South West Wales Energy Strategy (Draft)

Funded & supported by:

Gwasanaeth Ynni Energy Service

Prepared by:

Contents

Version:	Comment:	Issued:
V1.0	For issue	2020
V2.0	Accessibility updates	November 2021

Executive summary

This regional energy strategy for the South West Wales Region was commissioned by the Welsh Government and supported by the Welsh Government Energy Service. It has been developed by the South West Wales Energy Core Group, a sub-group of the Regional Directors' forum from the four local authorities in South West Wales, with additional support from an Advisory Panel and regional stakeholders. In this report the use of "We" refers to this collective group of stakeholders.

The overall objective of the strategy is to develop a strategic pathway identifying key interventions to deliver on the region's ambitions for decarbonising its energy system. An Energy Vision scenario has been modelled to set out a potential decarbonisation route that will put the region on track to achieve a net zero energy system by 2050.

Our vision for South West Wales (SWW) is:

Harnessing the region's low carbon energy potential across its on and offshore locations, to deliver a prosperous and equitable net zero carbon economy which enhances the well-being of future generations and the region's ecosystems, at a pace which delivers against regional and national emissions reduction targets by 2035 and 2050.

Our priorities for achieving this vision are:

1. Energy efficiency
2. Electricity generation
3. Smart and flexible systems
4. Decarbonise heat
5. Decarbonise transport
6. Regional coordination

The baseline energy assessment sets out the current energy use and generation in the region:

- South West Wales currently consumes around 36% of all energy consumed in Wales, more than its 22% share of the population partly due to the concentration of very large industrial sites within the region;
- Between 2005 and 2017, total energy consumption fell by 26%, including a 31% reduction from the commercial and industrial sector, which makes up 68% of the region's total consumption, and a 22% reduction from the domestic sector. The associated greenhouse gas emissions have fallen by 14% from 2005 to 2017;

- The region's total energy demand is dominated by the commercial and industrial sector, which makes up 68% of the total demand, with domestic demand accounting for 17% of total demand, and transport accounting for 15%.
- Renewable assets located in South West Wales currently generate the equivalent of 44% of the region's electricity consumption;
- South West Wales currently hosts 27% of Wales' renewable energy capacity, with 388MW of solar PV and 401MW of onshore wind;
- Of the 863MW of renewable energy installed capacity in the region, 146MW (17%) is locally owned;
- 46% of renewable generation in South West Wales is from onshore wind projects and 45% is from solar PV;
- 0.9% of homes in South West Wales have a heat pump or biomass boiler;
- Approximately 29,000 homes (~9%) are currently fuelled by oil, LPG, coal or other solid fuels;
- The average EPC rating is D and the region has the highest average energy efficiency ratings in Wales, with 71% of homes rated as EPC band D or above.
- Transport in the region is dominated by private car use with ~0.3% of cars pure electric, compared with an average of 0.6% of vehicles across Great Britain.
- In 2019, South West Wales hosted 128 public charging devices, including 11 rapid public chargers.

Note on scope: the baseline assessment and strategy is focussed on the energy system only, covering power, heat and transport. Very large industry is excluded due to a lack of data availability, and does not include greenhouse gas emissions or sequestration from non-energy related activity such as land use. The large industrial users should be included in the Zero2050: South Wales project led by National Grid.

Achieving our energy vision for South West Wales: to meet Welsh Government targets, and to be on track for net zero by 2050, South West Wales needs to reduce emissions from its energy system by 55% by 2035, split by sector as follows:

- 58% reduction in domestic heat and power emissions;
- 56% reduction in commercial and industrial emissions (excluding very large industrial use);
- 51% reduction in road transport emissions.

Figure 1: Summary of the Energy Vision's emission reductions by sector. Source: WGES analysis

The energy vision scenario modelling assumes a significant shift away from business as usual across these three sectors by 2035. The assumptions of the modelled future vision include:

Domestic:

- 85,000 homes improved from EPC band G, F and E to D, C and B;
- Over 78,000 heat pumps installed;
- 21,000 suitable houses accurately fitted with internal or external wall insulation;
- Over 140,000 other insulation measures in homes;
- 82,000 homes currently heated by fossil fuels to move to low carbon heating;
- Replacing heating systems in oil, LPG and solid fuel heated homes prioritised;
- No new gas connections for homes from 2025.

Commercial and industrial:

- A significant energy efficiency programme to reduce energy demand by 14%;
- A switch to alternative fuels, including hydrogen and electrification of heating;
- Decarbonising the electricity network through renewables and behind the meter renewable generation.

Road transport:

- 78% of vehicles driven in South West Wales in 2035 are electric, equivalent to 17,000 more electric vehicles per year by the mid-2020s, peaking at 38,000 per year in the 2030s. This is to be facilitated by the deployment of 9,500 public and on-street EV chargers;
- A 10% reduction in private vehicle mileage by 2035;

- A slowing of the growth in total number of vehicles on the road, facilitated by increased use of public transport and active travel.

Renewable electricity generation:

- Offshore wind capacity increased from 50MW to 696MW
- 800MW of onshore wind installed (399MW of new capacity);
- 1,215MW of solar PV installed (827MW of new capacity) with 375MW on rooftops and 840MW ground mounted;
- 1,061MW of marine technologies, including 696MW floating offshore wind and 320MW tidal lagoon:
- Sufficient flexibility, including storage, and network infrastructure upgrades to enable low carbon generation and demand technologies to connect;
- The region to generate the equivalent of 147% of its total electricity consumption in 2035 from regional renewable sources.

These assumptions summarise the level of action required between 2020 and 2035 to be on track to achieve net zero by 2050. The energy modelling focuses on known decarbonisation technologies and actions that could be implemented by 2035 in order to demonstrate a potential decarbonisation route.

The scenario is not intended to be prescriptive. There are a number of potential pathways to achieve energy system transformation, including new opportunities from technology innovation that will certainly emerge as the transformation takes place. The rapid evolution of technologies and pathways means that there are some major uncertainties and varying opinions about the precise route forward. One such alternative which has been developed is the Energy Network Association's "Pathways to Net Zero". The Pathways to Net Zero report focuses on a hybrid heat pump first approach. Wales and West Utilities has completed extensive research into its 2021-26 business plan which builds on this approach, the details of which are described in later chapters.

What is clear is that all of the different pathways must achieve significant decarbonisation; should less action be achieved in any of the areas summarised above, other sectors will need to compensate with higher action to achieve the same results. The level of transformation described by the energy modelling actions is significant. More importantly, the modelling demonstrates the potential to be on a net zero pathway by using known and proven technologies and underscores the critical role of short- and medium-term action. Innovation will be essential to compliment this action and to develop technologies, skills, and practices that continue to achieve decarbonisation beyond 2035.

The economic impacts of achieving the energy system vision have been assessed in terms of job creation, gross value added (GVA) and the investment (or spending) required for the energy transition, in comparison to business as usual.

The economic analysis demonstrates that almost £4 billion of additional investment/spending is needed to achieve the energy efficiency, electricity generation, and heat aspirations described in the energy vision between now and 2035. This represents approximately £286 million per year and will need to be financed from a range of sources including the private sector, households, and national and local government.

The energy system vision (ESV) scenario is estimated to result in an additional 16,000 net jobs, with an associated increase in GVA of nearly £1.6 billion, associated with the delivery of accelerated deployment of renewable electricity generation technologies and enhanced levels of energy efficiency. In addition, it is estimated that there will be over 900 more gross jobs associated with the provision of low-carbon heating technologies in the ESV scenario than the BAU scenario, associated with £200 million of GVA.

When considering the job figures presented its important to reflect on where these jobs will be located. The methodology focuses on direct jobs, a greater proportion of which are considered likely to be located in the region than indirect or induced jobs[1]. However, we are unable to comment on the specific location of the jobs estimated; a portion of the jobs are likely to be located in South West Wales and a portion may be held by persons residing outside of the region. The experience of Wales to date has been that many electricity generation jobs are held by those living outside of the region. This contrasts with energy efficiency jobs which are often held by local residents who provide services to the surrounding area. In order to help South West Wales benefit from jobs associated with future local electricity generation it will be important to first understand the reasons for any lack in local jobs and then to develop a policy response.

Note: please refer to the economic modelling chapter and technical annex for details on data sources, limitations and methodology.

Table 1. Estimated difference in jobs, GVA and investment between the energy vision scenario and business as usual, from 2020 to 2035

Energy vision scenario for:	Jobs**	**GVA**	**Investment required**
Electricity generation*	12,500 (net) **(+43%)**	£1,410m **(+39%)**	£3,280m **(+574%)**
Domestic heat	925 (gross) **(+66%)**	£200m **(+161%)**	£240m **(+73%)**
Domestic energy efficiency***	3,700 (net) (**+53%**)	£220m (**+53%**)	£780m **(+53%)**

[1] Direct jobs are typically associated with the manufacture, construction, and installation of equipment. Indirect jobs arise in the supply chain of the energy technology. Induced jobs related to jobs generated as a result of spending incomes earned from direct employment.

Total additional investment required to achieve the energy vision scenario	**£4,300m**
** Electricity generation jobs figures were calculated using direct job intensity indicators. Direct jobs are typically more likely to be held by residents local to an energy site. However, jobs related to manufacturing may be located outside of the region. Likewise, some jobs may be held by persons residing outside of the region who travel into the region to undertake these jobs. As such, it is not possible to comment on the geographic location of these jobs. The perceived experience of Wales to date is that many of the long term operational and maintenance jobs associated with these technologies are held by persons outside of the region who travel into Wales to perform their duties. In order to help the region benefit from jobs associated with future local electricity generation it will be important to first understand the reasons for any lack in local jobs and then to develop a policy response.* ***Impact on jobs is presented as either net or gross jobs depending on the available data.* ****Data on the percentage change in jobs and GVA for domestic energy efficiency is unavailable.* ****Data on the percentage change across all indicators for commercial and industrial energy efficiency is unavailable.*	

Green recovery from the Covid-19 pandemic: this strategy has been finalised in the midst of the COVID-19 pandemic. At the time of writing, the true economic and societal costs of the pandemic for South West Wales are not fully clear.

As we move from the immediate emergency response to considering our options for economic recovery, this energy strategy has the potential to play a significant role in helping South West Wales to recover and rebuild sustainably. It sets out a pathway for accelerating the shift to a decarbonised energy system in the region and demonstrates the potential for achieving far greater local economic benefits than could be achieved by returning to business as usual.

Next steps: Achieving a net zero energy system in South West Wales presents many challenges including, but not limited to, tackling deep retrofit in a large number of homes, reducing private car miles and enabling the low carbon vehicle roll-out including electric and hydrogen vehicles. There is an urgent need for action, using the Swansea Bay City Deal and more broadly engaging stakeholders from across the region to deliver transformational projects. However, decarbonisation also faces many potential benefits for the region, from enacting significant energy efficiency programmes to creating investment opportunities for local people and organisations. The transition to a decarbonised economy will also provide exciting opportunities in engineering, the digital and retrofit markets as well as local skills and employment.

There are three key next steps to help this strategy come to life and to create action: developing the governance structure, socialising the strategy throughout the region and developing an action plan.

Acknowledgements: We would like to thank all of the stakeholders who made valuable contributions to this work through their participation in workshops, completing surveys, providing data, and additional communication on the phone and by e-mail.

Acronyms and abbreviations

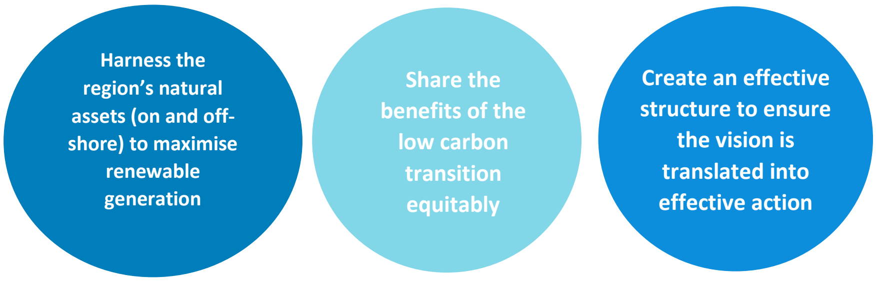
ASHP	**Air Source Heat Pump**
BEIS	The Department for Business, Energy, and Industrial Strategy
CCC	Committee on Climate Change
CHP	Combined Heat and Power
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CITB	Construction Industry Training Board
DNO	District Network Operator
DEFRA	Department for Environment, Food & Rural Affairs
DNS	Development of National Significance
ECO3	The Energy Company Obligation phase 3
EPC	Energy Performance Certificate
EV	Electric Vehicle
GSHP	Ground Source Heat Pump
GW	Gigawatt
GWh	Gigawatt hour
HGV	Heavy Goods Vehicle
HHP	Hybrid Heat Pump
kt	kiloton
kWh	Kilowatt hour
LPG	Liquid petroleum gas
MCS	Micro-generation Certification Scheme
MW	Megawatt
NAEI	National Atmospheric Emissions Inventory
NRW	Natural Resource Wales
PV	Photovoltaic
RHI	Renewable Heat Incentive
SME	Small and medium-sized enterprises
TWh	Terawatt hour
ULEV	Ultra Low Emissions Vehicle
WGES	Welsh Government Energy Service
WHQS	Welsh Housing Quality Standard
WPD	Western Power Distribution
ZILF	Zero Interest Loan Finance

Energy vision statement

Our Energy Vision

Harnessing the region’s low carbon energy potential across its on and offshore locations, to deliver a prosperous and equitable net zero carbon economy which enhances the well-being of future generations and the region’s ecosystems, at a pace which delivers against regional and national emissions reduction targets by 2035 and 2050.

Our vision is guided by three core principles

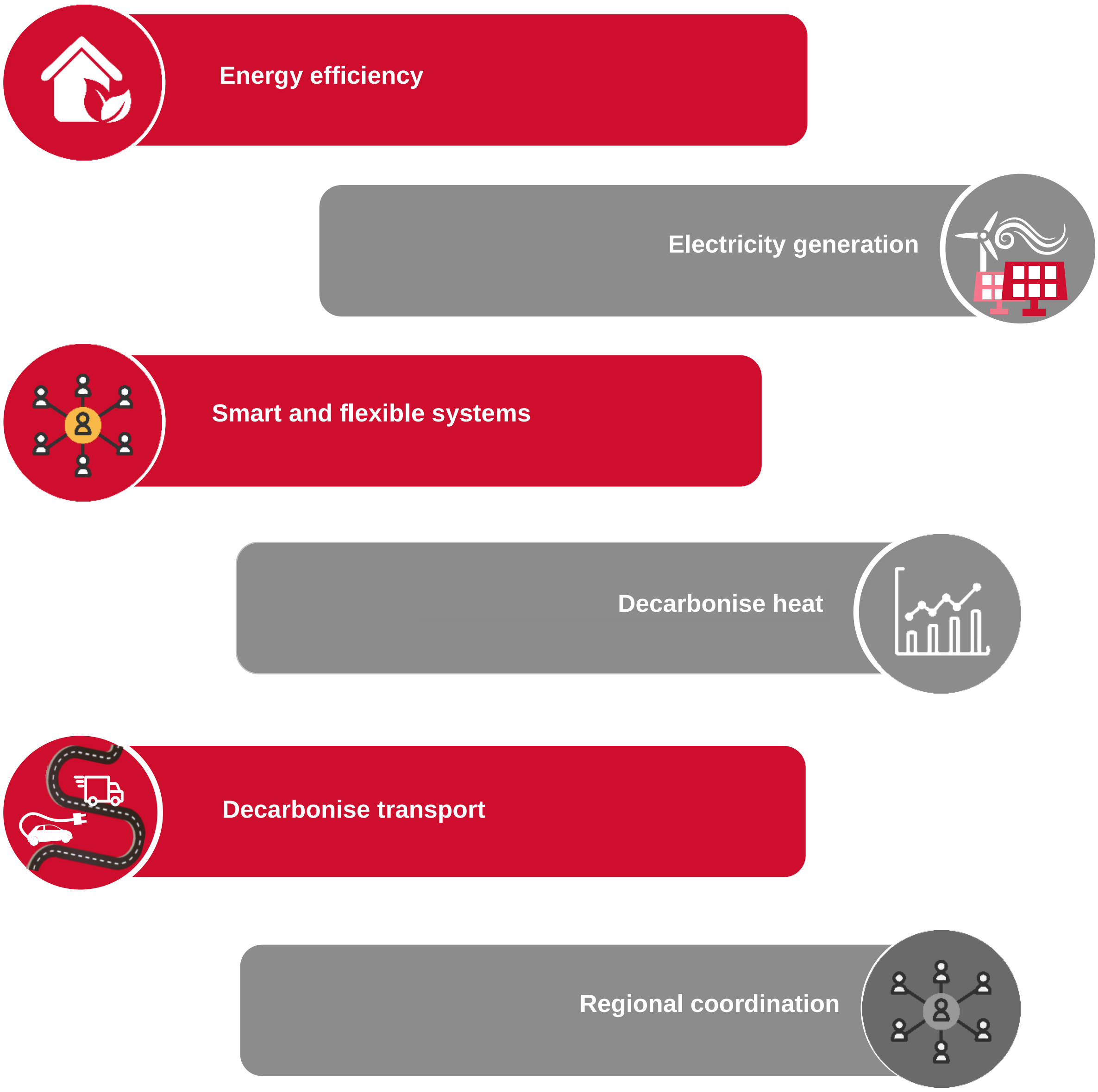


Core principles

- **Optimise the wide range of regional natural resources** such as solar, wind (on and off-shore, including floating off-shore wind (FLOW)), biomass, hydro and marine (including wave, tidal stream and tidal range technologies), to maximise low carbon electricity generation and help achieve a de-carbonised economy.
- The transition to a low carbon economy needs to **improve lives for all and for benefits to be shared in an equitable way**. The vision will support inward investment to the region; encourage the growth of sustainable local supply chains, including cutting edge research and development; the creation of resilient manufacturing, construction, operations and maintenance jobs; and affordable energy and energy efficient housing across the region.
- Led by a **proactive and effective regional delivery vehicle** - Our vision will be achieved by an effective regional delivery mechanism able to convert the vision into action.

Our priorities

To achieve our vision, we have defined the following six priority areas



Energy efficiency: a key priority for the region is to drive down energy demand

- Set the strategic direction to help homeowners become prosumers and homes as power stations (HAPS) which is an effective route to secure local renewable ownership
- Build effective supply chains to support HAPS and other new technology implementation
- Prioritise retrofitting needs and plan interventions with gaining a better understanding of the region through mapping EPC building ratings to focus resources on the least efficient buildings. This will also ensure minimum energy efficiency standards of privately rented properties being above EPC band E are being met
- Fully support the decarbonisation of the public sector by 2030
- Incorporate high levels of energy efficiency into the commercial value of buildings
- Provide advice and support to low income and low efficiency households, reduce fuel poverty and improve health and living condition of residents through the use of initiatives such as the Welsh Government Warm Homes programme (e.g. Arbed and Nest)
- Implement energy efficiency improvements on large industrial sites with the potential to demonstrate new and innovative solutions
- Energy efficiency should also benefit business parks, industrial estates, lighter industries and commercial businesses where significant energy saving potential exists
- Demonstrate how investment in a more energy efficient industrial sector can benefit non-industrial sectors
- Coordinate with industry groups e.g. South Wales Industrial Cluster (SWIC) to drive industrial efficiency
- Help building occupiers, communities and owners including public, private and RSLs, understand that energy efficiency measures will improve the quality of the indoor environment and also drive down energy related costs
- Support innovative solutions in energy efficiency, particularly those targeted on off-gas-grid areas
- All new homes should be built with a net-zero standard, as defined by the UK Green Building Council, and above a predefined EPC standard
- Encourage developers to improve standards where existing developments have planning permission that will not meet future regulations
- Promote the use of energy efficient appliances and lighting in the domestic and commercial sectors in order to reduce energy consumption
- Activities designed to decarbonise energy e.g. Carbon Capture Use and Storage (CCUS) and production of hydrogen (H_2), will in turn require more energy. Reducing

energy demand in all other energy-intensive activities will be key to allow for the decarbonisation of the industrial sector

Electricity generation: encourage a mix of low carbon energy technologies to increase the reliability and stability of electricity generation

- Maximise the range of energy sources exploiting different technologies such as PV, hydro, tidal, biomass, etc. as well as harnessing regional marine energy capabilities e.g. Simply Blue Energy and Total's 96 MW floating wind demonstration facility and the Swansea Bay Tidal Lagoon
- Seize the opportunity to develop a local supply chain for South West Wales to provide the foundation for, and then benefit from, long-term opportunities associated with the development of floating offshore wind and other renewable energy technologies
- Consider the private sector in developing renewable energy needs, particularly through alternative, public/private delivery models whilst considering local content as a pre-requisite
- Recognise the importance of local and community ownership of renewable energy assets and encourage community developers to play an active role in delivering additional capacity
- Aim to generate more than 100% of the region's electricity demand from low carbon sources on an annual basis, working towards meeting demand on a constant basis
- Invest in bulk energy storage systems, including batteries and hydrogen storage, to increase renewable energy utilisation and provide the electricity grid with the necessary flexibility for future demand
- Identify innovative storage methods and demand side response measures to enable a smoother demand profile
- Identify industrial land and space that can be harnessed for electricity generation e.g. rooftops for solar PV, onshore wind, and local capabilities/skills for H_2 production for local networks, transport and heating. Co-location of renewable technologies will also minimise land use
- Simplify and mainstream 'sleeving' / 'Energy Local' arrangements. Regional collaboration to deliver joint projects at sufficient scale to develop generation hubs (>100 MWp)
- Work with the National Procurement Service to support greater procurement of energy from locally generated renewable energy projects - could help de-risk development business cases
- Use planning powers to require developers to produce enough power for the dwellings/facilities being built, either on a community or plot by plot basis. Ownership of this action could be enforced via the planning system
- Support from local authorities for community energy projects to utilise their ability to spread knowledge, awareness and a feeling of community ownership whilst contributing to decarbonising the energy mix

- Explore potential to develop an electricity system that enables energy trading using decentralised energy generation, storage and grid exports
- Investigate how to adapt the local road and port infrastructure capacity to meet the challenge of the increasing size of wind turbines and sub-structures.

