Cabinet Prifddinas Ranbarth Caerdydd | Cardiff Capital Region Cabinet

28 JUNE 2021

CCR ENERGY STRATEGY – IMPLEMENTATION PRIORITIES 2021/22 AND EMBRACING THE RACE TO ZERO

REPORT OF CCR DIRECTOR

AGENDA ITEM 9

Reason for this Report

1. The emergent Energy Strategy for the Cardiff Capital Region (CCR) was agreed by Regional Cabinet in December 2020. The strategy is a dynamic one and considered more as a framework in recognition of the need to co-ordinate and align the approach across all ten partner Councils and wider stakeholders.

2. It was agreed in the report that an implementation plan would be developed to give practical effect to the framework and that the strategy and implementation plan would be re-presented to Regional Cabinet, to coincide with the commencement of duties under the Corporate Joint Committee (CJC) legislation (Wales). This is important since the advent of a CJC for the CCR would bring together all the levers, policy and delivery frameworks needed to underpin solid achievement of regional energy aims – Transport Plan, Strategic Development Plan, Economic Growth and the post-COVID recovery and Skills.

3. However, the date for the commencement of the CJC regulations in the CCR, is now 28 February 2022. In this intervening period, there will not only be a significant amount of work to do to plan, prepare and co-ordinate, but to transition existing arrangements, policies and frameworks to the new legal framework and environment of a corporate entity.

4. The urgent agenda around climate change, reinforced and compounded by the challenges and opportunities of the COVID-pandemic, cannot wait for administrative changes to take shape. As such, this report sets out a schedule of Implementation Priorities for 2021-22, in order to seize the opportunities that present, build upon the potential for positive legacy post-COVID and provide a springboard for the CCR CJC to rapidly deliver its agenda around arresting climate change.

5. To set out further reflections and recommendations developed through the CCR Net Zero Region Planning Day (integrated into the Implementation Priorities) – in

particular those concerning applying to be part of the Race for Zero campaign; inclusion within the Carbon Disclosure Project; complementary work on regional data capability and the pooled resources and commitments needed to deliver and hold the plan accountable.

The Energy Strategy and Approach

6. The Welsh Government Energy Service (WGES) is working with each region across Wales, with a support package up until March 2022. This partnership has created a CCR Energy Vision and Strategy with the assistance of over 100 key stakeholders across the region. The strategy has considered the 'business as usual' decarbonisation pathway alongside a detailed future scenario to put the region on a pathway to achieve net zero by 2050. The options are stark and there are no neutral decisions. The emergent Strategy was considered and approved in December 2020 and is attached again at Appendix 1.

7. In the December 2020 report concluded that further work was needed to organise around co-ordinated and aligned regional delivery. This further stated that an implementation plan would be the key galvanising and connecting factor and would be brought back to Regional Cabinet for endorsement and integration within the new CJC environment. Whilst good work is underway to deliver the strategy – all of which is set out in the Implementation Priorities document - the timeframe for implementation of the CJC is now 28 February 2022.

8. This is important as some of the key policy frameworks and levers needed to embed and implement the Energy Strategy – at scale – to commence work on planning, transport, housing, skills and new competencies around economic development, are enacted from this point. The fiscal freedoms and flexibilities afforded to a new corporate entity are more expansive and significant and allow for CCR to operate outside of its current single funding programme and narrowly defined Joint Working Agreement written in 2016 and within which 'energy' is not a stated aim.

Implementation Priorities

9. The climate crisis however cannot and will not wait for bureaucratic change – albeit it is clear our chances of addressing climate change are greatly improved by working at scale and with the necessary critical mass. As such, in this interim period, a set of Energy Implementation Priorities has been developed, which will span the next few years, but will be added to and further developed as regional capacity is progressively built and developed. There is not time for contemplation. Indeed, the establishment of a new Ministry for Climate Change within Welsh Government, which brings together Planning, Housing, Environment and Transport functions, sets a clear agenda for the type and pace of change needing to be forged.

10. A copy of the Energy Implementation Priorities, which has been informed ongoing by the stakeholder network, continued support from the Welsh Government Energy Service, Carbon Trust, CCR Energy Steering Group and partners such as Flexis and CS Connected, is attached at Appendix 2.

11. The Implementation Priorities reflect upon where CCR is building momentum:

- **Drawing on our understanding of R&D to get great ideas into the market and spread and scale the good things that already exist** - using the Challenge Fund to drive change at scale around LA Fleet, strategic partnership with Flexis and join-up with the developing Innovation Investment Fund and our approach to developing industrial-scale clusters;
- **Developing regional institutional capacity** – CJC being the driver for co-ordinated, ambitious and bold action at scale;
- **Policy making for impact and brave leadership** – starting with the revised Investment Strategy, adopted Responsible Investing Policy, risk framework and revised outcome statements;
- **Our deeds as individuals –** changing working patterns, the example of the Blaenau Gwent Citizen's Assembly on climate and personal actions.

12. It further seeks to set out the interventions at project-level to drive forward the agenda in the short-term:

- **Decarbonisation of Transport** – Metro Plus, Metro Central, CCR ULEV and 'try before you buy' schemes, role of InFuSe in building innovation capacity within public services and the LEV Fleet Challenge and potential around a hydrogen demonstrator fund;
- **Commercial and Industrial Decarbonisation –** energy provision for R&D Clusters, development of the STEP Fusion Nuclear Prototype Project, developing the region's capacity for a Gigaplant and supporting the work of SWIC;
- **Domestic –** preparing a business case in application-format for the scoping of a region-wide Optimised Domestic Retro-fit Programme and utilising the local wealth building challenge fund to develop the private sector domestic retro-fit proposal;
- **Renewable Energy –** developing the framework for local energy generation schemes and support for the WG-PIN notice for tidal development projects which could link to many of the wider initiatives set out above.

13. In respect of policy, data, partnership and future project development, the set of priorities further cover:

- **The development of a Digital Energy Twin for the Region** – developing smart capacity to manage, measure and understand the relative impacts of interventions, encouraging R&D capacity in the region as a result;
- **Participation in COP 26 –** as part of the FLEXIS application, CCR has applied to attend and take part to build its network and connections;
- **Partnering Agreement with Flexis** – this will be established to create long-term partnership capacity around early R&D in the region and demonstrator zones;
- **Receipt of submissions through the CCR Wider Investment Fund –** the fund is open for business;

- **Building a pipeline for discussion/development with the new UK National infrastructure Bank –** exploring project potential, developing appropriate IRRs and exploring innovative financing mechanisms.

14. In relation to Skills and Talent, the Regional Skills Partnership is working to develop and support its pipeline. CCR is engaged in discussions with FE Colleges about the potential to pioneer locally-led 'green skills' development linked to priority sectors and identified economies of the future. Work is also underway as part of the ULEV frameworks, to achieve wider community benefits.

Net Zero Region Planning Day

15. A regional energy planning day was held by CCR on 16 June to which all 10 LAs were invited. The event was facilitated by partners Flexis, Siemens and the WG Energy Service. The outcomes of this important and symbolic event are documented as a Postscript within the Implementation Priorities at Appendix 1. In summary, they included:

    - ***Partnership with Flexis*** *– critical to developing continued up-to-date strategic framework for the CCR Energy Strategy. With work spanning policy development, demonstration and application across Technology Readiness Levels and drawing on R&D activity of Welsh Universities; power partners and energy suppliers as well as a broad network of businesses and SMEs – it is clear that investing in building a partnership with Flexis will open the door to thought leaders, experts, partnerships and programmes that could begin to make an immediate impact in CCR*

    - ***Commitment to participate in the Race for Zero and the Carbon Declaration Project.*** *As part of our COP 26 commitment – it was unanimously agreed that a recommendation should be made to adopt the Race for Zero – a global campaign to rally leadership across business, cities and regions and investors, for a healthy, resilient and zero carbon recovery, which unlocks sustainable and inclusive growth. 708 cities, 24 regions, c2400 businesses, 163 global investors and 624 HEI institutions are on board as part of the Climate Change Alliance and backed by Bloomberg Philanthropies This is no passive commitment. To sign up, minimum criteria must be met backed by pledges, formal support and publication of a plan with the application to be made by November 2021. Further signing up to the compatible Carbon Disclosure Project by 29 July 2022, will provide a further layer of accountability, rigour and discipline to efforts. Whilst CCR has gone some way to achieving goals, gap analysis shows there is a way to go. This will not make for a comfortable experience – but it shouldn't be and will expose what remains to be done – as part of a City Region approach and will ensure CCR follows the few regions in the UK to have done this to date.*

    - ***Investment in central data systems and capability****. The ongoing reporting requirement associated with the above is a minimum of 30 days. This is without considering all of the data sources; and related issues of quality and alignment, integrity and access – across a whole region. Pooling resources to develop a robust set of analytics and create data feeds in real-world and*

real-time spectrums was seen as a foundational requirement. Whilst at overall outcomes level this is clearly key; developing data competency around the methodology for assessment of projects and interventions – was also seen as vital. A real sense of urgency was documented around this to ensure cohesion, joining-up and the pooling of resources to establish region-wide consistency.

- ***Leveraging procurement and supply chains**. Leveraging controllable spend through the public balance sheet and spending power was seen as a compelling lever. The Challenge Fund was seen as vital to supporting innovative procurement to enable procurement of innovation in this regard with ideas coming forward to complement those under development. It was also clearly expressed that some of the basics did not require super-innovation – but targeted, joined-up approaches across shared and common suppliers and making the changes necessary to embed carbon reduction as a core requirement of contracts.*

Getting There – Supporting Impact and Delivery

16. At the event, it was agreed that there should be a commitment to pooling resources around a regional co-ordinated approach. This would not detract from local-level actions and interventions and whilst building a central resource was unanimously supported – it would act and be available for regional-scale activity and would be over and above local level activity and local resources (albeit would add significant value to and provide alignment across the local-regional interface). This would support the two officers currently within the CCR team, both of whom have energy and sustainability as part of wider Transport/ Infrastructure briefs. It is suggested that to seed all of the above a contribution of £500,000 is required from the CCR Project Development Fund in 2021/22 with a more detailed analysis to inform a five year commitment being brought back to Regional Cabinet ahead of 2022/23. It is anticipated that through the CCR Programme Board, matched commitments against this amount can be leveraged – on an agreed contributions and outcomes basis, in order to both support a regional approach that supports local authorities to deliver ambitions at scale and pace. This work to provide a supportive regional energy function – could be the precursor to an eventual Regional Energy Agency.

Reasons for Recommendations

17. To seek Regional Cabinet approval of the Implementation Priorities for 2021/22 on the understanding this is an interim set of deliverables in the run-up to a more comprehensive approach through the functions and instruments to be adopted via CJCs.

Financial Implications

18. The City Deal Office team structure includes a number of roles to support an energy strategy. However establishing a regional energy resource as well as the one year interventions and actions set out in this report will have additional financial implications for CCRCD. It is estimated that this will require £500,000 from the wider investment fund revenue budget, which can act as seed funding

expenditure for 2021/22 including to support levering additional funds. Expenditure incurred will need to be clear on the outcomes and incurred in accordance with relevant procurement processes. Expenditure incurred will be reported throughout the year as part of performance monitoring reports. This level of expenditure can be supported as part of the existing WIF budget.

19. Joint Cabinet must be content that the interventions proposed support the objectives for which WG and HMT funding has been received and meets the terms and conditions of that funding. The approach to delivering the energy strategy objectives set out in the medium to long term will need to be costed in the business plan and budget setting updates for 2022/23. This will need to set out delivery approach, responsibilities, the staffing and resourcing implications including any additional contributions payable by local authority partners where relevant and the terms and conditions of external funding where receivable.

Legal Implications

20. It is noted that Regional Cabinet are being asked to approve a draft energy strategy. All future decisions and approvals required in line with the implementation of that strategy will be brought before Regional Cabinet for relevant consideration and approvals.

21. There are no further legal implications at this stage.

Well-being of Future Generations (Wales) Act 2015

22. In developing the Plan and in considering its endorsement regard should be had, amongst other matters, to:

    a) the Welsh Language (Wales) Measure 2011 and the Welsh Language Standards;

    b) public sector duties under the Equalities Act 2010 (including specific Welsh public sector duties). Pursuant to these legal duties Councils must in making decisions have due regard to the need to (1) eliminate unlawful discrimination, (2) advance equality of opportunity and (3) foster good relations on the basis of protected characteristics. Protected characteristics are: a. age; b. gender reassignment; c. sex; d. race – including ethnic or national origin, colour or nationality; e. disability; f. pregnancy and maternity; g. marriage and civil partnership; h. sexual orientation; I. religion or belief – including lack of belief, and;

    c) the Well-being of Future Generations (Wales) Act 2015. The Well-being of Future Generations (Wales) Act 2015 ('the Act') is about improving the social, economic, environmental and cultural well-being of Wales. The Act places a 'well-being duty' on public bodies aimed at achieving 7 national well-being goals for Wales - a Wales that is prosperous, resilient, healthier, more equal, has cohesive communities, a vibrant culture and thriving Welsh language and is globally responsible. In discharging their respective duties under the Act, each public body listed in the Act (which includes the Councils comprising the

CCRCD) must set and published wellbeing objectives. These objectives will show how each public body will work to achieve the vision for Wales set out in the national wellbeing goals. When exercising its functions, the Regional Cabinet should consider how the proposed decision will contribute towards meeting the wellbeing objectives set by each Council and in so doing achieve the national wellbeing goals. The wellbeing duty also requires the Councils to act in accordance with a 'sustainable development principle'. This principle requires the Councils to act in a way which seeks to ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs.

Put simply, this means that Regional Cabinet must take account of the impact of their decisions on people living their lives in Wales in the future. In doing so, Regional Cabinet must:

- look to the long term;
- focus on prevention by understanding the root causes of problems;
- deliver an integrated approach to achieving the 7 national well-being goals;
- work in collaboration with others to find shared sustainable solutions;
- involve people from all sections of the community in the decisions which affect them.

23. Regional Cabinet must be satisfied that the proposed decision accords with the principles above. To assist Regional Cabinet to consider the duties under the Act in respect of the decision sought, an assessment has been undertaken, which is attached at Appendix 3.

Equality Act 2010

24. In considering this matter, regard should be had, amongst other matters, to the Councils' duties under the Equality Act 2010. Pursuant to these legal duties the Regional Cabinet must in making decisions have due regard to the need to (1) eliminate unlawful discrimination (2) advance equality of opportunity and (3) foster good relations on the basis of protected characteristics. Protected characteristics are:

- age;
- gender reassignment;
- sex;
- race – including ethnic or national origin, colour or nationality;
- disability;
- pregnancy and maternity;
- marriage and civil partnership;
- sexual orientation;
- religion or belief – including lack of belief

RECOMMENDATIONS

25. It is recommended that the Cardiff Capital Region Regional Cabinet:

(1) re-endorses the approved CCR Energy Strategy in its current form, attached at Appendix 1;

(2) endorses the established set of objectives outlined in the Implementation Priorities for 2021/22, after which, a more expansive approach and strategy can be solidified and adopted through the proposed CCR Corporate Joint Committee;

(3) endorses the pledge to apply to join the high-profile and symbolic Race to Zero campaign for the Cardiff Capital Region, submitting a full application based on meeting the minimum criteria for November 2021, and making this CCR's key pledge for COP 26;

(4) signing up the CCR to the Carbon Disclosure Commitment and submitting an application by the deadline date of July 2022 and developing new layers of data capability, accountability and rigour to support the Race to Zero;

(5) supports the request for a seed fund of £500,000 from the CCRCD Project Development Fund for investment in the activity outlined in para 16 above in respect of the Partnership Agreement with Flexis, building data capability and project team support; and

(6) provides a mandate to the CCR Director and Programme Board to agree the match funded contributions and external funding opportunities against the seed fund in order to derive co-ordinated regional impact and local support and capacity.

Kellie Beirne
Director, Cardiff Capital Region City Deal
28 June 2021

Appendices
Appendix 1 Regional Energy Strategy
Appendix 2 Implementation Priorities 2021/22 – Race to Zero
Appendix 3 Future Generations Assessment Evaluation

Appendix 1

Prifddinas Ranbarth Caerdydd | Cardiff Capital Region

Cardiff Capital Region Energy Strategy

Funded & supported by:

Llywodraeth Cymru Welsh Government

Gwasanaeth Ynni Energy Service

Contents

Executive summary 4
Acronyms and abbreviations 10
Introduction and Background 12
Regional energy strategy overview 12
Impact of the COVID-19 pandemic 13
Our Energy Vision 17
The principles behind the vision 17
Our priorities 18
Our energy system, energy use and emissions 23
Modelling an Energy Vision scenario 23
Baseline and modelling results: by sector 26
Our Energy consumption 26
Our domestic energy consumption 29
Our commercial and industrial energy consumption 38
Our energy demand from transport 41
Baseline and modelling results: Electricity 44
Our annual electricity demand 44
Our electricity generation 46
Summary 54
Economic Assessment 58
Next Steps 69

Executive Summary

Executive summary

This regional energy strategy for the Cardiff Capital Region was commissioned by the Welsh Government and supported by the Welsh Government Energy Service. It has been developed by Cardiff Capital Region City Deal with additional support from 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 Cardiff Capital Region (CCR) is:

To create the conditions for a transition to a carbon neutral economy and society in the CCR, using low carbon energy as an enabler of economic regeneration, growing our regional income whilst maintaining guardianship of our environment through a laser-focus on clean growth.

Our priorities for achieving this vision are:

1. Energy efficiency and heat
2. Electricity and flexibility
3. Decarbonise transport
4. Grow business and jobs
5. Coordination, planning, regional support and ownership of the plan

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

- Cardiff Capital Region currently consumes around 36% of all energy consumed in Wales, less than its 49% share of the population;
- Between 2005 and 2013, total energy consumption fell by 22% and since 2013, energy consumption in the region has remained relatively stable. The associated greenhouse gas emissions have fallen by 35% from 2005 to 2017;
- The region's total energy demand is split roughly into thirds across transport, domestic heat and power, and commercial/industrial heat, power and processes.
- Commercial and industrial electricity consumption constitutes 55% of all electricity consumption in the region, approximately 10% less than the Great Britain average;

- Renewable assets located in the Cardiff Capital Region currently generate the equivalent of 25% of the region's electricity consumption;
- Cardiff Capital Region currently hosts 22% of Wales' renewable energy capacity, with 311MW of solar PV and 299MW of onshore wind;
- Of the 709MW of renewable energy installed capacity in the region, 221MW (31%) is locally owned;
- 50% of renewable generation in CCR is from onshore wind projects and 18% is from solar PV;
- CCR has the lowest number of renewable heat installations with just 0.2% of homes having a heat pump or biomass boiler;
- 90% of homes are connected to the gas network, the highest of any Welsh region and above the GB average.
- Approximately 27,000 homes (~4%) 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 75% 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.
- CCR currently hosts 173 public charging devices, including 31 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 it 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 Cardiff Capital Region: to meet Welsh Government targets, and to be on track for net zero by 2050, Cardiff Capital Region needs to reduce emissions from its energy system by 55% by 2035, split by sector as follows:

- 51% reduction in domestic heat and power emissions;
- 54% reduction in commercial and industrial emissions;
- 60% 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:

- 154,000 homes improved from EPC band G, F and E to D, C and B;
- Over 140,000 heat pumps installed;
- 42,000 suitable houses accurately fitted with internal or external wall insulation;
- Over 185,000 other insulation measures in homes;
- 112,000 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 13%;
- 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:

- 64% of vehicles driven in Cardiff Capital Region in 2035 are electric, equivalent to 15,000 more electric vehicles per year by the mid-2020s, peaking at 70,000 per year in the 2030s. This is to be facilitated by the deployment of 10,000 public and on-street EV chargers;
- 3,300 gas and hydrogen HGVs and 1,000 hydrogen vehicles;
- A 20% 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:

- 532MW of onshore wind installed (233MW of new capacity);

- 830 MW of solar PV installed (520 MW of new capacity of which 190 MW is roof-mounted and 325 MW from solar farms.);
- 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 ~50% of its total energy 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 different pathways all 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 £3.4 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 £227 million per year and will need to be financed from a range of sources including the private sector, households, and national and local government. This investment is 65% more than is expected to be spent in the corresponding sectors under a business as usual scenario.

The energy system vision (ESV) scenario is estimated to result in an additional 16,700 net jobs, with an associated increase in GVA of nearly £1.7 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 3,000 more gross jobs associated with the provision of low-carbon heating

technologies in the ESV scenario than the BAU scenario, associated with £361 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 the Cardiff Capital Region 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 Cardiff Capital 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.

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*	7,400(net) **(+23%)**	£853m **(+21%)**	£748m **(+204%)**
Domestic heat	3,000 (gross) **(+311%)**	£361m **(+320%)**	£701m **(+277%)**
Domestic energy efficiency***	9,300 (net) (**+43%**)	£555m (**+43%**)	£1.9b **(+43%)**
Total additional investment required to achieve the energy vision scenario			**£3,405,554,659**

** 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.*

[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.

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 Cardiff Capital Region 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 Cardiff Capital Region 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 Cardiff Capital Region 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 growth 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

Introduction

Introduction and Background

Regional energy strategy overview

In 2018, the Welsh Government commissioned the Welsh Government Energy Service to provide support to the Cardiff Capital Region City Deal and a number of regional partners and stakeholders such as the Economic Growth Partnership, the Business Council, Skills Partnership and Transport Authority to develop an energy strategy for the Cardiff Capital Region.[2] Similar regional energy strategies have also been developed with the remaining three economic regions of Wales.

The Welsh Government Energy Service (WGES) supports the public sector and communities to generate benefit for Wales from the transition to a low carbon economy. Support is provided to develop and implement large scale energy efficiency and renewable energy projects as well as wider advice to achieve targets for decarbonisation.

The Welsh Government declared a climate emergency in 2019 and accepted the recommendation from the Committee on Climate Change (CCC) to target a 95% reduction in greenhouse gas emissions by 2050 relative to 1990. After the Welsh Government accepted the CCC's recommended target, it presented in parallel an ambitious plan to go further and reach "net zero" by 2050. Wales had already announced in 2017 their ambitions for the Welsh public sector to be carbon neutral by 2030. The desire of the Welsh Government to aim for a more ambitious pathway than the one advised by the CCC is partly due to the unique legislative framework for climate policy that applies to Wales. The Well-being of Futures Generations (Wales) Act 2015 provides a ground-breaking legal framework for improving the social, economic, environmental and cultural well-being of Wales embracing the idea of a prosperous nation rather than an economic rich one. It mandates that all policy must contribute to sustainability and not undermine long-term goals.

Achieving this climate change target will require substantial transformation of our energy system and will result in radical changes in the technologies we use to heat our homes, to travel and to generate electricity. Transitioning to a modern, decarbonised energy system fit for the twenty-first century poses plenty of challenges, but it also has the potential to bring great benefit, both for the environment and for the economic and social wellbeing of our communities.

This work seeks to provide a strategic direction for the future of a decarbonised energy system including heat, power and transport within Cardiff Capital Region. It will define steps to begin to overcome the challenges we face. Furthermore, while the energy transition has the potential to bring benefits to our communities, maximising this benefit requires reflection on past experiences and would also benefit from an increased strategic focus.

The work has coincided with tremendous efforts that are underway to develop a City Deal for the region. Desired outcomes for the work include the identification of strategic projects that can be considered by the City Deal. More broadly, the plan provides a

[2] Full list will be in the Appendix.

considered approach and an evidence base for the region to move forward collaboratively towards a future decarbonised energy system through more tailored, detailed Local Area Energy Planning. This strategy is presented in five chapters.

Chapter 1: Vision - The energy system vision that is presented in this strategy was developed with stakeholder contributions through the project's first workshop, survey feedback, and targeted stakeholder conversations. The vision describes the region's aspiration for what a future energy system will achieve and how it will function. Five core values have been defined that should be at the heart of future energy projects and decisions.

Chapter 2: Priorities - A literature review was undertaken combining key policy and evidence documents with expert interviews and workshop consultation to build a more comprehensive picture of the challenges and opportunities in the Cardiff Capital Region. This includes available levers, barriers to development and key technologies. This research, and in particular the thoughts and ideas shared by stakeholders, informed the development of strategic priority areas. These priorities are central to achieving the region's decarbonisation goals and are important to its stakeholders.

Chapter 3: Energy system, energy use & emissions - A baseline study provides a portrait of the Cardiff Capital Region energy economy and landscape today. This chapter also summarises energy modelling that evaluates potential options for a pathway to a net zero energy system in the region.

Chapter 4: The future of energy and the economy - The fourth chapter considers the energy system pathways modelled and the economic impact of those pathways in terms of jobs, gross valued added (GVA), and the investment required to make those pathways a reality.

Chapter 5: Next Steps – Outlining the three key next steps that we will take to translate the Cardiff Capital Region energy system vision into reality.

Impact of the COVID-19 pandemic

This strategy has been finalised in the midst of the COVID-19 pandemic, which is having a profound effect on the lives of millions of people around the world, bringing unprecedented challenges for our economy, our society and our communities. At the time of writing, the true economic and societal costs of the pandemic for Wales and the Cardiff Capital Region are not fully clear, but the severity of the impacts on the global economy are forecast by many commentators to exceed that of the 2008 financial crisis.

The pandemic is also taking place against the backdrop of the ongoing climate emergency. And whilst the economic damage caused will undoubtedly result in a short-term reduction in greenhouse gas emissions, it is possible that emissions could rebound if climate positive solutions are not included as central elements in our economic stimulus packages.

