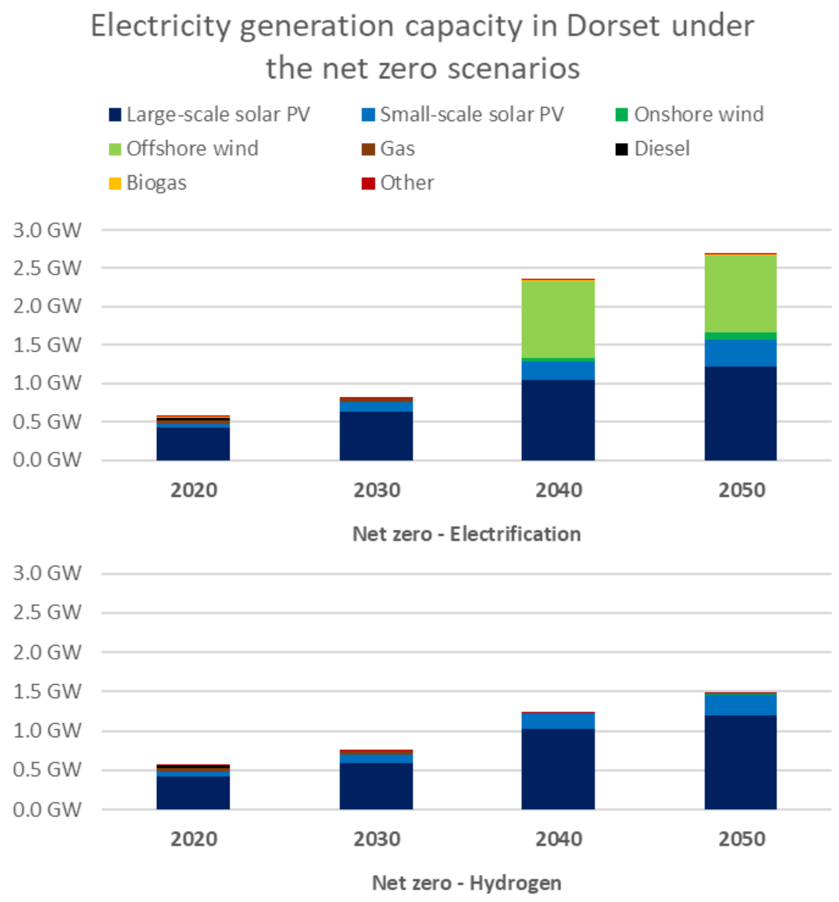
4.3.1. Renewable electricity

Dorset has excellent solar PV resource, for both large-scale ground-mounted solar farms and small-scale rooftop solar. The baseline already contains 500 MW of solar PV. In both net zero scenarios, the imminent advent of subsidy-free large-scale solar projects results in total solar PV capacity doubling by the mid-2030s and tripling to 1500 MW by 2050.

Offshore wind also offers a huge opportunity for the area. With offshore wind generating around four times as much as solar per MW. One offshore wind farm of 1000 MW could generate the energy equivalent to around 50% of Dorset's total energy demand by 2040.

There is also substantial onshore wind resource in Dorset, with areas outside protected areas in the south-east and north having high windspeeds, around 100 MW of onshore wind is projected in some scenarios.

The Portland Bill site has been identified as a potential area for tidal stream generation. This has not been included in the scenarios due to the uncertainty around the economic feasibility of tidal generation; however, it remains an area of interest if tidal stream generation develops towards commercial viability in the coming years.



4.3.2. Fossil fuels

At present, Dorset has over 70 MW of fossil fuel generation capacity connected to the electricity network, in the form of the Chickerell Power Station and 26 MW of assorted smaller-scale diesel projects. With air pollution limits being tightened, it is expected that diesel generation will cease well before 2030. The Chickerell Power Station is expected to operate very infrequently as an embedded flexibility service, though it may struggle to compete with faster-response gas reciprocating engines and battery storage. While remaining online into the 2030s, it is projected that electricity generation will be very low.

In addition, Dorset is a significant producer of oil and gas through Wytch Farm. In 2019, planning permission was granted for a replacement and repowering of 24 MW of gas generation for on-site electricity consumption.

Unabated burning of fossil fuels would not be in accordance with the UK's legally binding 2050 net zero commitment, and therefore any oil or gas production or combustion at Wytch Farm by 2050 would need to be used for abated processes, such as industrial processes with carbon capture.

4.3.3. Small Modular Reactors

The decommissioned Winfrith nuclear reactor site has noted as potential to site a small modular reactor. Due to the current stage of development of small modular reactors, this technology has not been explicitly included in a scenario, but the location of the site in the south of England near to major population centres, and the history of the Winfrith site, could be promising if technological development and national strategy were to align.