Smart and flexible systems:

- Support an increase in future electricity grid capacity, as well as other sources of flexibility such as microgeneration, energy storage and Demand Side Response (DSR) schemes, to accelerate the electrification of transport and heating
- Explore and encourage innovative energy storage technologies and local generation, to maximise the use of locally produced energy while avoiding some of the challenges posed by constraints in the current electricity grid infrastructure. Greenlink interconnector with Ireland could become a valuable source of flexibility and an energy trading channel
- Facilitate the installation of smart meters, DSR and energy storage, particularly for high energy users. Smart meters can support innovative markets and services including smart contracts (with time of use (ToU) and dynamic tariffs), DSR and system balancing. As domestic batteries are becoming financially viable, a further opportunity is in community scale, and managed, energy storage
- Hydrogen can play a flexibility role equivalent to natural gas without the emissions. We will have a world class gas grid, largely plastic, by 2030. We therefore have the transportation and storage capability already in place. That storage capacity gives great flexibility in terms of storage and use of hydrogen for industry, transport, home heating and back-up power generation
- Leverage the ‘Homes as Power Stations’ pilot scheme to raise awareness and support innovation in the field of energy efficiency and flexibility
- Use the Active Buildings model to further link electricity grid storage capacity and a flexible electricity system.

Heat: a ‘whole system’ and ‘one heating problem to one heating solution’ approach

- Encourage a whole system approach drawing on the expertise of academic research institutions such as the Active Building Centre at Swansea University, energy parks such as at Baglan, IGEM, Ofgem funded projects and the Energy Networks Association.
- All off-gas-grid properties to be moved to decarbonised heating solutions. A Welsh delivery system bioLPG could be launched to supply off-gas-grid homes across the region. Hybrid heating

systems could be used to reduce gas demand and make BioLPG more viable due to reduced volume of demand.
- Design and apply a multi-faceted approach to heating using electric heat pumps, hybrid heating systems and heat networks to decarbonise the heat sector
- Acknowledge the rural nature of the region to identify the appropriate solution e.g. decarbonised heating solutions for off-gas-grid properties should be financially incentivised to overcome affordability issues
- Identify and exploit the long-term waste heat produced by industrial clusters, especially those close to densely populated areas, to provide low-cost hot water for domestic and commercial use via the local heat distribution networks
- Support energy efficiency measures for both commercial and residential buildings. For example, where appropriate encourage further external and internal wall insulation, double and triple glazing etc to homes across the region particularly to improve living conditions of low-income households
- Incorporate low carbon sources of heating such as heat pumps into the heating mix. For off-gas-grid areas microgeneration by means of micro-CHP, using low carbon fuels where possible, could provide a feasible future solution
- Ensure an appropriate level of local expertise is available to facilitate the development of these solutions
- Environmental levies could be shifted from electricity to heat to prioritise energy efficiency measures within residential households
- Determine potential heat decarbonisation pathways (e.g. hydrogen, biomethane, biomass and heat pumps) that the region is likely to follow to minimise redundant investment in different technologies whilst recognising that hydrogen and renewable electricity will have complementary roles in decarbonising homes, businesses, power and transport.

Transport: lead the decarbonisation of transport and promote active travel behaviour

- Encourage the use of public transport using schemes such as on demand bus services, EV car clubs, integration of different public transport modes under efficient governance, and transport hubs, such as the Integrated Transport Hub in Neath Port Talbot
- Further support the decarbonisation of public transport and work closely with TfW and the Swansea Bay and South West Metro to deliver an effective, integrated public transport system.
- Backing a shared ownership model e.g. mobility as a service (MaaS), which encourages a shift away from personal ownership of transportation towards mobility being provided as a service, will be an important part of achieving this transition given the

rural nature of parts of the South West region and its consequent high reliance on private vehicles

- Supporting the rollout of Electric Vehicles is critical especially as Wales has the lowest number of EV charging point per capita in the UK. Installing charging points where there is electricity grid capacity and collaborating with the Distribution Network Operators to ensure the increased EV demand is matched with an increase in electricity grid capacity is therefore essential
- Ensure that a strategic vision for modern EV charging infrastructure, and where appropriate hydrogen refuelling facilities, throughout the region will be adopted, facilitating a reduction in emissions from cars as well as allowing industry, with the appropriate incentives, to assist by moving to a ULEV fleet
- Large industry can support this by installing charging points, help balance the grid and produce H_2 for buses, trains and HGVs
- Given the region's high renewable energy potential, we will explore the opportunity for cost effective green hydrogen generation locally that could be used within hydrogen fuel cell vehicles to further support the decarbonisation of transport
- Where possible, active travel modes will be encouraged through dedicated cycle lanes and bicycle storage space at intermediate transport locations as has been the case for the cycling track built along the former railway in Pembrokeshire i.e. the Brunel Trail
- Support innovation in transport behavioural change with initiatives such as the Active Cycle Shelter projects developed by SPECIFIC to encourage the shift from ICE vehicle to active travel
- Develop cutting edge research capabilities through initiatives such as the Global Centre of Rail Excellence (GCRE) being developed in Onllwyn, Neath Port Talbot
- Local and regional regulation could also encourage more environmentally friendly behaviour. Enforcing speed limits such as on the M4 motorway, and encouraging Ultra Low Emission Zones (ULEZs), can significantly improve air quality within urban areas
- Explore the possibility of a network of regional multimodal transport hubs with similar ticketing systems and providing services such as car sharing, EV charging, public transport, combined delivery systems and bike storage
- Deliver an effective integrated regional public transport system through the Swansea Bay and West Wales Metro
- Encourage vehicle fleets such as taxis, buses, public sector vehicles to transition to EVs, or hydrogen where considered more appropriate.
- Demonstrate how the EV transition could generate a potential source of revenue for EV charging points providers (e.g. hospital EV charging points in car parks)
- Encourage collaboration between EV charging companies to allow users access to more chargers

- Understand the medium-term implications of Covid impacts e.g. working from home shifting consumption from the public estate to private homes

Build a regional coordinated approach to infrastructure planning and delivery

- Improve collaboration within the public sector when planning for new infrastructure: liaising with the DNO (Western Power Distribution), Wales & West Utilities, National Grid Electricity Transmission and National Grid Gas Transmission when considering new developments to understand their own grid extension plans and make better use of public money
- Support investment in transmission network upgrades to facilitate the expansion of renewable generation capacity and increase engagement with BEIS to ensure that the Celtic Sea area is considered as part of its offshore transmission network review.
- Align the development of the South West Wales regional energy plan with the Regional Economic Development Plan to better address the 20% productivity gains gap that exist between SWW and the UK.
- Support the development of physical port infrastructure which will be required to deploy the full range of marine energy technologies from South West Wales and to maximise the economic opportunity.

The energy system, energy use & emissions

1. Modelling an Energy Vision scenario

1.1 Aims of modelling an Energy Vision scenario

Scenario modelling has been undertaken to create a 2035 South West Wales Energy Vision scenario that would put the region on track for a net zero energy system by 2050. The modelling outcomes are unique to the region, taking advantage of local resources and opportunities, and input from local stakeholders, in particular through the online workshop organised on 30th March 2020 gathering over 40 participants from the public, private and third sectors, a supplementary online workshop on 19th February 2021 with members of the region's Energy Core Group and Advisory Panel, and individual interviews with representatives from key sectors.

The modelling presents a potential development scenario that is intended to:

- Highlight the scale of the net zero energy system challenge
- Identify existing opportunities and barriers
- Point to new opportunities and key decisions
- Provoke discussion and inspire action planning.

The scenario is not intended to be prescriptive. There are a number of potential pathways to achieve energy system transformation, including new opportunities from technological innovation and changes to energy demand that will certainly emerge as the transformation takes place.

The scenario focuses on known decarbonisation solutions that could be implemented by 2035, which would put South West Wales (SWW) on a pathway consistent with achieving net zero emissions by 2050. However, this does not mean that activity around innovative new technologies should not also be pursued. The modelling takes a whole system approach to energy, considering the interactions between heat, transport and electricity demand. For example, the impact of decarbonising heat through electrification is reflected through an increase in electricity demand.

1.2 Revising the 2018 Swansea Bay City Region Energy Vision study to reflect net zero ambitions

The Swansea Bay City Deal is an investment of up to £1.3 billion in a portfolio of major programmes and projects across the Swansea Bay City Region – which is made up of Carmarthenshire, Neath Port Talbot, Pembrokeshire and Swansea. The City Deal is being funded, subject to the approval of project business cases, by the UK Government, the Welsh Government, the public sector and the private sector.

In 2018, Regen worked with the Institute of Welsh Affairs' Re-energising Wales project to produce the Swansea Bay City Region Energy System

Vision study[2]. The project aimed to produce a credible energy system vision for the region in 2035.

Since the 2018 Energy System Vision was produced, many things have changed. A climate emergency was declared in Wales on 29 April 2019. In March 2021 the Senedd agreed to revise Wales's statutory climate commitment to net zero by 2050, in line with the CCC's December 2020 advice.
The modelling undertaken to support the development of this energy strategy builds on and extends the assumptions and stakeholder engagement from the 2018 Energy System Vision study. Its aim is to create an updated Energy Vision that puts the region on track to achieving a net zero energy system in 2050, in line with the new climate emergency commitments and heightened ambitions of stakeholders in the region. While the "absolute contraction" model used for this strategy results in a net zero position by 2050, it should be noted that the interim (2025 and 2030) targets within the CCC's Balanced Sixth Carbon Budget pathway are more ambitious than the targets at the same milestones within the "absolute contraction" model. However, this model has been used within the energy strategies of the other three Welsh regions and has been used in the South West to maintain consistency across Wales.

Stakeholder feedback on the overall level of ambition

A webinar was held on 30 March 2020 with a supporting online survey to understand stakeholders' views on the Energy Strategy and the level of ambition in particular. Stakeholders were asked to comment on the objectives of the 2018 Energy System Vision study and to indicate the level of support for each objective.

There was a desire from stakeholders for the region's aims to be ambitious. For example, stakeholders wanted South West Wales "to become the most energy efficient region of Britain" and "to transform the energy system for South West Wales into one that is highly efficient, flexible and low carbon, providing affordable power and transport to support a healthy and equitable society". There was strong support for the strategy to "include an ambition to be net zero by 2050".

Following a change in regional energy governance, from the Swansea Bay City Deal (SBCD) to an Energy Sub Group of the Regeneration Directors from the four local authorities in South West Wales, a supplementary online workshop was held on 19th February 2021 with members of the region's Energy Core Group and Advisory Panel, followed by individual interviews with representatives from key sectors.

[2] Regen - Swansea Bay City Region: A Renewable Energy Future

An analysis of decarbonisation trajectories shows that the level of ambition in the 2018 Energy System Vision needs to be increased for the region to be on track for a net zero energy system in 2050

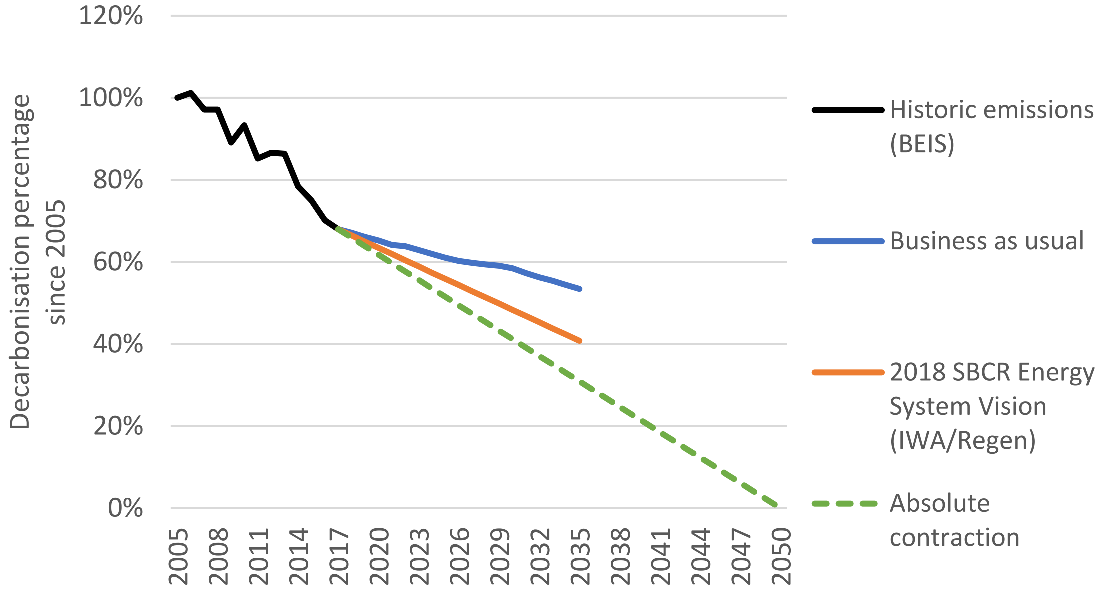


Figure 2: Business as usual and the 2018 Energy System Vision decarbonisation trajectories compared to a net zero absolute contraction method

1.3 Methodology in brief

The modelling sets an indicative decarbonisation trajectory to 2035. It has been created using a methodology that reflects the high-level methodology used by the Committee on Climate Change in its 2019 Progress Report to Parliament[3]. This absolute contraction method assumes a constant rate of decarbonisation is achieved between now and achieving net zero by 2050. This is used as a preliminary benchmark, pending 2020's more detailed assessment by the Committee on Climate Change, which will set out carbon budgets consistent with the new net zero target.

The methodology results in a bottom-up, stakeholder-informed Energy Vision for SWW

[3] Committee on Climate Change (2019) Progress Report to Parliament

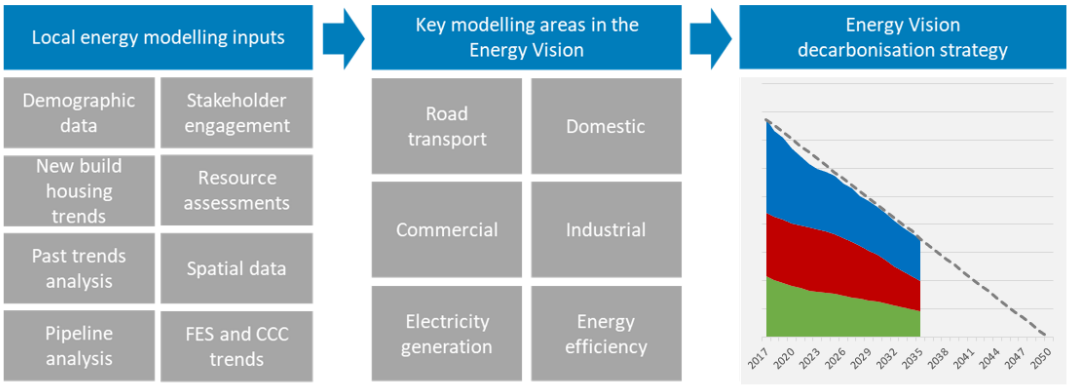


Figure 3: Outline modelling methodology

The SWW local energy modelling inputs, or baseline, was established by gathering and analysing national and local datasets of energy consumption, energy efficiency and generation. The baseline was run through a whole energy system model, applying assumptions about the level of uptake of measures and technologies that is possible by 2035 to create the Energy Vision scenario. Assumptions have been drawn from a range of sources, including:

- The 2018 SBCR Energy Vision study
- Engagement and workshops with local, regional and national stakeholders
- Committee on Climate Change reports[4,5]
- National Grid's Future Energy Scenarios[6]
- The project team's past work on future energy scenarios for Wales & West Utilities and for Western Power Distribution[7] and current work for both network operators on Net Zero South Wales.

[4] Ibid
[5] Committee on Climate Change (2018) Hydrogen in a low-carbon economy
[6] National Grid (2019) Future Energy Scenarios
[7] Regen (2019) Wales & West Utilities – Regional Growth Scenarios for Gas
Regen (2019) Future Energy Scenarios

Figure 4 shows a worked example of the modelling approach taken for domestic heat, showing the inputs and variables considered to create the level of decarbonisation required by the Energy Vision scenario.

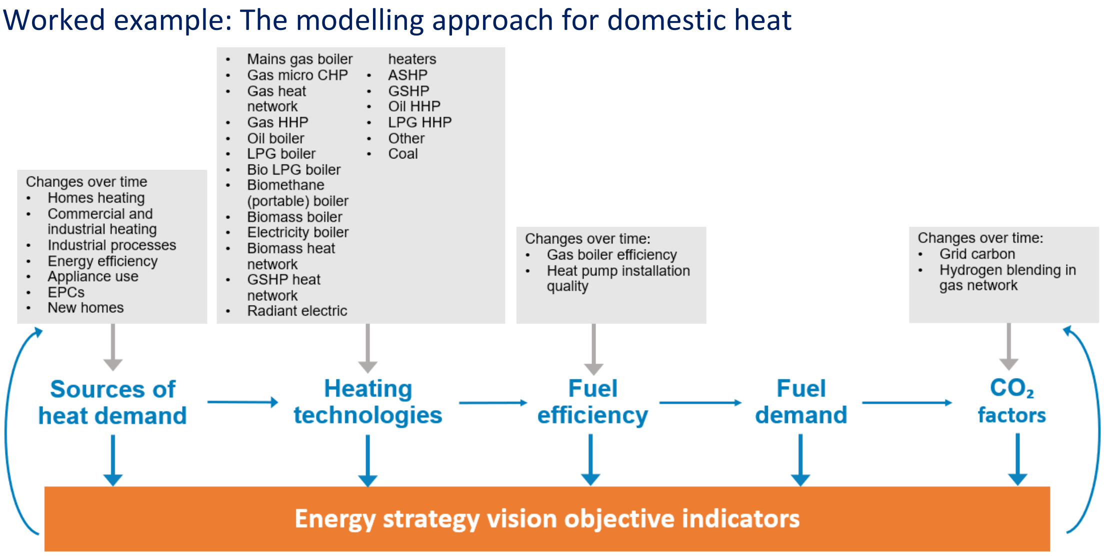


Figure 4: Diagram of the modelling approach for domestic heat

A note on scope

The strategy is focused on emissions associated with the energy system in SWW. As a result, the scope of the modelling is limited to the energy system, which includes transport, power and heat use. Emissions or sequestration from non-energy activity such as agriculture and land use are not considered in the model. Data limitations and issues around whether emissions are considered locally or nationally mean that some other emissions that are within the energy system are also not considered by the model. These include aviation, shipping and some very large industrial energy users.

Table 2: Summary of modelling scope

In scope	Out of scope: Energy emissions not considered regionally	Out of scope: Non-energy emissions
• Domestic heat, power and energy efficiency • Commercial and industrial heat, power and energy efficiency • Road transport • Local renewable energy generation	• Very large industry • Rail • Shipping • Aviation	• Non-energy agricultural emissions • Non-energy emissions • Land use change • Waste management • Chemical processes • Scope 3 emissions

2 Analysis of decarbonisation targets by sector

2.1 Baseline total energy consumption by sector

In total, SWW annually consumes around 31 TWh of energy[8], of which nearly half is consumed in very large industrial sites. Fuels used to generate electricity are not included in this analysis, which is focussed on final consumption.

In total, the region accounts for around 36% of all energy consumed in Wales[8], which is more than its 22% share of the Welsh population[9] due to the concentration of very large industrial sites within the region. Commercial and industrial demand makes up two thirds of the energy consumed in the region. The remaining third is split fairly evenly between domestic users and transport[7].