As we move from the immediate emergency response to save lives, support the health sector, retain jobs and support our society and economy, we must recognise that our approach to the economic recovery that will follow provides us with a unique

opportunity to sustainably rebuild our economy and make greener investments and climate positive decisions that set us on a pathway that aligns with the Welsh, UK and international climate targets.

CCR have recently reconsidered and endorsed revised programme priorities in terms of reaction to COVID-19 and future economic adaptation. In this context, it is hoped that with the commitment to decarbonisation that CCR is making, that there will be acknowledgement that our economic recovery and growth plans need to be developed as part of driving down greenhouse gas emissions. We need to recognise the significant economic potential that a green recovery can contribute to rebuilding a sustainable economy in CCR.

The Committee for Climate Change (CCC)[3] has identified 6 key principles for a resilient recovery from the pandemic, and we must ensure that our strategy is underpinned by these cross-cutting principles to help put CCR in a position to capitalise on opportunities that may arise from the recovery:

1. Use climate investments to support economic recovery and jobs
2. Lead a shift towards positive, long-term behaviors
3. Tackle the wider 'resilience deficit' on climate change
4. Embed fairness as a core principle
5. Ensure the recovery does not lock-in greenhouse gas emissions or increased risk
6. Strengthen incentives to reduce emissions when considering tax changes.

We must also learn from the pandemic, taking the lessons from our response and apply them to the climate emergency. This may include for example:

- the need for openness and transparency;
- the importance of good data;
- the speed with which people can change behaviours and industry re-purpose;
- the need to support individuals and businesses through economic transition; and
- the importance of global collaboration.

Other lessons will undoubtedly emerge. But perhaps the biggest lesson from the COVID-19 pandemic is about the need for anticipation and preparedness in dealing with major societal issues, and the population's capacity and willingness to accept significant lifestyle changes if it is deemed necessary for the good of society. If it teaches us anything it is that we cannot afford to ignore science or expert judgement about the risks faced by our societies, or wait for problems to arrive before taking action. Learning lessons from the response to a global health emergency, and applying this to that of the global climate emergency could pave the way for the accelerated and sustained change that is so critical in solving the problem of climate change.

[3] https://www.theccc.org.uk/2020/05/06/take-urgent-action-on-six-key-principles-for-a-resilient-recovery/

As the COVID-19 crisis is still ongoing at the time of writing, it is still somewhat unclear when and how Wales will emerge fully from the current restrictions, and the process and timeframe through which the social distancing will be eased; or, indeed, whether we will encounter a subsequent lockdown in the future, whether at national or local levels. We must therefore acknowledge the significant uncertainties that exist around how the CCR economy will emerge from the crisis as well as the uncertainties associated with the shape of the future economic growth and decarbonisation trajectories modelled in this strategy. As such, the economic and climate modelling that underpins this strategy will need to be kept under review and updated when, and how, our emergence from the COVID-19 crisis becomes clearer. Certain elements of the strategy, such as our understanding of what it means to make 'futureproof decisions', may also need to be revisited.

In addition, CCR may be able to capitalise on the opportunity to sustain behaviours observed throughout the pandemic that have had a positive effect on reducing emissions, such as the increase in active travel, reduction in travel by private car, increased working from home practices and willingness to invest in domestic property improvements. Directing resources towards infrastructure that will support the embedding of such behaviours into business as usual for communities and businesses has the potential to drive lasting emissions reduction as we recover from the COVID-19 crisis.

However, the fundamental principles of this strategy remain firmly relevant. With its focus on cleaner, fairer economic growth, this energy strategy has the potential to play a significant role in helping CCR 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.

Our Energy Vision

Our Energy Vision

Our 2035 Energy Vision statement

To create the conditions for a transition to a carbon neutral economy and society in the CCR, using low carbon energy as an enabler of economic regeneration, growing our regional income whilst maintaining guardianship of our environment through a laser-focus on clean growth.

The principles behind the vision

Our vision is guided by three core principles:

Core Principles

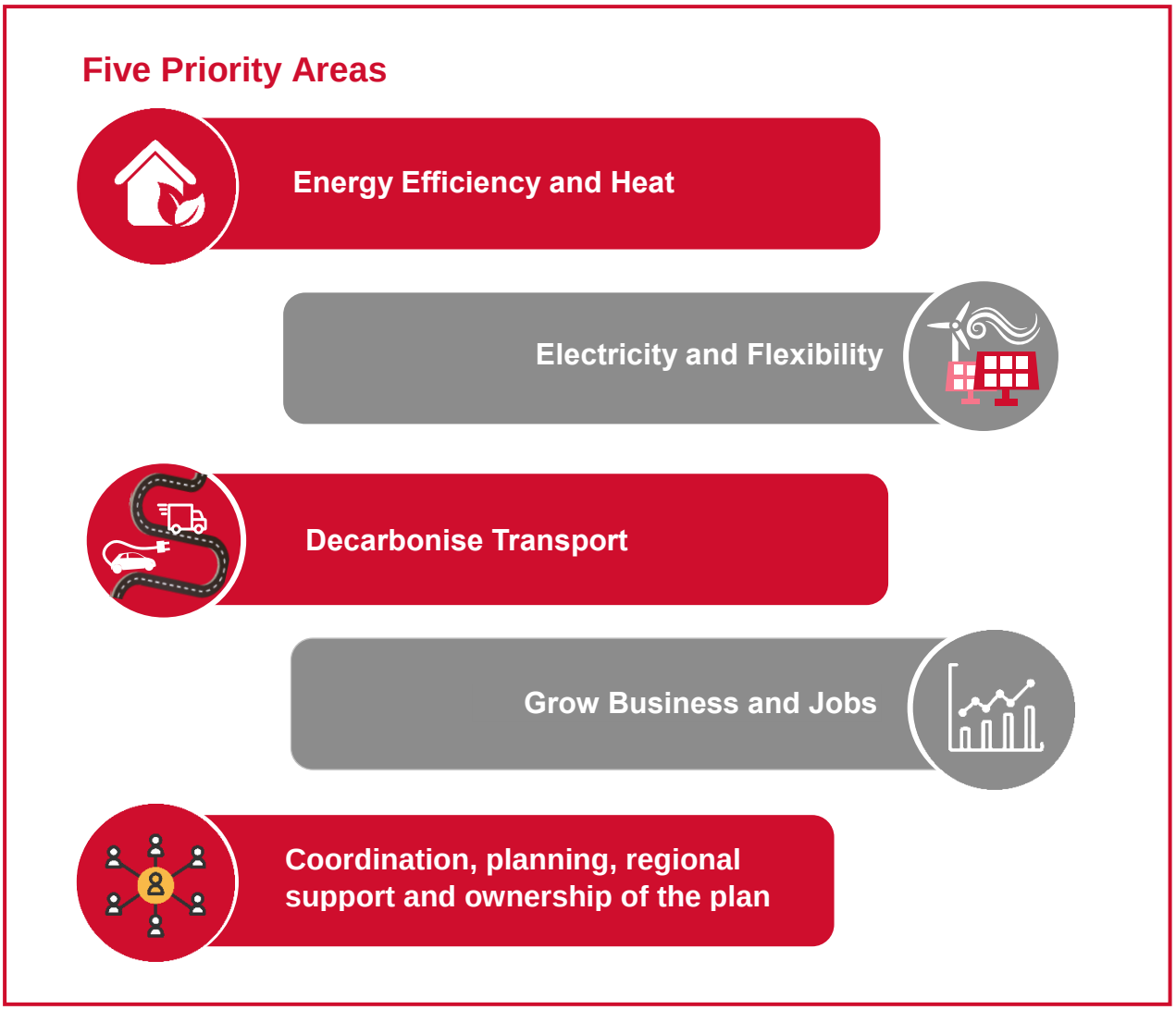
- **Act as an enabler to a sustainable regional economy:** deliver inclusive employment, profits and skills, lower costs and open up markets, and stimulate public and private investment in capital projects that deliver low carbon improvements across the region.

- **Contribute wider benefits to the region:** including alleviating fuel poverty, sparking innovation and developing local training and skills for people and businesses.

- **Decarbonise the energy system to meet national targets as a minimum**: make significant carbon reductions across all sectors, to have energy efficiency as a core focus, and to have a multi-vector system, that includes a range of low carbon technologies, that meets needs affordably and balances the best use of existing assets and resources.

Our priorities

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



Energy Efficiency and Heat

- Deliver fabric improvements (e.g. window glazing, internal wall and roof insulation) to the region's existing and new builds including delivering a whole house retrofit approach to the existing housing stock, to improve energy efficiency and deliver cost savings.
- Build new homes to align with evolving 'Part L building regulations' including developments currently with planning permission.
- Help homeowners understand the benefits of energy efficient housing including cost savings, improved comfort and health.
- Utilise alternative fuels for heat including hydrogen, bio-methane and solar thermal.
- Develop flexible and hybrid heating solutions e.g. hybrid heat pumps, building on the learnings from the Freedom project based in Bridgend.

Electricity and Flexibility

- Ensure there is a mix of generating technologies across the region to provide resilience and flexibility.
- Encourage local development of renewable energy projects by public bodies on publicly owned land to increase revenue generating potential for public bodies and to increase public ownership.
- Map renewable energy potential against upcoming developments, particularly developments of regional level scale.
- Pilot energy/battery storage projects to maximise renewable energy potential and build on previous trials in Cardiff and Bridgend.
- Encourage uptake of smart meters, ensuring the public sector has smart meters installed across its estate, to open up the potential of load shifting and access to balancing/flexibility markets.
- Adopt generation technologies, demand patterns and battery storage technologies which reduce loads on the distribution network and work with the DNO to maximise the capacity of the existing network.
- Encourage low carbon technologies e.g. LED lighting, and invest in behaviour change programmes to reduce consumption
- Encourage smart digital integration and support wider local innovative grid flexibility pilots for roll out across the region.

Decarbonise Transport

- Prioritise investment in public transportation.
- Make public transport services more affordable and convenient to encourage a modal shift from private transport.
- Enable changes in people's travel methods capitalising on changing behavioural patterns as a result of the Covid-19 crisis.
- Promote electrification of public transport and build on trials including electric buses in Caerphilly and Cardiff, and the decarbonisation of the South Wales Metro.
- Encourage use of active travel modes e.g. walking and cycling.
- Develop an electric vehicle charging infrastructure, in collaboration with Transport for Wales and OLEV, taking a coordinated approach across the region e.g. the Gwent study, and encourage public sector fleet transitions to EVs.
- Lobby for additional Metro nodes to increase rural accessibility and connectivity.
- Ensure metro stations are integrated with other economic priorities and housing.
- Work with Welsh Government to identify a solution to the Newport/Cardiff trunk road bottleneck and consider addition of a dedicated bus lane.
- Consider hydrogen as an alternative fuel source where electrification is less suitable e.g. HGVs.
- Encourage the shift towards home-working created by Covid-19 especially in rural areas.

Grow Business and Jobs

- Create a commercial property strategy which incorporates access to renewable energy sources and access to public transport links
- Promote continued research into battery and hydrogen technologies, and continue to develop academic excellence in this field
- Develop supply chain opportunities for energy efficiency retrofit and renewable energy manufacturing
- Evaluate the region's capacity and capabilities in retrofit and renewable energy deployment and develop training opportunities/incentives as necessary.

- Build on the region's strong reputation for research and innovation through engagement with Higher Education Institutes, including developing digital and "smart" solutions to energy transitions, as well as future proofing ongoing developments.
- Upskill and retrain the workforce to ensure the industrial sector needs are balances with local needs, and that it delivers support to those people and places that are most likely to lose out from economic and technical change.

Coordination, planning, regional support and ownership of the plan

- Deliver against a shared vision and approach.
- Demonstrate aligned ambition and leadership across the region with plans agreed and championed by Chief Executives and leaders.
- Maximise economies of scale potential through the facilitating role of the region and through collaboration with other regions.
- Governance to use the framework for the City Deal Investment operations and will consult with the Regional Economic Partnership, Regional Business Council and Regional Skills Partnership. This will provide an enduring organizational structure which will secure the long-term delivery objectives of the plan.

Our energy system, energy use & emissions

Our energy system, energy use and emissions

Modelling an Energy Vision scenario

Aims of undertaking scenario modelling

Scenario modelling has been undertaken to create a 2035 Cardiff Capital Region Energy Vision scenario that could deliver against the level of ambition set out in the Energy Vision statement. The modelling outcomes are unique to the region, taking advantage of local resources and opportunities, and input from local stakeholders.

The overall aim of the scenario is to describe a potential decarbonisation pathway that will put the region on track to achieve a net zero energy system by 2050. 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 rapid evolution of technologies and pathways means there are uncertainties and varying opinions about the precise route forward. One such alternative is the Energy Network Association's "Pathways to Net Zero" which proposes pathways for decarbonising heat. Wales and West Utilities has completed extensive research into its 2021-26 business plan which builds on this alternative, the details of which are described in more detail in the chapter below. What is clear from research is that different pathways all must achieve significant decarbonisation.

The energy system vision pathway modelled 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 modelling presents a potential development scenario that is intended to:

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

The scenario focuses on known decarbonisation solutions that could be implemented by 2035, which would put CCR 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.

Why does the scenario look to achieve zero emissions from energy in 2050 and not 95% decarbonisation?

The Committee on Climate Change recommended in its 2019 report, 'Net Zero: The UK's contribution to stopping global warming', that Wales adopt an overall

decarbonisation target reduction of 95%, against a 1990 baseline, by 2050[4]. This target, which is lower than the equivalent UK 2050 net zero decarbonisation target, recognises that Wales faces several additional challenges including higher greenhouse gas emissions from its agriculture and parts of its heavy industry. However, Welsh Government has expressed an ambition to exceed this target and aim for 100% decarbonisation. Non-energy agriculture emissions are out of scope of this energy system study. Both a Welsh 95% and a 100% emissions reduction target require the energy system to maximise its decarbonisation, reserving any residual emissions for more difficult to decarbonise sectors such as agriculture and heavy industry. It is worth noting that during the course of our engagement, stakeholders in the region and across Wales have expressed very strong support for ambitious energy system decarbonisation.

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[5]. 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 more detailed carbon budgets consistent with the new net zero target.

The CCR energy baseline has been established by gathering and analysing national and local datasets of energy consumption, energy efficiency and generation. The Energy Vision scenario has been created through a bottom-up analysis of the level of uptake of measures and technologies that is possible by 2035. Assumptions have been drawn from a range of sources, including:

- Committee on Climate Change reports[6,7]
- National Grid's Future Energy Scenarios[8]
- The project team's past work on future energy scenarios for Wales & West Utilities and for Western Power Distribution[9]
- Engagement and workshops with local, regional and national stakeholders.

[4] Committee on Climate Change (2019) Net Zero, The UK's contribution to stopping global warming. May 2019 https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf
[5] Committee on Climate Change (2019) 2019 Progress Report to Parliament https://www.theccc.org.uk/publication/reducing-uk-emissions-2019-progress-report-to-parliament/
[6] Ibid
[7] Committee on Climate Change (2018) Hydrogen in a low-carbon economy https://www.theccc.org.uk/publication/hydrogen-in-a-low-carbon-economy/
[8] National Grid (2019) *Future Energy Scenarios*, http://fes.nationalgrid.com/media/1409/fes-2019.pdf
[9] Regen (2019) Wales and West Utilities – Regional Growth Scenarios for Gas https://www.regen.co.uk/project/wales-and-west-utilities-regional-growth-scenarios-for-gas/
Regen (2019) Future Energy Scenarios. https://www.regen.co.uk/area/local-future-energy-scenarios/

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

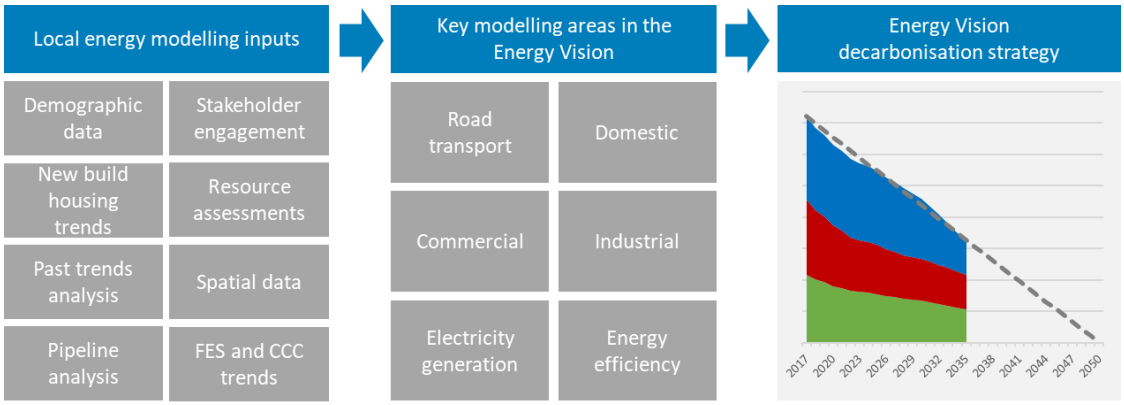


Figure 2: Outline modelling methodology

Worked example: The modelling approach for domestic heat

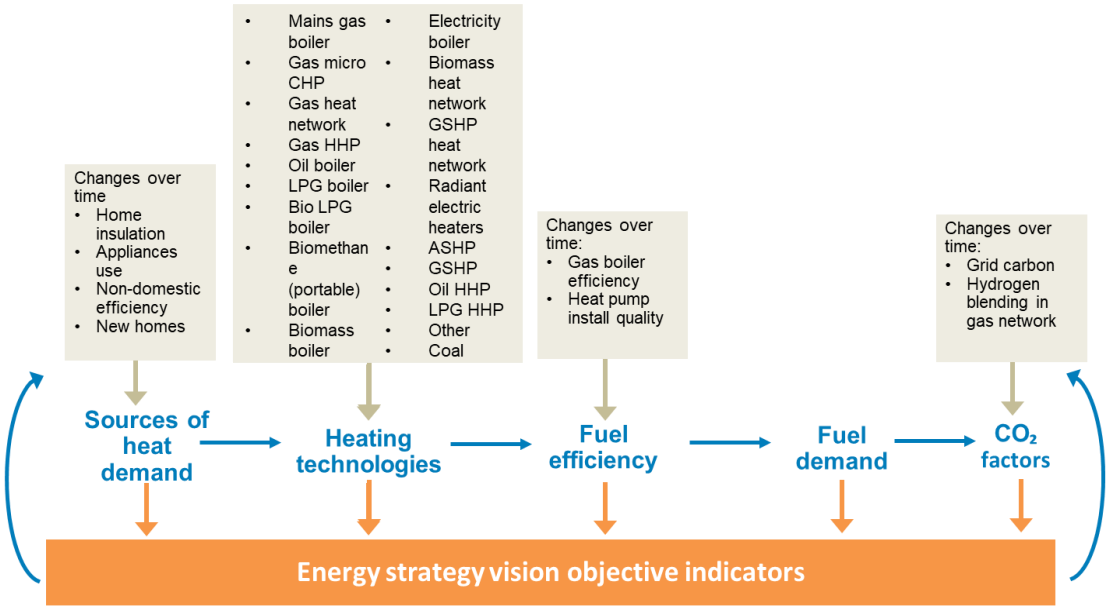


Figure 3: Diagram of the modelling approach for domestic heat

A note on scope

The strategy is focused on emissions associated with the energy system in CCR. 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 such as the SWIC, as expanded on in the introduction.

Baseline and modelling results: by sector

Our Energy consumption

Baseline: energy consumption by sector

CCR currently uses around 32 TWh of energy[10]. The region accounts for around 36% of all energy consumed in Wales[10], which is less, on a pro-rata basis, than its 49% share of the Welsh population[11]. Fuels used to generate electricity are not included in this analysis, which is focussed on final consumption.

The region's total energy demand is split roughly into thirds across transportation, domestic heat and power, and commercial/industrial heat, power and processes[7].

CCR is the most urban region of Wales with the highest proportion of buildings connected to the gas network and so is the Welsh region with the highest consumption of gas, but also the lowest emissions per household due to the low number of homes heated by other, high carbon fossil fuels.

Energy consumption in CCR by sector and fuel

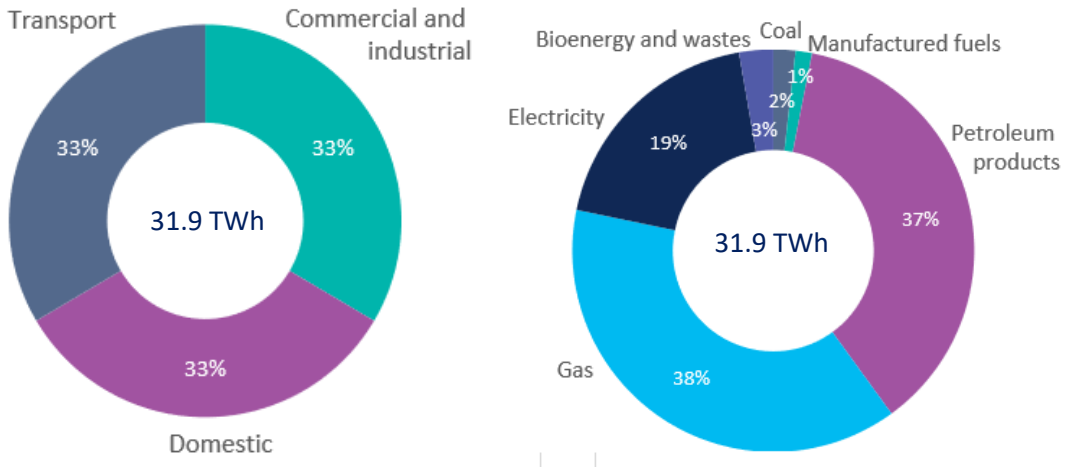


Figure 4: Breakdown of energy consumption in Cardiff Capital Region. Source: BEIS sub-national total final energy consumption, 2019.

[10] BEIS (2019) Regional and local authority electricity consumption statistics 2005 to 2018, https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics

[11] StatsWales (2019) Population estimates by local authority and year https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Estimates/Local-Authority/populationestimates-by-localauthority-year

CCR's trend for decreasing energy consumption has plateaued in recent years

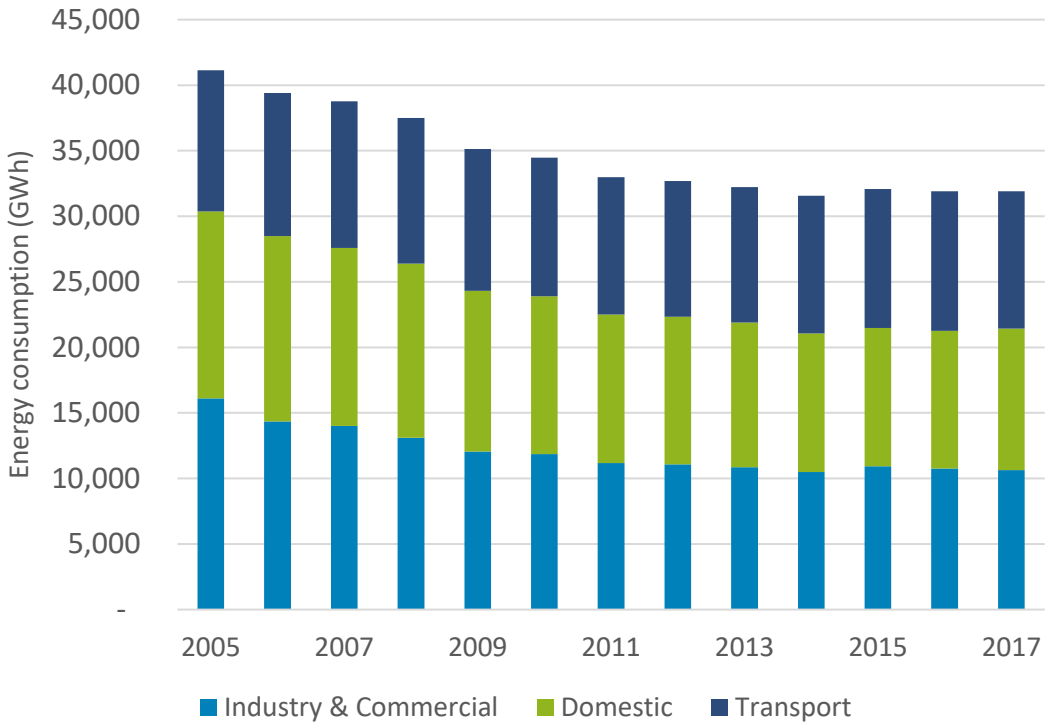


Figure 5: Trend of energy consumption in the Cardiff Capital Region, by sector. Source: BEIS sub-national total final energy consumption, 2019. (Excludes bioenergy and wastes)

Analysis of BEIS sub-regional data[12] shows that total energy consumption fell by 22% between 2005 and 2013, an average rate of about 2.4% per year. This is slightly greater than the 18% reduction in energy demand experienced across Great Britain over the same period. This is predominantly due to a significantly greater reduction in commercial and industrial energy consumption in CCR compared to Great Britain.

The 22% reduction in CCR's energy demand is predominantly due to the commercial and industrial sector's energy consumption reducing by 34%, while the domestic sector's energy consumption reduced by 24%. This is likely to be the result of deindustrialisation and behavioural change/energy efficiency measures in each sector respectively. Since 2013, energy consumption in the region has been relatively stable.