4.3.4. Green gas and hydrogen

Over 200,000 tonnes of crop and waste feedstock is currently used to produce green gas in Dorset, predominantly burned for heat and power with a small proportion injected to the gas grid as biomethane. As per the CCC's 6th Carbon Budget, total bioenergy supply is not expected to increase by more than 20% compared to today's levels, as levels of waste feedstocks decrease to be replaced by energy crops and imports from abroad. However, it is projected than bioenergy will be used for 'negative' emissions through carbon capture and storage in the majority of cases, rather than burnt in-situ for heat and power.

4.3.5. Energy 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 the area is believed to have 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.

In the Net Zero – Electrification scenario these pipeline projects are commissioned over the coming decade, and further battery storage projects are developed as flexibility is provided by battery storage rather than fossil fuels. By 2050, over 300 MW of battery storage may be installed in the area, around half of which provides flexibility services to the electricity grid, with the remainder in homes, energy-intense businesses or co-located with renewable power production.

4.4. Future energy for transport

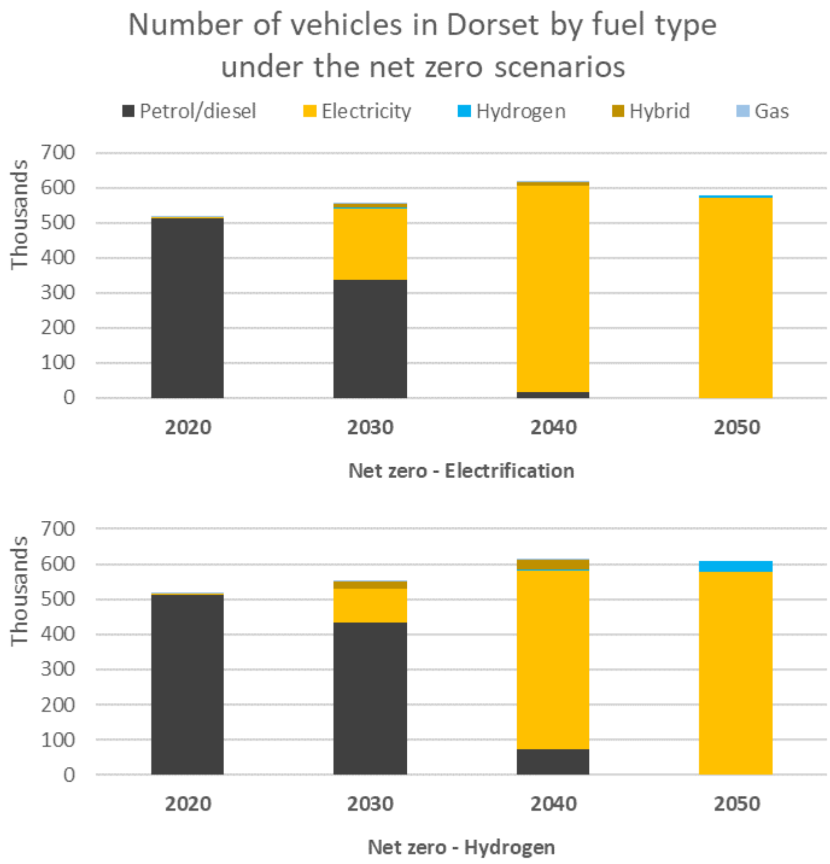
4.4.1. Road vehicles

Like the rest of UK, the vast majority of road vehicles in Dorset currently run on petrol or diesel, totalling 99.1% of all road vehicles. Hybrids make up a further 0.4%, and electric vehicles, mainly cars and LGVs, the remaining 0.5%.

Electric cars replace petroleum cars in all scenarios, following national trends, prompted by the UK government ban on sales of new petrol and diesel vehicles from 2030. Even under the non-compliant scenario, by 2050 the vast majority of road transport is electrified. By 2040, between 83% and 95% of road vehicles are electric in the net zero scenarios, compared to 58% in the non-compliant scenario.

For non-car road vehicles, particularly HGVs and buses, electrification is not the only route to lowering transport emissions in the scenarios. Low carbon gas, either hydrogen or biomethane, is used for larger long-distance vehicles that may be less suitable for complete electrification. Hydrogen vehicles represent 5% of all vehicles in the Net Zero – Hydrogen scenario, but this represents over 30% of fuel consumption, due to the much higher efficiency of electric vehicles and greater average mileage of HGVs and buses.

In addition to fuel switching, both net zero scenarios feature a shift to active travel and public transport to reduce inefficient personal car journeys and vehicle ownership.