SWW has a significant amount of heavy industry such as Tata Steel, based in Port Talbot, and the Pembrokeshire Oil Refinery, hence its high commercial and industrial energy consumption. Although data on very large energy users is included in these baseline figures, these heavy industry sites fall outside of the scope of the energy vision modelling due to their national significance and commercial sensitivities, meaning that data on individual sites' energy use is not publicly available, which results in difficulties in creating viable decarbonisation pathways.

Energy consumption in SWW by sector and fuel, including very large industrial sites

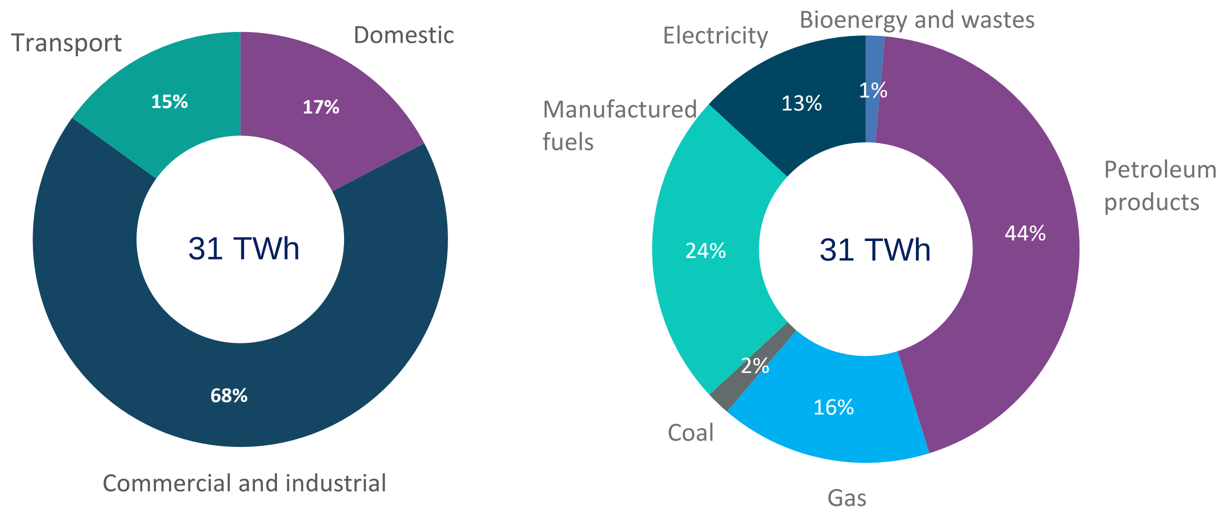


Figure 5: Breakdown of energy consumption in South West Wales, including very large industrial sites. Source: BEIS sub-national total final energy consumption, 2019.

[8] BEIS (2019) Sub-national total final energy consumption statistics: 2005 to 2017
[9] StatsWales (2019) Population estimates by local authority and year

Energy consumption baseline in SWW

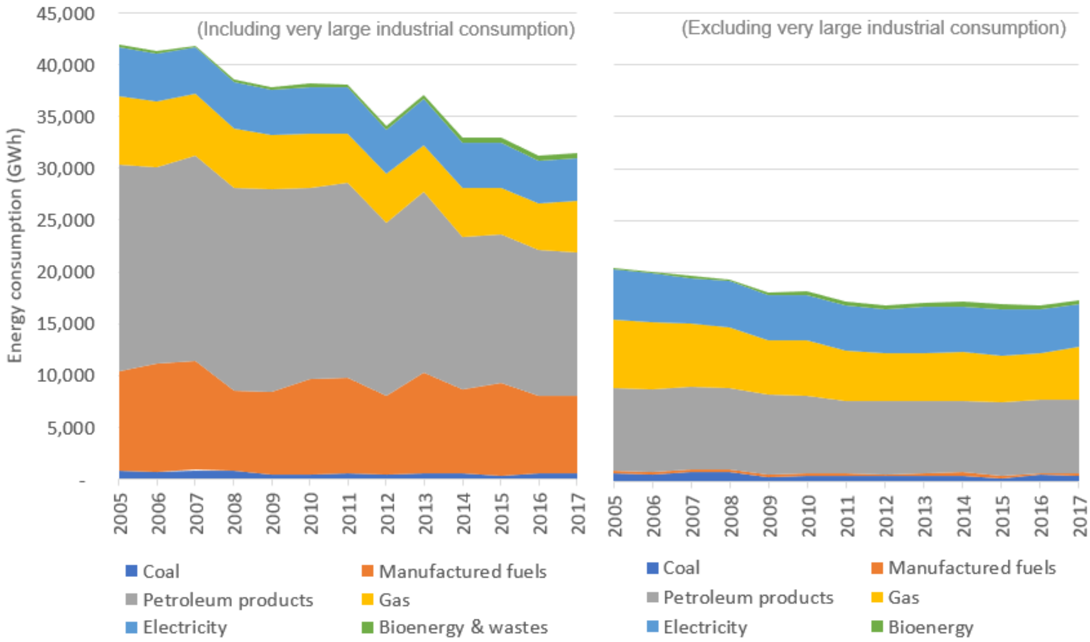


Figure 6: Trend of energy consumption in the South West Wales, by sector. Source: BEIS sub-national total final energy consumption, 2019.

Analysis of BEIS sub-regional data[10] shows that total energy consumption fell by 26% between 2005 and 2017. This is greater than the 18% reduction in energy demand experienced across Great Britain over the same period. The reduction rate has not been consistent across that period, as shown by Figure 6.

From 2005 to 2017, the commercial and industrial sector's energy consumption reduced by 31%, while the domestic sector's energy consumption reduced by 22%. This is likely to be the result of deindustrialisation and behavioural change/energy efficiency measures in each sector respectively.

10 BEIS (2019) Regional and local authority electricity consumption statistics 2005 to 2018

Sectoral carbon emissions in SWW

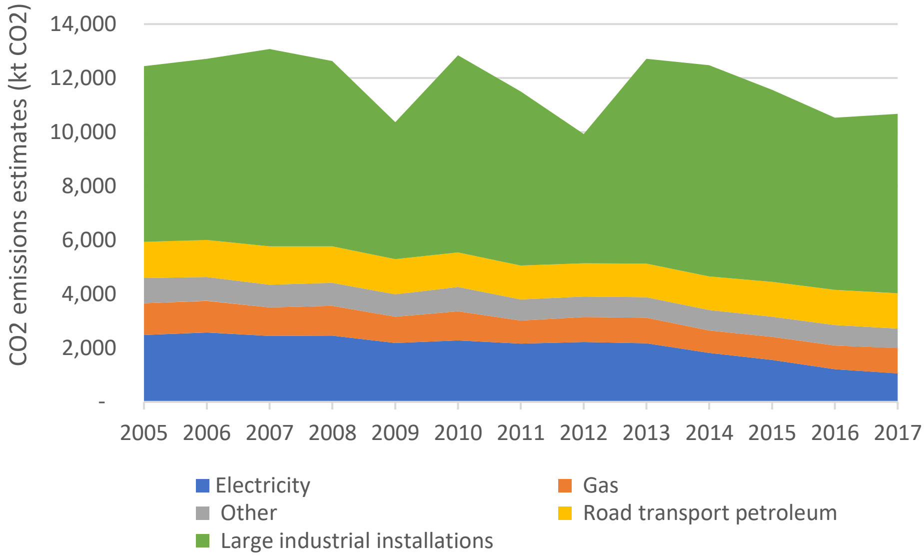


Figure 7: Estimated historic emissions in SWW show that large industrial consumption accounts for more than 50% of emissions in SWW Source: BEIS sub-national emissions

Emissions from energy consumption (including very large industrial consumption) reduced by around 14% from 2005 to 2017[11] as a result of falling demand and decarbonisation of the national electricity grid.

[11] BEIS (2019) UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2017

2.2 Decarbonisation targets by sector

Stakeholders at the regional webinar and through the survey indicated their support for the region to aim for a net zero energy system in 2050.

Applying the absolute contraction methodology to the baseline total energy consumption shows that to be on track for net zero by 2050, SWW needs to achieve 55% decarbonisation of its energy system by 2035.

Applying an absolute contraction methodology to baseline demand in SWW

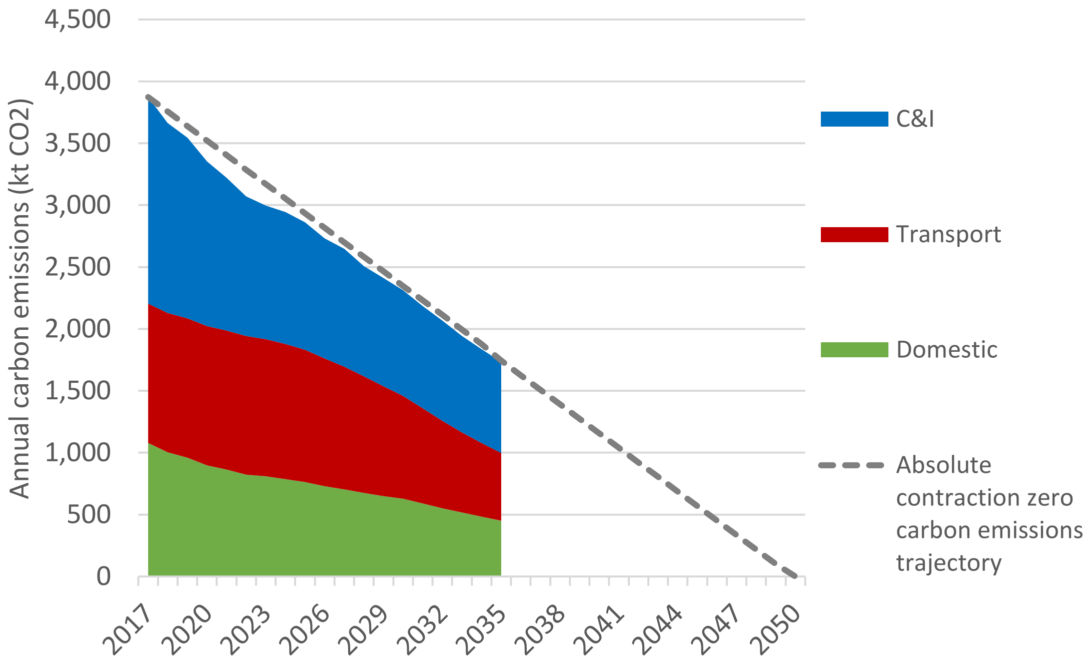


Figure 8: SWW's Energy Vision decarbonisation trajectory by sector to meet net zero 2050 under an absolute contraction methodology. Source: WGES analysis

Having analysed the measures that could be implemented in SWW by 2035, this 55% decarbonisation target can be split by sector into:

- 58% reduction in domestic heat and power emissions (including a 52% reduction in domestic heat emissions)
- 56% reduction in commercial and industrial emissions (excluding very large industrial use)
- 51% reduction in transport emissions.

This analysis excludes approximately 6,600 kt of emissions from large industrial consumption. Although not modelled, large energy consumption will also need to be decarbonised to achieve the area's net zero energy system aims. Actions to support the decarbonisation of heavy industry will be explored through the region's Energy Strategy Delivery Plan.

Figure 9: Summary of the Energy Vision's emission reductions by sector. Source: WGES analysis

3. Baseline and modelling results: Energy consumption by sector

3.1 Domestic energy consumption

A 58% reduction in emissions from domestic energy usage is needed to achieve the Energy Vision's aims. Domestic energy consumption can be split into heat and electricity:

- The decarbonisation of electricity consumption is covered in section 4.
- Domestic heat demand needs to achieve a 52% reduction in emissions; this requires the installation of significant numbers of both energy efficiency measures and low carbon heating technologies.

3.1.1 Baseline: domestic heat demand

Around 25,000 new homes have been built in the region since 2005[12]. Despite this, domestic heating demand has fallen by 34% in the region since 2005, reflecting the trend for Great Britain, which has resulted from more efficient heating appliances, combined with behavioural change and more energy efficient homes.

SWW contains a mixture of predominantly agricultural areas in Carmarthenshire and Pembrokeshire and more urban areas in Swansea and Neath Port Talbot, hence the pattern seen in figure 10.

[12] Welsh government, Household estimates for Wales - households by type by local authority, 1991 to 2017

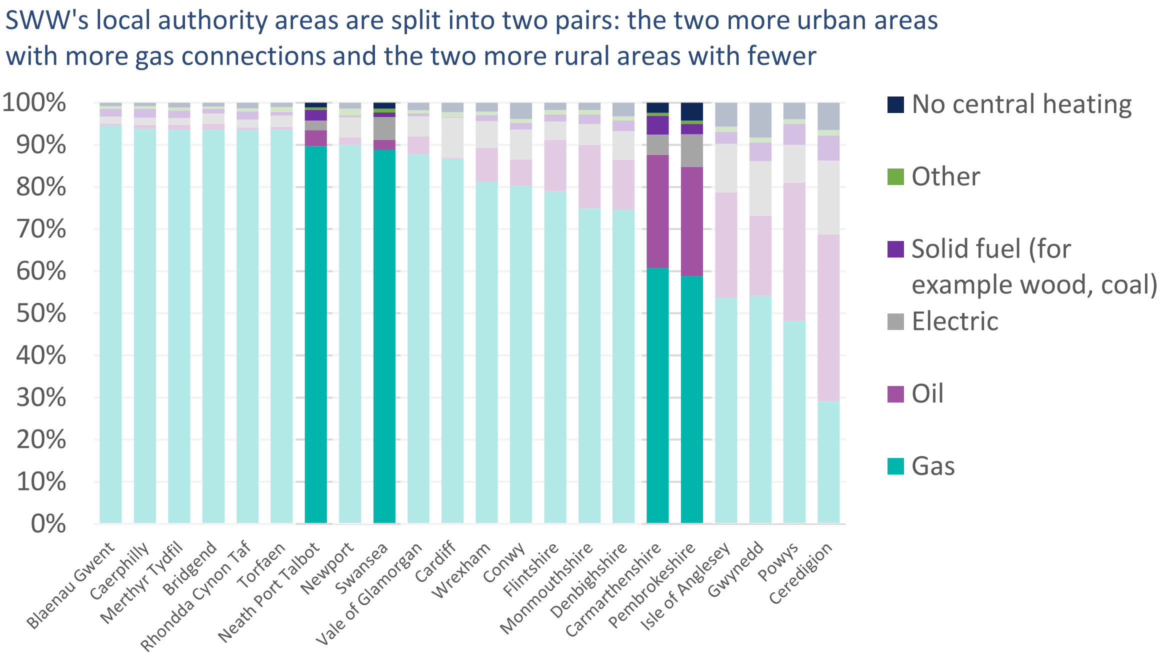


Figure 10: Proportion of homes heated by each heating fuel type, by local authority. Source: Census, 2011. MHCLG, Energy Performance Certificates[13].

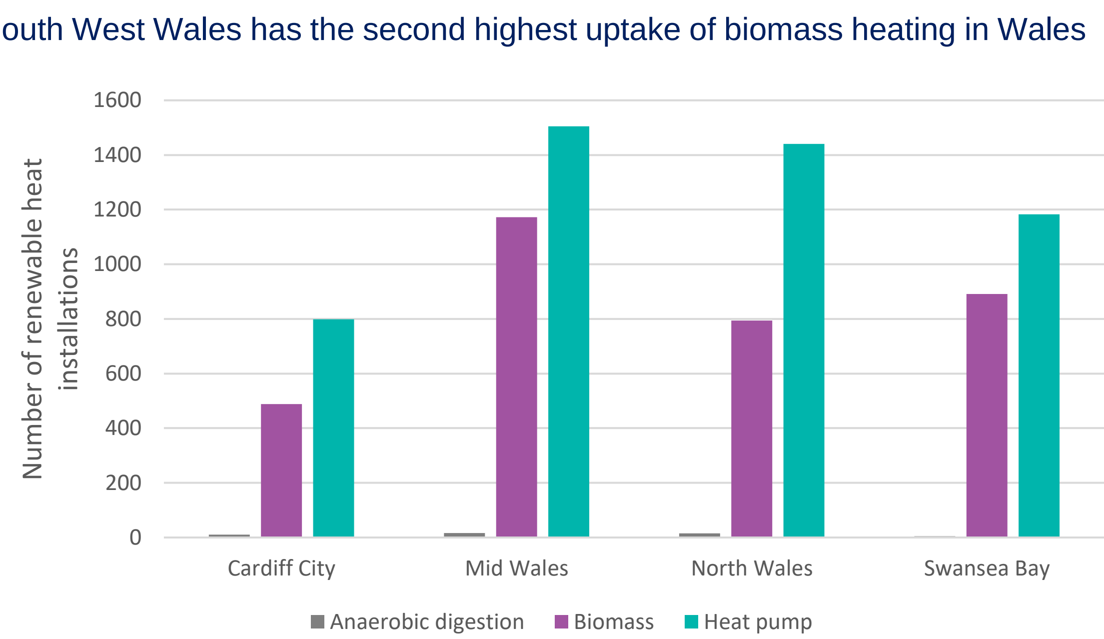


Figure 11: Renewable heat installations in Wales. Source: Energy Generation in Wales 2018

Overall uptake of renewable heat technologies has been limited in Wales to date. In SWW, 0.9% percent of homes have a heat pump or biomass boiler.

[13] To note, the Census data is now nearly 10 years old but EPC data and data on renewable heat shows little shift in heating types over that time.

SWW’s domestic properties have an average EPC rating of D

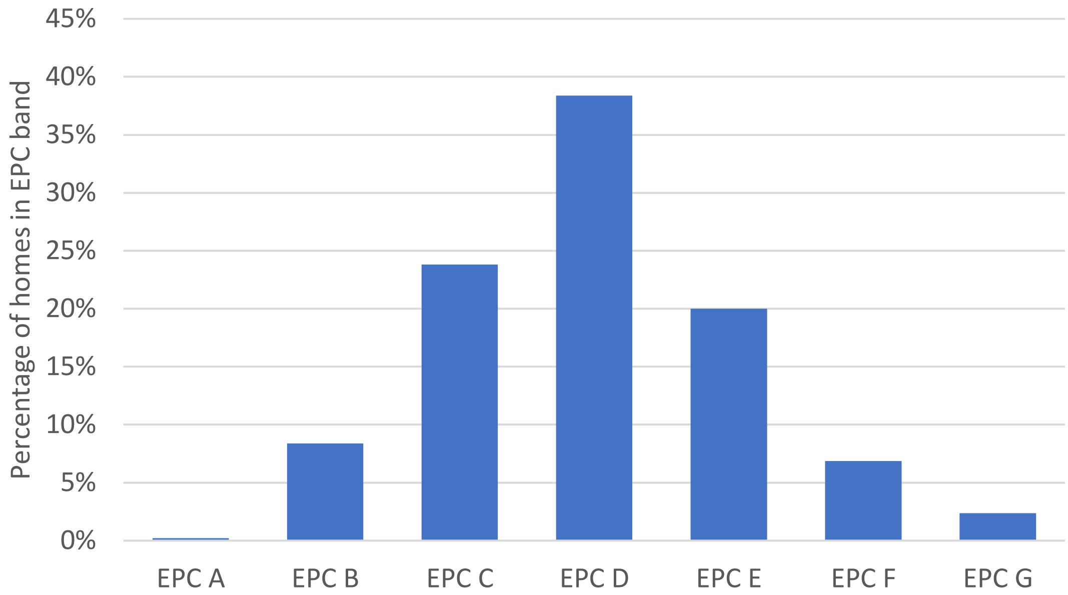


Figure 12: Proportion of homes in SWW in each EPC band. Source: MHCLG, Energy Performance Certificates

South West Wales has 71% of homes rated as EPC band D or better, slightly lower than the Great Britain (GB) figure of 77%. The average rating (mean, median and mode) is a D, and there are only around 600 A-rated properties.

3.1.2 Energy Vision scenario: domestic heat demand

Stakeholder views on the level of ambition: domestic heat demand

Through the engagement survey, stakeholders were presented with the objectives developed through the 2018 Energy System Vision Study and asked to comment and rate their agreement with the objective (Note the energy efficiency and decarbonisation of heat objectives tested include commercial and industrial use).

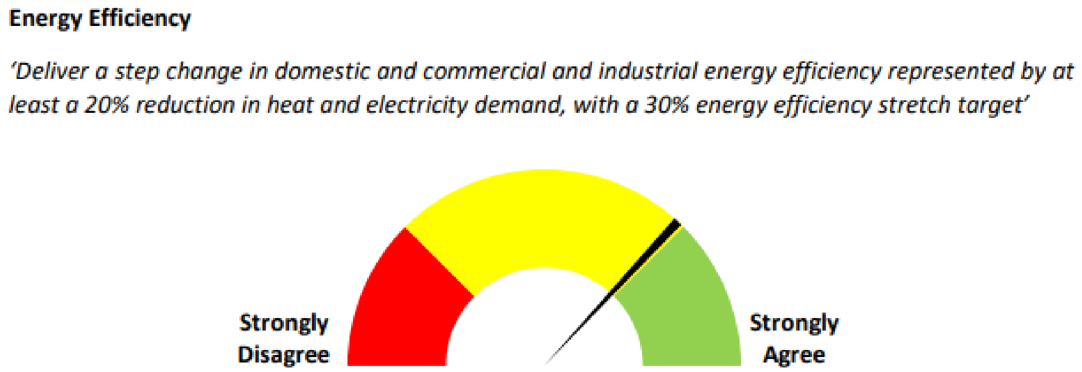


Figure 13 – Results of stakeholder engagement, highlighting stakeholder agreement with the energy efficiency objective.