[12] BEIS (2019) Regional and local authority electricity consumption statistics 2005 to 2018, https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics

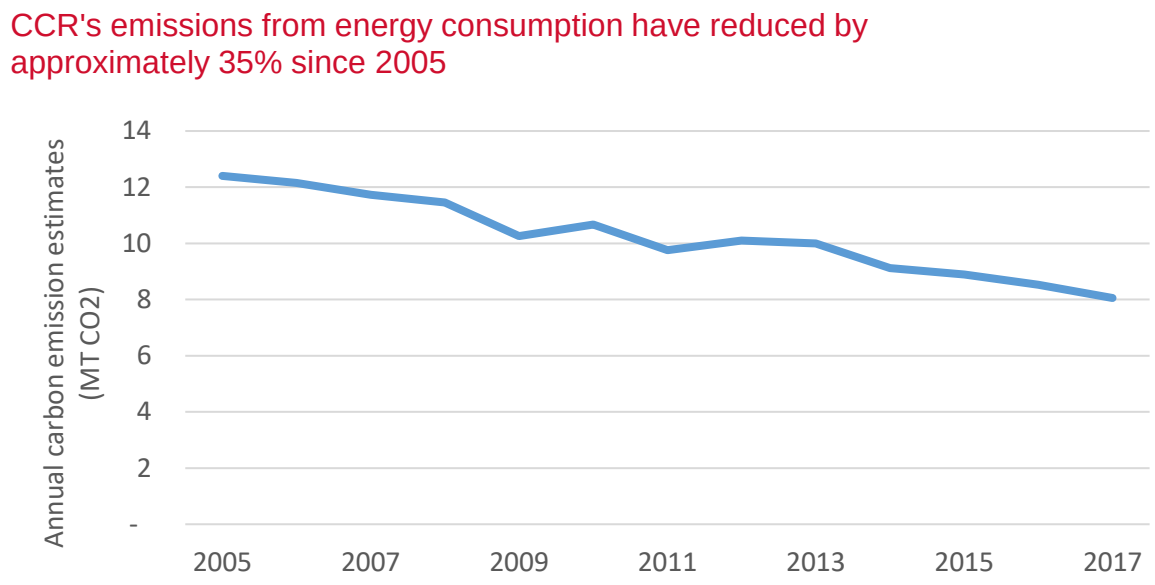


Figure 6: Estimated historic emissions in CCR. Source: BEIS sub-national emissions

Emissions from energy consumption reduced by around 35% from 2005 to 2017[13] as a result of falling demand and decarbonisation of the national electricity grid.

Energy system vision: energy consumption by sector

To be on track for net zero by 2050, CCR needs to achieve 55% decarbonisation of its energy system by 2035.

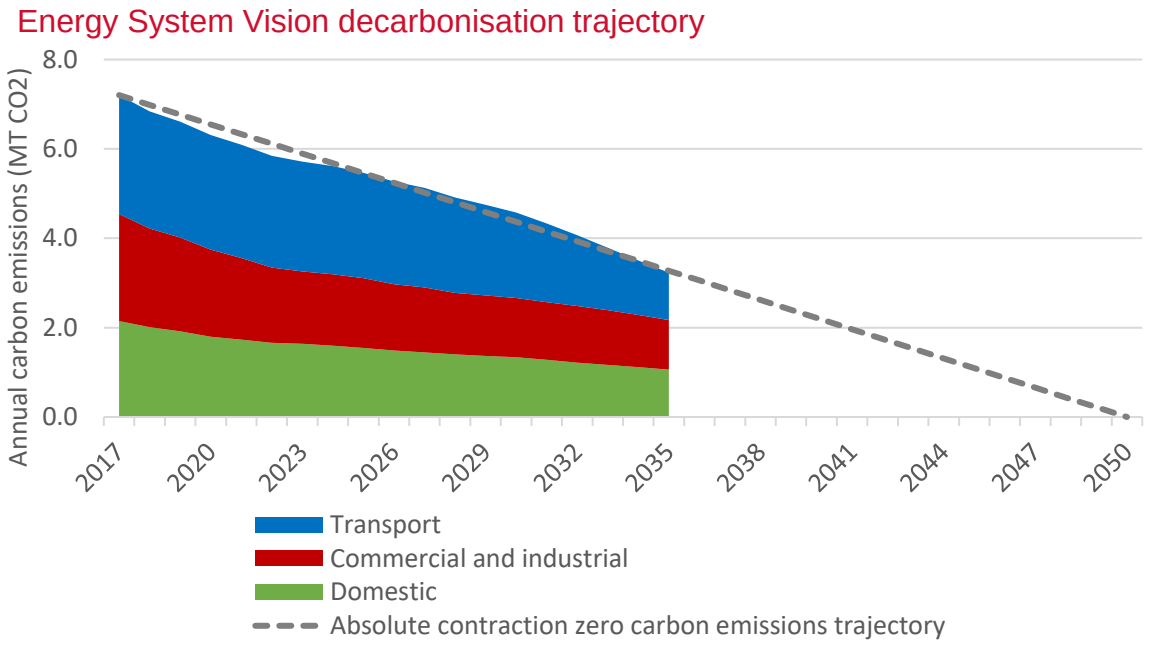


Figure 7: CCR's Energy Vision decarbonisation trajectory by sector to meet net zero 2050 under an absolute contraction methodology. Source: WGES analysis

[13] BEIS (2019) UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2017 https://www.gov.uk/government/collections/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics

- By reviewing the measures that could be implemented in CCR between the baseline year (2017) and 2035, this 55% decarbonisation target can be split by sector into:
    - 51% reduction in domestic heat and power emissions
    - 54% reduction in commercial and industrial emissions
    - 60% reduction in transport emissions.

The industrial decarbonisation will be addressed from decarbonising electricity, transferring heating from fossil fuel to electricity and rely on a small uptake of hydrogen.

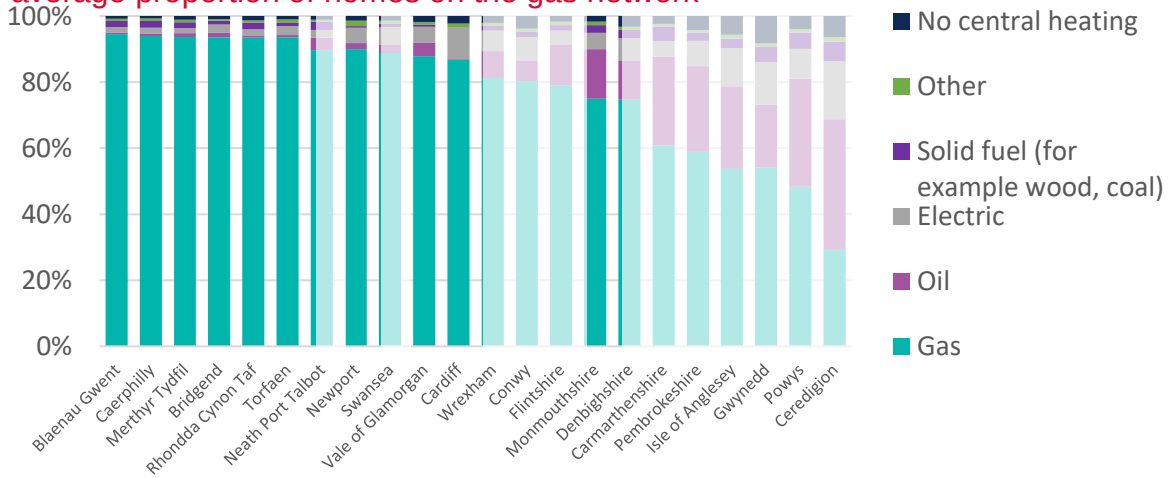
Figure 8: Summary of the Energy Vision's emission reductions by sector. Source: WGES analysis

Our domestic energy consumption

Baseline: domestic heating

Around 50,000 new homes have been built in the region[14] since 2005, but despite this, domestic heating demand has fallen by 31% since then, reflecting the national trend resulting from more efficient homes, appliances and lighting, and behavioural change.

Cardiff Capital Region's local authority areas have an above average proportion of homes on the gas network



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

Figure 9: Proportion of homes heated by each heating fuel type, by local authority. Source: Census, 2011. MHCLG, Energy Performance Certificates.[15]

Cardiff Capital Region is the Welsh region with the lowest number of renewable heat installations

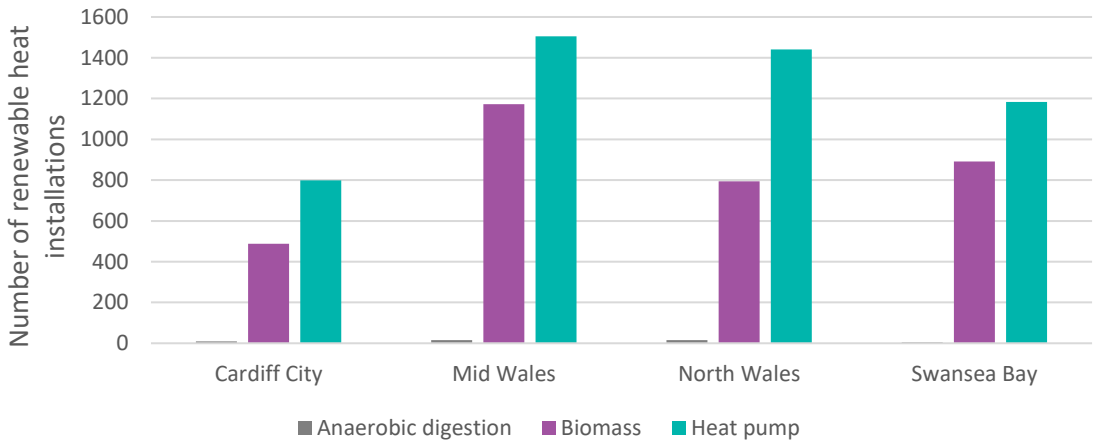


Figure 10: Renewable heat installations in Wales. Source: Energy Generation in Wales 2018

Despite hosting nearly half of all homes in Wales, CCR has the lowest number of renewable heat installations; it can be assumed this is due to the high proportion of on gas properties, meaning it is difficult for renewable heat technologies to compete against the low cost of natural gas. Just 0.2% of homes have a heat pump or biomass boiler.

Cardiff Capital Region's domestic properties have an average EPC rating of D

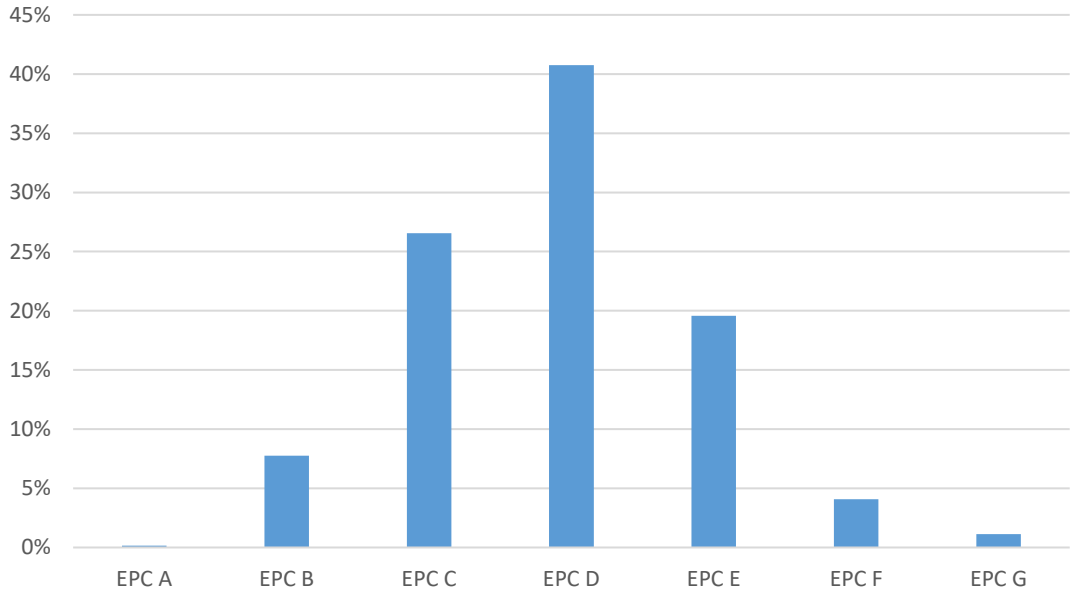


Figure 11: Proportion of homes in CCR in each EPC band. Source: MHCLG, Energy Performance Certificates

[15] 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.

CCR has the highest average energy efficiency ratings in Wales, with 75% of homes rated as EPC band D or above. This is, however, still below the Great Britain figure of 77% band D and above. The average rating (mean, median and mode) is a D, and there are virtually no A-rated properties; there is a significant need to improve energy efficiency to decarbonise the energy system.

Energy Vision scenario: domestic heating

Box 1: Assumptions regarding the decarbonisation of domestic heating in CCR[16]

The Cardiff Capital Region energy strategy modelling assumptions for domestic heating are based on input from regional stakeholders and the 2019 Wales & West Utilities Distribution Future Energy Scenario (DFES) project which explored potential future scenarios for the gas network in Cardiff Capital Region in 2035. Some of the key scenario highlights from the 2019 DFES included:

- Around 20% of homes could be heated by a heat pump by 2035, predominantly air source or ground source heat pumps replacing more expensive oil, LPG or solid fuel heating.
- 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 be 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 up to 4% of energy supplied by the gas distribution network in Cardiff Capital 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.
- Consumption of natural gas energy in Wales could fall by over 20% between now and 2035.
- Projections on the uptake of heat pumps, including the proportion of hybrid heat pumps, were based on FES 2019 scenarios. Since then, the FES 2020 study has been published and includes a higher proportion of hybrid gas heat pumps, particularly under the Leading the Way scenario.

These findings have been built on in developing the Cardiff Capital Region Energy Vision scenario.

Wales and West Utilities' 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 can exceed 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.

[16] Regen (2019) Regional Growth Scenarios for Gas and Heat for Wales & West Utilities https://www.regen.co.uk/regional-future-energy-scenarios-for-heat-and-gas/

Table 2. Regional Growth Scenarios for Gas and Heat compared with energy modelling

Key assumptions for domestic heating fuels		2019 WWU DFES Study			WGES Energy Strategy Study
		Two Degrees Scenario	Community Renewables Scenario	Hybrid Accelerator scenario	
Heat pump deployment (% of houses with a HP by 2035)		12%	19%	17% (including significantly higher proportion of hybrid heat pumps)	19%
Biomethane and bioSNG energy	**Biomethane and bioSNG heat energy for domestic and C&I heating in 2035**	324 GWh	436 GWh	380 GWh	362 GWh (note the scope excludes some large industrial sites)
	Biomethane and bioSNG percentage of heat delivered by the gas network	3% of gas network energy	4% of gas network energy	3% of gas network energy	4% of gas network energy
Hydrogen use for domestic and commercial heating **(Hydrogen for industrial processes and transport is modelled separately)**		1% of gas network energy	None modelled before 2035	2% of gas network energy	None modelled before 2035 although there is potential for some domestic heating associated with industrial clusters

Existing homes

Achieving a 51% reduction in domestic carbon emissions by 2035 requires a significant shift in the way homes are heated and their level of energy efficiency. This is recognised in Prosperity for All: a low carbon Wales, Proposal 10, which looks at the challenges and opportunities around low carbon heat, and Proposal 11, which considers increasing the use of waste heat and low carbon heat.

One pathway to achieve this would be to focus on improving the worst performing homes, eliminating all E, F and G ratings through improvements, as well as some improvements to homes with higher ratings. For example, a 51% reduction could be achieved if 154,000 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. This should take account of the balance between the cost of building fabric improvements against the cost of gas and electricity grid decarbonisation

Upgrades to nearly all homes rated E, F and G required to deliver Cardiff Capital Region's Energy Vision

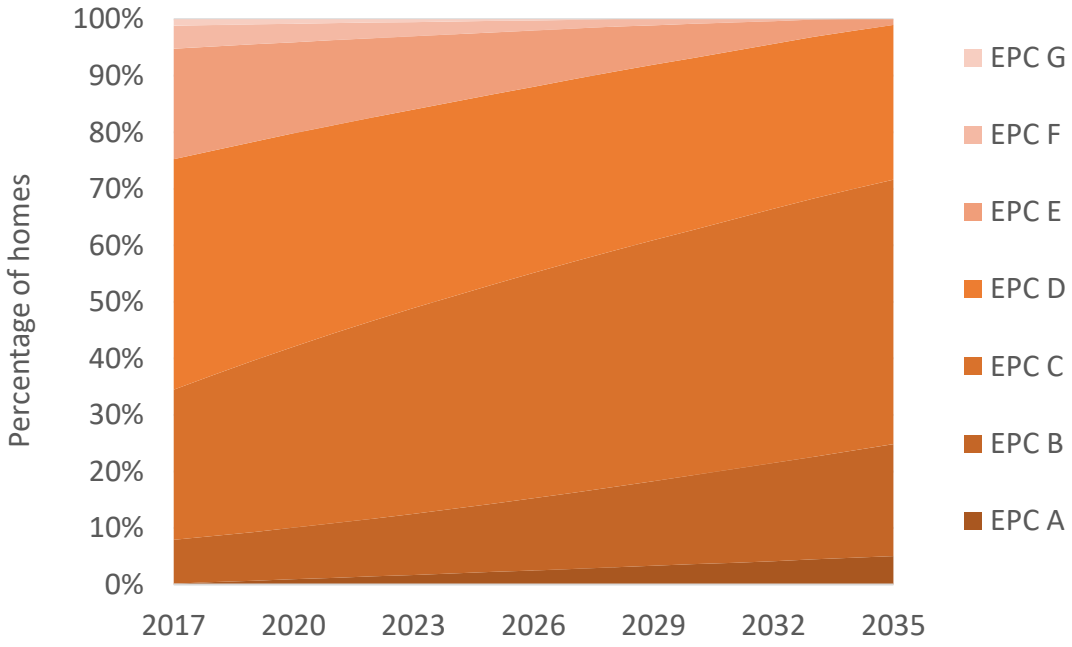


Figure 12: Estimated domestic EPC band changes to deliver the Energy Vision scenario. Source: WGES analysis

Around 112,000 homes, 17% of existing homes, need to move from using fossil fuel heating to low carbon heating by 2035, looking at cost effective solutions which consider fuel poverty, as heat pumps may not be affordable for all. Of these, approximately 27,000 (~4%) are currently fuelled by oil, LPG, coal or other solid fuels, with the remainder currently 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 shared ground loops. By 2035, over 140,000 heat pumps are assumed to have been installed in CCR, including over 28,000 heat pumps

in new homes and around 8,000 homes connected to heat pump-fuelled heat networks. The Vision includes a smaller role for biomass and bio-LPG heating options.

Air source heat pumps are the dominant new low carbon heating source introduced by 2035 under the Cardiff Capital Region's Energy Vision scenario

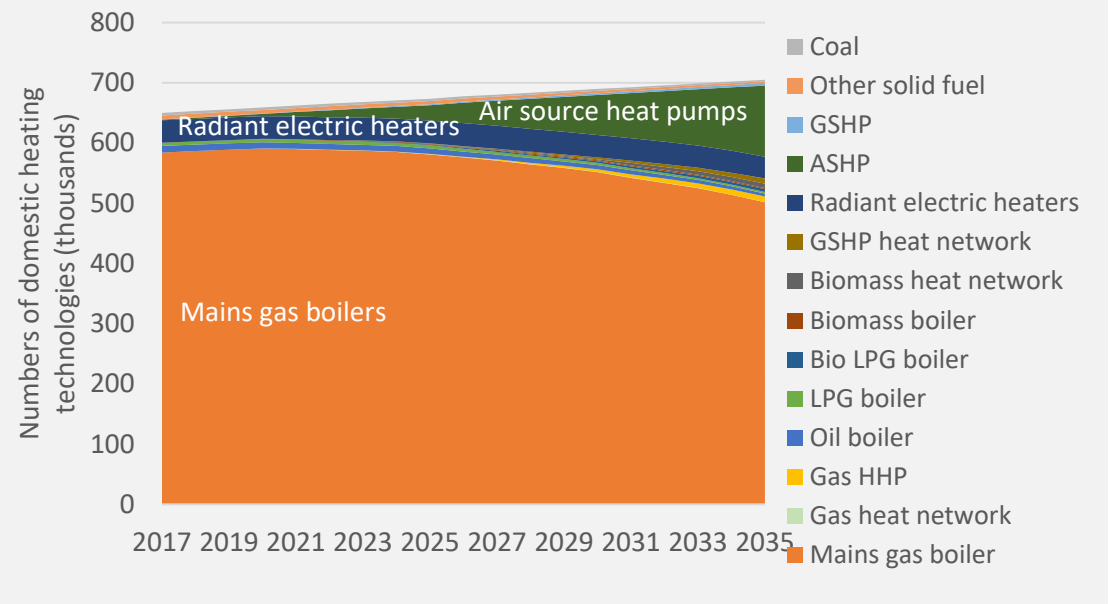


Figure 13: Breakdown of domestic heating technologies in the CCR Energy Vision scenario, including existing and new build houses. Source: WGES analysis

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.

Box 2. Alternative Domestic energy and heat Pathway – 'balanced' scenario

The Energy Networks Association's 'Pathways to Net Zero' report explores the role of gas networks in a future Net Zero energy system, producing cost-optimised scenarios out to 2050. The Pathways to Net Zero report presents an alternative pathway called the 'balanced scenario' for a decarbonized heating system that can also be applied to the Cardiff Capital Region.

The "balanced scenario" describes a future where low carbon and renewable gases are used in a *balanced* combination with low carbon electricity, where electrification plays a less dominant role and renewable gas grid conversion is prioritized. It highlights the significant role of renewable gas in meeting net zero by 2050, especially in cases where existing homes can't be renovated or all-electric heat pumps are not an appropriate solution. However, it also identifies current barriers to achievement, for example, a significant reliance on timely Carbon Capture Use and Storage implementation and accompanying policies to support this.

WWU have considered these principles into its 2021-26 business plan, consulting over 20,000 stakeholders and consumers in the process.

<u>'Balanced scenario' overview for domestic energy and heat:</u>

- Deployment of hybrid heat systems becomes main heat source in buildings not suitable for all-electric heat pumps and where connecting to a district heating network is not an option
- Heat supply is mostly hydrogen and biomethane
- Moderate renovation in existing buildings

The key difference between the balanced scenario and the energy system vision scenario modelled for this report concerns the level and timing of the installation of heat pumps versus hybrid heat pumps. The balanced scenario, when applied to the Cardiff Capital Region would focus on hybrid heat pump installation first. Another key difference between the balanced scenario and the energy system vision scenario are timelines. The balanced scenario models out to 2050, whereas the energy system vision modelling has modelled out to 2035.

Detailed energy planning is required to provide certainty on the pathway and short term actions required in CCR to decarbonise not just heating, but the wider energy system. The gas and electricity DNOs, and the local authorities in the region, are vital to this process. Electrification is currently one of the few proven scalable options for decarbonising heat, with heat pumps playing a substantial role in any Net Zero scenario. Local area energy planning will identify the preferred combination of technological and system changes needed to the local energy system, to decarbonise heat, and local transport, and realise opportunities for local renewable energy production.

Box 3: The Freedom Project

The Freedom Project, a joint innovation project between Western Power Distribution and Wales & West Utilities, installed and ran 75 gas hybrid heat pumps in Bridgend between 2016 and 2019. The project investigated the carbon and cost impacts of using an air source heat pump for the majority of heat demand, with a gas boiler providing heat during the coldest months of the year.

Hybrid heat pumps could provide significant reductions in emissions from domestic heating in the near-term and the project found the potential for lower system costs from a hybrid approach rather than through electrification alone.

In a net zero scenario, homes heated by a hybrid heat pump with a fossil gas backup would either have to transition to a fully electrified heat pump or be supplied by a low carbon gas such as hydrogen or biomethane.

New homes

The recent consultation from Welsh Government on Building Regulations Part L (responses from which are currently being reviewing) is looking to establish the standards for housing construction for 2020 to 2025 and give industry notice by exploring the expected standards that will be in place from 2025. The current proposals for 2020 are to improve the target emission rate for new build homes by raising the fabric standards, and introducing renewable energy technology into the notional building that sets the target emission rate. To meet the new target, developers may, for example, choose to install low carbon heating but if not, will be required to future proof so that low carbon heating can be easily retrofitted in the future. The target outcome is that homes built in 2025 will emit 75% to 80% less carbon than those built to the 2014 Part L requirements[17]. The challenge will be to close the remaining gap to true zero carbon development.

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. If Welsh Government or the local authorities in CCR choose to bring this date forward, there will be a direct benefit in that the number of homes needing to be retrofitted by 2050 would be reduced.

Table 3: Scenario summary: domestic

Sector	Example outcomes Energy Vision scenario	Energy prize	Carbon saving potential
Domestic heat and energy efficiency	42,000 suitable houses accurately fitted with internal or	18% reduction in gross thermal energy demand	666 kt CO_2 (51% reduction)

[17] Welsh Government (2019) Welsh Government Consultation Document: Building Regulations Part L and F Review https://gov.wales/sites/default/files/consultations/2019-12/consultation-document-building-regulations-part-l-review.pdf

	external wall insulation. Over 185,000 other insulation measures in homes Over 140,000 heat pumps installed. Replacing heating systems in oil, LPG and solid fuel heated homes prioritised No gas in new homes from 2025, to avoid retrofitting at a later date	30% net decrease in domestic heating energy consumption, taking into account demand reduction and improved heat technology efficiencies, including the impact of heat pump performance.	