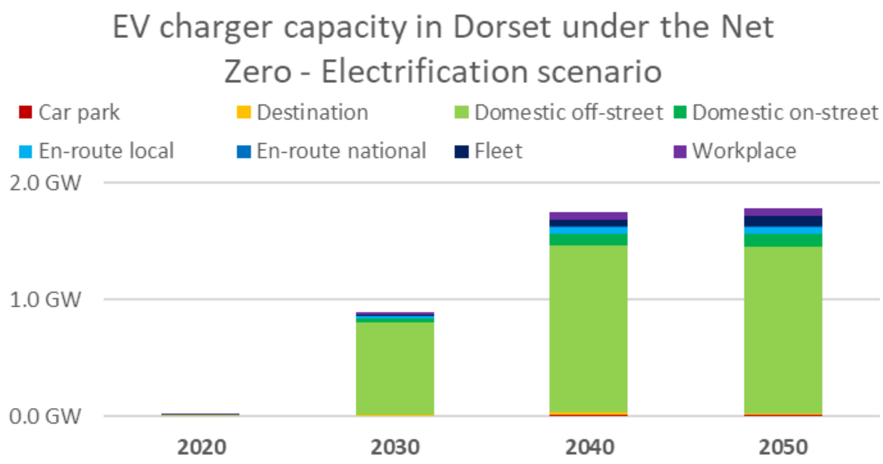
4.4.2. Charging and refuelling infrastructure

The rapid uptake of electric vehicles will require a similarly rapid rollout of EV charging infrastructure. The scenarios estimate that over 1.7 GW of charging capacity will be required by 2050, 80% of which is projected to be domestic chargers. Under the Net Zero – Electrification scenario, where the shift to electric vehicles is quickest, half of this charging capacity is installed by 2030.

Hydrogen refuelling stations may be served by on-site electrolysis, or have hydrogen delivered by tankers similar to existing petrol and diesel fuelling stations. Even in the Net Zero – Hydrogen scenario, hydrogen vehicles make up less than 10% of total vehicles, and therefore hydrogen fuelling facilities may be less common, situated along the main trunk roads and urban areas

4.4.3. Non-road vehicles

Non-road vehicles and transport, such as agricultural, also require decarbonisation by 2050 to achieve net zero. Currently, the only low carbon option for agricultural vehicles is biofuels. According to the CCC's 6th Carbon Budget, agricultural vehicles would likely follow a similar trajectory to heavy goods vehicles, with electrified and hydrogen-fuelled options coming to market in the late 2020s and 2030s. Biofueled vehicles are likely to remain niche as bioenergy production is prioritised for negative emissions and hard-to-decarbonise sectors such as some industrial processes.



5. Conclusions

It is clear that Dorset has significant opportunities and challenges within the shift to net zero.

Opportunities

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. An offshore wind project means that Dorset becomes a net exporter of power.

An excess of low carbon generation from wind and solar in the area goes hand-in-hand with the opportunities in Dorset around **energy storage and the future development of 'green' hydrogen** by electrolysis for decarbonisation of heavy transport, industry and the marine sector.

The natural capital of both Portland's **salt caverns** and the **potential to repurpose the existing oil and gas infrastructure** provide a unique opportunity for Dorset, to be a leader in the new hydrogen economy building new green industries with highly skilled engineering jobs and strong local investment.

Challenges

The biggest challenges for Dorset, and any other region looking at delivering net zero, is around **energy efficiency and heat in buildings**. Solutions are likely to be increasingly local and community-led with different solutions leading 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.

Both the energy efficiency and heat challenges offer significant potential in terms of development of new skills and jobs in the area. As the UK level policy on buildings develops, the councils and public sector should use their convening power to bring forward demand for services and **stimulate the retrofit and low carbon heat sector.**

Finally, although the pathway to decarbonising transport by electrification is increasingly clear, it is important to remove blockers to that transition by ensuring there is enough **public charging solutions for both the local and seasonal populations**.

Another key area is to **develop both demand and supply solutions for harder to electrify transport** including marine transport, haulage through Poole Port, agricultural vehicles and heavy machinery, potentially using hydrogen or biofuels.

Bringing this together is the energy infrastructure in Dorset, and the electricity networks in particular, where the area currently has significant constraints. It is important that strategic conversations are started between local government and the local networks to identify the strategic sites for the green economy and processes required to **develop the right energy infrastructure to support net zero in Dorset.**

These opportunities and challenges are expanded further in the Energy Investment Opportunities Document.

Evidence and sources

The Dorset Low Carbon Energy Route Map and Evidence Base is based on local project data, engagement with local stakeholders and developers, and national future energy scenarios from the Climate Change Committee and National Grid ESO.

Figures for existing energy consumption, generation and storage are based on BEIS statistics, Department for Transport statistics, local DNO project data, EPC data and supplementary research into individual projects.

Dorset's low carbon resource assessments are based on Regen's resource assessments for local DNOs, analysis of previous and existing low carbon projects and market insight.

The future energy scenarios for Dorset are based on national level net zero scenarios from the Climate Change Committee and National Grid ESO, alongside local Distribution Future Energy Scenarios produced by Regen for the electricity distribution networks in Dorset, which reflect local, bottom-up drivers, evidence and stakeholder feedback.

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