While identifying the priorities for the region, stakeholders agreed that energy efficiency is the most important priority. Extensive retrofitting is required, with stakeholders placing a priority on retrofitting based on poorest EPC rating and homes experiencing fuel poverty, assisted through mapping of EPCs. The level of agreement with this objective was slightly lower than other objectives due to concerns about achieving the commercial/industrial efficiencies required.

Decarbonisation of Heat

'40% of heat supply from decarbonised heat supply sources – through electrification, gas decarbonisation and use of renewable energy sources. Reduce the overall carbon emissions from supply of heat (including energy efficiency) by at least 40% compared to 2017.'

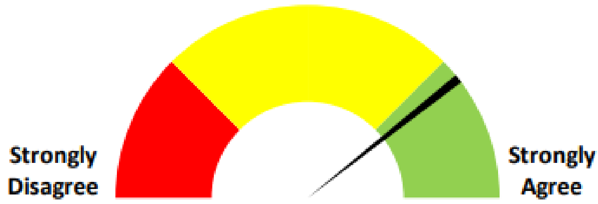


Figure 14 – Results of stakeholder engagement, highlighting stakeholder agreement with the decarbonisation of heat objective.

The decarbonisation of heat objective saw strong agreement, with comments suggesting different opportunities to decarbonise heat in the region such as through heat pumps, hydrogen or both, as well as tying the transition in with energy efficiency through retrofits.

3.1.3 Assumptions: domestic heat demand

The assumptions developed drew on those used in the 2019 Wales & West Utilities study, as well as stakeholder engagement.

Box 1: 2019 study assumptions regarding the decarbonisation of domestic heating

In a 2019 study with Wales & West Utilities (WWU), members of the Regen team worked with WWU and South Wales stakeholders to explore potential future scenarios for the gas network in Wales in 2035. Some of the key scenario-based results of the work include:

- Around 20% of homes could be heated by a heat pump by 2035, predominantly air source heat pumps in new build homes and hybrid systems with heat pumps alongside gas boilers in existing homes.
- Hydrogen offers a number of significant opportunities for Wales, particularly through the development of industrial clusters in North Wales and extending into the Wirral, and in South Wales in Pembrokeshire, Port Talbot and industrial zones around Cardiff and Newport. A number of hydrogen projects are planned and there is a high likelihood that hydrogen for industrial and transport applications will become an important fuel over the next decade. There is the potential that some hydrogen from these trial projects could be used to supply heat to adjacent homes and commercial buildings, however hydrogen is not expected to become economically viable or widely available for network distribution as a heating fuel before 2035.
- Biomethane from food waste and sewage in populous areas, alongside farm waste in more rural areas, could provide over 4% of energy supplied by the gas distribution network in the region by 2035. The proportion of biomethane that is injected into the mains gas network will depend on the availability of feedstocks and level of demand from other biomethane uses such as power generation.
- Currently, 0.8% of domestic and commercial properties are served by a heat network, typically fuelled by mains gas. By 2035, up to 5% of properties could be heated via a heat network, including low carbon networks driven by ground-source or water-source heat pumps or utilising waste heat from nearby industrial sites.
- Consumption of natural gas energy in Wales could fall by over 20% between now and 2035.

These findings have been built on in developing the SWW Energy Vision scenario.

WWUs' outlook regarding the potential for biomethane and hydrogen has evolved since the modelling was undertaken following the UK government evolution to a net zero target last year. Net zero scenario shows higher potential for biomethane and hydrogen. For example, biomethane levels in some parts of the WWU network will reach over 20% by 2021. This would facilitate the decarbonisation of homes using smart hybrid heating systems.

Source:[1] Regen (2019) Regional Growth Scenarios for Gas and Heat for Wales & West Utilities [13]

The following assumptions were used to create a decarbonisation pathway capable of reducing domestic heat carbon emissions by 52% by 2035:

- Significant further decarbonisation of the electricity grid through renewable generation, from approximately 0.266 $kgCO_2/kWh$ now to 0.03 $kgCO_2/kWh$ in 2035.
- 35% reduction in the energy demand of homes, facilitated by ambitious uptake of energy efficiency measures. This is an increased level of ambition from the 30% stretch target used in the 2018 Energy System Vision.
- 40% of heat supply from decarbonised heat supply sources. This is the same as the 2018 Energy System Vision, which was found to be ambitious and consistent with a net zero trajectory.
- Concerted effort to replace oil, LPG, and solid fuels with heat pumps, bio-LPG and electricity.
- Hybrid heating systems are considered a transition technology in hard-to-treat on-gas houses.
- No pure hydrogen heating within strategy timescales, except for early 100% hydrogen transition associated with industrial cluster activities, floating offshore wind and electrolysis and the potential BEIS Hydrogen Village trials.
- From 2025, there is no gas heating in new homes, with the uptake of ASHPs prioritised.

The role of biomethane

- Alongside the electrification of heat and energy efficiency improvements, the decarbonisation of gas through biomethane is expected to play a relatively small but important role in a future net zero energy system. The 2035 Energy Vision for South West Wales includes a role for blended biomethane, providing approximately 5% of mains gas domestic heating energy consumption.
- The amount of biomethane generation for domestic heat in the Energy Vision is less than in the previous 2018 Energy System Vision. Regen's 2019 Regional Future Energy Scenarios for Gas study for Wales & West Utilities involved detailed analysis of the potential for consumption of biomethane, both for mains gas biomethane injection and biomethane heat networks. Additional stakeholder engagement and a detailed mapping analysis of farm locations in relation to the gas network were undertaken, resulting in the conclusion that opportunities for biomethane consumption were lower than projected in the 2018 Energy System Vision study.
- It is assumed that biomethane will be generated from a variety of sources, including anaerobic digestion of farm residues, energy from waste and sewage sludge. The table below summarises the amount of

biogas energy consumption in the Energy Vision compared to other studies.

Table 3: 2035 biomethane consumption estimates by study

Biomethane consumption source	2018 SBCR Energy System Vision	2019 WWU Regional Future Energy Scenarios for Gas	2021 SWW Energy Vision (this study)
Mains gas biomethane injection	270 MWh	168 MWh	168 MWh
Via district heat networks	186 MWh	107 MWh	107 MWh
BioLPG		6 MWh	6 MWh

3.1.4 Decarbonisation pathway: Domestic heat demand

Existing homes

Achieving a 52% reduction in domestic heat emissions by 2035 requires a significant shift in the way homes are heated and their level of energy efficiency.

One pathway to achieve this would be to focus on improving the worst performing homes, eliminating all E, F and G EPC ratings and homes experiencing fuel poverty through efficiency improvements, as well as some improvements to homes with higher ratings. For example, a 52% reduction could be achieved if over 85,000 homes were improved from G, F and E to D, C and B, leaving just 1% of properties with an EPC rated E or worse.

Mapping EPC ratings within the region will help achieve this, as suggested during the various stakeholder engagement activities.

Upgrades to nearly all homes rated E, F and G required to deliver South West Wales' Energy Vision

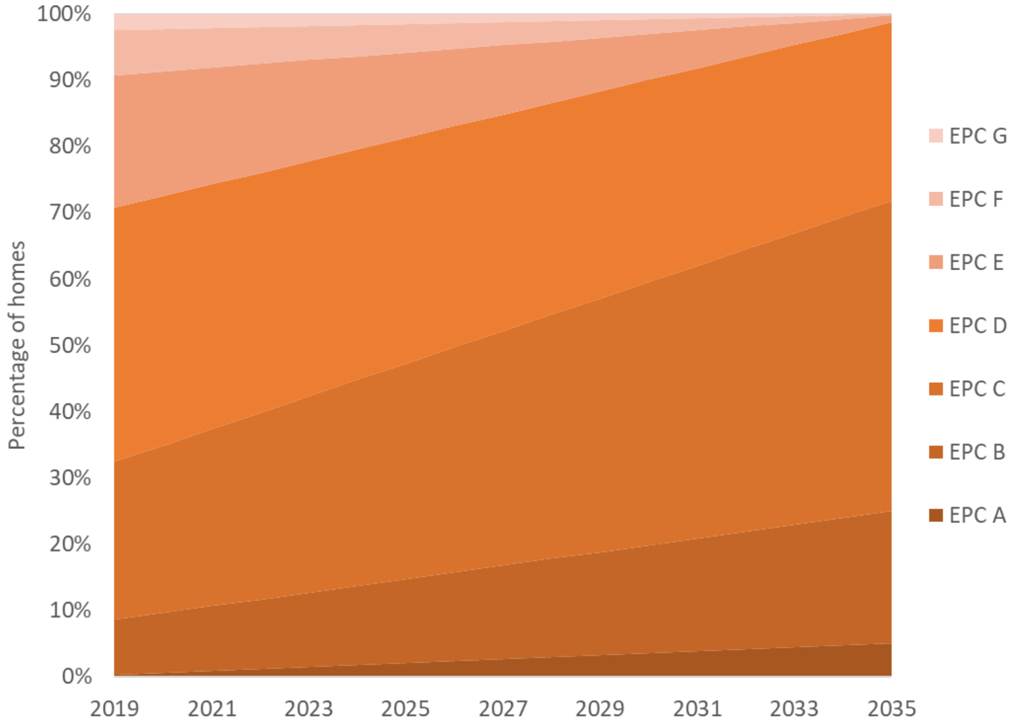


Figure 15: Estimated domestic EPC band changes to deliver the Energy Vision scenario. Source: WGES analysis

Around 82,000 homes, 27% of existing homes, would need to move from using fossil fuel heating to low carbon heating by 2035. Of these, approximately 29,000 are currently fuelled by oil, LPG, coal or other solid fuels, while the remainder are on mains gas.

The Energy Vision scenario assumes that the transition to low carbon heating will be dominated by a shift to air source heat pumps, with a supporting role for individual ground source heat pumps and, more significantly, shared ground loops. Other low carbon heat technologies also play a role with an increase in biomass boilers to account for off-gas oil and LPG boilers or a form of hybrid heating if insulation measures combined with ASHP are not appropriate. By 2035, over 78,000 heat pumps are assumed to have been installed in South West Wales, including over 13,000 heat pumps in new homes and around 6,000 homes connected to heat pump-driven heat networks.

Air source heat pumps are the main new low carbon heating source introduced by 2035 under South West Wales' Energy Vision scenario

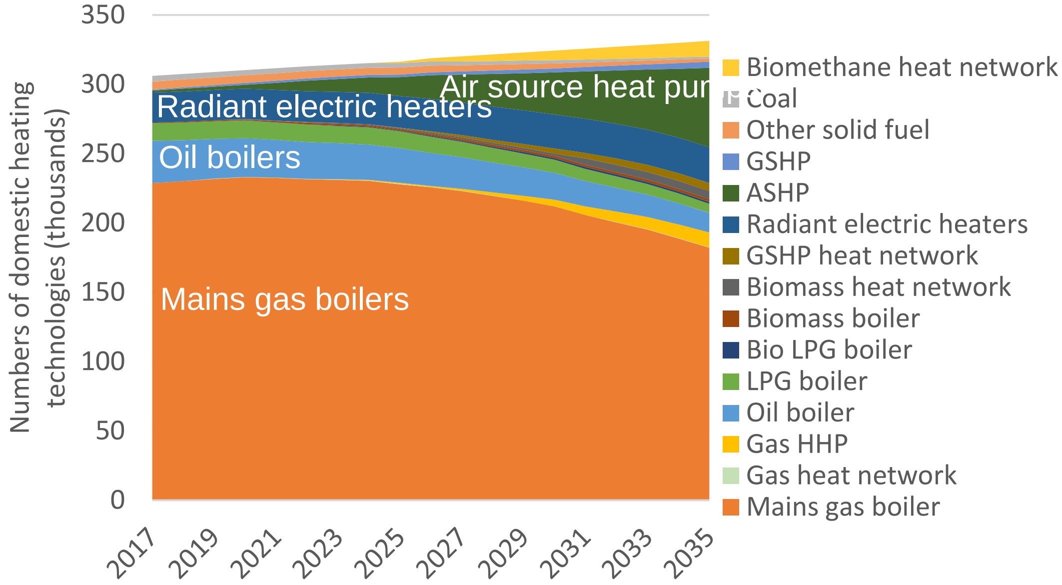


Figure 16: Breakdown of domestic heating technologies in the SWW Energy Vision scenario, including existing and new build houses. Source: WGES analysis

Despite these significant shifts to low carbon heat sources, gas boilers remain the dominant technology in existing homes in 2035; post-2035, there will need to be a focus on fully decarbonising these remaining on-gas homes.

New homes

The recent consultations from Welsh Government on Building Regulations Part L (latest consultation ended 17/02/21) is looking to lay down the standards for housing construction up to 2025 and exploring the standards that will be in place from 2025. The current proposals up to 2025 are to introduce a 37% reduction in carbon emissions for new homes (compared with current standards), delivered by raised fabric standards and low carbon/renewable sources, as well as to require heating systems that can be easily retrofitted for low carbon heating. The target outcome is that homes built from 2025 will emit 75% to 80% less carbon than those built to the 2014 Part L requirements[14]. The challenge will be to close the remaining gap to true zero carbon development.

[14] Welsh Government (2019) Welsh Government Consultation Document: Building Regulations Part L and F Review

The Active Building Centre in Swansea aims to provide the case for the national adoption of Active Buildings. These Active Buildings integrate innovative renewable energy generation, storage technologies and state of the art design, in order to create properties with the potential to substantially reduce both operational costs and energy demand. They are currently

The Energy Vision scenario relies on new homes being built with low carbon heating and high standards of energy efficiency from 2025, rather than building properties that will need retrofitting at a later date. This assumes that a 2025 standard is in place that effectively requires new homes to be decarbonised and does not allow them to have fossil-fuelled heating.

3.1.5 Scenario summary: domestic heat demand

Sector	Example outcomes Energy Vision scenario	Energy prize	Carbon saving potential
Domestic heat demand	21,000 houses fitted with internal or external wall insulation Over 140,000 homes fitted with other insulation measures Over 65,000 heat pumps 23,000 homes connected to low carbon heat networks Replacement of heating systems in oil, LPG and solid fuel heated homes prioritised No fossil gas in new homes from 2025	18% reduction in gross thermal energy demand 34% net decrease in domestic heating energy consumption, taking into account demand reduction and improved heat technology efficiencies, including the impact of heat pump performance.	422 kt CO_2 (52% reduction)

3.2 Commercial and industrial energy consumption

To note:

The baseline and scenario analysis for commercial and industrial consumption excludes analysis of very large industrial consumption (which accounts for around 70% of all commercial and industrial consumption). For further information, see section 1.3.

3.2.1 Baseline: commercial and industrial

Commercial and industrial energy demand, including large industrial users, in SWW has decreased by 31% since 2005 and emissions have decreased by 45%. The greater reduction in emissions when compared to the reduction in energy demand, is largely due to the decarbonisation of the UK's electricity grid.

South West Wales' commercial and industrial energy demand decreased by 31% between 2005 and 2017

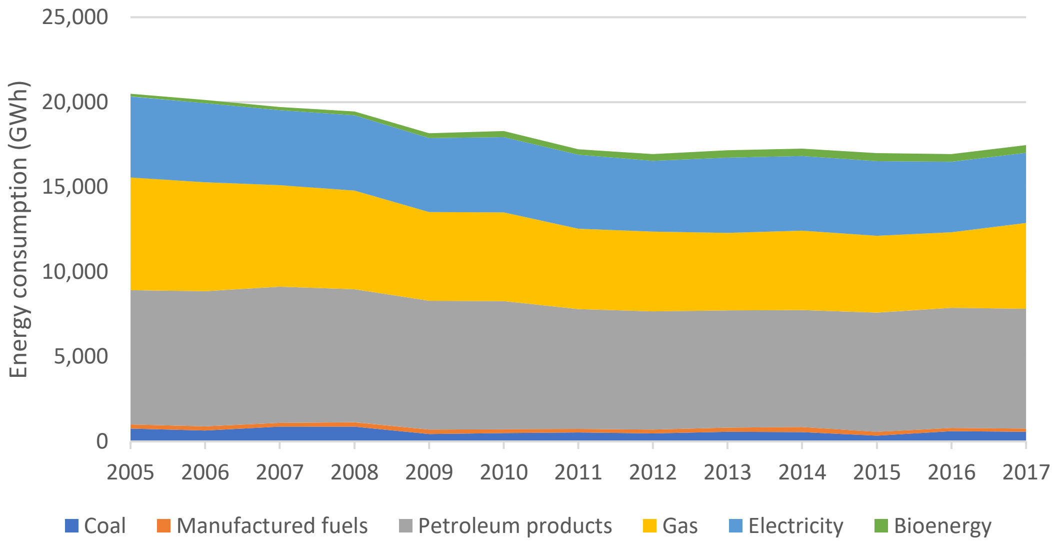


Figure 17: South West Wales' baseline commercial and industrial energy consumption, by fuel. Source: BEIS total final energy consumption (2019)

3.2.2 Energy Vision scenario: commercial and industrial

Stakeholder views on the level of ambition: Commercial and industrial

The objectives for energy efficiency and heat decarbonisation discussed with stakeholders via the engagement survey (shown in figures 13 and 14), cover both the domestic and non-domestic sectors.

Stakeholders commented that they were concerned about how energy efficiency and heat decarbonisation would be practically achieved in the commercial and industrial sector. They suggested setting separate, more realistic objectives for the industrial sector.

3.2.3 Assumptions: commercial and industrial

The assumptions used in the Energy Vision scenario reflect stakeholders' concerns around the difficulties in implementing energy efficiency measures and heat decarbonisation for this sector. The scenario sets out a pathway to achieve a 56% reduction in commercial and industrial emissions by 2035 through:

- A 14% decrease in energy demand through energy efficiency and process efficiency measures.
- Switching to low carbon fuels and heating, including electrification and use of low carbon hydrogen in industrial processes (Hydrogen industrial clusters are likely to be more prevalent in the out-of-scope, very large industrial sites).
- Significant further decarbonisation of the electricity grid through renewable generation, from approximately 0.266 kgCO_2/kWh now to 0.03 kgCO_2/kWh in 2035.
- An uptake of on-site renewable CHP generation is assumed across the Energy Vision, but are likely to be more prevalent in the out-of-scope, very large industrial sites.

3.2.4 Decarbonisation pathway: commercial and industrial

SWW's Energy Vision scenario includes a 14% decrease in commercial and industrial energy consumption by 2035

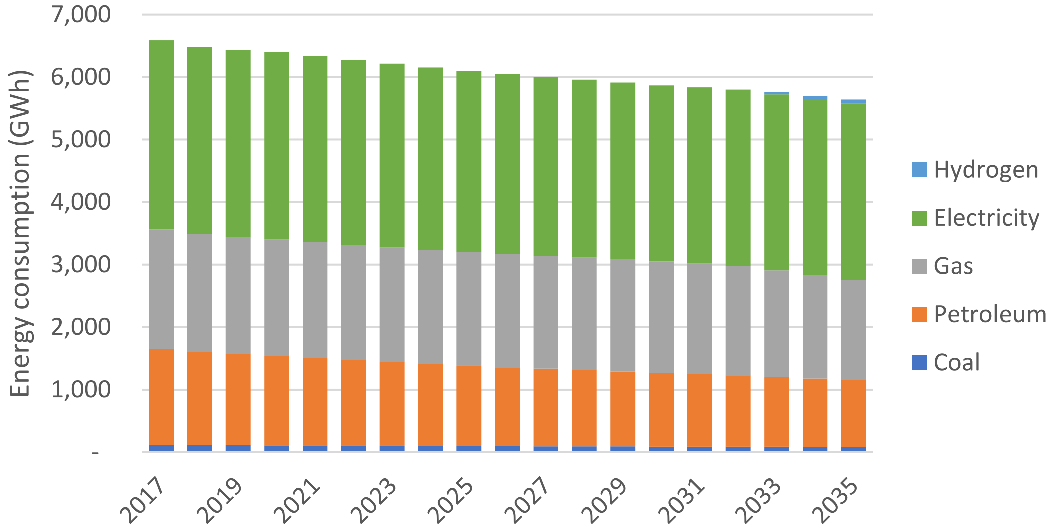


Figure 18: Energy Vision scenario commercial and industrial energy consumption, by fuel. Source: WGES analysis

Reaching a grid electricity average carbon intensity of 30 gCO_2/kWh[15] would in itself (with no additional demand reductions) achieve a 43% reduction in all commercial and industrial emissions in SWW, as shown in figure 19. This very low electricity carbon factor would depend on significant installation of new, low carbon generation capacity both in SWW and across the UK.