Our commercial and industrial energy consumption

Baseline: commercial and industrial

Industrial energy demand has decreased by 34% since 2005 and emissions have decreased by 49%. The greater reduction in emissions, compared to the reduction in energy demand, is largely due to the decarbonisation of the UK's electricity grid. This has been achieved through the increase of low carbon and renewable electricity generation, such as wind and solar PV, and the decrease of traditional fossil fuel plants, such as coal and gas. As noted above, due to data limitations some very large industrial energy users are not included in this analysis.

Cardiff Capital Region's commercial and industrial energy demand declined rapidly between 2005 and 2011, before levelling out

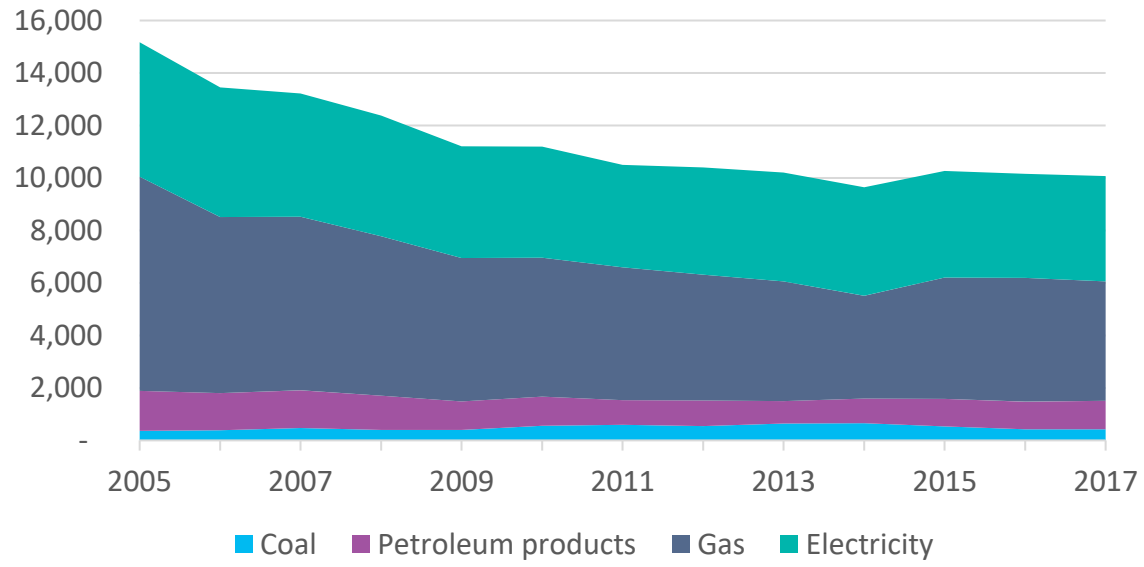


Figure 14: Cardiff Capital Region's historic commercial and industrial energy consumption, by fuel. Source: BEIS total final energy consumption (2019)

Energy Vision scenario: commercial and industrial

The Energy Vision scenario sets out a pathway to achieve a further 54% reduction in commercial and industrial emissions by 2035 through:

- A 13% decrease in energy demand through energy efficiency measures and electrification of heat and process demand
- Switching to low carbon fuels and heating, including electrification and some use of low carbon hydrogen in industrial processes
- Significant further decarbonisation of the electricity grid through renewable generation.

CCR's Energy Vision scenario includes a 13% decrease in commercial and industrial energy consumption by 2035

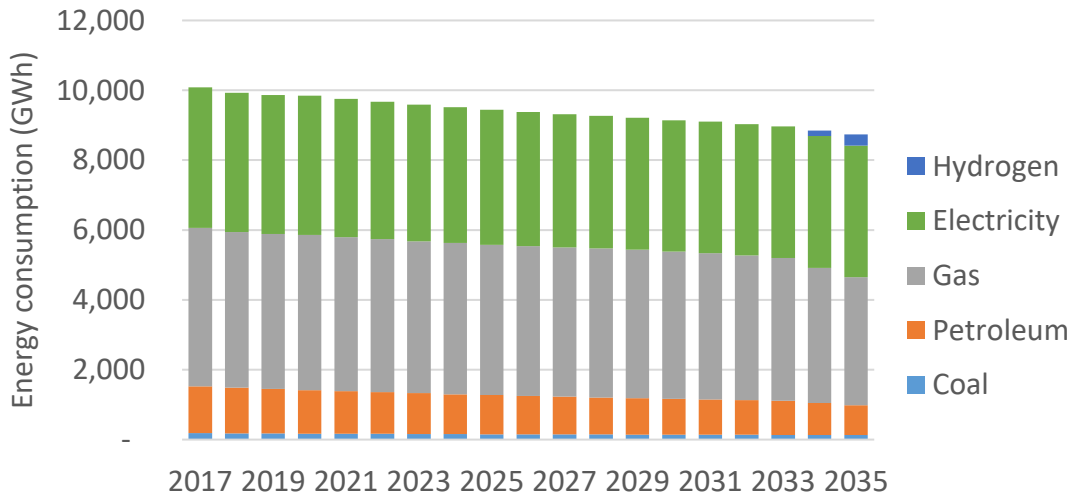


Figure 15: Energy Vision scenario commercial and industrial energy consumption, by fuel. Source: WGES analysis

Existing effort in this area can be built on, through the work of the South Wales Industrial Cluster (SWIC), which brings together a group of major industrial companies in CCR and other parts of South Wales to share knowledge, co-ordinate funding and collaborate on decarbonisation projects. It's focus areas include energy efficiency, carbon dioxide avoidance, the hydrogen economy, carbon capture, utilisation and storage (CCUS) and low carbon power generation.

Reaching a grid electricity average carbon intensity of 30gCO_2 per kWh[18] would in itself (with no additional demand reductions) achieve a 40% reduction in all commercial and industrial emissions in CCR, as shown in Figure 15. This very low electricity carbon factor would depend on significant installation of new low carbon generation capacity both in CCR and across the UK.

[18] Assumption based on Community Renewables and Two Degrees scenarios in National Grid (2019) *Future Energy Scenarios*, http://fes.nationalgrid.com/media/1409/fes-2019.pdf

Cardiff Capital Region's Energy Vision scenario results in a 51% decrease in commercial and industrial energy emissions by 2035, dependent in large part on decarbonisation of the electricity network.

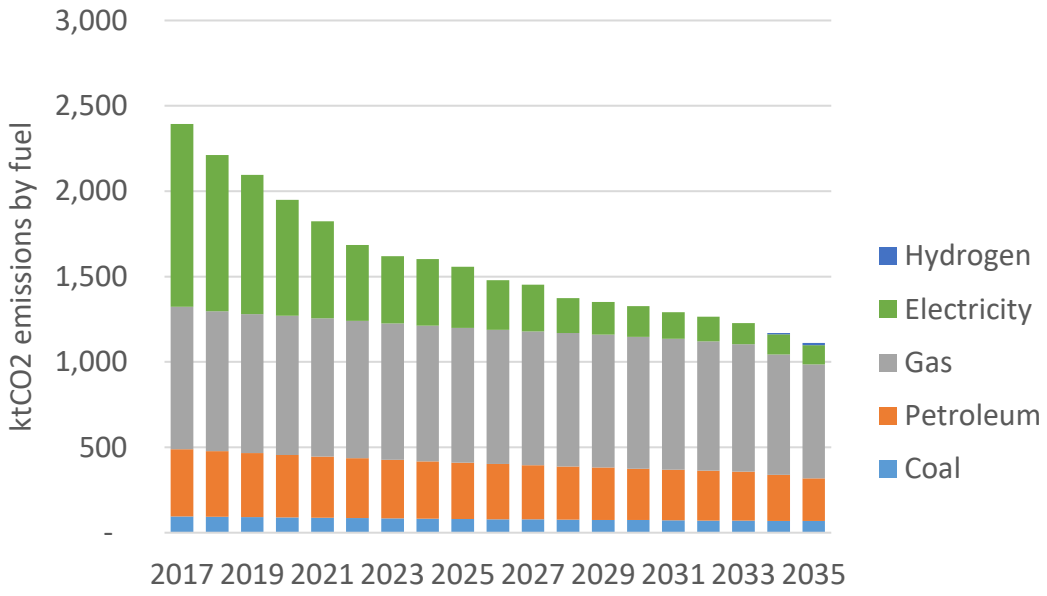


Figure 16: Energy Vision scenario commercial and industrial emissions estimates, by fuel. Source: WGES analysis

The future impact on energy utilities' networks and whole system decarbonisation in the CCR and beyond are beginning to be addressed through the Zero2050: South Wales initiative led by National Grid.

Use and production of hydrogen

Feedback from CCR stakeholders was that there is strong support for the region to lead the way on the development of hydrogen production, storage and use technologies. It is key to prioritise the use of hydrogen based on regional cost-effectiveness in the industrial sector before transport and then heating. Regen's (see **Box 1**) found that before 2035, under some scenarios, there could be some use of hydrogen in the region in industrial clusters. Based on stakeholder interest and detailed scenario analysis, the Energy Vision scenario assumes early hydrogen adoption, beginning with its use in industrial processes in a CCR cluster around 2033.

To achieve the region's net zero carbon ambitions, hydrogen should be produced either using excess renewable energy to power electrolysis or through other methods such as steam methane reformation with effective carbon capture and storage. To be viable for widespread hydrogen use, further pilots will be required to help with realising cost reduction and further technology development.

Research has already begun in this area in the region with the collaboration between the University of South Wales, Cardiff University and Swansea University for the FLEXIS project. The FLEXIS project, which has a demonstration area in Neath Port Talbot, includes work packages on hydrogen, syngas, BIOH2 and BIOH4, on subjects such as storage, sustainable production, efficient use and purification.

Table 4: Scenario summary: commercial and industrial

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	35% reduction in coal and petroleum energy consumption 19% reduction in gas consumption 4% of demand supplied by hydrogen through industrial clusters 6% reduction in electricity demand	1,284 kt CO_2 (51% reduction)

Our energy demand from transport

Baseline: transport

CCR has a high dependence on private cars for transport. Average annual vehicle miles in CCR are similar to those in other Welsh regions at 9,330 miles per car, 17% higher than the UK average[19]. Less than 1% of road miles are driven by buses and coaches in CCR[19].

The £738 million Metro project – the cornerstone of the £1.2billion City Deal - will create a credible mass transport infrastructure that is likely to drive a modal shift from private vehicle use to public transport.

To date, CCR has seen a slow 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. Similarly, despite a surge in charger installations in 2019, CCR currently hosts 173 public charging devices, including 31 rapid public chargers[20]. This is relatively low, as is the case across Wales, where there are half the number of public EV chargers per capita compared to Scotland.

Wales has significantly lower bus utilisation rates than England or Scotland

[19] DFT (2019) Road traffic statistics (TRA) https://www.gov.uk/government/collections/road-traffic-statistics and Regen transport model

[20] DFT (2019) Electric Vehicle Charging Device Statistics https://www.gov.uk/government/statistics/electric-vehicle-charging-device-statistics-october-2019

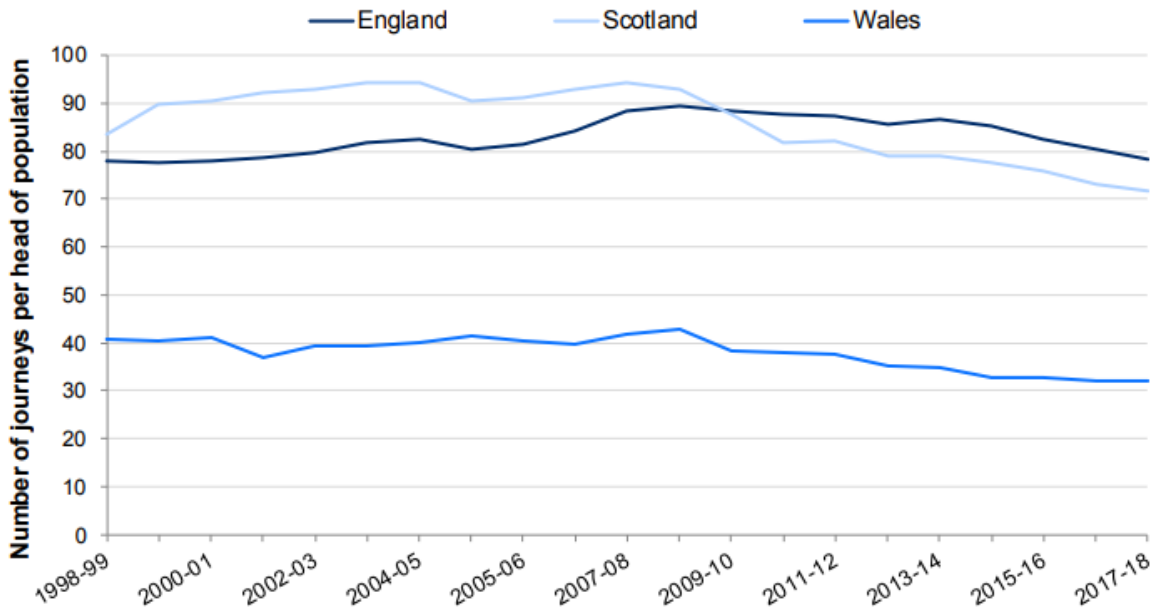


Figure 17: Passenger journeys per head on local bus services by country, 1998-2018. Source: Public service vehicles statistical bulletin, 2019

Energy Vision scenario: transport

Achieving a 60% reduction in transport emissions by 2035 is a significant challenge for Cardiff Capital Region with its high dependence on private vehicles. The Energy Vision scenario assumes:

- 64% of vehicles driven in Cardiff Capital Region in 2035 are electric, with the ban on fossil fuel vehicle sales brought forward to 2030.
- A 20% 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 and active travel.

The reduction in private vehicle mileage was originally set at 15%. However, feedback from stakeholders in the region was that the urban environment and projects such as the current Metro and Metro Plus projects should inspire the region to aim for a greater percentage reduction. The reduction in transport-related emissions due to the changing way businesses have operated during the lockdown caused by COVID-19 provides a tremendous opportunity to permanently reduce travel emissions if these new working practices are sustained post COVID-19. It should also be noted however that forecasts undertaken over the last couple of years (pre-COVID-19) by Transport for Wales (TfW) using their SE Wales Transport Model indicates that even sizeable percentage uplifts in public transport usage results in only minor percentage reductions in private car mileage due to the sheer number of car journeys that already take place. The effects of making all public transport in SE Wales free to use were modelled and it was found that by 2026 this would more than double bus use, triple rail use, but have only a 6% reduction in private car use. Thus, a reduction in private car mileage is not only dependent on increases in public transport facilities and usage, but will also requires significant behavioural change.

Cardiff Capital Region's Energy Vision scenario requires a significant decrease in the number of petrol and diesel vehicles

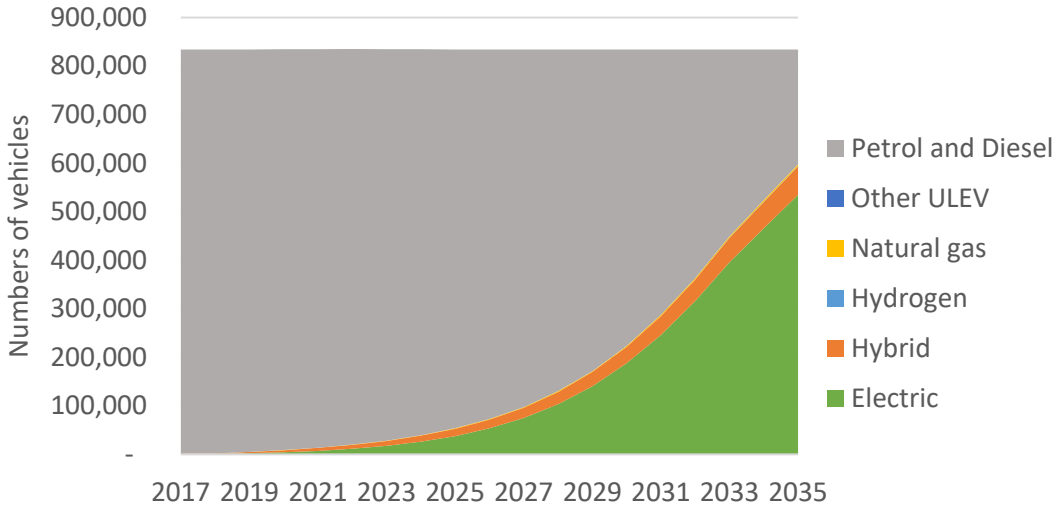


Figure 18: Cardiff Capital Region's Energy System Vision road vehicle numbers, by vehicle fuel. Source: WGES analysis

Cardiff Capital Region's Energy Vision scenario results in road transport emissions reducing by around 60%

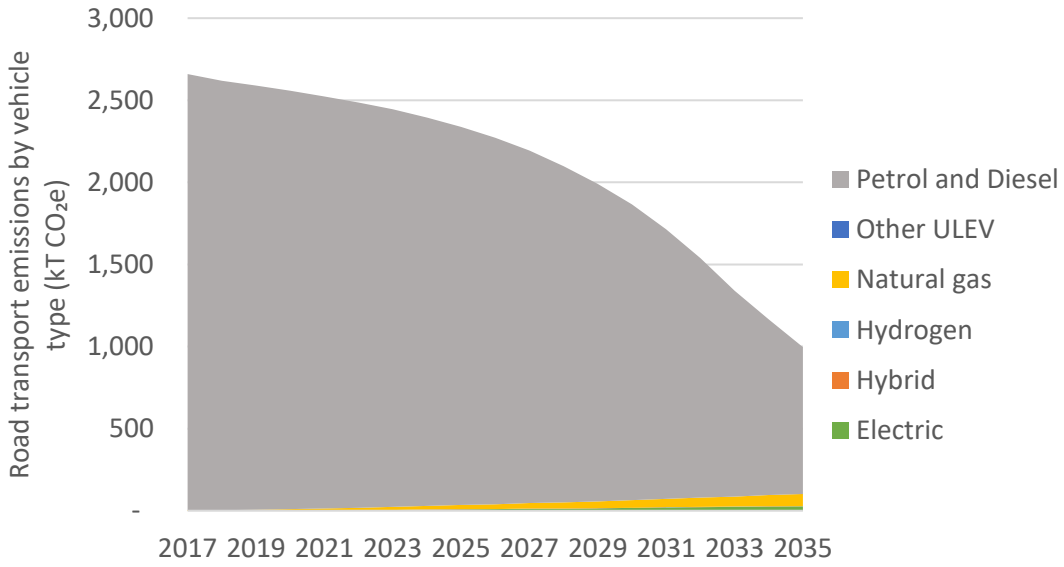


Figure 19: Energy System Vision road vehicle emissions, by vehicle fuel. Source: WGES analysis

Table 5: Summary: Transport

Sector	Example outcomes Energy Vision scenario	Energy prize	Carbon saving potential
Road transport	516,000 electric cars 3,300 gas and hydrogen HGVs 1,000 hydrogen vehicles 10,000 public and on-street EV chargers 20% reduction in private vehicle mileage	6.7 TWh reduction in petrol and diesel energy consumption 1.4 TWh increase in electricity consumption	1,606 kt CO_2 (60% reduction)

Achieving these outcomes requires 15,000 EV sales per year by the mid-2020s, peaking at 70,000 per year in the 2030s before reducing to 60,000 per year. Peak sales of fossil-fuelled cars in Cardiff Capital Region have historically reached 70,000 per annum[21]. Additional support, such as a scrappage scheme alongside a 2030 ban on new fossil-fuelled car sales[22], would be needed to retire some fossil-fuelled vehicles earlier than their average lifespan, in order to achieve a peak of 70,000 EV sales per year in the 2030s.

This level of EV sales will also require a supportive, area-wide EV charging network. Similarly, the switch to gas and hydrogen heavy goods vehicles and buses is reliant on the fuelling infrastructure being in place.

Baseline and modelling results: Electricity

Our annual electricity demand

Baseline: annual electricity demand

Annual electricity demand in CCR is currently approximately 6.2 TWh[23]. It has fallen steadily since at least 2005, when electricity demand was nearly 7.6 TWh[23], as a result of efficiency improvements and deindustrialisation.

Commercial and industrial electricity consumption constitutes 55% of all electricity consumption, approximately 10 percentage points less than the Welsh and GB average. Almost all of the remaining electricity demand is used in domestic buildings

[21] DFT (2019) Road traffic statistics (TRA) https://www.gov.uk/government/collections/road-traffic-statistics and Regen analysis

[22] 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.

[23] BEIS (2019) Regional and local authority electricity consumption statistics 2005 to 2018, https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics

and appliances. The Energy Vision includes ambitious uptake of renewable energy, including on-site generation, in order to contribute to the UK's decarbonised electricity supply.

Energy Vision scenario: annual electricity demand

The scenario projection shows an overall net increase in annual electricity demand in CCR of 10% by 2035, compared to 2017. Increased energy efficiency measures and appliance efficiency lead to a continued decrease in the 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.

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

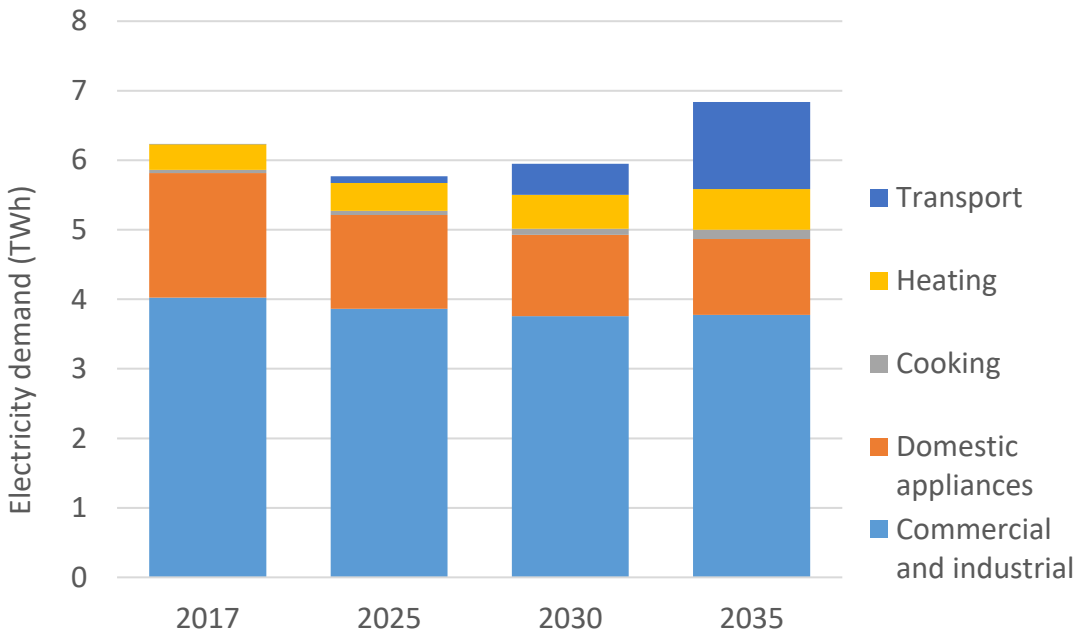


Figure 20: Cardiff Capital Region's Energy Vision scenario demand by sector. Source: WGES analysis

Our electricity generation

Baseline: electricity generation

Cardiff Capital Region hosts 311 MW of solar PV and 299 MW of onshore wind

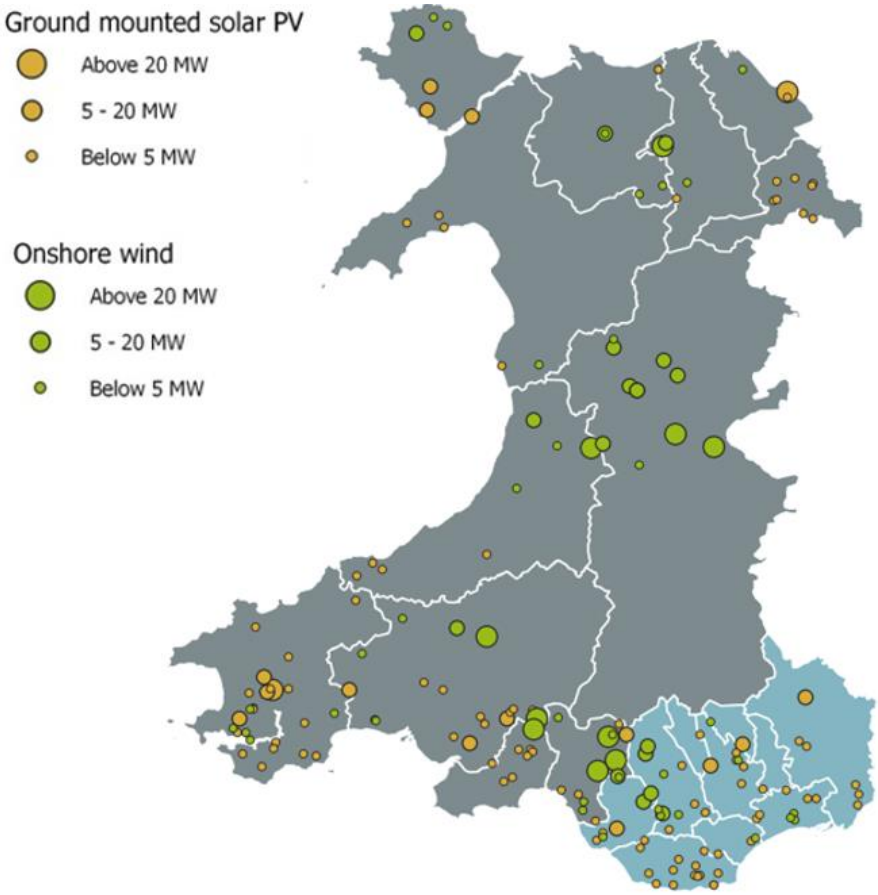


Figure 21: Solar PV and onshore wind projects (>1MW) currently generating in Wales. Source: BEIS Renewable Energy Planning Database, 2019

In 2019 there was a total of 709 MW of installed renewable electricity capacity in the region, with 221 MW of this locally owned[24].

Renewable electricity generation in CCR is mainly from onshore wind and solar PV. Solar PV has a relatively high installed capacity with 311 MW, but, due to a lower capacity factor, provides around 18% of renewable electricity generation in the region.

Cardiff Capital Region hosts approximately 40% of the Pen y Cymoedd wind farm, the largest wind farm in England and Wales. This project and nearly 90 others contribute to onshore wind currently generating 50% of the Cardiff Capital Region's renewable electricity generation.

[24] See Welsh Government (2019) Energy Generation in Wales, 2018 https://gov.wales/sites/default/files/publications/2019-10/energy-generation-in-wales-2018.pdf for definition of locally ownership.

The majority of the remaining renewable electricity generation in the region is made up of energy from waste, anaerobic digestion and biomass electricity/CHP projects.

Table 6: Current renewable energy generation in the region

Technology type	2018 Number of projects	2018 installed capacity (MW)	2018 Estimated annual generation (GWh)
Anaerobic digestion	10	9	48
Biomass electricity and CHP	13	42	245
Energy from Waste	1	30	125
Hydropower	25	1	2
Landfill gas	9	13	47
Onshore wind	91	299	770
Sewage gas	2	4	16
Solar PV	22,063	311	294
Total	22,214	709	1,549

50% of renewable generation in CCR is from onshore wind projects

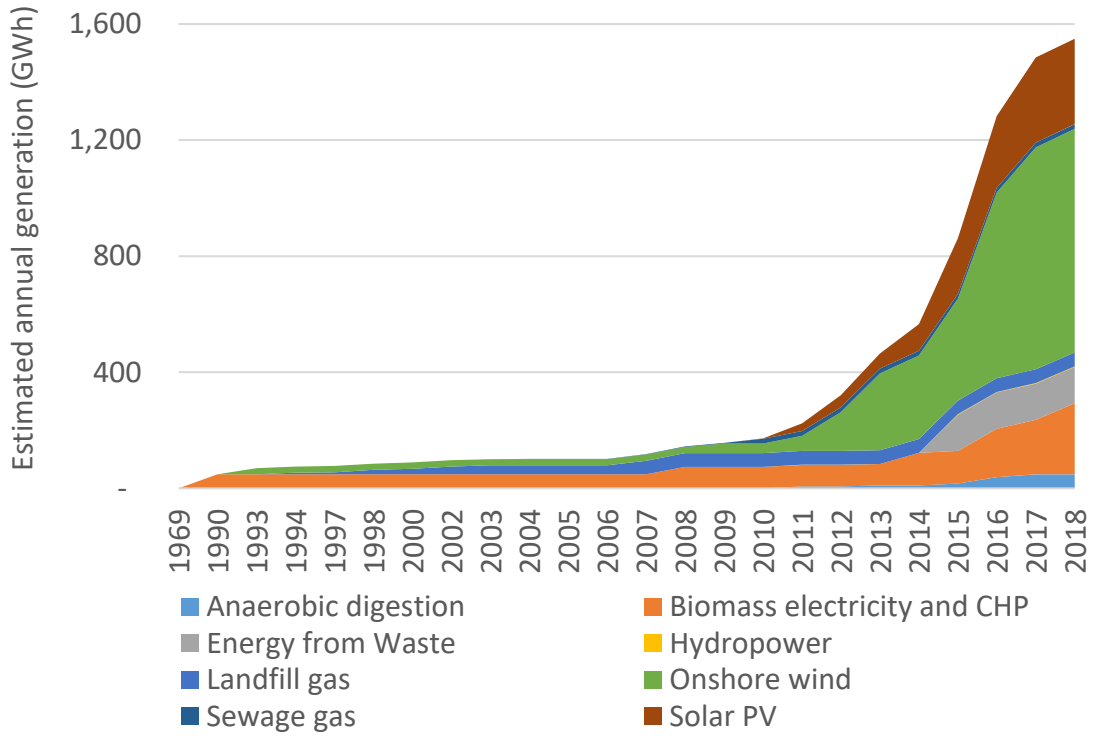


Figure 22: Cardiff Capital Region's renewable electricity generation trends 2008-2018. Source: WGES analysis, Energy Generation in Wales 2018

CCR hosts around a quarter of Wales' onshore wind capacity and a third of solar PV capacity.

Cardiff Capital Region hosts 22% of current Welsh renewable electricity capacity

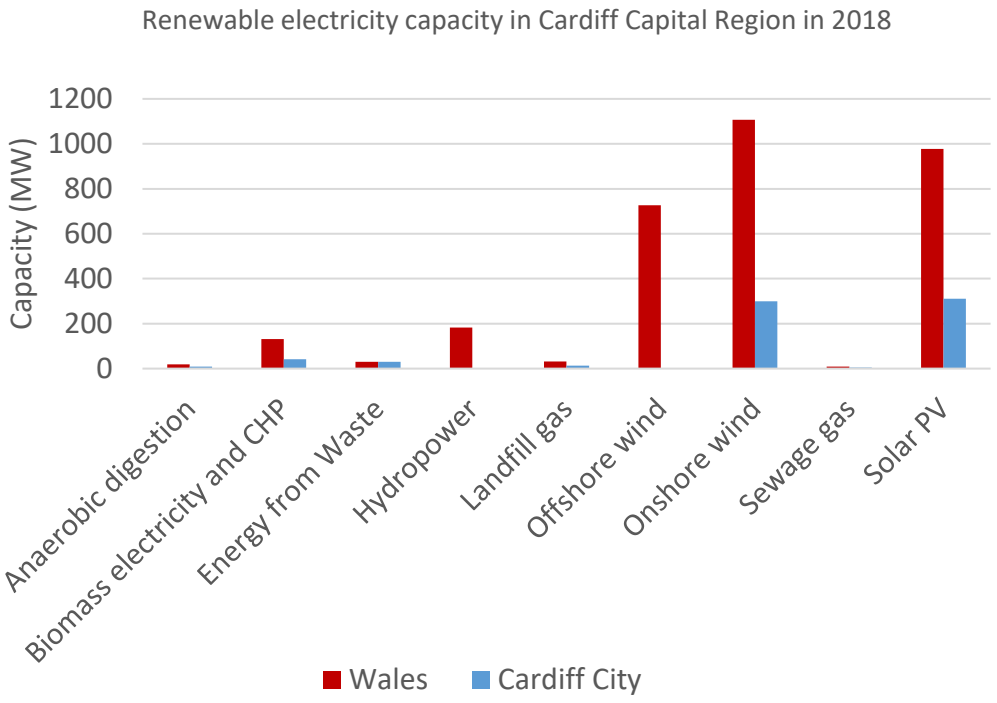


Figure 23: Renewable electricity capacity in Cardiff Capital Region, 2018. Source: WGES analysis, Energy Generation in Wales 2018

Cardiff Capital Region currently generates the equivalent of 25% of its electricity consumption from local renewable sources

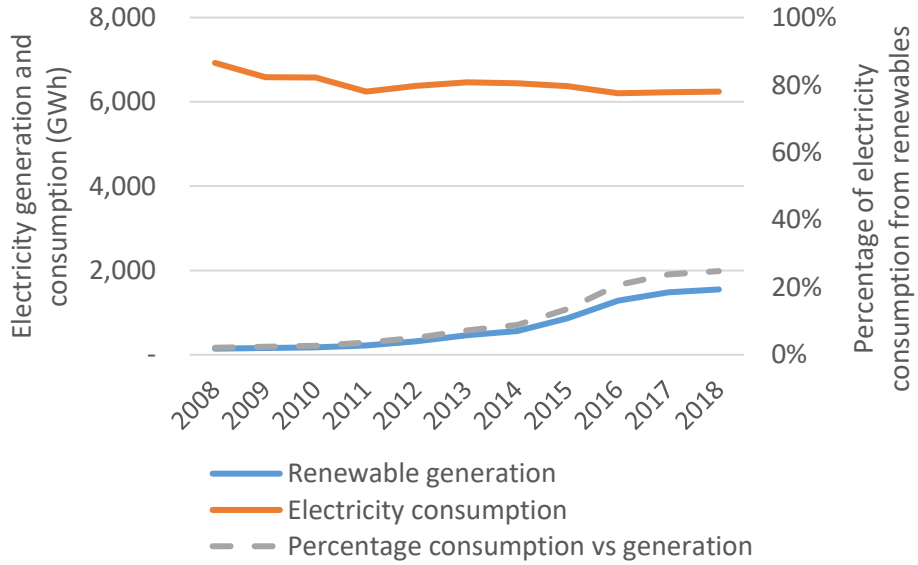


Figure 24: Percentage of electricity consumption from renewables in Cardiff Capital Region. Source: WGES analysis, Energy Generation in Wales 2018

Energy Vision scenario: electricity generation

Stakeholders engaged through the workshops for CCR were keen for the region to increase the amount of renewable electricity that is generated in the region. Compared to the other regions of Wales, it will be more challenging to exceed the equivalent regional annual consumption, with renewable electricity generation, due to the higher population base and lower availability of renewable resources.

As a result, the Energy Vision scenario includes the ambition that the region generates the equivalent of approximately 50% of its total energy consumption in 2035 from regional renewable sources. This figure is less ambitious than 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[25]. Potential benefits to the region in addition to supporting decarbonisation 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. This would also support Welsh Government's target to have 1GW of renewable electricity and heat capacity in Wales to be locally owned by 2030, and for all new energy projects to have at least an element of local ownership from 2020[26]

Box 4: 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. Cardiff Capital Region has the natural resources and the ambition to play an increased role in delivering renewable energy deployment.

[25] This Energy Vision projection does not include a Cardiff or Newport Tidal Lagoon project.

[26] https://gov.wales/sites/default/files/publications/2020-02/policy-statement-local-ownership-of-energy-generation-in-wales.pdf

To enable Cardiff Capital Region to meet the equivalent of 50% of its 2035 electricity consumption from local renewables requires a significant increase in generation and efficiency savings to offset new sources of electricity demand

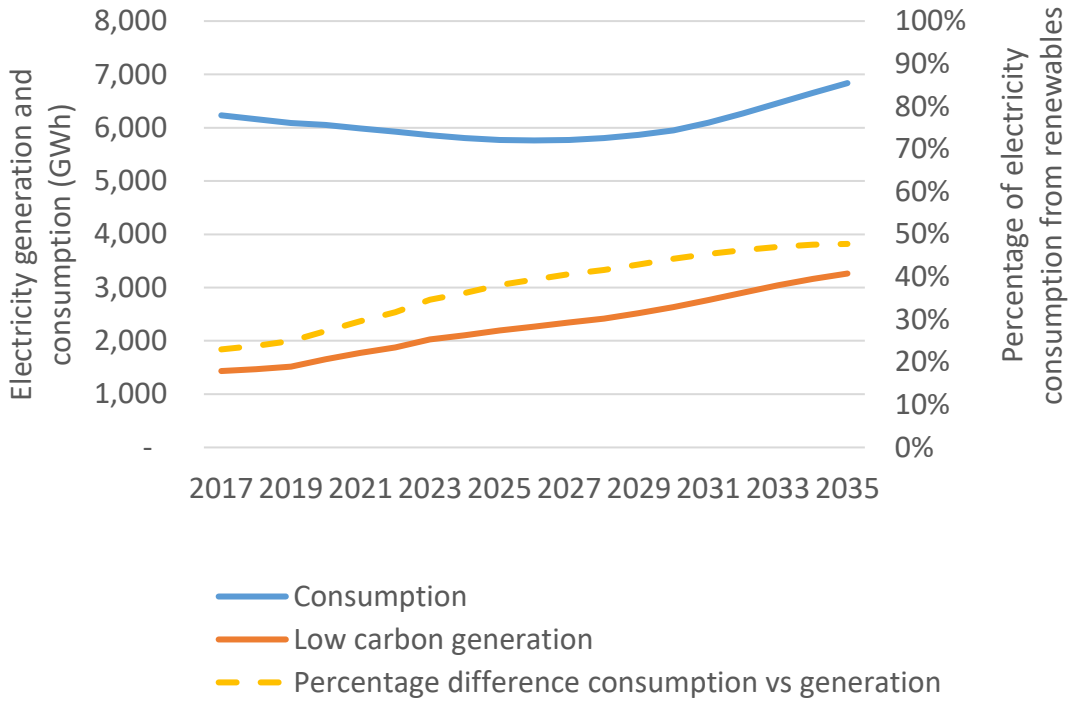


Figure 25: CCR's Energy Vision scenario electricity consumption vs low carbon generation. Source: WGES analysis

Figure 25 shows one pathway to achieving this level of electricity generation in the region.

Onshore wind and solar PV are the main electricity generating technologies focussed on in Cardiff Capital Region's Energy Vision scenario

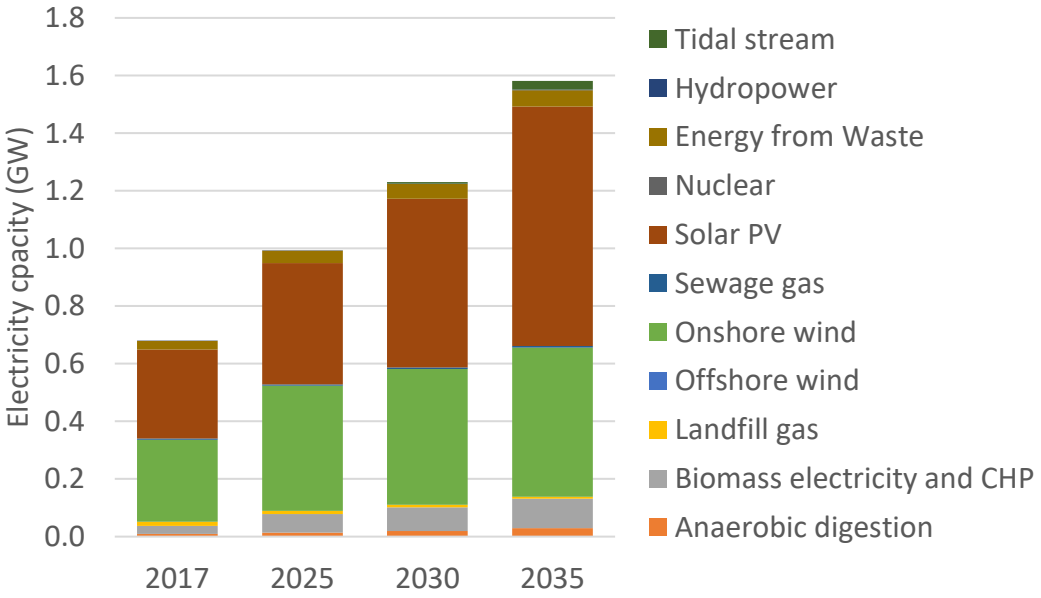


Figure 26: Renewable energy capacity increases under Cardiff Capital Region's Energy Vision scenario. Source: WGES analysis

Onshore wind

The Energy Vision scenario includes an increase in onshore wind capacity of 233 MW. This is a relatively small proportional increase, due to a lack of available sites, primarily due to the urban nature of the region. The capacity increase is made up of:

- a small number of projects currently in development
- new projects in the existing Strategic Search Area F (SSA)
- new projects in Priority Areas as designated in the National Development Framework (NDF) consultation
- new projects (made up of small numbers of large turbines) outside of areas designated by the NDF and SSAs
- and a number of small to medium-scale farm or community projects.

CCR's Energy Vision includes an increase in onshore wind capacity of over 70%

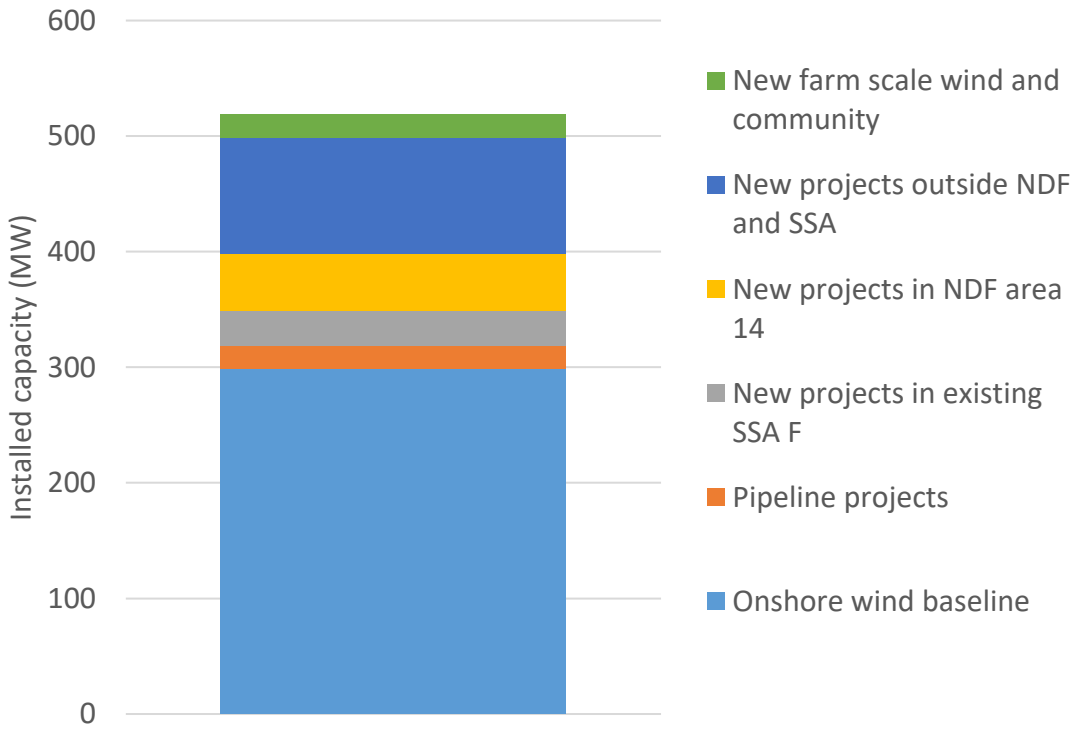


Figure 27: CCR's Energy Vision scenario for onshore wind. Source: WGES analysis

Solar PV

The Energy Vision scenario includes 0.5 GW of new solar PV, with 190 MW on rooftops and 325 MW from solar farms. 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

Stakeholder input and additional expert research suggested that, despite support and interest, a tidal lagoon project would be unlikely to be developed in the region by 2035 and its inclusion in the Energy Vision could mask the need to focus on other technologies.

Tidal power in the form of a barrage, lagoons or tidal stream continues to receive support in South Wales, with the potential Swansea Bay project (in the neighbouring region) and similar related projects investigated off Newport and Cardiff. Support for a tidal lagoon project is also highlighted within the CCR strategic business plan.

The Swansea tidal lagoon received significant commercial and public interest and was granted a development consent order in 2015[27]. But despite the interest in the area, to date there has been limited progress.

The Newport and Cardiff tidal lagoons are both potential projects in the pre-application stage of the National Infrastructure Planning register; however, no progress has been recorded on the register for either site since 2017[28]. Innovation is still required in this sector to reach a level of economic viability seen by other renewable energy technologies.

For tidal stream, the resource in the CCR area is limited and there are no projects in development in the public domain. Better tidal stream resource has been identified in Pembrokeshire and around Anglesey. The highest velocity tidal stream resource in the CCR region is near to Aberthaw in the Vale of Glamorgan. However, there are issues with the velocity at these sites being both marginal and/or unidirectional, meaning there is a better flood or ebb flows but not both. In addition, the best resource is in the main shipping lane, with limited options to divert shipping due to shallow waters either side[29].

Network infrastructure

At present there are significant network constraints on the transmission network in the licence area that supplies CCR. As a result, there is an embargo on controllable generators that run at peak times connecting to the Western Power Distribution (WPD)

[27] Planning Inspectorate (2020) National Infrastructure Planning https://infrastructure.planninginspectorate.gov.uk/projects/wales/

[28] National Infrastructure Planning register https://infrastructure.planninginspectorate.gov.uk/

[29] Welsh Assembly Government (2011) Marine renewable Energy Strategic Framework https://gov.wales/sites/default/files/publications/2019-09/marine-renewable-energy-strategic-framework-technical-addendum.pdf

network in the South Wales licence area. This doesn't affect onshore wind, solar or generators under 1 MW, but does affect the deployment of battery storage, gas generation, energy from waste and bio-energy that generates electricity.

It is possible that a system of Active Network Management on the distribution system could manage the constraint with a non-investment solution or equally the constraint may worsen and the embargo would continue. WPD are exploring whether exemptions to this embargo can be made for storage projects.

WPD's network capacity map shows significant further constraints for generation and demand customers across the region[30]. One method of working around network constraints would be through local flexibility and alternative connection agreements. The current embargo on connecting battery storage over 1 MW presents a barrier to some aspects of flexibility.

Storage and flexibility

Cardiff Capital Region hosts one of Wales' first large scale batteries, The Parc Stormy 4 MW/4.8 MWh storage project that came online in February 2018 and provides Firm Frequency Response (FFR) to the National Grid. Smaller-scale commercial behind the meter projects are known to be hosted in the region, in addition to tens of domestic battery projects[31].

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 Cardiff Capital Region 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.

Table 7: Summary: 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 532 MW of onshore wind (233 MW of new capacity)	Generating the equivalent of over 50% of electricity consumption in 2035	Contribution towards reduction in UK grid carbon factor

[3030] WPD (2020) *Network capacity map* https://www.westernpower.co.uk/our-network/network-capacity-map/

[31] Welsh Government (2019) *Energy Generation in Wales*

	830 MW solar PV (520 MW of new capacity)		

Summary

Under a Business as Usual scenario, CCR is expected to achieve only 26% decarbonisation by 2035, approximately half of 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 CCR

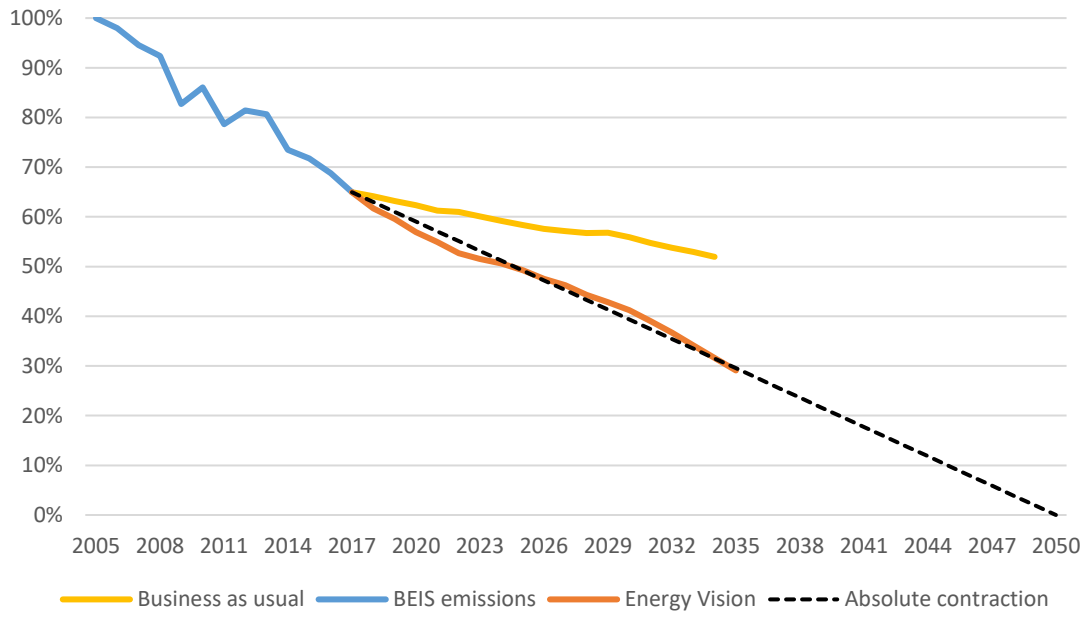


Figure 28: Decarbonisation trajectories in Cardiff Capital Region. Source: WGES analysis

The Energy Vision scenario focuses on known, deployable technology and behavioural change to 2035. Based on National Grid's 2019 Future Energy Scenarios[32] and the Committee on Climate Change[33], the scenario prioritises "clear, urgent, no regrets" actions. Table 1 summarises the results of the modelling, setting out key example outcomes to be achieved by 2035. Potential initial actions to set the region on course to achieve these outcomes are explored in the CCR 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. The delivery plan includes consideration for some of the longer-term issues raised,

[32] National Grid (2019) *Future Energy Scenarios*, http://fes.nationalgrid.com/media/1409/fes-2019.pdf
[33] Committee on Climate Change (2019) 2019 Progress Report to Parliament https://www.theccc.org.uk/publication/reducing-uk-emissions-2019-progress-report-to-parliament/

such as supporting research and development on hydrogen generation and use through the region's universities and heavy industries.