[15] Assumption based on Community Renewables and Two Degrees scenarios in National Grid (2019) Future Energy Scenarios

South West Wales' Energy Vision scenario results in a 56% decrease in commercial and industrial energy emissions by 2035, dependent in large part on decarbonisation of the electricity network

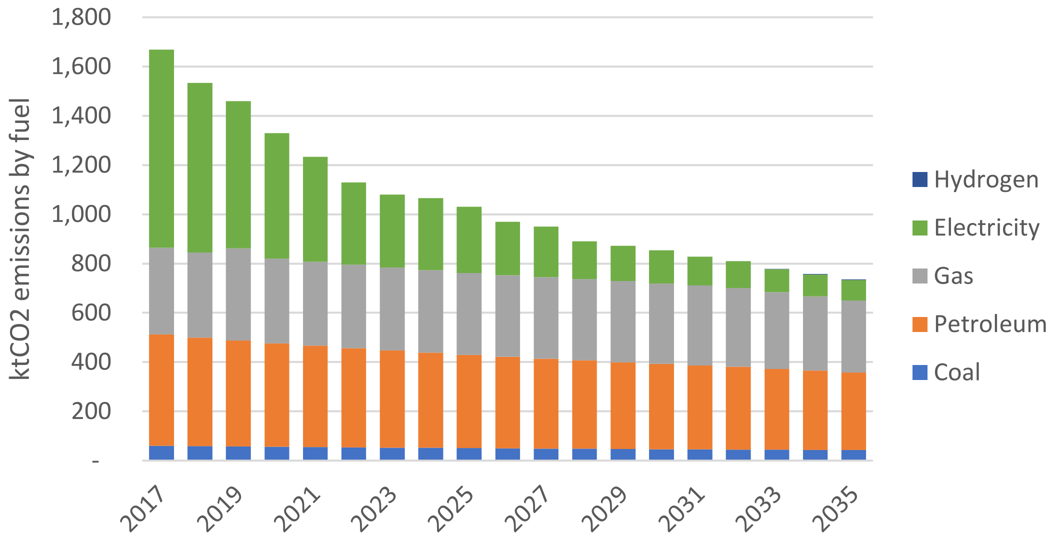


Figure 19: Energy Vision scenario commercial and industrial emissions estimates, by fuel. Source: WGES analysis

Use and production of hydrogen

South West Wales has long been the hub of hydrogen development in South Wales, with the Flexis hydrogen demonstration project based across Swansea and Neath Port Talbot. Due to the potential for hydrogen to decarbonise the heavy industry that dominates the southern coastline of Wales, there was significant support amongst stakeholders for exploring the role of hydrogen through the energy strategy.

Regen's analysis for Wales & West Utilities (see **Box 1** in section 3.1.3) found that before 2028, under some scenarios, there could be some use of hydrogen in the region in industrial clusters. Based on this and stakeholder interest, the modelling assumes the use of hydrogen for commercial and industrial processes beginning around 2030.

Welsh Government has established a Hydrogen Reference Group to bring together key stakeholders and provide a focus for encouraging hydrogen development and provide a core focal feedback to the Welsh Government. In January 2021 Welsh Government launched a consultation seeking views on the Welsh Government's commissioned 'Hydrogen in Wales'. This document sets out a proposed pathway and next steps for developing the hydrogen energy sector in Wales.

To ensure hydrogen use that aligns with the region's net zero ambitions, the hydrogen needs to be produced either through excess or dedicated renewable energy to power electrolysis (e.g. from wave and tidal stream projects and Floating Offshore Wind in the Celtic Sea) or through steam methane reformation with very efficient carbon capture and storage (e.g.

through the potential collaboration of the South Wales Industrial Cluster with the HyNet project in North West England). In order to be viable for widespread use, both methods of production will need to see cost reductions and technological development.

RWE launched the Pembroke Net Zero Centre (PNZC) in May 2021 as a major initiative for decarbonisation using hydrogen. Hydrogen consumption feasibility studies and green hydrogen production including floating offshore wind development in the Celtic Sea are core pillars of the centre's mission.

Milford Haven: Energy Kingdom (MH:EK) in Pembrokeshire is now conducting a £4.5 million project exploring the vital role hydrogen could play in a decarbonised energy future. The project is primarily delivering a Front End Engineering Design (FEED) study laying the foundations for what could be the first of many Smart Local Energy Systems, and seeks to make a strong business case for investment in hydrogen to the Government and engaged key stakeholders in the Waterway.

This is an area likely to see greater exploration within the region. Other potential projects include using the excess energy from solar and other renewable technologies at the Swansea Bay Technology Centre to produce hydrogen at the nearby Hydrogen Centre to fuel hydrogen vehicles[16].

Sector	Example outcomes Energy Vision scenario	Energy prize	Carbon saving potential
Commercial and industrial energy demand	Significant energy efficiency programme A switch to alternative fuels, including hydrogen and electrification of heating Decarbonisation of electricity network through renewables and behind-the-meter low carbon generation	30% reduction in coal and petroleum energy consumption 16% reduction in gas consumption 1% of demand supplied by hydrogen through industrial clusters 7% reduction in electricity demand	932 kt CO_2 (56% reduction)

[16] Supporting Innovation and Low Carbon Growth Project

3.3 Energy demand from transport

3.3.1 Baseline: transport

SWW has a high dependence on private cars for transport. Average annual vehicle miles in SWW are similar to those in other Welsh regions at 8,500 miles per car, 7% higher than the UK average (see figure 20).

Wales has significantly lower bus utilisation rates than England or Scotland

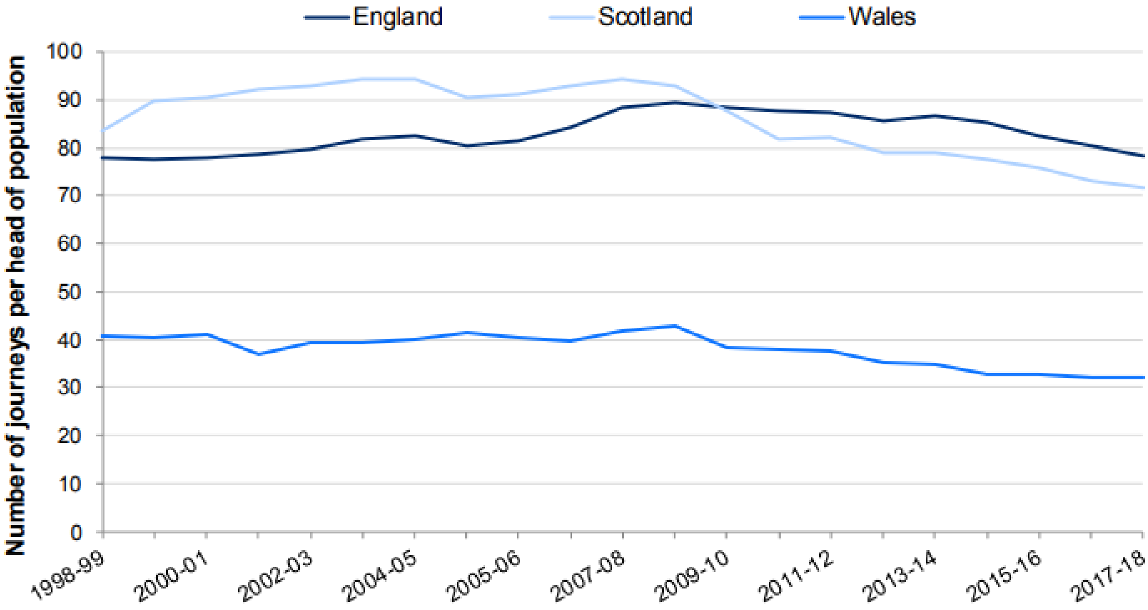


Figure 20: Passenger journeys per head on local bus services by country, 1998-2018. Source: Public service vehicles statistical bulletin, 2019

To date, SWW has seen a limited uptake of electric vehicles. Approximately 0.3% of cars registered in the region are pure electric, compared with an average of 0.6% of vehicles across Great Britain. SWW currently hosts 128 public charging devices, including 11 rapid public chargers [17]. The urban areas of Neath Port Talbot and Swansea host 6 and 10 devices per 100,000 people respectively. These figures are relatively low, as is the case across Wales, where there are half the number of public EV chargers per capita compared to Scotland. The region's chargepoint numbers are set to increase with Carmarthenshire and Swansea winning funding from the Office of Low Emissions Vehicles' off-street residential charging scheme.

[17] DFT (2019) Electric Vehicle Charging Device Statistics

3.3.2 Energy Vision scenario: transport

Stakeholder views on the level of ambition: transport

Decarbonisation of Transport

'Become a leading region for the reduction of vehicle emissions through:

- *the electrification of transport with 80% of new cars, and over 30% of all cars electric 2035*
- *growth and decarbonisation of public transport with 100% Ultra Low Emission Vehicles by 2035.'*

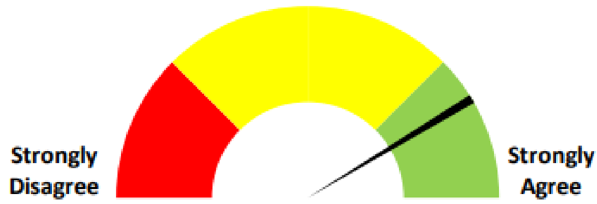


Figure 21 – Results of stakeholder engagement, highlighting stakeholder agreement with the decarbonisation of transport objectives.

Whilst a high level of ambition for decarbonising transport saw strong support, as indicated in figure 21, a lot of concern was also raised by stakeholders about how this was to be achieved. Improvements to charging infrastructure were seen as a priority, but there were also socio-economic, accessibility and geographic issues, such as the proportion of terraced housing and low incomes in the region. The regional approach to tackling these issues will be detailed further in the delivery plan for the Energy Strategy.

3.3.3 Assumptions: transport

Updating the 2018 Energy System Vision study with a net zero ambition has meant, in particular, increasing the level of decarbonisation that the transport sector needs to achieve; for example, the assumed proportion of electric vehicles in 2035 has increased from 30% to 78%. However, the greater level of transport decarbonisation in this study is supported by the UK government's ban on the sale of fossil fuel cars being brought forward to 2030, with the potential that it may be earlier still.

Achieving the 51% reduction in transport emissions by 2035 means that meeting the vision's objectives is a significant challenge for South West Wales. The Energy Vision scenario assumes:

- 78% of vehicles in South West Wales in 2035 are electric.
- A 10% reduction in private vehicle mileage in 2035 facilitated by significantly increased use of public transport and active travel.
- A slowing of the growth in total number of vehicles on the road, facilitated by increased use of public transport, car sharing and active travel.

3.3.4 Decarbonisation pathway: transport

With the region's large rural areas relying on private cars for transport, EVs will be a large part of the pathway to decarbonising transport. Low Carbon Swansea Bay's EV group is supporting the roll out of EVs in the region.

Hydrogen vehicles may also have a part to play, led by the Hydrogen Centre, particularly for HGVs, buses, coaches and trains.

South West Wales' Energy Vision scenario requires a significant decrease in the number of petrol and diesel vehicles

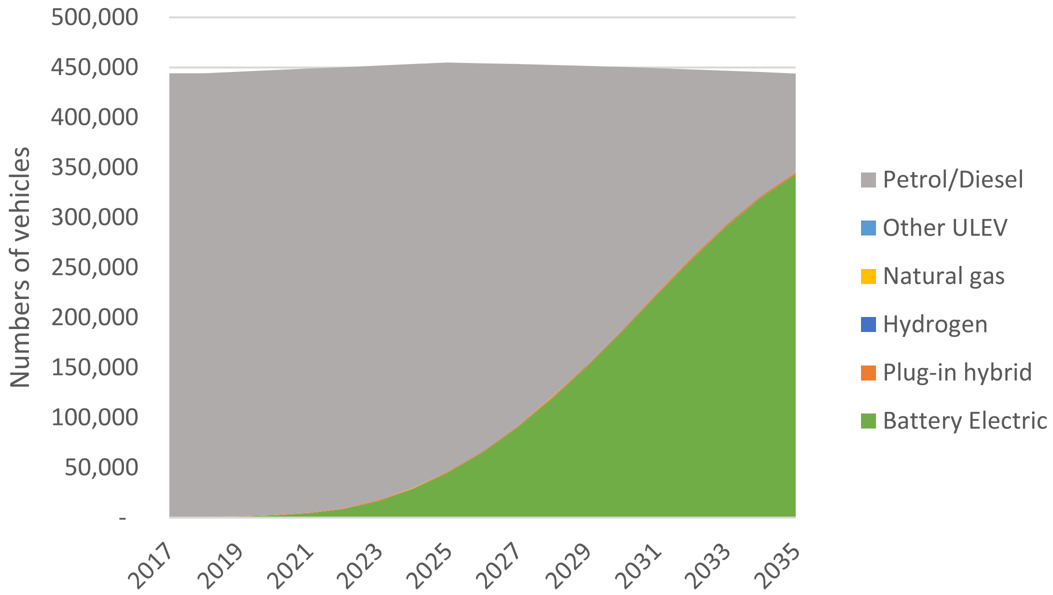


Figure 22: South West Wales' Energy System Vision road vehicle numbers, by vehicle fuel. Source: WGES analysis

The increased use of public transport in the region could be supported by the extension of services currently available in the south, such as a collaboration to extend the South Wales Metro from the Cardiff Capital Region. For such a large and rural region, there can be barriers to increasing public transport, but the requestable Bwcabus scheme in Carmarthenshire and EV car clubs present potential solution.

South West Wales' Energy Vision scenario results in road transport emissions reducing by around 49%

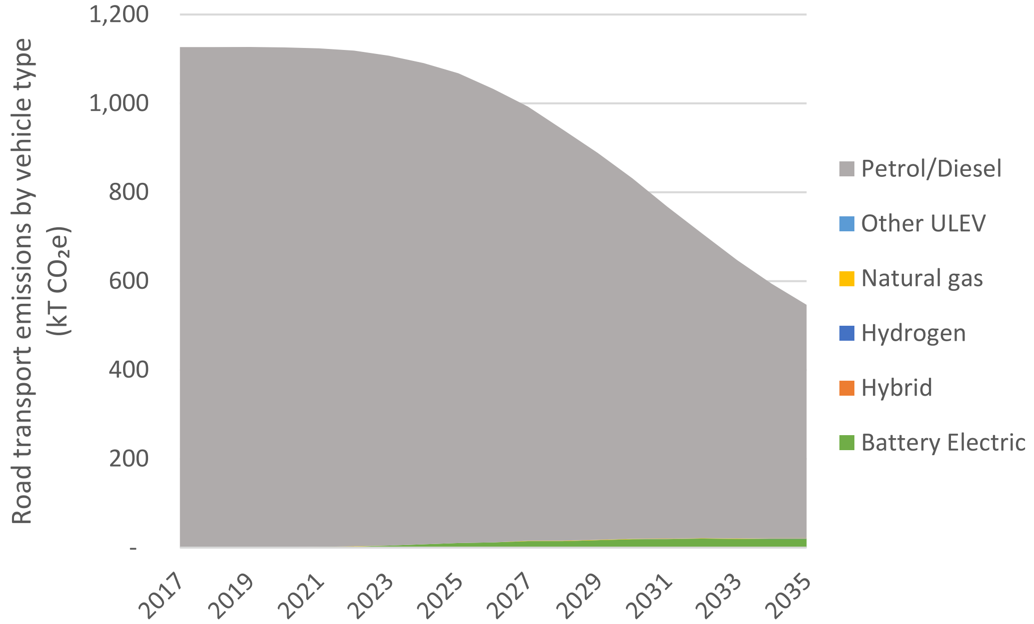


Figure 23: Energy System Vision road vehicle emissions, by vehicle fuel. Source: WGES analysis

3.3.5 Scenario summary: Transport

Sector	Example outcomes Energy Vision scenario	Energy prize	Carbon saving potential
Road transport	320,000 electric cars 9,500 public and on-street EV chargers 10% reduction in private vehicle mileage	2.5 TWh reduction in petrol and diesel energy consumption 0.6 TWh increase in electricity consumption	580 kt CO_2 (51% reduction)

Achieving these outcomes requires 17,000 EV sales per year by the mid-2020s, peaking at 38,000 per year in the 2030s before reducing to 30,000 per year by 2035. Peak sales of fossil-fuelled cars in SWW have historically reached 33,000 per annum[18]. Additional support, such as a scrappage scheme alongside a 2030 ban on new fossil-fuelled car sales[19], would be

[18] DFT (2019) Road traffic statistics (TRA) and Regen analysis
[19] The UK Government is due to consult on bringing forward the fossil-fueled vehicles ban to 2035 or earlier. The analysis assumes this is brought forward to around 2030.

needed to retire some fossil-fuelled vehicles earlier than their average lifespan, in order to achieve a peak of 38,000 EV sales per year in the 2030s.

4. Baseline and modelling results: Electricity demand and renewable electricity generation

4.1 Annual electricity demand

4.1.1 Baseline: annual electricity demand

Annual electricity demand in SWW is currently approximately 4.1 TWh[20]. It has fallen since 2005 when electricity demand was around 4.8 TWh[20].

Non-domestic electricity consumption constitutes 73% of all electricity consumption, approximately 11 percentage points more than the Welsh and GB average proportions. Almost all of the remaining electricity demand is used in domestic buildings and appliances.

4.1.2 Energy Vision scenario: projected annual electricity demand

Based on the assumptions developed through section 3, the scenario projection shows an overall net increase in annual electricity demand in SWW of 4% by 2035, compared to 2017. Increased energy efficiency measures and appliance efficiency lead to a continued decrease in base electricity demand; however, by 2025 this is overtaken by the increased demand resulting from the electrification of heating and transport. Peak demand increases may be higher, depending on whether time of use tariffs and other smart methods are successful in shifting demand across each 24-hour period.

[20] BEIS (2019) Regional and local authority electricity consumption statistics 2005 to 2018

In the SWW Energy Vision scenario, decreasing base annual electricity demand is outweighed by increasing demand from electrified heat and transport

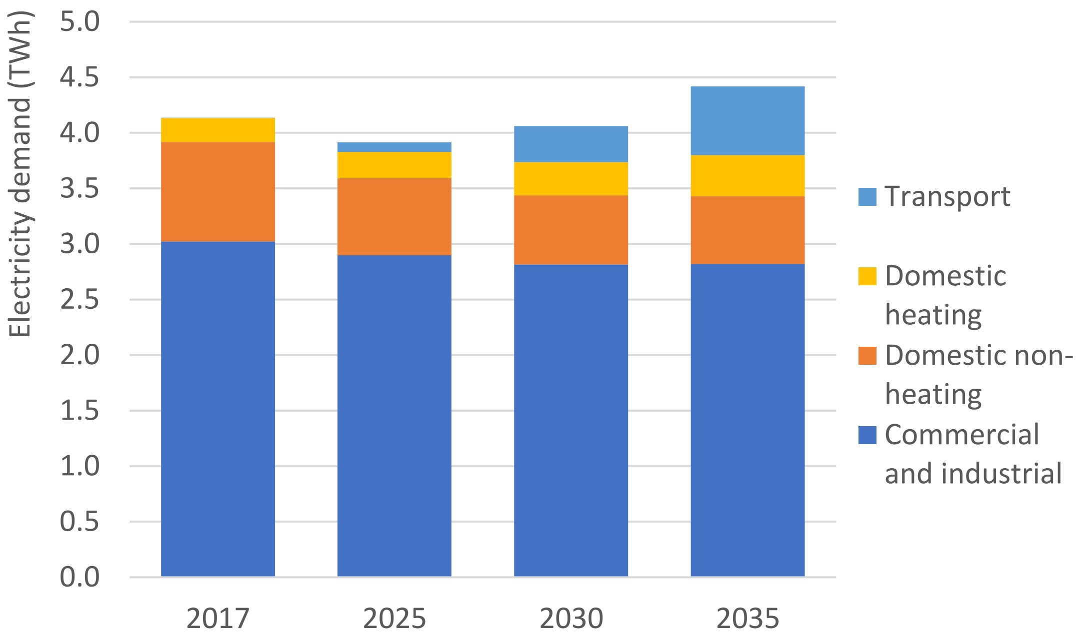


Figure 24: SWW's Energy Vision scenario demand by sector. Source: WGES analysis

4.2 Renewable electricity generation

4.2.1 Baseline: renewable electricity generation

In 2018, there was a total of 863 MW of installed renewable electricity capacity in the region, with 146 MW of this locally owned[21].

Renewable electricity generation in SWW is mainly from onshore wind and solar PV. Solar PV has a relatively high installed capacity with 388 MW, but, due to a lower capacity factor than wind, provides around 20% of renewable energy generation in the region.

South West Wales hosts approximately 60% of the Pen y Cymoedd wind farm (40% of the installed capacity is located in Rhondda Cynon Taf), the largest wind farm in England and Wales. This project, and nearly 280 others, contribute to onshore wind currently providing 55% of SWW's renewable electricity generation.

The majority of the remaining renewable electricity capacity in the region is made up of biomass generation projects.

[21] See Welsh Government (2019) Energy Generation in Wales, 2018 for definition of locally ownership.

South West Wales hosts 388 MW of solar PV and 401 MW of onshore wind

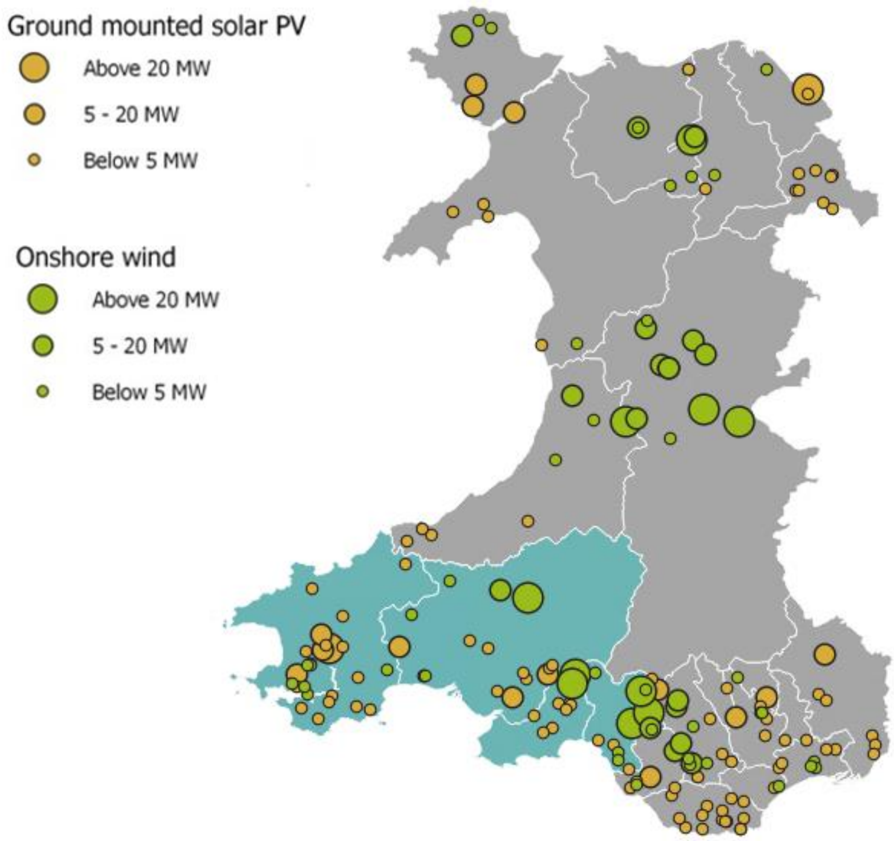


Figure 25: Solar PV and onshore wind projects (>1 MW) currently generating in Wales. Source: BEIS Renewable Energy Planning Database, 2019

Table 4: Baseline renewable electricity capacity in SWW

Technology type	2018 Number of projects	2018 installed capacity (MW)	2018 Estimated annual generation (GWh)
Anaerobic digestion	4	1	3
Biomass electricity and CHP	5	56	324
Hydropower	41	6	12
Landfill gas	5	8	29
Onshore wind	277	401	1,046
Sewage gas	2	4	13
Solar PV	12,111	388	367
Total	12,445	863	1,794

SWW hosts around 36% of Wales' onshore wind capacity and 40% of Wales' solar PV capacity.

SWW hosts 27% of current Welsh renewable electricity capacity

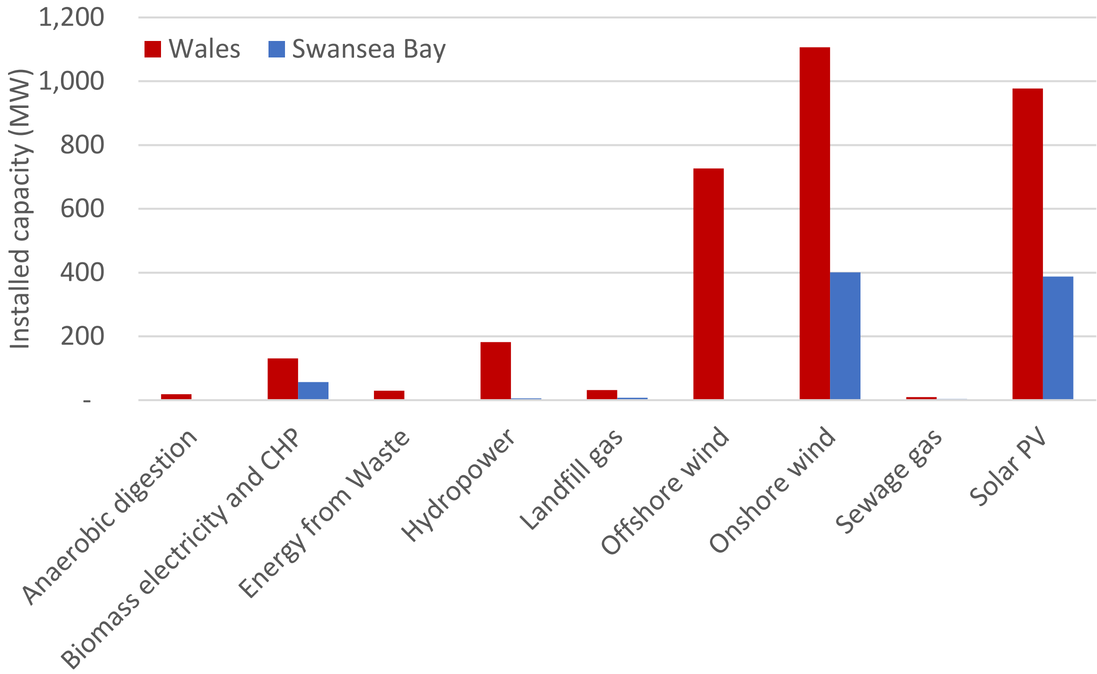


Figure 26: Renewable electricity capacity in Wales and SWW, 2018. Source: WGES analysis, Energy Generation in Wales 2018

55% of renewable generation in SWW is from onshore wind projects

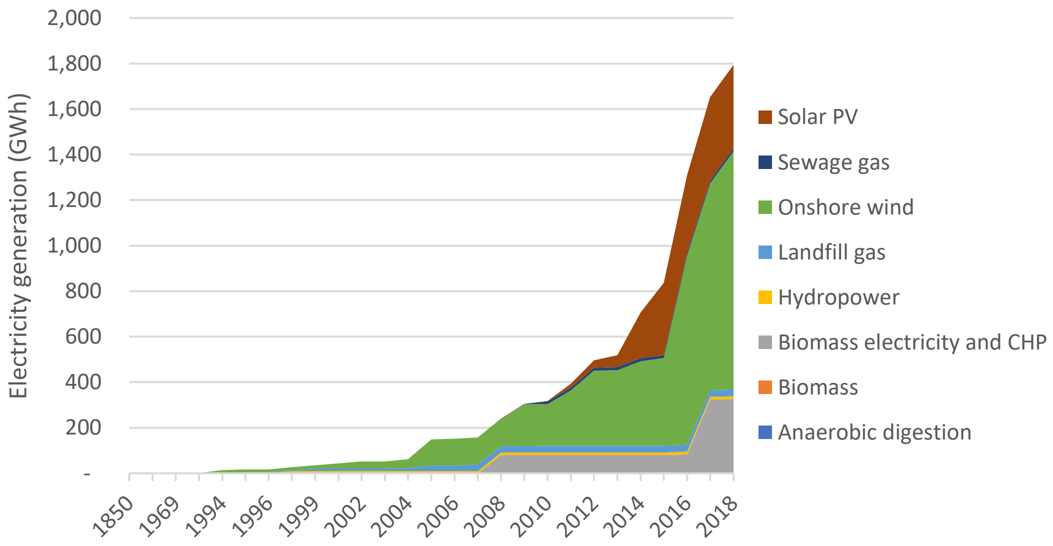


Figure 27: SWW's renewable electricity generation trends 2008-2018. Source: WGES analysis, Energy Generation in Wales 2018

SWW currently generates the equivalent of 44% of its electricity consumption from local renewable sources

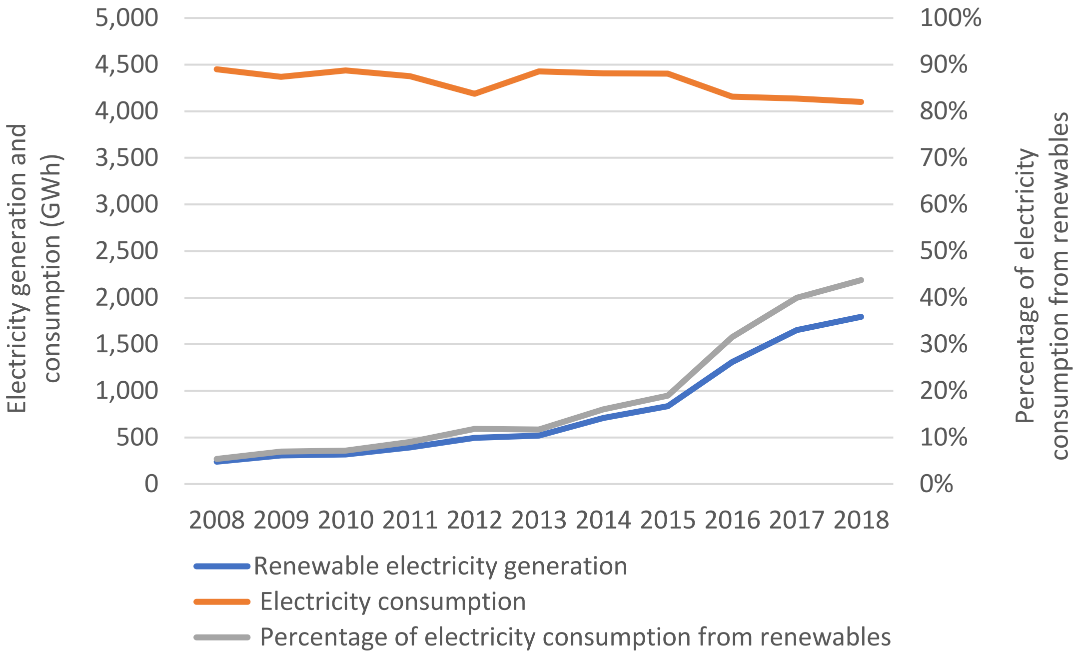


Figure 28: Percentage of electricity consumption from renewables in SWW. Source: WGES analysis, Energy Generation in Wales 2018

4.2.2 Energy Vision scenario: renewable electricity generation

Stakeholder views on the level of ambition: renewable electricity generation

Renewable Energy Generation

'100% of consumption: Maximise use of regional energy resources to achieve a target of renewable electricity generation equivalent to 100% of electricity consumption on an annual basis. Deliver an overall carbon intensity < 50g CO_2e/kWh from local renewable generation and imported (or backup) electricity'

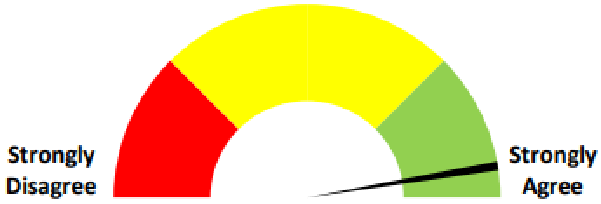


Figure 29 - Results of stakeholder engagement, highlighting stakeholder agreement with the annual renewable energy generation objectives.

As highlighted in Figure 29, there was strong support for the region's renewable electricity generation to be at least equivalent to its electricity consumption on an annual basis. The comments focussed on maximising the use of the region's renewable electricity generation resources.

4.2.3 Assumptions: renewable electricity generation

- Projections in this study for increases in low carbon generation in SWW are largely consistent with those in the 2018 Energy System Vision, with the exception of offshore wind which is increased from 50MW to 696MW.
- As a result, the Energy Vision scenario includes the ambition that the region generates at least the equivalent of 147% of its total electricity consumption in 2035 from regional renewable sources. This figure is less ambitious than some other parts of Wales, but has been arrived at by balancing the region's ambition against the available resources, investment requirement and potential grid capacity.

Potential benefits to the region in addition to supporting decarbonisation and contributing to meeting renewable energy targets, would include investment opportunities, job creation, supply chain stimulation and community benefit funds. If projects are developed by or invested in by the public and community sector there are additional potential economic and social benefits that could result, enabling the region to retain a higher proportion of the value created.

Box 2: A note on grid carbon factors

Achieving net zero carbon emissions across the UK requires the decarbonisation of the electricity grid. In line with industry best practice, the modelling for the Energy Vision scenario applies the UK grid carbon factor to electricity consumed in the region, rather than creating a regional factor based on electricity generated locally.

To be on track for net zero, the Energy Vision scenario assumes that an average UK grid carbon factor of 30 gCO_2/kWh has been achieved by 2035, in line with the assumptions used by National Grid's 2019 Future Energy Scenarios[1]. In order to achieve this level of grid decarbonisation, National Grid's Community Renewables and Two Degrees scenarios require a net increase of 68 and 74 GW of low carbon electricity capacity respectively across the UK by 2035. SWW has the natural resources and the ambition to play an increased role in delivering renewable energy deployment.

4.2.4 Decarbonisation pathway: renewable electricity generation

Figure 30 shows one pathway to achieving the renewable generation of the equivalent of 147% of electricity consumption in the region.

To enable SWW to meet the equivalent of 147% of its 2035 electricity consumption from local renewables requires a significant increase in generation and efficiency savings to offset new sources of electricity demand

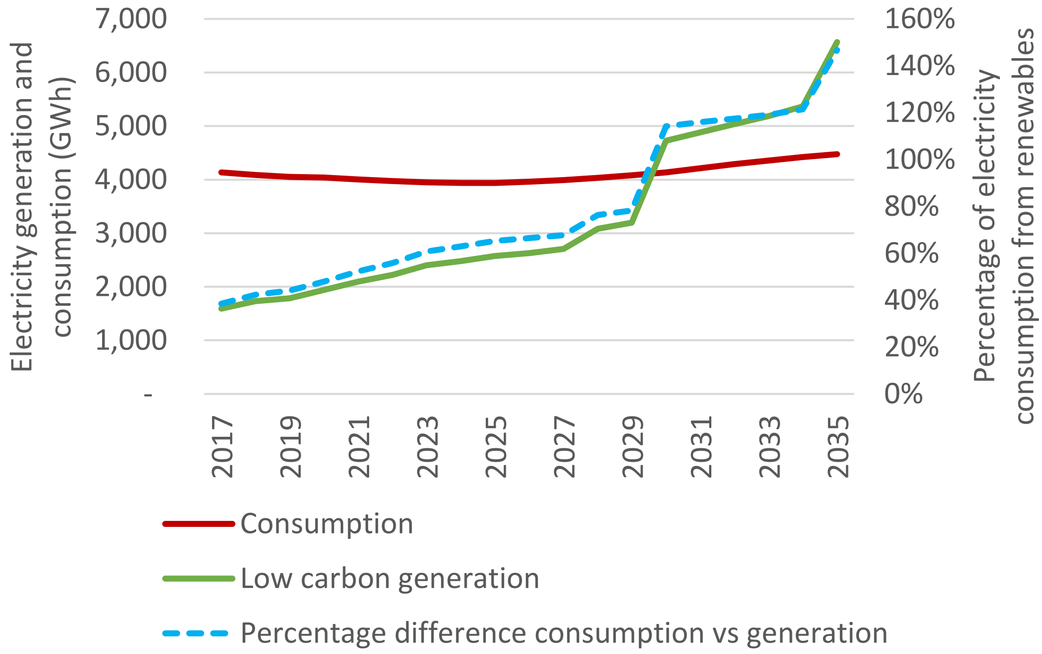


Figure 30: SWW's Energy Vision scenario electricity consumption vs low carbon generation. Source: WGES analysis

Offshore wind, onshore wind and solar PV are the main electricity generating technologies focussed on in South West Wales' Energy Vision scenario

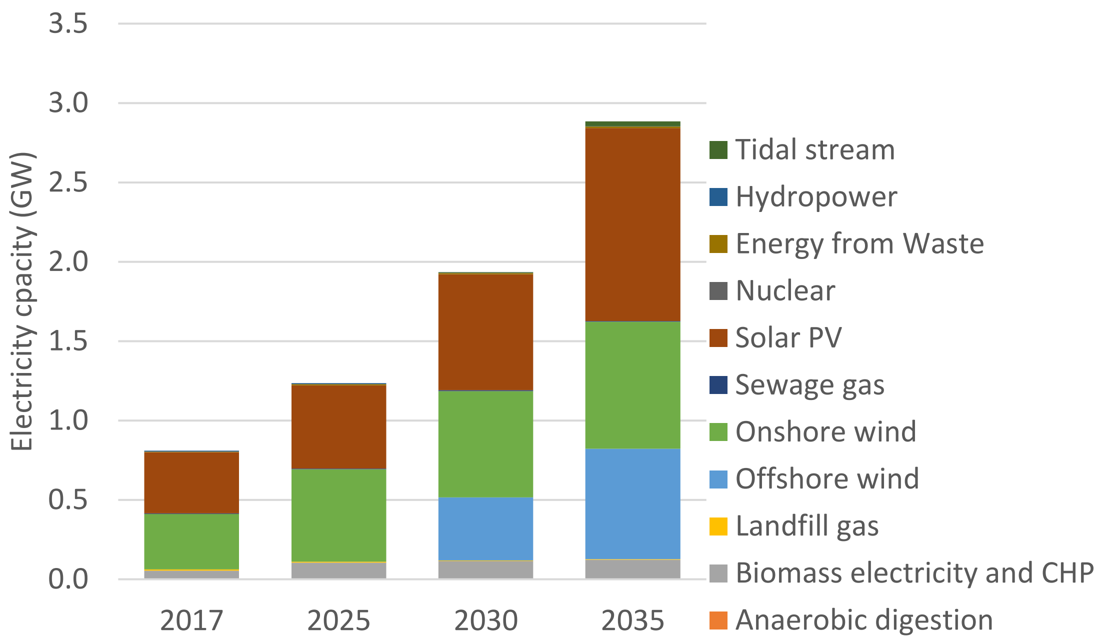


Figure 31: Renewable electricity capacity increases under South West Wales' Energy Vision scenario. Source: WGES analysis

Onshore wind

The Energy Vision scenario includes an increase in onshore wind capacity of 399 MW. This doubles the capacity within the region due to the availability of suitable sites. The capacity increase is made up of:

- a small number of projects currently in development
- new projects in the existing Strategic Search Area G (SSA)
- new projects in Priority Areas 8 and 9 as designated by Future Wales: The National Plan 2040
- new projects (made up of small numbers of large turbines) outside of areas designated by Future Wales and SSAs
- a number of small-to-medium-scale farm or community projects.

Solar PV

The Energy Vision scenario includes 827 MW of new solar PV, resulting in a total of 375 MW on rooftops and 840 MW in solar farms in 2035. Roof-mounted solar PV has an important role to play in the urban environment, particularly in engaging households and businesses in understanding the energy they consume as well as what they can generate.

Other renewables

The Energy Vision scenario also includes small increases in the deployment of anaerobic digestion (including biomethane-producing sites), and biomass electricity/CHP. Each of these technologies could have a small but significant impact on local renewable energy generation with associated economic benefits.

Marine

Tidal Lagoon

The Swansea Bay Tidal Lagoon project is a strategic project, which could stimulate a new tidal energy industry. Given the level of local support and importance of the lagoon both for the energy and socio-economic development of the region, the lagoon has been included in the Energy Vision scenario. The planned installed capacity is 320 MW, which would generate over 500 GWh per annum.

The project is an important strategic project for the region's Energy Vision. If this project did not go ahead, and given the limitations and constraints on onshore development, more offshore wind would be needed in the energy mix to achieve the region's wider energy goal.

Nascent Marine Technologies

The Energy Vision Scenario modelling includes a small amount of tidal stream and wave energy from projects such as the Ramsey Sound tidal stream device and other wave and tidal projects further offshore, facilitated by Pembroke Dock Marine, a project developed as a part of the city deal.

In addition, the modelling includes an ambitious amount of floating offshore wind by 2035. This includes the Blue Gem Wind floating wind development off the coast of Pembrokeshire. The joint venture between Total and Simply Blue Energy has put in an application for its first demonstration site: the 96 MW Erebus project south of Pembroke Dock, which has received seabed rights.

In addition to the Erebus demonstration project, it is assumed that Blue Gem Wind's 300 MW Valorous project and an additional 300 MW of offshore wind could be commissioned within the strategy's time period.