Table 8: Summary of Energy Vision scenario modelling results

Sector	Example outcomes Energy Vision scenario	Energy prize	Carbon saving potential
Domestic heat and energy efficiency	• 42,000 houses fitted with internal or external wall insulation • Over 185,000 other insulation measures in homes • Over 140,000 heat pumps • Replacing heating systems in oil, LPG and solid fuel heated homes prioritised • No gas in new homes from 2025, to avoid retrofitting at a later date	• 18% reduction in gross thermal energy demand • 30% net decrease in domestic heating energy consumption, taking into account demand reduction and improved heat technology efficiencies, including the impact of heat pump performance.	666 kt CO_2 (51% 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	• 35% reduction in coal and petroleum energy consumption • 19% reduction in gas consumption • 4% of demand supplied by hydrogen through industrial clusters • 6% reduction in electricity demand	1,284 kt CO_2 (51% reduction)
Road transport	• 260,000 electric cars • 2,600 gas HGVs • 1,000 hydrogen vehicles • 2,000 public EV chargers • 20% reduction in private vehicle mileage	• 3.2 TWh reduction in petrol and diesel energy consumption • 0.6 TWh increase in electricity consumption	660 kt CO_2 (55% reduction)
Flexibility and renewable generation	• Sufficient flexibility, including storage, and network infrastructure upgrades to enable low carbon generation and	• Generating the equivalent of over 50% of electricity consumption in 2035	Contribution towards reduction in UK grid carbon factor

	demand technologies to connect • 532 MW of onshore wind (233 MW of new capacity) • 830 MW solar PV (520 MW of new capacity)		

The future of energy and our economy

Economic Assessment

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 heat our homes, generate our electricity, and produce our energy will also affect the economic landscape. Examples of these effects include:

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

We have built on the scenario modelling described in the previous chapter to try to better understand the impact on net job creation and gross value added. Additionally, we have estimated the level of investment required to achieve the scenarios. The impacts that 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 energy prices are not included in analysis. Where possible, we have sought to estimate the specific changes to the Cardiff Capital Region economy.

Approach

We have used an indicator-based approach to estimate job creation, gross value added, and investment. This involves using literature reviews to identify the most appropriate estimates such as jobs/MW, or GVA/employee. Subsequently, these indicators are applied to the results of the energy 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: 1) transport and 2) commercial and industrial energy efficiency. The transport sector was excluded because 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 frequently assumed that 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 because 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 refers 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 related to jobs generated as a result of spending incomes earned from direct employment. Figure 29 below visualises these concepts.

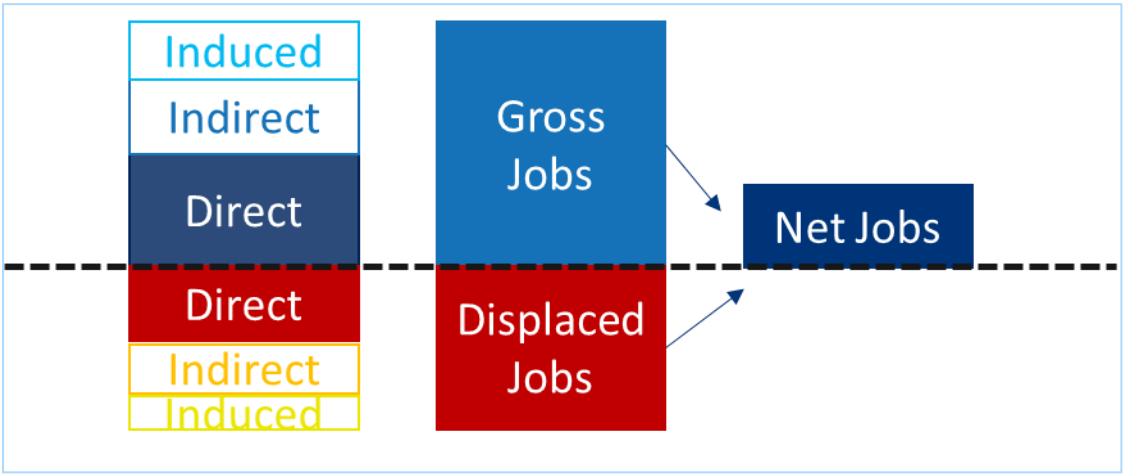


Figure 29. Shows the relationship between gross, displaced, and net jobs. Indirect direct and induced jobs are also shown. Indirect and induced jobs have not been filled with colour because these jobs are not taken into account in this analysis. [34]

Throughout this analysis we only calculate direct jobs, as depending on the area of decarbonisation, these are more likely to be 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 the Cardiff Capital Region; other jobs may be held by those who travel into the region to perform their roles.

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

Electricity generation

The results from assessing the economic impact related to the change in energy generation technologies estimate that achieving the energy system vision scenario will require nearly £750 million of additional investment, equivalent to approximately £50 million per year, compared against the business as usual scenario. This spending 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 7,400 additional annual jobs and contribute nearly £850 million more in GVA than the business as usual scenario between 2020 and 2035. The location of these additional jobs is an important question and a difficult one to answer with a precise number. Construction, operation and maintenance jobs will occur locally – however manufacturing jobs may occur inside of outside of the region. Likewise, persons could travel into the region to provide operational support while being based elsewhere. Ultimately, a portion of the jobs figures presented are likely to be located within the Cardiff Capital Region however other jobs will be held by persons resident outside of the region. In order help the region benefit from jobs associated with future local electricity generation it will be important to fist understand the reason why operation and maintenance jobs may be located outside of the region in order to develop a policy response.

Table 9 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. Similarly,Table 10 summarises the additional investment, jobs, and GVA associated with the Energy System Vision (ESV) scenario.

Table 9 BAU and ESV economic impact2020- 2035[35]

Scenario	Gross Jobs including losses*	Average annual jobs including losses*	Discounted GVA	Discounted Investment
Business as usual (BAU)	32,737	2,182	4,110,777,412	£366,128,354
Energy system vision (ESV)	40,166	2,678	4,964,582,623	£1,114,348,193
**Gross and annual 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. Non-manufacturing direct electricity generation jobs are typically more likely to be held by residents local to an energy site. The experience of Wales to date is that many of the long term operational and maintenance jobs associated with these technologies are held my persons outside of the region who travel into Wales to perform their duties.*				

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

Table 10. Difference between the ESV and BAU scenarios 2020-2035[36]

Scenario	Net Jobs	Discounted GVA	Discounted Investment
Difference between ESV and BAU	7,429	853,805,211	£748,219,839
Difference between ESV and BAU (percentage)	23%	21%	204%

Investment

In terms of investment, the energy system vision scenario requires additional investment associated with the amount of new electricity generation included in the scenario, as well as the specific technologies involved. Onshore wind, solar PV, energy from waste, and biomass electricity and CHP each are related with approcimately 1/5th of the additional investment required to achieve the energy system vision. Figure 30 shows the breakdown of the additional estimated investment required by technology area to achieve the energy system vision scenario compared with the business as ususal scenario.

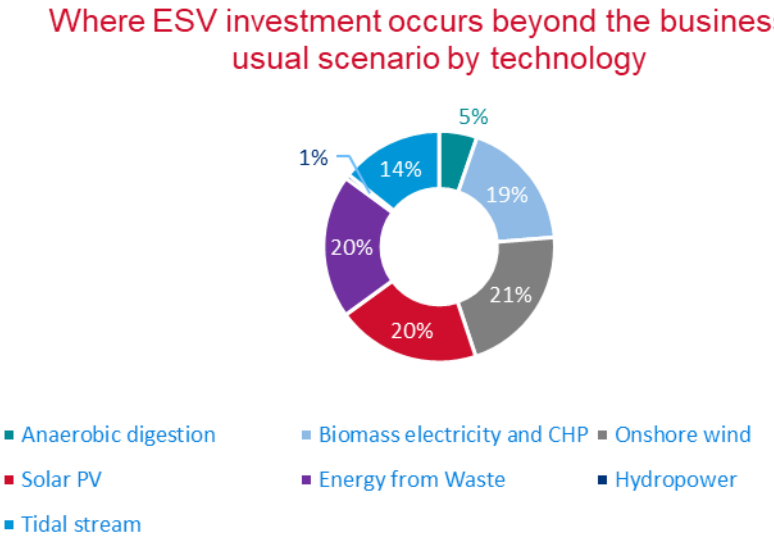


Figure 30 Where ESV Investment occurs beyond the BAU scenario by technology

Jobs

The jobs figures presented in table 6 include both the jobs associated with increases in capacity and output from some generation technologies (for example solar PV) as well as the fact that some jobs will be lost as the capacity and output from fossil-fuel

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

based generation technologies falls. The breakdown of jobs required in the energy system vision scenario is visualised on an annual basis in Figure 31 below.

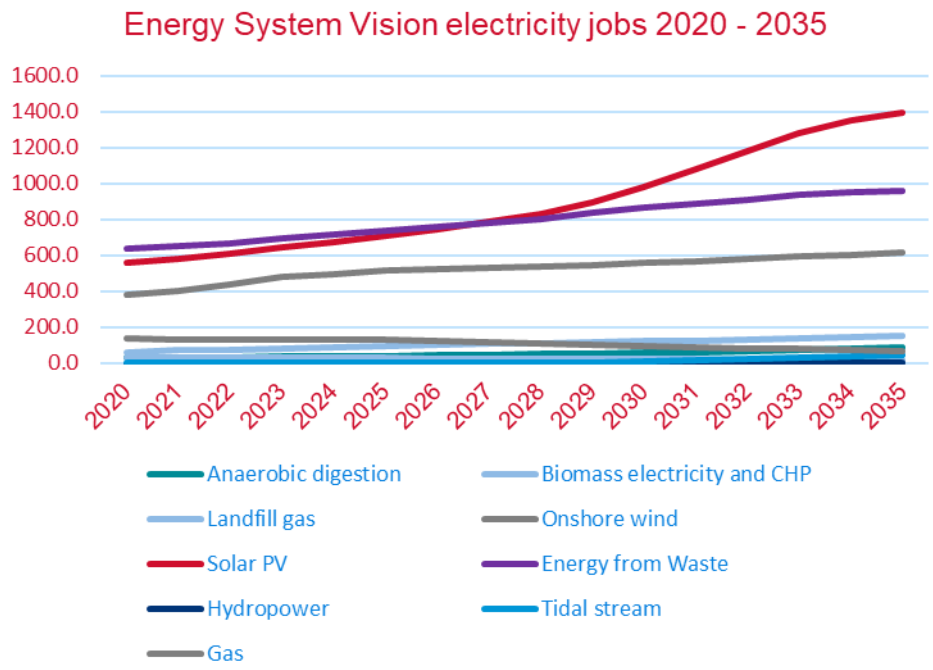


Figure 31. ESV Gross Jobs including job losses

It is estimated that in the energy system vision scenario electricity generation is responsible for 40,166 direct gross jobs from 2020 to 2035. This represents an average of 2,678 jobs per year. The number of annual jobs related to this scenario changes over the 2020 - 2035 as the deployment of technologies change. For example, in 2020 the energy system is estimated to support 1,821 jobs of which 133 are related to gas powered generation. Of renewable jobs in 2020, energy from waste is related to the largest number of jobs at approximately 634. By 2035, we estimate that the energy system vision scenario will support 3,323 jobs of which only 66 relate to gas generation. By 2035, solar PV requires the largest number of renewable jobs with 1,393 jobs or ~42% of the total jobs in that year.

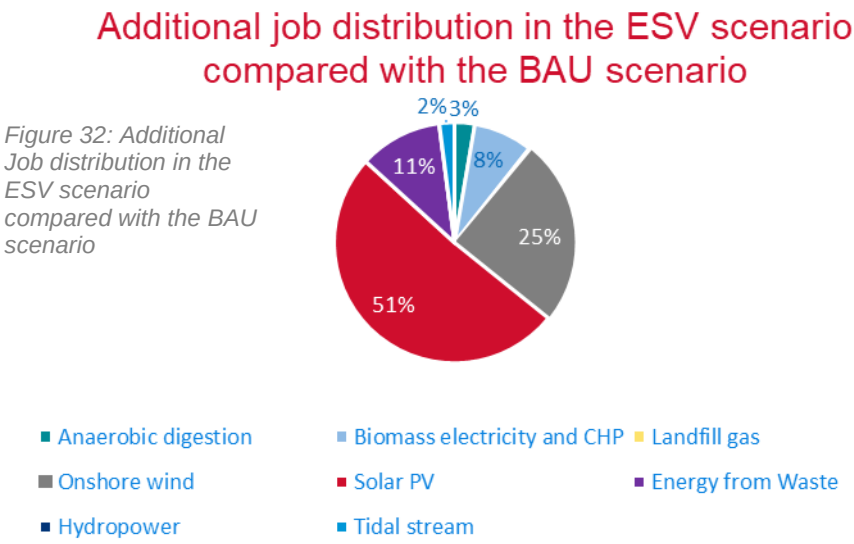


Figure 32: Additional Job distribution in the ESV scenario compared with the BAU scenario

Figure 32 looks at which technologies in the energy vision scenario supports additional jobs in comparison with the business as usual scenario. The difference between the two scenarios (known as net jobs) represents the net additional jobs supported by the energy system vision in comparison with the business as usual. Solar PV represents that largest difference in jobs between the two scenarios, followed by onshore wind and energy from waste.

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 11.

Table 12 shows that the energy system vision requires approximately 1.6 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 11. Domestic Energy Efficiency additional economic impact of the ESV scenario compared with the BAU scenario from 2020 -2035[37]

Scenario	Net jobs	Discounted GVA	Discounted Investment
Business as usual (BAU)	21,900	£1.3b	£4.6b
Energy system vision (ESV)	31,300	£1.9b	£6.5b
Difference between ESV and BAU	9,300	£600m	£2b
Difference between ESV and BAU (percentage)	43%	43%	43%

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

* Figures are rounded.
** Net jobs figures do not include estimations of operation and maintenance jobs associated with the energy efficiency improvements.

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 33.

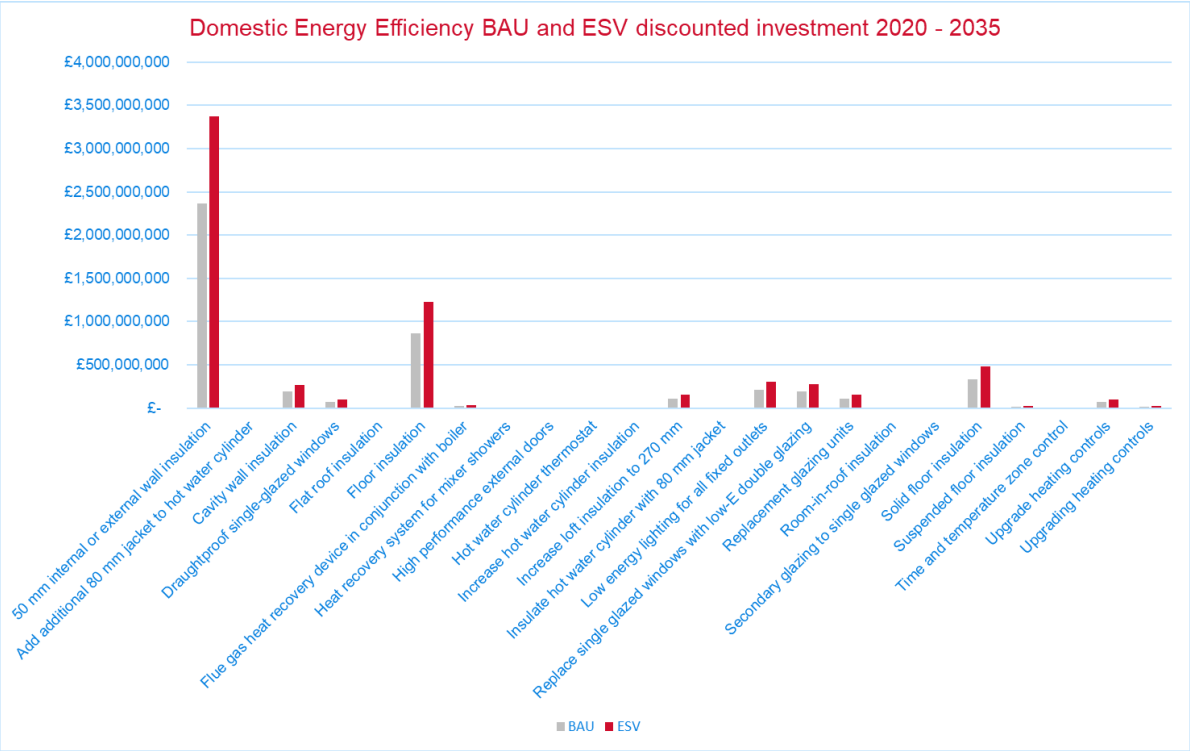


Figure 33. BAU and energy efficiency Investment requirements 2020- 2035

Jobs

9,300 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 jobs.

The majority (52%) of the additional jobs in the ESV scenario relate to installation of 50 mm internal or external wall insulation and 20% of jobs relating to floor insulation. Figure 34 below show the estimated jobs required to implement the energy efficiency measures that relate to the EPC shift in the BAU and ESV scenarios.

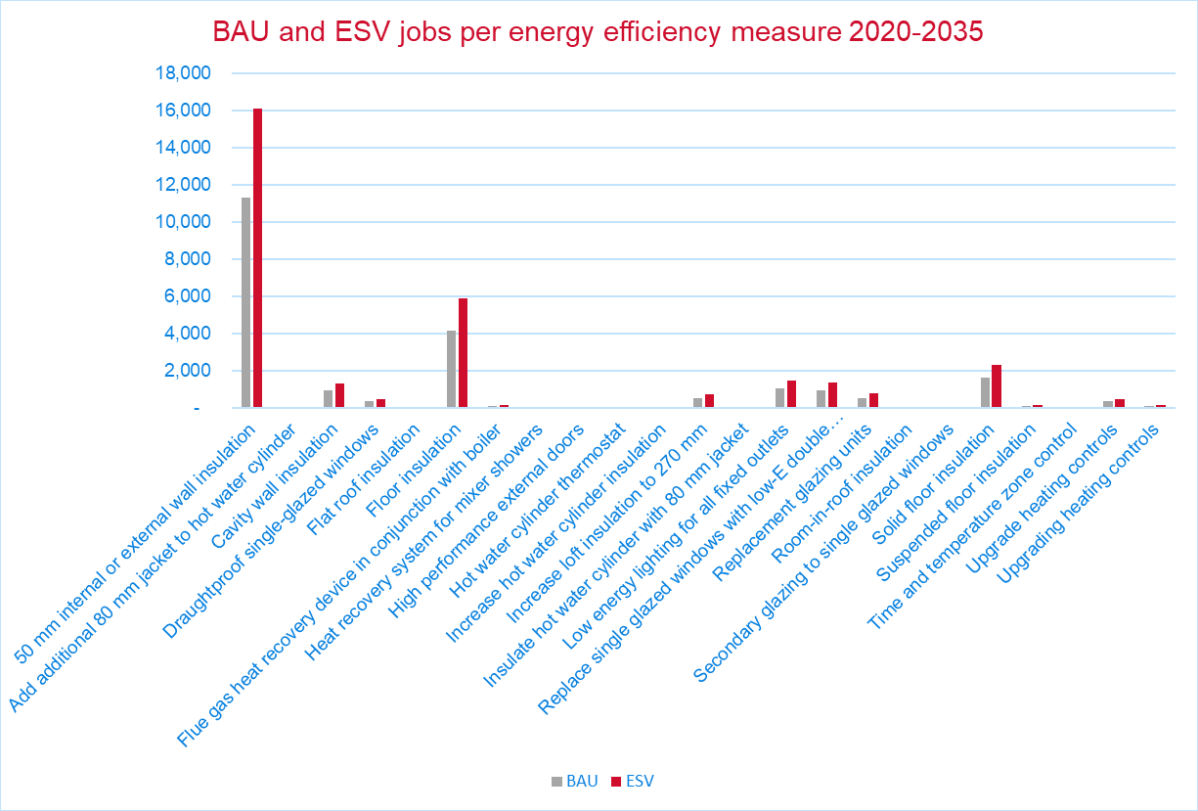


Figure 34. Net BAU and ESV jobs per energy efficiency measure 2020 – 2035.

Domestic heat

For domestic heat, we estimate that the energy system vision scenario has a larger economic impact than the business as usual scenario when it comes to investment and GVA. For example, the GVA related to the energy system vision scenario is 320 percent greater than the BAU. Similarly, the energy system vision scenario requires nearly triple the level of investment compared with the business as usual scenario. The ESV scenario also requires more jobs related to low carbon heating. However, a lack of data on jobs associated with traditional heating technologies means a comprehensive comparison in the jobs impacts from the switch to low-carbon heating technologies is not possible. Table 12 below summarises the economic impact of both scenarios and also shows the difference between the scenarios. A comparison of the investment required in the BAU scenario and the ESV scenario is presented in Figure 35.

Table 12. BAU and ESV economic impact as well the difference between ESV and BAU economic impact 2020-2035[38]

Scenario	Gross jobs associated with low carbon heating*	Discounted GVA associated with all heating technologies	Discounted Investment associated with all heating technologies

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

Business as usual (BAU)	966	112,904,278	£253,448,346
Energy system vision (ESV)	3,971	474,208,575	£954,916,917
Difference between ESV and BAU	3,005	361,304,297	£701,468,570
Difference between ESV and BAU (percentage)	311%	320%	277%
*For domestic heat it is more difficult to link jobs to the local economy. This is because energy efficiency jobs are related to the manufacturing of energy efficiency technologies and products as well as their installation. A portion of these jobs is likely to be located within the Cardiff Capital Region however other jobs will be held by persons resident outside of the region.			

Investment

Figure 35 reflects that the shift to low carbon heating in the ESV scenario happens faster and at largest scale than the BAU scenario. For example, between 2020 and 2025, the ESV see less investment in gas boilers reflecting a faster shift away from this technology. The most predominant trend is across all year is that a substantial amount of additional investment is required in air source heat pumps. Investment particularly increases from 2025 in relation to air source heat pumps.

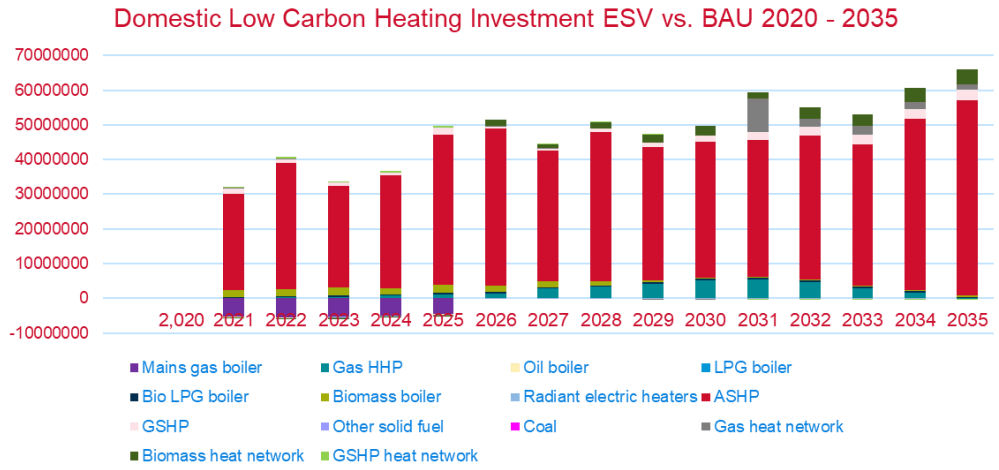


Figure 35. ESV vs. BAU discounted heat investment 2020 – 2035. Discounted at a rate of 3.5%.

Jobs

The job figures estimated for domestic heat differ from those calculated for electricity generation. Fewer studies have been undertaken to quantify the jobs related to the installation of heating technologies than electricity generation technologies. Specifically, indicators of FTEs/ £m turnover in non-heat network low carbon heating technologies were available. For heat networks the indicators used were permanent jobs per annual GWh heat generated.

However, our estimate of jobs related to heating technologies only relates to low carbon heating and does not include jobs related to the installation of more traditional heating technologies such as gas boilers, due to a lack of available high-quality data.

Figure 36 below shows the difference in low carbon heating jobs between the ESV scenario and the BAU scenario. Like investment, the majority of jobs related to air source heat pumps. It's worth emphasizing that these figures relate to low carbon heating only and don't include jobs related to traditional heating technologies such as gas or oil boilers (either within the BAU or ESV scenarios). Additionally, as stated at the beginning of this section on domestic heating, it is difficult to comment on the location of these jobs; some jobs will be held by Cardiff Capital Region residents while others will be held by those outside of the region.

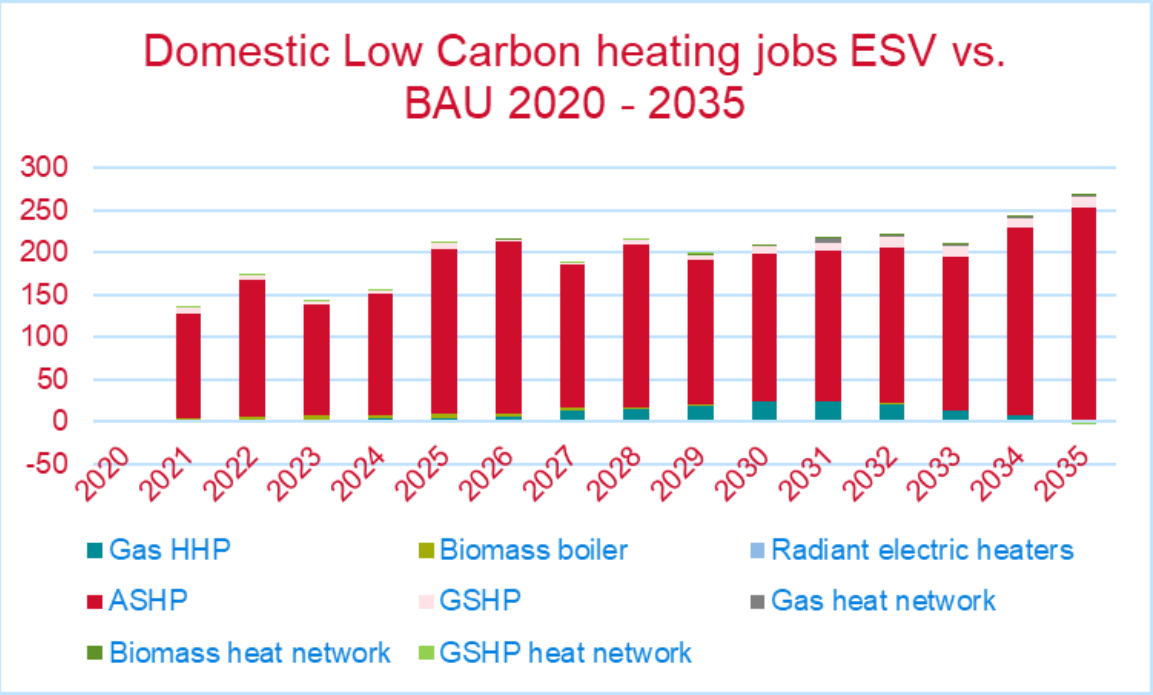


Figure 36. Domestic Low Carbon heating jobs ESV vs. BAU 2020-2035

Summary

Across all technologies, the substantially higher level of effort related to decarbonisation and the energy transition in the energy system vision scenario requires more investment when compared against the business as usual scenario. Likewise, achieving the ESV scenario delivers more jobs and additional GVA. In total the ESV scenario requires £3.4 billion of additional investment which is a 65% increase against business as usual. In terms of jobs, the ESV scenario is estimated to require an additional 16,700 net jobs to deliver the accelerated deployment of renewable electricity generation technologies and the enhanced levels of energy efficiency. These additional jobs are associated with nearly £1.7 billion more GVA (discounted at 3.5% over the period 2020-2035). In addition, it is estimated that there will be over 3,000 more gross jobs associated with the provision of low-carbon heating technologies in the ESV scenario than the BAU scenario, associated with £361 million of GVA.

Next Steps

Next Steps

The Cardiff Capital Region Energy Strategy has undertaken several important first steps towards addressing the climate emergency in CCR. We have developed a collaborative vision for the future energy system in CCR and defined key priority areas that are essential to achieving that vision. The assessment of current energy sector emissions has enabled a deeper understanding of the progress that has been made in decarbonisation to date as well as the gap between our current activities and a net zero energy system.

Building on this, the energy modelling demonstrates a potential pathway to 2035 that is consistent with the long term aim of achieving net zero by 2050. This is coupled with an assessment of the economic benefits associated with transforming our energy system in alignment with this trajectory. This will be critical in communicating the benefits of action and demonstrating the potential for far greater local economic benefits than could be achieved by return to business as usual, particularly in the context of a green, economic recovery from the COVID-19 pandemic.

There are three crucial next steps that we will now take to transition from a strategy to real world action in the delivery of our CCR energy system vision:

1) **Defining the strategy governance.** We will establish a robust and formal governance structure for the CCR Strategy. This will include defining a structure of cross-sectoral governance, powers, roles and responsibilities for overseeing the implementation of the strategy, and the monitoring and evaluation of its progress. This is essential to coordinate and unlock action, and to ensure momentum going forwards.

2) **Communicating and socialising the strategy.** We will undertake a series of engagement activities to communicate, socialise and build support for the final strategy amongst key political, corporate and community stakeholders throughout the region. This activity will help to align a diverse stakeholder group to the CCR energy vision and raise awareness of insights arising from the analysis and engagement undertaken as part of the strategy development.

3) **Establishing a delivery plan.** We will create a delivery plan for addressing the challenges identified in the energy modelling work, and for defining the processes and actions that could be taken forward to realise the energy system vision. We anticipate that the delivery plan will be a living document that is regularly reviewed and updated, and may be influenced by future local area energy planning or other relevant developments and research.

The energy modelling presented has shown that significant action is required for the Cardiff Capital Region to be on track for a net zero future and that we have the tools and technologies to make progress now. The economic assessment confirms that the challenge is large and will require investment from households, businesses, investors, and the public sector. This challenge is matched with a vision that reflects the values demonstrated by stakeholders throughout the development of this strategy.

The economic assessment also illustrates that the energy system transition may bring benefits to the Cardiff Capital Region in the form of jobs, however additional investigation is required to maximise these benefits. Likewise, the energy vision clearly sets out the intention that the future energy system should support the wellbeing of communities wherever possible. These next steps will help to scale up the existing decarbonisation and energy transition efforts in the region and turn the vision into action.

CCR ENERGY STRATEGY: IMPLEMENTATION PRIORITIES 2021-22 COMMITTING TO THE RACE TO ZERO (APPENDIX 2)

Background

CCR has, in collaboration with colleagues in the Welsh Government Energy Service (WGES), produced and adopted a region-wide Energy Strategy. This marks a genuinely integrated approach to delivering scale-shift transformation in the way that energy is generated, transported and utilised and to support a just transition to a clean growth economy. Our work to date has spanned over 100 different stakeholders and groups and considers a 'business as usual' pathway to decarbonisation alongside a detailed scenario that puts the region on a path to achieving net zero by 2050.

It is clear that the interlinked challenges of climate, historic UK low growth-productivity and the post-COVID economic recovery, make for a real opportunity for CCR to play a distinctive role in the radical shifts required. This must build upon the region's unique natural energy generating assets and using the strength of our existing manufacturing base as a springboard for transition to future technologies such as hydrogen.

The recent "10 Point Plan for a Green Industrial Revolution" by UK Government provides important context as well as recent enshrinement of the new law to slash emissions of 78% by 2035 pave the way for an accelerated drive for Net Zero. Coupled with continued commitments to increased R&D and infrastructure spending, there is an opportunity to align CCR's work to this and ensure the targeted flow of public investment to catalyse such developments and 'level-up' the UK economy.

Additionally, the creation of new super-Ministry for Climate Change within WG, comprising a range of functions including Housing, Planning, Transport and Environment, brings significant opportunities for synergistic impact. Coupled with the advent of new Corporate Joint Committees, which for CCR, will go live in February 2022 places a statutory requirement to produce a range of plans and execute regional delivery functions that embed Net Zero commitments.

Addressing climate issues however, will not wait for the environment post-February 2022 and a new CJC. As such, this document sets out initial priorities for regional-scale delivery, with a more comprehensive implementation plan to be developed under the auspices of the new CCR CJC, leveraging the connections across land-use planning, housing, transport and the economy. Clearly, not all the priorities set out will be completed within the interim period – there are no quick fixes here. However, they are not 'interim priorities' either and are part and parcel of some of the big and bold solutions and drives need if we are to seriously take part in the Race to Zero.

Vision

Our vision for Cardiff Capital Region was approved by Regional Cabinet in December 2019 is:

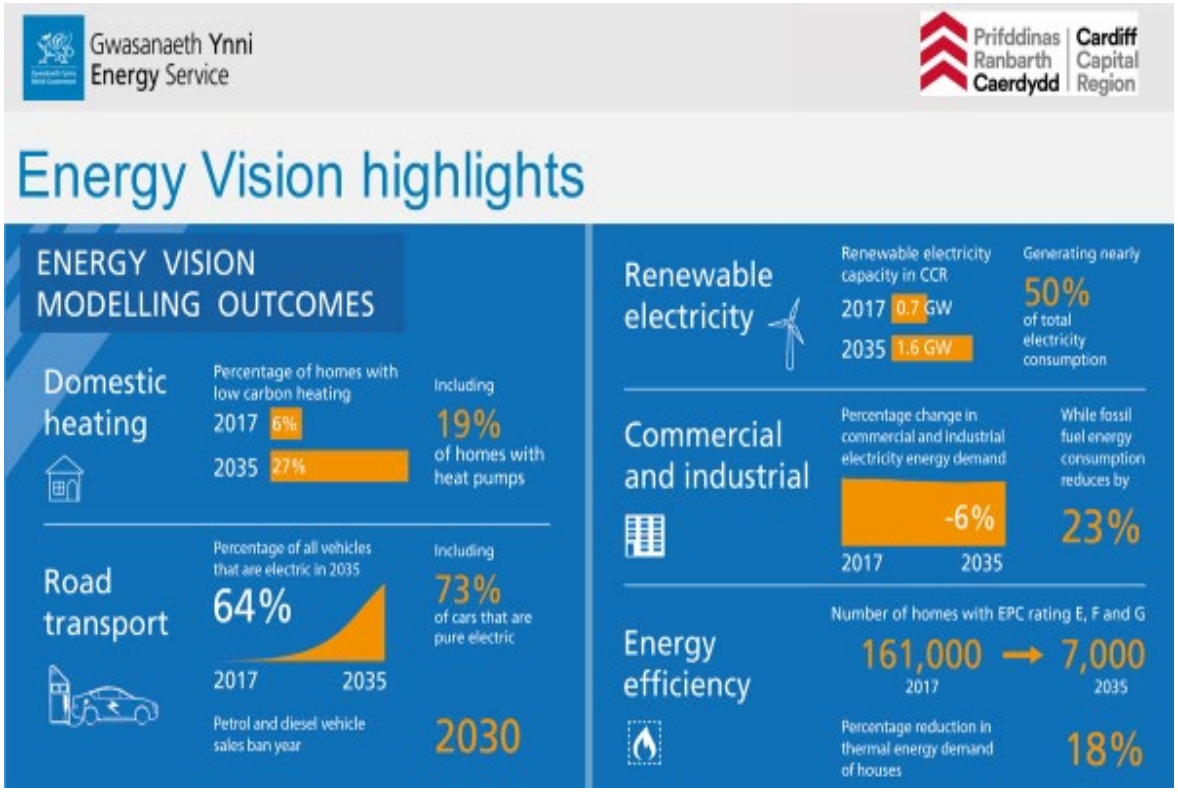
To create the conditions for a transition to a carbon neutral economy and society in the CCR, using low carbon energy as an enabler of economic regeneration, growing our regional income whilst maintaining guardianship of our environment through a laser-focus on clean growth

This is set out in further detail in the Energy section of the CCR's new Investment Prospectus: Prosperity in our Place, which sets out progressive ambitions for the region's sustainable energy future.

Analysis shows that within all sectors in the region, energy use is 33 terawatt hours each year across heat, electricity, transport and fuel. This is significant and compared to Mid Wales which uses 5 terawatt hours – demonstrates the hive of industrial and consumer activity in CCR. Currently only about one sixth of this comes from renewable sources, predominantly electricity. The challenge of decarbonising the remaining five sixths is significant. The analysis pertaining to this is captured in the draft CCR Energy Strategy (Appendix 1).

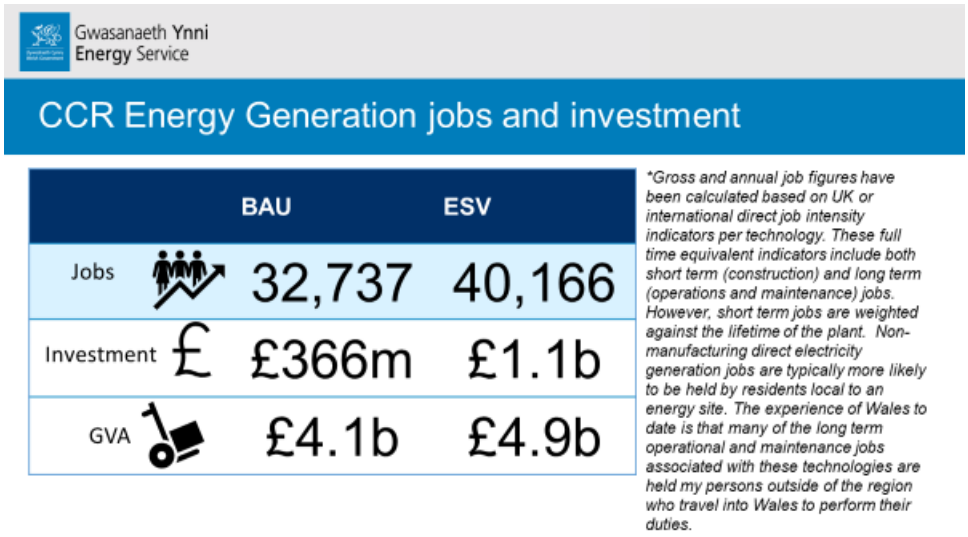
To meet the targets Cardiff Capital Region needs to reduce emissions from its energy system by 55% by 2035, split by sector as follows:

- 51% reduction in domestic heat and power emissions;
- 54% reduction in commercial and industrial emissions;
- 60% reduction in road transport emissions.



Benefits and Impact

Safeguarding the environment whilst delivering good economic growth are one and the same fight. Indeed, focussing on a series of proactive, co-ordinated, net-zero-emissions aligned investments, which not only meet the above targets and modelled outcomes, but align with our core economic base and support the growth of existing capabilities such as around next generation compound semi-conductors – can deliver economic and societal benefits. Strategic investments in these areas can help build capacity for the economy of the future. Such investments, made alongside others such as 5G networks, superfast broadband, innovation, R&D and skills more broadly, are also crucial for achieving innovate sustainable growth. Moreover, they can deliver a series of co-benefits, including cleaner air, more liveable spaces and hence ultimately improve living standards, quality of life and wellbeing.



Momentum

The above gives us a clear-eyed depiction of the challenge upon us. New projects and initiatives won't be enough. There are four central components to driving momentum and organising our approach.

1 - **We need to draw on our understanding of innovation and promoting R&D to get new ideas into the market and to help spread and scale the good things that exist.** Knowing the areas in which innovation is already helping reduce emissions and what breakthrough technologies are needed will be key to this. That is why we have established a strategic partnership with FLEXIS – a cross consortium of strategic partners including Cardiff and Swansea Universities and University of South Wales. The partnership's aim is to create a culture of R&D to develop energy systems capability in Wales. Aligned to opportunities in the pipeline such as the CCR Innovation Investment Fund – a scale-up risk capital fund – we can play a stronger role in supporting our innovation and industrial-scale clusters to thrive sustainably.

2 – **Developing regionalism and regional institutional capacity**. The CCR is transitioning from a single funding programme City Deal to a model of regional

economic governance via a new Corporate Joint Committee. This will bring together a new level of co-operation and a wider platform for co-ordinated strategic impact. This will be supported by the requirement for a governance structure that brings together the economy, transport, planning and skills as well as immediate duties around the commencement of a Strategic Development Plan and a Regional Transport Plan.

3 **– Policies that can be developed and adopted that will demonstrate leadership and impact.** This will start with the CCR Investment Strategy, Risk Implementation Framework and Responsible Investing Policy – all of which give clear interpretation and meaning to stated objectives of Resilience and clean growth. This means that such provisions can be meaningfully embedded in investment decisions becoming a prominent part of all considerations in the process of project assessment.

4 – **The deeds that we as individuals can do to keep CCR, other parts of government, our employers, partners and stakeholders accountable.** From a citizen perspective, the personal actions we take will send important signals to the market-place; as a consumer we can alter supply-demand dynamics; and, as employees or shareholders we can push our employers to do their part. The work of the recently convened Blaenau Gwent Citizen's Assembly on climate change could provide a blueprint for anchoring the new types of engagement needed to connect at this level and is relevant to the requirement for Race to Zero. Indeed, changing the way of working of the City Deal Office to be closer to town and city centres, less car reliant and closer to public transport and active travel options, will see us lead by doing. The CCR Challenge Fund for local wealth building will continue to play a key role in allowing for experimentation and promoting behavioural change.

The COVID-19 pandemic has been devastating and has impacted lives, livelihoods, families, businesses and tested governments and leaders the world over. However it has also shone the spotlight on civic co-operation, social action, the healing properties of nature and the power of science, research and innovation. There is an opportunity to maintain positive legacy.

Implementation Priorities 2021-2022

This period will stem from April 2021 – until the inception of the CJC in February 2022 and will be both a developmental and delivery period. Again, these priorities won't be delivered and completed in this period as there are no quick fixes – but it is the time for a serious, integrated and truly regional approach to playing our part.

Priority 1 - Decarbonisation of Road Transport

In view of the massive contributor of the sector to Co2 emissions and the density of road connections in the region in particular, it is vital that action is taken in respect of transport infrastructure. This brings a good opportunity to build on the role and work of the Regional Transport Authority and to support more inclusive forms of growth through improvements to air quality. This will focus on:

- Continued delivery of the ULEV Strategy – match funding now in place as part of the Metro Plus programme to sit alongside the comprehensive plan for charging infrastructure in the region. By end of 2021, over £11m will be invested

in augmenting LEV infrastructure in the region to deliver 31 dual use 50kw chargers for taxi use only, a minimum of 159 (and maximum 400) 7kw and 22kw public use chargers throughout public car parks and on street, with the option of battery storage for when the grid is at capacity. A concession framework, with profit share, that can be added to over the next four years as and when funding becomes available. An all-Wales framework has been established that other Regions, TfW and WG can use when delivering their infrastructure.

- LEV Taxi 'try before you buy' scheme - £4M to incentivise transition to LEV in the region's tax industry and to allow the sector to experiment with and play its part in the ULEV strategy by focussing on behavioural barriers to change. This will deliver 44 Nissan Dynamo taxis for a month free trial at zero cost to the taxi driver/company to encourage them to transition. The trial would allow for 968 drivers to trial the vehicles over the period of the trial. The successful company managing the trial will also manage a Cardiff lease scheme which will see 15 vehicles leased on a trial basis, and which can be expanded region wide if successful. It is anticipated that tender returns may offer significantly more vehicles to be used in the trial, funded by the successful bidder. Following the completion of the trials, the vehicles can either be used for a regional lease scheme, or can be sold into the second hand market within the Region.
- Scoping programme for HGV and heavy commercial vehicles in the region, and working with IUK on the SBRI for zero road emission freight.
- Scoping programme, both electric and hydrogen, for the public bus network, including both infrastructure and vehicles, and including school transport; working with Welsh Government and producing heat map of the bus network to identify locations for additional charging infrastructure on network corridors where charging will be required. Further scoping to identify grid shortage and renewable energy options.
- Opportunities for car club scheme within the region, which could particularly benefit rural locations.
- INFUSE and focus on Net Zero – During November we engaged with Chief Executives and Political Leaders to agree the two emergent themes for Infuse to work on further. Through this engagement the two key themes have been chosen as have the associated questions for the Cohort Alpha which commenced on the 4th May: -
    - Theme One - Accelerating Decarbonisation - Q: What does it mean to declare a Climate Change Emergency
    - Theme Two - Supportive Communities – Q: What are the New Operating Models for Local Authorities post COVID-19?

- Development of the CCR-wide Net-zero Fleet Challenge that seeks to rapidly adapt an approach to innovative procurement in order to procure an innovative shared solution to a low-carbon fleet across all public sector services in the region. This will include an emphasis on Mobility as a Service; depot and

storage capacity; local supply links into advanced electric propulsion systems work (NWF, Meritor) and challenge-led procurement processes connected into the £16M CCR Challenge Programme and with sights set on the £1BN Public Sector Decarbonisation Fund.

- Scoping a Hydrogen Demonstrator Fund to establish a competition to fund ambitious feasibility studies for a future zero emission vehicle demonstration for hydrogen cell vehicles. There is significant opportunity for this to link with UK Government's Hydrogen Supply Programme and build on some of the capacity and innovation underway in the region to assess the potential future demand for hydrogen as an alternative source for Fuel Cell Electric Vehicles (FCEVs) as part of the Wales/ UK's transition to net-zero. This study supports further work that Welsh Water are progressing in conjunction with Costain, Innovate UK and Welsh Government to develop a hydrogen production facility using waste gases from the sewage treatment process as a source to create purified hydrogen. The development of the business case for this facility will only be viable if there's enough demand for this fuel source and hence the nature of this study is to initially assess if said demand is sufficient.

Priority 2 - Commercial and Industrial Decarbonisation

Reducing the carbon footprint of heavy and energy intensive industries presents a major challenge to the region with concentrated use attributed to digital and data; the power electronics sector, steel and other heavy industry such as advanced manufacturing. Building on efforts to accelerate innovation, it is critical we help drive timely and cost-effective private investment in industrial decarbonisation and strengthen the competitiveness of regional businesses as a result:

- Strategic sites assessment for mature 'cluster' activity. The CCR Cluster Framework is in development and supports the creation of a series of priority sectors. The way in which these sectors develop, is usually around physical hubs and brings together a geographical critical mass of businesses, public organisations, universities and community interests. A good example is the accumulation of power electronics companies around Imperial Park and the integrated energy assessment performed to provide for future energy needs in a low carbon and sustainable way. This site is constrained in terms of the further affordable energy from the grid, meaning that this site is a priority for considering power resilience and on site renewables. With further sites identified for similar cluster development around med-tech, advanced manufacturing, creative industries and fintech – 'whole system' energy solutions will be a core requirement.

- STEP-Fusion Nuclear Prototype Project – CCR alongside the Vale of Glamorgan Council in conjunction with commercial partners, site owners, WGES and supported by FLEXIS and CS Connected, have submitted an a successful application to nominate Aberthaw Power Station site for the Fusion

Nuclear Prototype project to UKG's Atomic Energy Agency for a £250M R&D project. Commercially viable nuclear fusion power is drawing increasingly close. In a fusion process – two atomic particles combine to form a heavier nucleus, while releasing non-radioactive 'clean' energy. A fusion reactor produces helium which is an inert or noble gas. The proposed site is strategically positioned with adjacency to Cardiff (Wales) Airport and Bro Tathan (Aerospace Enterprise Zone). The potential is to leverage connections across digital infrastructure, energy and place and the concept of a digital Gigapark providing net-negative solutions for digital and energy companies, creating high-order jobs in the process as well as strong R&D intensity. The Aberthaw Power Station site has been shortlisted by UK Atomic Energy Agency as one of 15 preferred sites in the UK and due diligence is underway with regards interest to acquire the Aberthaw site from RWE.

- Gigaplant support – from previous interest in the Bro Tathan, St Athans' site, we know it to be one of only a handful in the UK capable of accommodating a lithium-ion battery Gigaplant on the scale of 30GWH. It is important that CCR working with the Vale of Glamorgan and WG, proactively considers options for the site and the benefits of a City Region-led approach.

- The CCR has areas of competitive commercial and industrial strength. The region has all the ingredients to develop similar growth in the energy and environment sector. In line with UK ambition on hydrogen, the Welsh Government has commissioned a pathway strategy document for hydrogen in Wales, and this together with a baseline hydrogen activity assessment will be completed this year and will inform the low carbon transition plan moving forward, and also align activity to support creation of a hydrogen market. CCR has a large number of significant manufacturers who use large volumes of process gas, including Celsa, Rockwool, Dow Corning, Tarmac and Tata in Newport. Working with the South Wales Industrial Cluster, CCR will explore opportunities for up to 8 Clean Growth Hubs in South East Wales. Our proposition is to see a pioneering transition to hydrogen as an industrial fuel source. Within the Commercial and Industrial sector we also wish to deliver a significant energy efficiency programme, with building integrated renewables to reduce energy demand by 13% and secure electrification of heating.

Priority 3 – Domestic

CCR's housing stock is amongst some of the oldest and least efficient in Europe and is responsible for 20% of the region's carbon emissions. The composition of the housing stock in the region means the space-heating energy demand is higher than in other parts of the UK – as are fuel poverty levels. Given the variations in type, age, physical form and construction condition, there is no single solution for decarbonising such a varied housing stock and retrofit work must be developed with close understandings of specific characteristics in mind. CCR has scoped an initial feasibility and technical brief that focuses on the following with a view to securing external funds

for the work needed to develop an Optimised Domestic Retro-fit Programme. To be on track to achieve the 2050 targets, the following needs to be achieved by 2035:

- 154,000 homes must be improved from EPC Band G,F and moved to E to D, C and B
- Working with Wales and West Utilities we want to build on Project Flexis and achieve over 140,000 installations of heat pumps
- 42,000 suitable houses fitted with internal or external wall insulation
- Over 185,000 other insulation measures in homes
- 112,000 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

Barriers to progress are manifold. There are insufficient mechanisms to incentivise householders and commercial properties to tackle harder retrofit initiatives. Recent research by Local Partnerships suggests the main barriers concern availability of funds and suitable payback periods; knowledge of 'what to do'; trusted and skilled labour to undertake the work; and the levels of disruption involved.

CCR is developing work to scope feasibility of a future delivery programme that could funded via CCR, Shared Prosperity Fund and potentially, sources such as the UK Infrastructure Bank. This is in line with the objective for local energy projects that begin to establish and assess scheduling considerations, legal and state aid issues, procurement and other technical factors that help to overcome some of the current barriers to progress. Aligned to this, one of the submissions that has been considered positively thus far, under the CCR local Wealth Building Challenge Fund, is the case for privately owned domestic retrofit in Bridgend. This builds upon the good work commenced in Bridgend around community heating, work with the Energy Systems Catapult and a series of connected SBRI challenges.

Priority 4 – Renewable Electricity

Sufficient storage, network and connectivity upgrades are key to underpinning sustainable delivery of renewable energy. On and offshore wind and solar PV are likely to play a major part in closing the gap around renewable energy generation.

The Energy Vision modelling has assessed the land within the CCR region in terms of areas zoned for renewables from planning policy Strategic Search Areas and the Welsh Government's National Development Framework (due to be launched early 2021). This analysis showed that it is possible to install 1.6GW of renewable electricity in the CCR region (which includes 532MW of wind and 820MW of solar).