Network infrastructure

At present, there are significant network constraints on the transmission network in the licence area that supplies South West Wales. In May 2016 WPD received notification from NGET (National Grid Electricity Transmission) to advise that due to a significant increase in levels of embedded generation connecting in the South Wales region, NGET studies were highlighting concern around capacity and system overloads at peak times. This resulted in NGET imposing a restriction on all new thermal plant connecting at Grid Supply Points (GSPs) in the South Wales region. This NGET restriction did not apply to renewable types of generation such as solar and wind.

On 28th September 2020, WPD received an update from NGESO (National Grid Electricity System Operator). The update confirmed that due to a combination of factors (changes to the contracted background, the formal closure of large thermal plant on the system, the embedding of the Capacity Mechanism and new information on the market behaviours and the role of batteries in providing both flexibility and a range of other grid services), NGESO were able to lift the restriction upon new thermal plant connections in South Wales. Whilst the restriction on thermal plant has been lifted, any new connections will be subject to assessment by WPD via their standard design process and by NGESO via the Statement of Works/Appendix G process. These assessments could still highlight more local restrictions on both the WPD distribution network and NGET transmission system which could limit capacity availability in certain areas.

WPD’s network capacity map shows significant further constraints for generation and demand customers across the region[22]. One method of working around network constraints would be through local flexibility and alternative connection agreements.

Storage and flexibility

SWW hosts Wales’ largest battery storage project, the 22 MW Pen y Cymoedd Energy Storage project in Neath Port Talbot. Smaller-scale commercial behind-the-meter projects are known to be hosted in the region, in addition to tens of domestic battery projects[23].

Further deployment of electricity storage, alongside flexibility such as demand-side response provision or the creation of local energy markets, could support the decarbonisation of energy generation in SWW by enabling more renewables to connect to the network in constrained areas and supporting the business case for investing in renewables. These will be explored further through the delivery plan.

[22] WPD (2020) Network capacity map
[23] Welsh Government (2019) *Energy Generation in Wales*

4.2.5 Summary: renewable electricity generation

Sector	Example outcomes Energy Vision scenario	Energy prize	Carbon saving potential
Renewable generation	Sufficient flexibility, including storage, and network infrastructure upgrades to enable low carbon generation and demand technologies to connect 800 MW of onshore wind (399 MW of new capacity) 1,215 MW solar PV (827 MW of new capacity) 1,061 MW of marine technologies, including 696 MW floating offshore wind and 320 MW Tidal lagoon	Generating the equivalent of over 147% of electricity consumption in 2035	Contribution towards reduction of GB grid carbon factor

5. Summary

Under a 'Business as Usual' scenario, SWW is expected to achieve only 20% decarbonisation by 2035, far less than the 55% needed to be on track for net zero. Delivering the Energy System Vision scenario represents a very significant step up from a Business as Usual scenario and will only happen with significant local, regional and national commitment.

Potential Business as Usual and Energy Vision decarbonisation trajectories in South West Wales

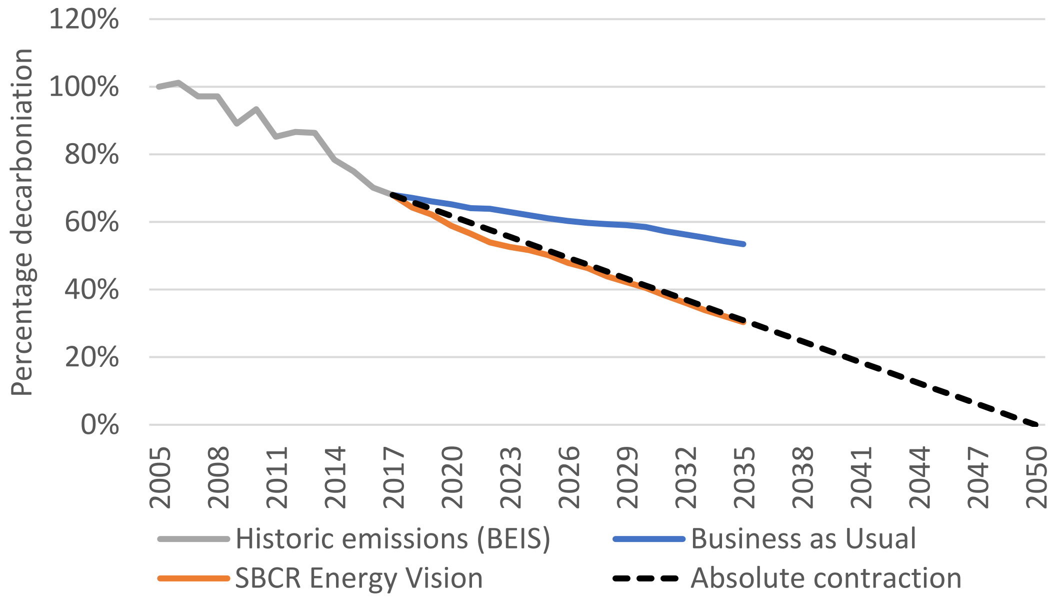


Figure 32: Decarbonisation trajectories in SWW. Source: WGES analysis

The Energy Vision scenario focuses on known, deployable technologies and behavioural change to 2035. Based on National Grid's 2019 Future Energy Scenarios[24] and the Committee on Climate Change[25], the scenario prioritises "clear, urgent, no regrets" actions. Table 5 summarises the results of the modelling, setting out key example outcomes to be achieved by 2035.

Some potential initial actions to set the region on course to achieve these outcomes have been mentioned in this chapter but will be explored further in the South West Wales delivery plan.

Beyond 2035, and to achieve net zero, further decarbonisation of all aspects of the energy system will be required. In some cases, this further decarbonisation is dependent on innovation, national policy and/or overcoming significant challenges.

[24] National Grid (2019) Future Energy Scenarios
[25] Committee on Climate Change (2019) 2019 Progress Report to Parliament

Table 5: Summary of Energy Vision scenario modelling results

Sector	Example outcomes Energy Vision scenario	Energy prize	Carbon saving potential
Domestic heat and energy efficiency	• 21,000 houses fitted with internal or external wall insulation • Over 140,000 other insulation measures in homes • Over 65,000 heat pumps • Replacing heating systems in oil, LPG and solid fuel-heated homes prioritised • No fossil gas in new homes from 2025, to avoid retrofitting at a later date	• 18% reduction in gross thermal energy demand • 34% net decrease in domestic heating energy consumption, taking into account demand reduction and improved heat technology efficiencies, including the impact of heat pump performance.	422 kt CO_2 (52% reduction)
Commercial and industrial energy demand	• Significant energy efficiency programme • A switch to alternative fuels, including hydrogen and electrification of heating • Decarbonisation of electricity network through renewables and behind-the-meter low carbon generation	• 30% reduction in coal and petroleum energy consumption • 16% reduction in gas consumption • 1% of demand supplied by hydrogen through industrial clusters • 7% reduction in electricity demand	932 kt CO_2 (56% reduction)
Road transport	• 320,000 electric cars • 9,500 public and on-street EV chargers • 10% reduction in private vehicle mileage	• 2.5 TWh reduction in petrol and diesel energy consumption • 0.6 TWh increase in electricity consumption	580 kt CO_2 (51% reduction)
Flexibility and renewable generation	• Sufficient flexibility, including storage, and network infrastructure upgrades to enable low carbon generation and demand technologies to connect • 800 MW of onshore wind (399 MW of new capacity) • 1,215 MW solar PV (827 MW of new capacity)	• Generating the equivalent of over 147% of electricity consumption in 2035	Contribution towards reduction in UK grid carbon factor

	• 1,061 MW of marine technologies, including 696 MW floating offshore wind and 320 MW tidal lagoon		

6. Economic assessment

6.1 Introduction

The changes required to develop a decarbonised future energy system have impacts that reach beyond reducing carbon emissions. Changing the technologies that we use to generate our electricity, use our energy and heat our homes, will also affect the economic landscape. Examples of these effects include changes in:

- the geographic distribution of jobs as energy generation becomes less centralised,
- the job intensity required to produce electricity because this is unique to each generation technology,
- the costs to install, construct, and operate new technologies, and
- how income and spending circulates around local economies as a result of these changes.

We have built on the energy system modelling described in the previous chapter to better understand the impact on net job creation and gross value added. Additionally, we have estimated the level of investment required to deliver the scenarios. The impacts we consider; job creation, gross value added, and investment required, are just some of the economic impacts related to the energy transition. Other impacts, such as the impact on the cost of supplying energy, and associated prices, are not included in the analysis.

6.2 Approach

We have used an indicator-based approach to estimate job creation, gross value added, and investment. This involved a literature review to identify the most appropriate methodologies such as jobs/MW, or GVA/employee. These indicators have been applied to the results of the energy system modelling and allow us to estimate the economic impact of changes in electricity generation, energy efficiency and domestic heating. A technical annex that accompanies this report provides additional detail on the calculations and sources used in our analysis.

In practice, this approach has an important limitation in relation to low carbon heating. There is significantly less data available to assess the number of jobs associated with the transition to low carbon heating than electricity generation or energy efficiency. This means that the low carbon heating jobs are not comparable with the electricity generation or energy efficiency jobs. We discuss this in more detail in the low carbon heating section below.

In terms of scope, the economic impact in terms of jobs, GVA and investment has not been calculated in relation to two sectors in the energy modelling i.e. transport, and commercial and industrial energy efficiency. The transport sector was excluded as the production and employment benefits associated with EV manufacture will not be strongly influenced by the speed of customer switching to EVs in the same region. It is also assumed there will be no net change in jobs from the transition to EV manufacturing and assembly. Commercial and industrial energy efficiency has not been assessed as the energy modelling inputs do not allow us to identify energy efficiency impacts from other factors influencing energy demand change, such as the macroeconomic assumptions underpinning the future energy scenarios.

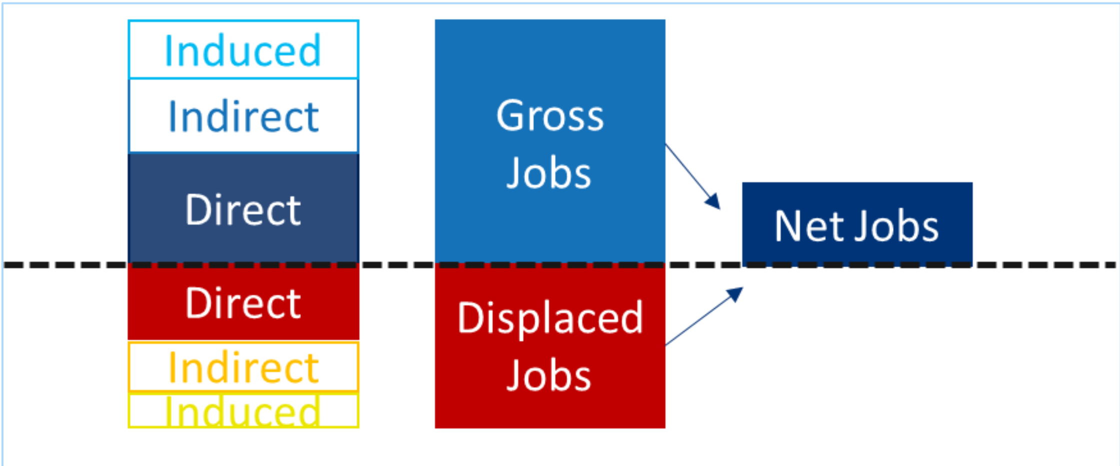
Finally, it is important to provide clarity on the definition of the term "jobs" within the context of this analysis and how this applies to each technology area. Political and media commentary on "jobs" often refer to gross jobs, which are the direct jobs related to a specific project or intervention. In examining the economic impact of the energy transition the accepted standard is to calculate net jobs – this considers the net impact of the job gains alongside the job losses associated with transitioning from one technology to another. Where data sources have made this possible, we have sought to present jobs estimates in net terms, in line with this best practice. We also define jobs in terms of Full Time Equivalents (FTE) wherever data allows.

Additionally, there is a difference between direct, indirect and induced jobs. In an energy context, direct jobs are typically associated with the manufacture, construction and installation of equipment. Indirect jobs arise in the supply chain of the energy technology. Induced jobs relate to jobs generated as a result of spending incomes earned from direct employment.

Figure 33, below, shows the relationship between gross, displaced, and net jobs. Indirect, direct and induced jobs are also shown. Indirect and induced jobs have not been filled with colour as these jobs are not taken into account in this analysis. [26]

[26] Adapted from UKERC. 2014. Low carbon jobs: The evidence from net job creation from policy support for energy efficiency and renewable energy.

Figure 33: Relationship between gross, displaced and net jobs (including direct, indirect and induced jobs)



Throughout this analysis we only calculate direct jobs as, depending on the area of decarbonisation, these have a higher probability of being local jobs than indirect or induced jobs. However, the analysis does not allow us to comment on the exact location of the job estimates. Some jobs are likely to be held by residents of South West Wales; other jobs may be held by those who travel into the region to perform their roles and others may be located elsewhere in the manufacturing supply chain.

6.3 Electricity generation

The results from assessing the economic impact related to the change in electricity generation technologies show that achieving the energy system vision scenario will require approximately £3,280 million of additional spending/investment over the period 2020 to 2035 (including c £1.4bn for offshore wind and c £1.2bn for the Swansea Bay Tidal Lagoon), equivalent to approximately £220 million per year, compared with the business as usual scenario. This spending/investment will be made by a wide range of parties included businesses (and their investors), households, as well as local and national government. The energy system vision scenario will also create an estimated 12,500 additional jobs and contribute approximately £1,410 million more in GVA than the business as usual scenario. These jobs may be located inside or outside of South West Wales, with the experience of Wales to date being that many electricity generation jobs are located outside of the region. In order help South West Wales optimise the benefit from jobs associated with future local electricity generation, it will be important to understand the reasons for the lack of local jobs and develop a policy response.

Table 6 summarises the estimated economic impact of the business as usual and the energy system vision scenarios. The figures shown in the table represent the total value from all years from 2020 through to 2035.

Table 6: BAU and ESV electricity generation economic impact 2020- 2035[27]

Scenario	Gross Direct Jobs including losses*	Discounted GVA**	Discounted Investment**
Business as usual (BAU)	28,800	£3,600m	£570m
Energy system vision (ESV)	41,300	£5,010m	£3,850m
Difference between ESV and BAU	12,500	£ 1,410m	£3,280m
Difference between ESV and BAU (percentage)	+43%	+39%	+574%
**Gross direct job figures have been calculated based on UK or international direct job intensity indicators per technology. These full-time equivalent indicators include both short term (construction) and long term (operations and maintenance) jobs. However, short term jobs are weighted against the lifetime of the plant. A significant proportion of direct electricity generation could be taken by local residents. However, to date this has not been the experience of Wales. If business as usual policies continue, it may be that a potentially significant number of these jobs will be held outside of the region.* **All figures are rounded.			

6.3.1 Investment

The energy system vision scenario requires approximately £3,280m of additional investment in new electricity generation. Figure 34 below shows the breakdown of this investment by technology. Offshore wind requires the most additional investment at 41% of the £3,275m. This is followed by tidal lagoon (35%), onshore wind (10%) and solar PV (8%).

[27] A discount rate of 3.5% is applied to calculate investment and GVA over the 2020 – 2035 time period.

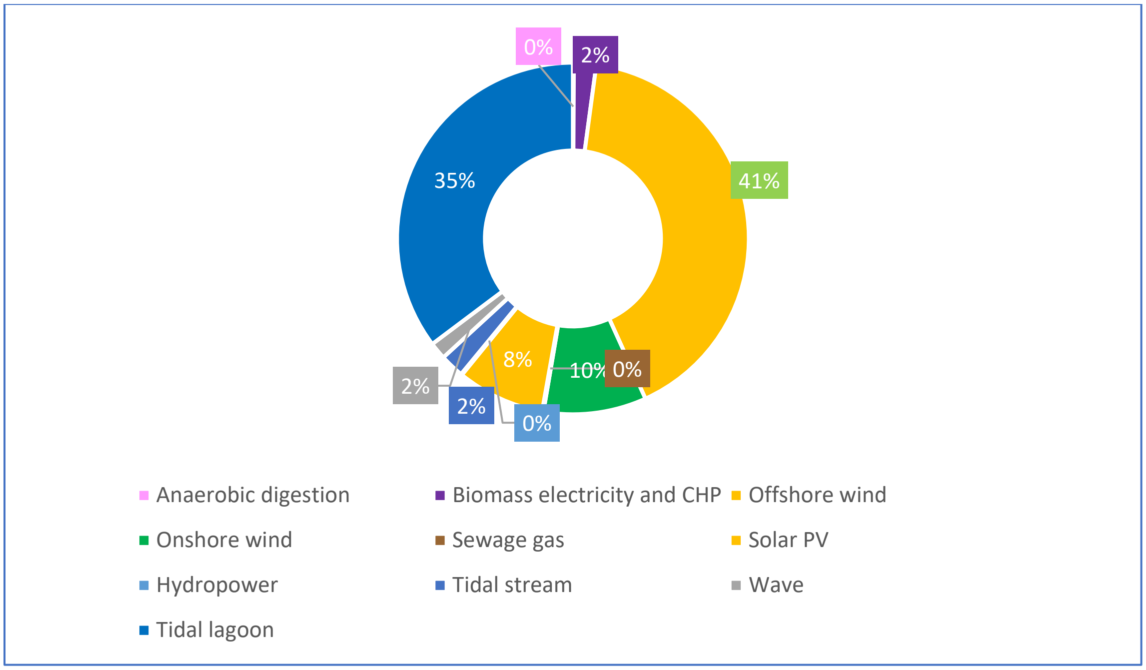


Figure 34: ESV investment in electricity generation required beyond the business as usual scenario (2020 – 2035)

6.3.2 Jobs

The jobs figures presented include both the jobs associated with increases in capacity and output from some generation technologies (for example offshore wind) as well as jobs lost as the capacity and output from fossil-fuel based generation technologies falls. The jobs calculated are direct jobs which means that they relate to the manufacturing, construction, operation, and maintenance of the plant and equipment. A significant proportion of these jobs could be taken by residents that are local to energy generation sites, whereas indirect or induced jobs are expected to be more geographically diffuse. However, the experience in Wales to date is that many renewable jobs are held by those living outside the region who commute to the region to undertake these jobs. The breakdown of jobs required in the energy system vision scenario is visualised on an annual basis in Figure 35 below.

It is estimated that in the energy system vision scenario electricity generation is responsible for just over 41,000 direct gross FTE jobs from 2020 to 2035.

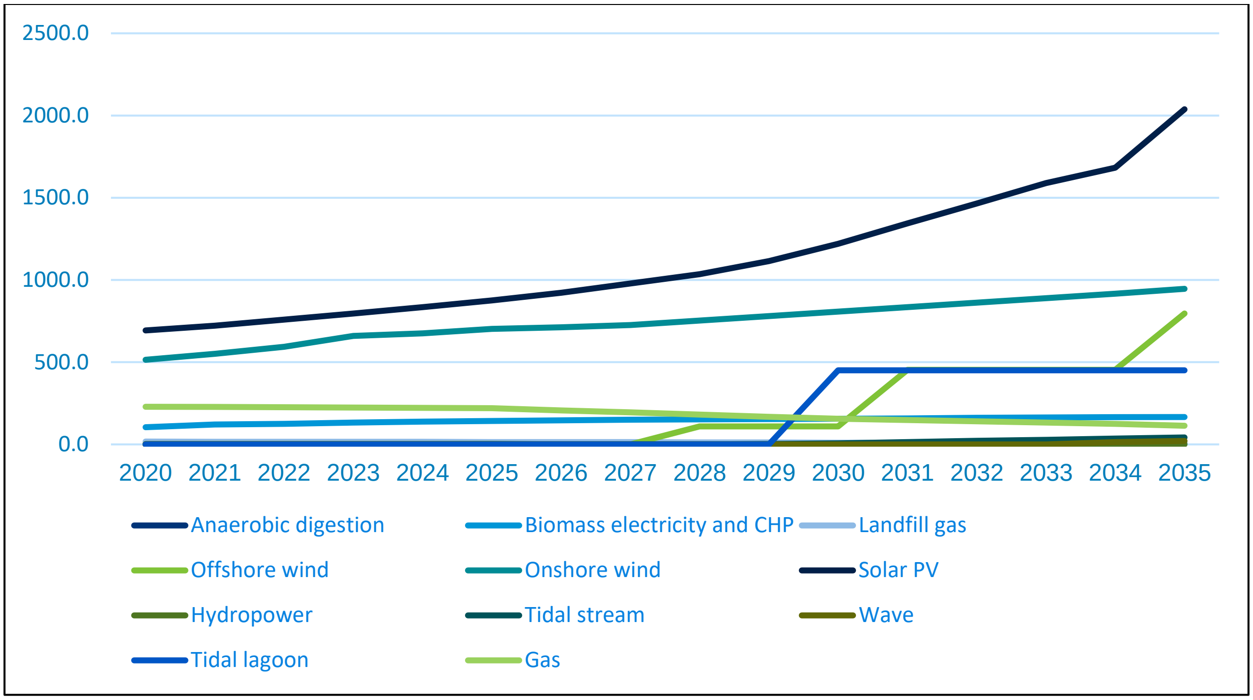


Figure 35: ESV electricity generation net jobs (2020 – 2035)

Figure 36 shows which technologies in the energy vision scenario support additional jobs in comparison with the business as usual scenario. The difference between the two scenarios represents the net additional jobs supported by the energy system vision in comparison with business as usual. Solar PV accounts for the largest difference in jobs between the two scenarios (32%), followed by offshore (19%) and onshore wind (19%), and tidal lagoon (17%).

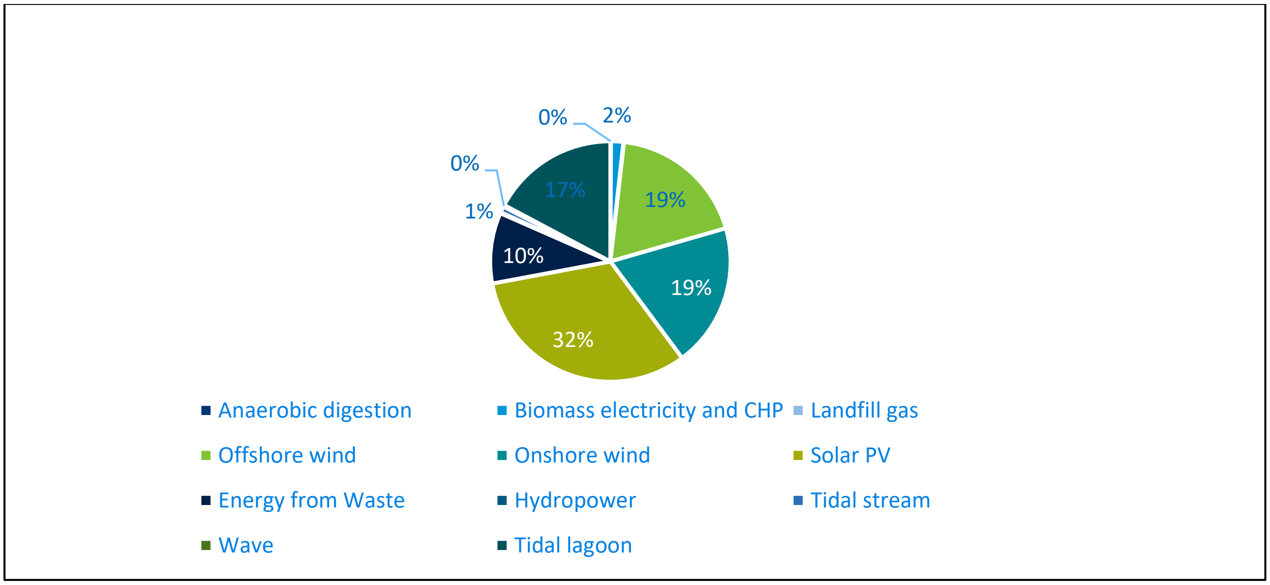


Figure 36: Additional Job distribution in the ESV scenario compared with the BAU scenario

6.4 Domestic energy efficiency

As with electricity generation, the increases in domestic energy efficiency associated with the Energy System Vision scenario relative to the BAU scenario, require more investment, support more jobs, and lead to an enhanced contribution to GVA. This reflects that the energy system vision sees a more dramatic shift in the number of homes achieving higher EPC ratings and the larger number of energy efficiency improvements needed to achieve this outcome. These figures are presented in Table 7.

Table 7 shows that the energy system vision requires approximately 1.5 times the investment and jobs compared with the business as usual scenario. Additionally, it supports approximately 1.6 times the GVA associated with the business as usual scenario.

Table 7: BAU and ESV domestic energy efficiency economic impact 2020 -2035[28]

Scenario	Net jobs**	Discounted GVA*	Discounted Investment*
Business as usual (BAU)	7,000	£415m	£1,470m
Energy system vision (ESV)	10,700	£635m	£2,250m
Difference between ESV and BAU	3,700	£220m	£780m
Difference between ESV and BAU (percentage)	+53%	+53%	+53%
* Figures are rounded. ** Net jobs figures do not include estimations of operation and maintenance jobs associated with the energy efficiency improvements.			

6.4.1 Investment

The majority of investment required to install the energy efficiency measures described by the BAU and ESV scenarios is related to insulation measures. The investment requirements can be seen in Figure 37.

[28] A 3.5% discount rate was applied to calculate the GVA and Investment over the 2020 – 2035 time period.

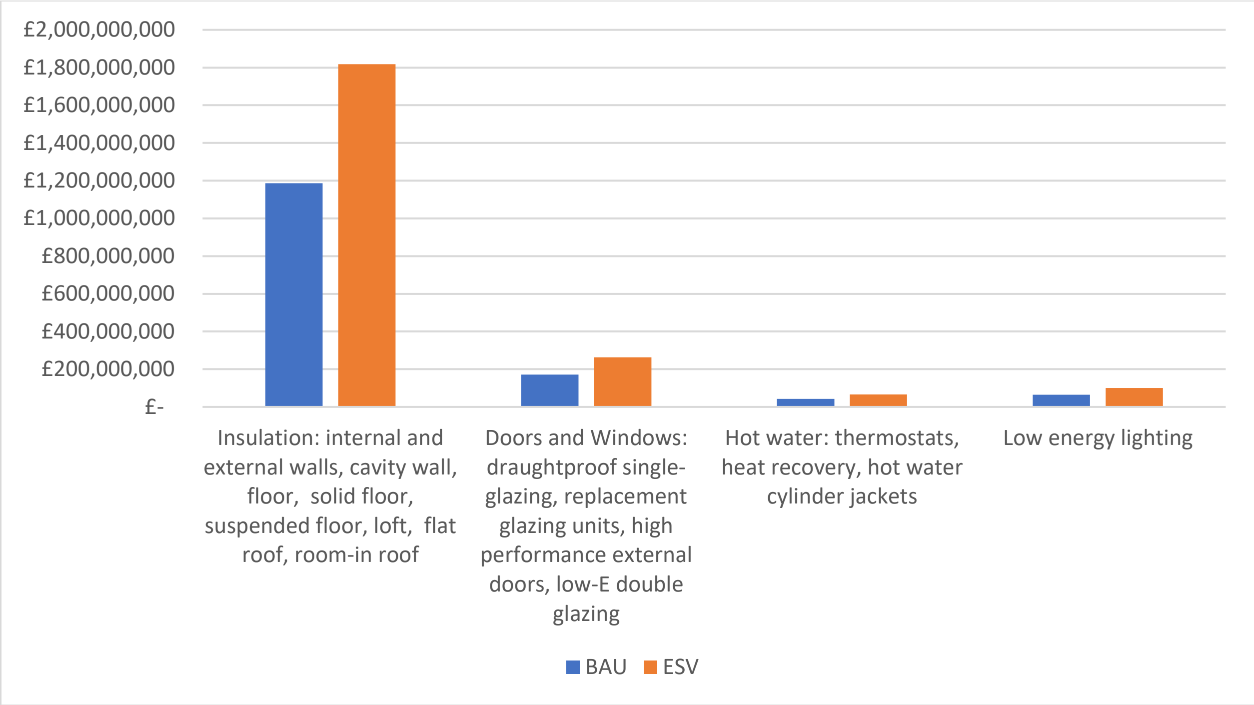


Figure 37: BAU and ESV domestic energy efficiency investment requirements 2020-2035

6.4.2 Jobs

3,700 additional net jobs are related to the energy system vision scenario in comparison with the business as usual scenario between 2020 and 2035. These are net direct jobs and take account of the fact that energy efficiency requires additional jobs to deliver and install the relevant technologies, but could also reduce jobs associated with the reduced need for energy production and supply. Like electricity generation, some energy efficiency jobs may be held by those residing in the region and other jobs may be held by people who travel into the region to perform these tasks.

The majority (51%) of the additional jobs in the ESV scenario relate to installation of 50 mm internal or external wall insulation, 24% of jobs relating to floor and solid floor insulation, and 7% of jobs relate to the replacement of single glazed windows with low-E double glazing. Figure 38 below shows the estimated jobs required to implement the energy efficiency measures that relate to the EPC changes between the BAU and ESV scenarios.

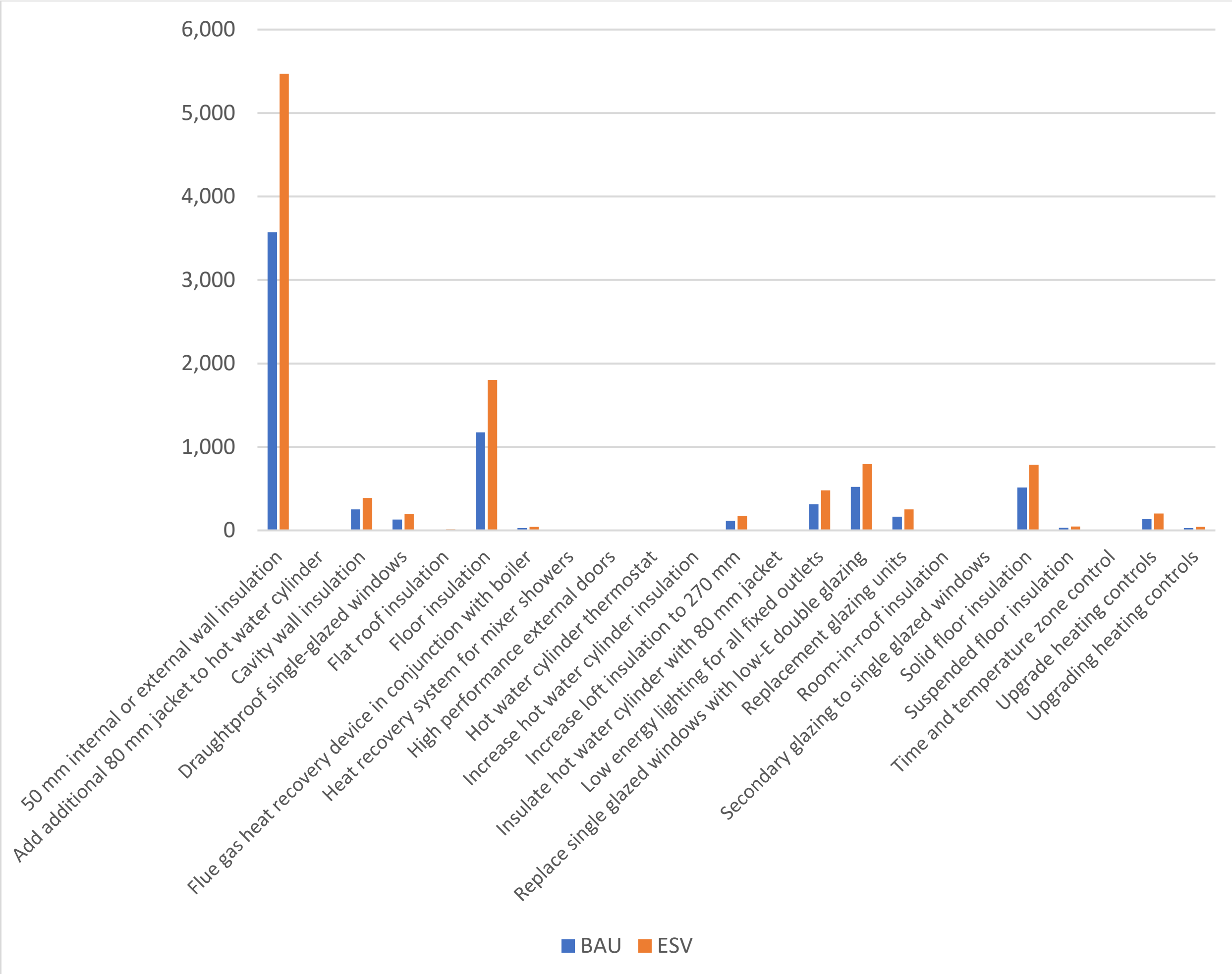


Figure 38: BAU and ESV net jobs per domestic energy efficiency measure 2020 – 2035

6.5 Domestic heat

The more intensive switch to low carbon heating in the energy system vision scenario requires additional investment, which increases the GVA associated with these activities. The GVA associated with heating technologies is 161% greater than in the business as usual scenario while the energy system vision scenario requires 73% more investment compared with the business as usual scenario. The ESV scenario also supports more jobs related to low carbon heating. However, due to a lack of data on jobs associated with traditional heating technologies, a comprehensive comparison in the jobs impacts from the switch to low-carbon heating technologies has not been carried out. Table 8 below summarises the economic impact of both scenarios and the difference between the scenarios. A comparison of the investment required in the BAU scenario and the ESV scenario is presented in Figure 39.

Table 8: BAU and ESV domestic heat economic impact 2020- 2035[29]

Scenario	Gross jobs associated with low carbon heating	Discounted GVA associated with all heating technologies	Discounted Investment associated with all heating technologies
Business as usual (BAU)	1,400	£ 120m	£ 335m
Energy system vision (ESV)	2,335	£ 320m	£ 575m
Difference between ESV and BAU	925	£200m	£ 240m
Difference between ESV and BAU (percentage)	+66%	+161%	+73%
*All figures are rounded.			

6.5.1 Investment

Figure 39 shows that the shift to low carbon heating in the ESV scenario happens faster and to a greater scale than in the BAU scenario. For example, between 2020 and 2035, the ESV sees approximately £17 million of additional investment per year in heat pumps, biomass boilers and radiant electric heaters compared with the business as usual scenario. At the same time, the ESV requires approximately £3.2 million less investment per year in gas boilers and gas hybrid heat pumps during this period compared with the business as usual.

[29] A 3.5% rate is applied to GVA and investment to calculate these figures over the 2020-2035 time period.

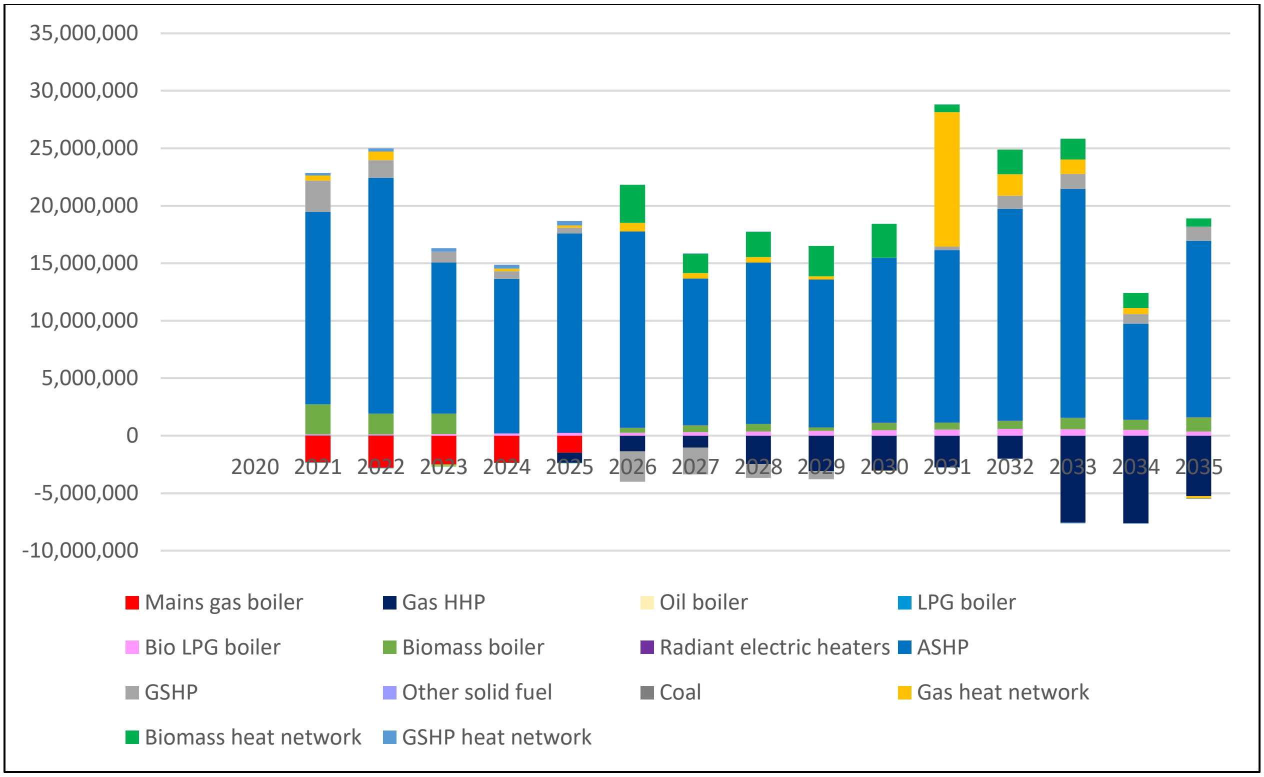


Figure 39: BAU and ESV domestic low carbon heating investment 2020 – 2035

6.5.2 Jobs

The job figures calculated for domestic heat differ from those calculated for electricity generation. Fewer studies quantify the jobs related to the installation of heating technologies than for electricity generation technologies. Given the limited number of studies, we use a jobs/£m turnover for non-heat network technologies, like heat pumps and biomass boilers, and use permanent jobs/annual GWh of heat generated for heat networks.

Moreover, due to a lack of quality data, our estimate of jobs related to heating technologies only relates to low carbon heating and does not include changes in jobs associated with the installation of more traditional heating technologies such as gas boilers.

Figure 40 below shows the difference in low carbon heating jobs between the ESV scenario and the BAU scenario. As with electricity generation and energy efficiency, some of the jobs presented may be held by residents of South West Wales while other jobs may be held by those residing outside of the region.

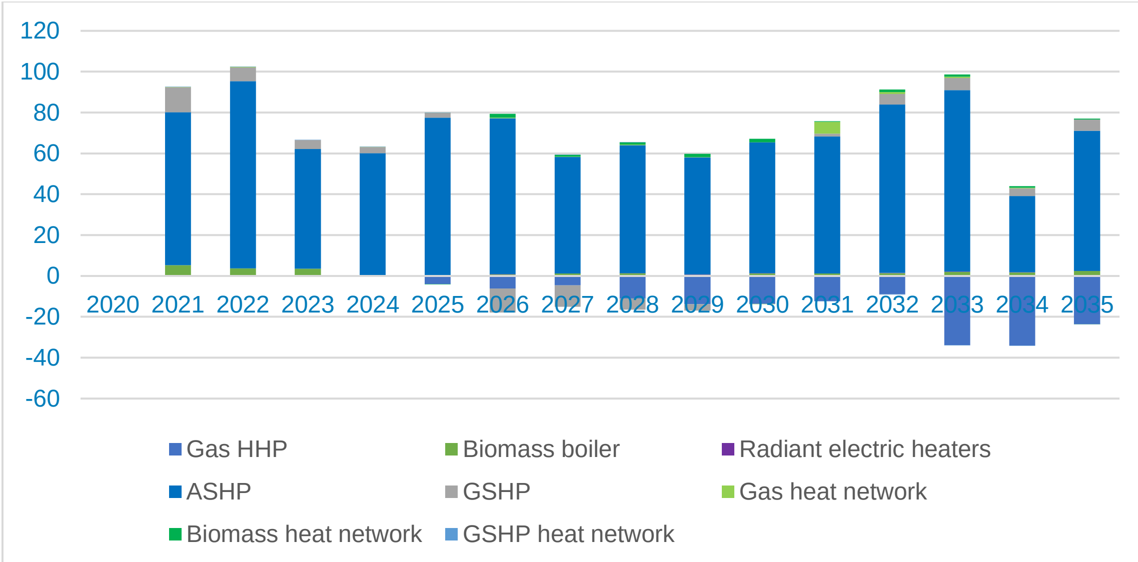


Figure 40. BAU and ESV domestic low carbon heating jobs 2020-2035

6.6 Summary

Across all technologies, the higher level of effort related to decarbonisation and the energy transition in the energy system vision scenario requires more investment/spending when compared with the business as usual scenario. The economic analysis demonstrates that over £4 billion of additional investment/spending is needed to achieve the energy efficiency, electricity generation, and heat aspirations described in the energy vision between 2020 and 2035. This represents approximately £286 million per year and will need to be financed from a range of sources including the private sector, households, and national and local government.

In terms of jobs, the ESV scenario is estimated to require over 16,000 additional jobs to deliver the accelerated deployment of renewable electricity generation technologies and the enhanced levels of energy efficiency. These additional jobs are associated with approximately £1,600m more GVA (discounted at 3.5% over the period 2020-2035). In addition, it is estimated that there will be over 900 additional gross jobs associated with the provision of low-carbon heating technologies in the ESV scenario than the BAU scenario, associated with approximately £200m of GVA.