CCR will work with the local DNO Western Power to explore opportunities for sufficient flexibility, including storage, and network infrastructure upgrades to enable low carbon generation and demand technologies to connect.

New Welsh Government policy requires local ownership of new energy assets. CCR will work with developers and stakeholders to understand the practical arrangements to make this happen. Additional opportunities also exist directly on the public sector estate with approximately 95MW of wind projects identified on the public sector estate, with favourable grid and planning prospects. CCR will work with public bodies to ensure the necessary capacity is in place to progress these projects at pace and scale.

GW4 draws together the research excellence of Bath, Bristol, Cardiff and Exeter Universities, with collaborations that connect government, industry, civil society, charities and communities. Such new intra-regional partnerships to produce, translate and embed research and innovation into policy, society and business will be key. Our intra-regional synergies, combined with extensive resources of skills, expertise and partnerships, make the GW4 region a natural testbed to explore how the transition to net zero emissions can be a just transition, helping to address social and economic inequalities and 'level up' the region and the UK

There are multiple options for Tidal Lagoon along our Coastal corridor and even further options across the combined geography of the Western Gateway. WG has issued a PIN Notice seeking EOIs for tidal power across whole of Wales. Many reviews of Seven Tidal Energy have concluded landlocked bodies of water produce the least amount of ecological damage whilst generating large volumes of viable and reliable power. Also, the scale of engineering required at the lagoon level is far more manageable than a seven barrage.

WG have aspirations to work with CCR to develop renewable options at our charging sites, where battery storage is one option being considered to add capacity when the grid is at its peak. Solar car ports are an additional solution being investigated.

Support programmes like Protium's, The Zero Emission Freight Project (ZEF), which aims to evaluate the feasibility of zero emission heavy-duty freight transport (44t HGVs) using hydrogen fuel cell electric vehicle trucks (FCEV). The proposed feasibility study will involve transport routes and hubs along the M4 corridor, and include 6 work packages:

1) Current vehicle routes and payload planning
2) Fuel cell integration, vehicle design and performance modelling
3) Evaluation and planning for hydrogen refuelling station
4) Modelling carbon and economic benefits
5) Stakeholder engagement & consortium building
6) Project plan development

The outcome of the project will include a plan to deploy HGV FCEVs, first along the M4 corridor and then more broadly across the UK. Through the ZEF Project, Protium will also engage government bodies to secure funding for vehicle trials and commercial rollout.

Direct outcomes within our Region could include:-

- Direct emission reductions from transition of more than 250+ ICE HGVs with implications on air quality (this figure is only the 44t fleet of the consortium partners, but the results could be applicable more broadly)
- Development of new infrastructure (hydrogen refuelling stations along the corridor)
- Attracting new companies, technologies & investment (Protium recently opened their first office in Wales, the main technology partner could locate future production facilities in Wales depending on the outcomes of the project)
- Direct investments into local companies (Protium will be sub-contracting work package 5 to a welsh company called Afallen)

Data, Partnerships and Policy Development

Technology and the smart use of data will play a critical role in enabling the region to hit the net zero target by 2050 and in data recording through the newly introduced Welsh Public Sector Net Zero Reporting. It is clear that investing in data and systems infrastructure to facilitate a green economy and ensuring business and organisations have the skills in place to take full advantage of technology – will all be key. In CCR we will focus on

- Signing up to the Carbon Disclosure Project (CDP). CDP provides a global platform for cities and regions to measure, monitor and disclose their environmental data. It is a globally recognised reporting framework and allows local government to present one unified platform for climate reporting, streamlining the process of reporting and ensuring simplicity and standardisation. Authorities are currently considering the use of CDP with a view to utilising alongside the new WG Net Zero reporting requirement for Scope 1, 2 and 3 emissions.

- Commissioning the development of a Digital Energy Twin work in CCR. This will be critical to develop a digital representation of the whole region, detailing and modelling all physical assets, processes and systems in real-time to visualise impacts and effects; to leverage good asset data; create an open and connected environment; and, access trusted, accurate and trusted data. This will help model the future energy vision for the region – bringing our work to life and setting out the important sequence of interventions that could have best effect in realising the CCR energy vision. Beyond building out the model, and potentially, using this as a centrepiece for the Local Wealth Building Challenge Fund, there is the wider potential of attracting R&D and developmental programmes to a ‘testbed’ region.

- Participate in COP26 – CCR will attend the COP 26 UN Climate Change Conference as part of SWITCH – South Wales Industrial Transition from Carbon Hub. This unique academic-industrial-business aims to decarbonise the industrial base and communities in the region. Participating through

attendance, exhibition space and participation in key discussions will enable CCR to build the international network and ensure the region is equipped to make a meaningful contribution in the light of the UK's G7 presidency.

- Develop relationships with the new UK Infrastructure Bank in respect of bringing forward the pipeline of energy programmes set out in the CCR Investment Prospectus and modelling innovative forms of finance with payback periods in line with acceptable IRRs.

- In addition to all of the above, the CCR Wider Investment Fund is open for business. The revised Investment Strategy and Outcomes Statements, enshrine Net Zero aims and expectations. As such and ongoing, CCR will seek to receive submissions, from public, private and community sector organisations, for projects, programmes and schemes that can make a demonstrable contribution to our energy strategy targets and ambitions.

- Partnering arrangement with Flexis – this arrangement will be established to create long-term partnership capacity around early R&D in the region and demonstrator zones. Early opportunities will include:
    - Support to the CCR Steering Group/WGES in the continued development of the Implementation Plan and Pathway to Zero Carbon
    - Expert project advice and developmental support
    - Research into what's out there, what's possible, and what's coming next
    - Support for commissioning Digital Energy Twin build for the region
    - Support for operation of specific initiatives falling out of the implementation plan e.g. a hydrogen/energy challenge fund or demonstration hub; or behavioural/social sciences aspects re: adoption
    - UKAEA STEP proposal support
    - CCR Energy Agency advice and support
    - Presence at COP26

Priority 5 – Skills and Talent

Urgent action is needed to plug the deficit in skills that currently undermines the growth of low carbon supply chains across the CCR economy. Supporting higher and further educators to better meet the needs of local employers and update apprenticeship standards; and, mid-career re-skilling qualifications to equip the workforce with skills needed in a net zero emissions economy, must quickly form core priorities. It is essential that in the aftermath of Covd-19, there is a collective regional response to labour-market challenges and opportunities that focuses on:

- Supporting HE and FE to tailor courses, training and qualifications to more closely match the needs of local employers and low carbon job creation. This

will require the establishment of Energy Academies and HE developing new, short-term training on low carbon skills. Consider partnership with Bridgend College who for the past 3 years, has been building a network and broad base of expertise in the skills gaps facing employers, supply chains and educational institutions in the move to achieve Net Zero by 2050. Their ambition to become a leading player in this space is written within our Strategic Plan as is our desire to become an extraordinary place of education that places true value on the future needs of our stakeholders and the wider community.

- Future apprenticeship schemes and graduate scheme must require and incentivise businesses to provide apprentices with low-carbon skills that go beyond their short-term and immediate priorities.
- Greater adoption of community benefits and social clauses in line with the National TOMs and monitored via the Social Value Portal. This will provide increased opportunity to encourage and mandate targeted recruitment and training for green energy opportunities
- Resources and capability to deliver. CCR, via its Programme Board of the 10 LA Chief Executive, will develop the commitment to pooling resources and sharing expertise to deliver local and regional impact via the creation of central and 'roving' resource within CCR and a binding pledge to shared endeavour. This is the potential precursor to a Regional Energy Agency.

Next steps

This will be hard – it should be. This set of implementation priorities is not exhaustive and in some ways, simply a starter for ten. This is because it has to track the evolution of CCR from single funding programme to a broader strategic regional body with the remit and capability to drive the scale of change needed. This is underway.

Whilst these implementation priorities will guide the creation of responses in the immediate future, the medium-long-term focus will be continually built through the development of key facets of the overall approach to implementation – though transport, land-use, housing and wider economic policy. Next steps will require the region to sign-up to these priorities and work through the process of aligning, pooling and sharing resources to get things done and to create the governance mechanisms to respond in a timely, responsible and responsive way.

'We need to accomplish something gigantic we have never done before, much faster than we have ever done anything similar. To do it we need:

- Lots of breakthroughs in science and engineering
- To build a consensus that does not exit and create public policies to push a transition that would not happen otherwise.
- The energy system to stop doing all things we do not like and keep doing all the things we do like – in other words to change completely and also stay the same'.

'But don't despair. We can do this. There are lots of ideas out there for how to do it some of them more promising than others', Bill Gates (2020).

POSTSCRIPT – CCR NET ZERO REGION PLANNING DAY 16 June 2021

CCR held the above day-long event facilitated by partners Flexis and with input from Siemens, CCR Challenge Fund and WGES – supported by the Programme Board of Council Chief Executives.

The following was resolved as a means of enhancing the Implementation Priorities and accelerating and amplifying impact:

1) **Partnership with Flexis** was seen as critical to developing the continued strategic framework for the ongoing development, evolution and up-to-date deployment of the CCR Energy Strategy. With work spanning policy development, demonstration and application across Technology Readiness Levels and drawing on R&D activity of Welsh Universities; power partners and energy suppliers as well as a broad network of businesses and SMEs – it is clear that investing in building a partnership with Flexis will open the door to thought leaders, experts, partnerships and programmes that could begin to make an immediate impact in CCR
2) **Commitment to participate in the Race for Zero and the Carbon Declaration Project.** As part of our COP 26 commitment – it was unanimously agreed that a recommendation should be made to CCR Cabinet to adopt the Race for Zero – a global campaign to rally leadership across business, cities and regions and investors, for a healthy, resilient and zero carbon recovery, which unlocks sustainable and inclusive growth. 708 cities, 24 regions, c2400 businesses, 163 global investors and 624 HEI institutions are on board as part of the Climate Change Alliance and backed by Bloomberg Philanthropies This is no passive commitment. To sign up, minimum criteria must be met backed by pledges, formal support and publication of a plan. CCR has until November to demonstrate a match for the minimum criteria. Alongside the adoption of the Carbon Disclosure Project, City Regions are classed as Cities for the framework with regions classified as Wales, Scotland and NI. Applications must be made by 29 July 2022 with scores available beforehand in order to provide guidance and advice. A trial option is also available. Whilst CCR has gone some way to achieving goals, gap analysis shows there is a way to travel. This will not make for a comfortable experience – but it shouldn't be and will expose what remains to be done – as part of a City Region approach.
3) **Investment in central data systems and capability**. The ongoing reporting requirement associated with the above is a minimum of 30 days. This is without considering all of the data sources; and related issues of quality and alignment, integrity and access – across a whole region. Pooling resources to develop a robust set of analytics and create data feeds in real-world and real-time spectrums was seen as a foundational requirement. Whilst at overall outcomes level this is clearly key; developing data competency around the methodology for assessment of projects and interventions – was also seen as vital. A real

sense of urgency was documented around this to ensure cohesion, joining-up and the pooling of resources to establish region-wide consistency.

4) **Leveraging procurement and supply chains**. A strong point was made that rather than seeking new money or investment – we have to start with better leveraging what we have and can control – a significant collective public balance sheet and spending power – LAs as super end customers. The Challenge Fund approach was seen as vital to supporting innovative procurement to enable procurement of innovation. Ideas came forward to supplement existing challenges of LA fleet, housing retrofit, food resilience and air quality to span areas such as rapid notification of flood alerts and carbon audits of supply chains. It was also clearly expressed that some of the basics did not require super-innovation – but targeted, joined-up approaches across shared and common suppliers and making the changes necessary to embed carbon reduction as a core requirement of contracts.
5) **Adaptive leadership** – one participant commented that it was difficult to ask others to do what they themselves had not yet done. This demonstrated some of the cultural shifts and changes required. Adaptive leadership v business as usual leadership. Capability/ expertise v generic capacity. Meetings/ conversations v doing and being. Creating the right conditions can feel intangible, however, the group re-committed to programmes such as InFuSe to ensure the capacity for challenge, innovation, curiosity and creativity was further developed to make Net Zero the core priority.
6) **Resources to deliver**. It was agreed that there should be a commitment to pooling resources around a regional co-ordinated approach. This would not detract from local-level actions and interventions and whilst a central resource was supported – this would act and be available for regional-scale *and* local-scale activity and support. Currently, the level of commitment is not sufficient and this needs to be amplified to support all of the above in 2021/22 with further scaling-up beyond this.

……..

APPENDIX – 1 The Implementation Framework

The implementation plan will be delivered in line with the WGES Regional Energy Planning process. This will comprise:

Task 1: Define a framework and evaluation criteria for the Action Plans

Objective: To agree a framework and evaluation criteria for the development of the action plans

In advance of developing and Implementation Plan, we define an Implementation Plan Framework, agreeing the priority areas of focus and the timelines and evaluation criteria for the Action Plans. The agreed framework will be used as a structure to steer the development of the Implementation Plan.

As part of this activity, we will undertake a high-level review of Action Plans that have been developed across the UK, in order to draw insights and lessons learnt into the approach taken for the regions of Wales.

We will undertake a regional SWOT analysis to inform priority areas for the Action Plan, focussed on identifying and mapping the existing responsibilities, powers and levers that different stakeholders have (e.g. local authorities, regional bodies) in order to inform priority areas of focus.

A successful Action Plan that achieves its aims will require the implementation of a wide range of strategic activities. We will therefore incorporate a range of different types of actions, including:

- Capital investment in the form of projects and programmes
- Policies
- Governance structures and improving collaboration
- R&D
- Skills and supply chain
- Communicating regional needs to national government

Task 2: Identifying actions

- **Objective:** Identify a long list of actions for inclusion in the Action Plans
- We propose to use a combination of top-down and bottom-up processes in the identification of a long list of potential opportunities for inclusion in the Action Plans.

Step 1: Action identification using results from pathway analysis and evidence base

- Step 1 will focus on the identification of actions through the analysis of the energy system vision modelling delivered as part of the energy strategies and the development of an implementation roadmap, providing a timeline of

milestones associated with each of sectoral scenarios and their corresponding interventions. This activity will connect the results of the pathway analysis to the actions required to make the transition to net zero a reality, enabling key decision makers to take a strategic approach to addressing the climate emergency.

- We will first focus on extracting the critical messages from each of the pathways, and the key areas of action required to decarbonise the sectors. Next, we will map the timescales, sequencing of actions and key decision points associated with the delivery of interventions identified across

Step 2: Review existing activities and programmes, and opportunities for scale up

- Step 2 will focus on undertaking a review of the existing and planned activities and programmes already underway (including that which has been gathered during Phase 1 of the Regional Energy Planning and other strategic plans including the Wales Low Carbon Delivery Plan), and matching these against the top-down actions identified during step 2 of the Action identification. Our evaluation will focus on understanding the potential to scale up existing and planned mitigation efforts, and identifying where there is potential for better coordination to deliver economies of scale and accelerated delivery across different sectors.

Step 3: Targeted sector specific engagement to co-develop actions

- The analysis conducted during steps 1 and 2, will form the evidence base for engagement with the regional governance/delivery groups and key stakeholders across the regions in order to co-create actions that will deliver decarbonisation across the energy system, as well as identify levers the region can pull to influence emissions reduction. We propose to deliver and facilitate this through targeted, engagement activities centred of areas of focus within the action plan (e.g. targeted across the Domestic, Commercial & Industrial, Transport, Renewable Energy Generation and Flexibility & Networks sectors). Engagement will be facilitated by subject matter experts, drawn from the Welsh Government Energy Service expertise.

Task 3: Prioritise actions

- **Objective:** Assess long list of actions against agreed evaluation criteria to prioritise a short list to form the basis of the Action Plans

- The list of actions will be evaluated against the agreed evaluation criteria to determine the final shortlist of actions that will form the basis of the Action Plans, determined by the regional focal points. We will support this process through the provision of interviews, expert and stakeholder consultation. After each action has been evaluated, it will be incorporated into a prioritisation matrix, in order to create a ranking and arrive at a final portfolio of interventions for the Action Plans.

- Data and information on each intervention will be analysed and visualised using advanced data analytics techniques to enable a better understanding to inform prioritisation. In order to facilitate this, we will build an initial prioritisation matrix in Excel, and subsequently use PowerBI to better understand and visualise the results of the evaluation. This tool could also be used to efficiently interpret the data when sharing the evaluation and prioritisation results with key stakeholders.

Task 4: Development of the Action Plans

- **Objective**: Development of draft and final Action Plans
- The last stage of the Action Plan development is to develop the Action Plans, incorporating the relevant information for each action, as outlined within the Action Plan framework.
- As a minimum, we anticipate that this will incorporate an assessment of roles and responsibilities for each action identified within the Action Plan. Other information could include: resource requirements, funding opportunities, risks, alignment with national policy and next steps.
- Further detail on the approach to assessing stakeholder roles and responsibilities is outlined below:
- Stakeholder roles - We will consider the roles and responsibilities in the delivery of the actions across the short, medium and long term. Actions could be structured into the following levels:

    1. Actions led by, or under the responsibility of the Region (e.g. Growing Mid Wales Partnership).
    2. Actions led by, or under the responsibility of the Local Authority area administrations within the region.
    3. Actions for the region to influence or collaborate with key stakeholders.
    4. Actions for the region to monitor/be aware of.

- In considering stakeholder roles, we will consider the capacity and capability to deliver, economies of scale and the potential to embed action into parallel work streams.

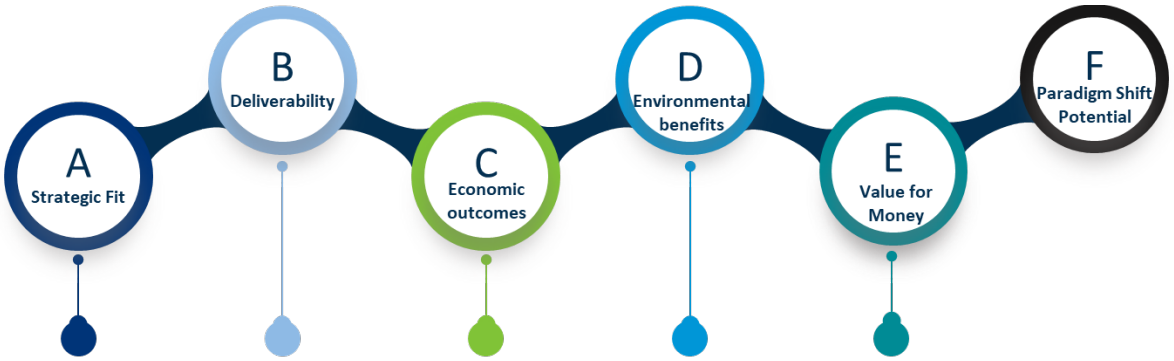
Action Plan Framework

The following framework will be adopted to develop action plans

	Description
Themes	Categorising actions into agreed priority areas: 1. Domestic 2. Low carbon generation and flexibility 3. Transport 4. Commercial and industrial Cross cutting themes: - Economic Growth - Wellbeing and Future Generations - Governance arrangements
Timescales	Action mapped across Five-Year periods to target date (2035) to align with a focus on ensuring sufficient detail in the short-term actions.
Geography	Actions will be categorised across the national, regional and local levels.
Roles and responsibilities	• Actions led by, or under the responsibility of CCR. • Actions led by, or under the responsibility of the Local Authority area administrations within CCR. • Actions for CCR to influence or collaborate with key stakeholders. • Actions for CCR to monitor/be aware of.
Categories of actions	Agreement of project types for inclusion in the Action Plan including: • Capital investment in the form of projects and programmes • Policies • Governance structures and improving collaboration • R&D, skills and supply chain • Communicating regional needs to national government
Project information	Project information to incorporate for each action. To be discussed: For example, this could include an assessment of resource requirements, stakeholder roles & responsibilities, funding opportunities, risks (e.g. Capacity, Financial, Policy, Technology), stage of development (e.g. aspirational plan, feasibility, business case, commercialisation, procurement, construction, operation), technology maturity, alignment with national policy.

Critical Success Criteria

The following diagram details the critical success criteria to be applied to the evaluation process:



Strategic Fit
How well aligned is the project to local strategic concerns?

Deliverability
Is the project realistic and deliverable within the timeframes?

Economic outcomes
Will the project improve job opportunities and drive economic growth?

Environmental Benefits
Does the project deliver climate change mitigation through absolute carbon reduction or the reduction of emissions intensity to facilitate sustainable growth?

Value for money
Does the project achieve a competitive levelised cost of energy (LCOE)?

Paradigm Shift Potential
Will this action lay the foundations for lasting (transformational) change?

Thematic Workshops

Thematic workshops will be held for each of the 4 themes from May-July 2021to inform actions being developed.

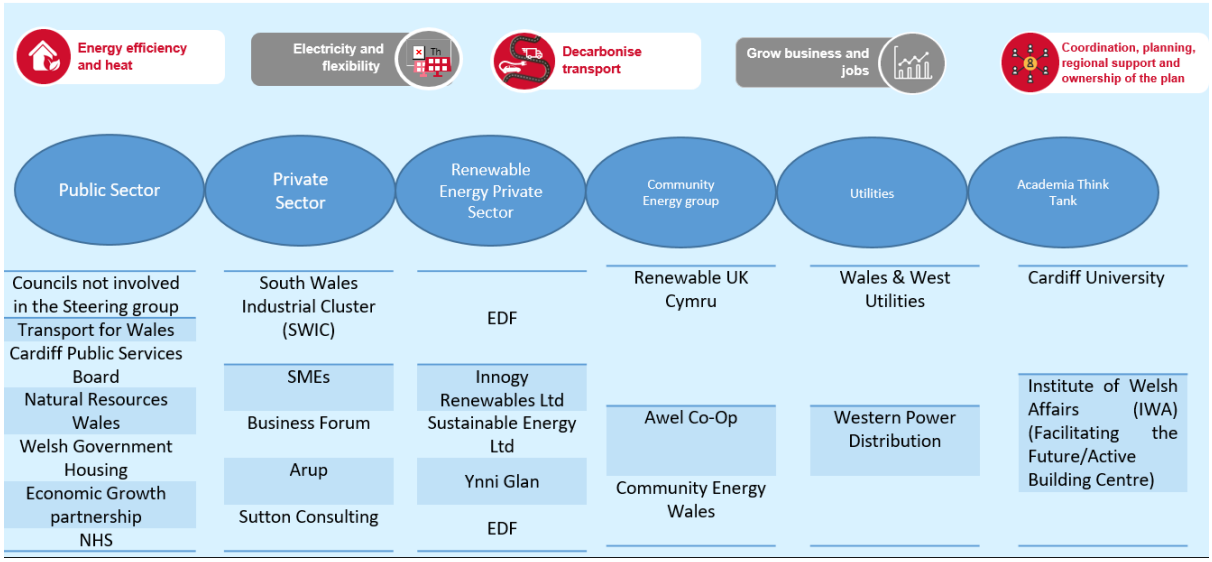
Each workshop will comprise:

- A top down analysis - roadmap of key actions extracted from the pathways and evidence base
- A bottom up analysis - what we know about what's already happening and our assessment of where there are gaps and where things could be scaled
- Analysis of the evidence - do stakeholders agree with the actions presented, is anything missing?
- Agreement of a long list of actions for the plan (including capital projects, programmes, R&D, project development, skills, supply chain, education, communicating regional needs to govt etc)
- Prioritisation of action against the evaluation criteria
- Sequencing of prioritised actions across the short, medium and long term - identifying quick wins but also short term enabling actions that will unlock delivery in the medium/long term
- Assignment of roles and responsibilities to the actions
- Consideration of resource requirements, funding opportunities, risks, and next steps for the prioritised actions.

Engagement and Consultation

Extensive engagement has already taken place via the regional energy officers group, via all Council Economic Development Leads, open-workshop events run by CCR and WGES and the Regional Business Council and the Regional Economic Growth Partnership. Wales and West Utilities has bene close to this work and this must be built upon to align with stated ambitions to decarbonise the gas grid in South Wales. All this continued work will be critical in ensuring ownership, buy-in and complementary connections across LA strategies and climate crisis pledges.

Engagement will be continue to be driven by a continued focus on developing the evidence base and data – not just in relation to the scale of the challenge – but the scale of opportunity.


Energy efficiency and heat
Electricity and flexibility
Decarbonise transport
Grow business and jobs
Coordination, planning, regional support and ownership of the plan
Public Sector
Private Sector
Renewable Energy Private Sector
Community Energy group
Utilities
Academia Think Tank
Councils not involved in the Steering group
Transport for Wales
Cardiff Public Services Board
Natural Resources Wales
Welsh Government Housing
Economic Growth partnership
NHS
South Wales Industrial Cluster (SWIC)
SMEs
Business Forum
Arup
Sutton Consulting
EDF
Innogy Renewables Ltd
Sustainable Energy Ltd
Ynni Glan
EDF
Renewable UK Cymru
Awel Co-Op
Community Energy Wales
Wales & West Utilities
Western Power Distribution
Cardiff University
Institute of Welsh Affairs (IWA) (Facilitating the Future/Active Building Centre)

Future Generations Assessment Evaluation
(includes Equalities and Sustainability Impact Assessments)

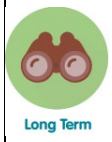
Name of the Officer completing the evaluation:	**Please give a brief description of the aims of the proposal**
Kellie Beirne **Phone no:** 07826 919286 **E-mail:** kellie.beirne@cardiff.gov.uk	Cardiff Capital Region Energy Strategy
Proposal: Cardiff Capital Region Energy Strategy	**Date Future Generations Evaluation form completed:** 7 December 2020

1. **Does your proposal deliver any of the well-being goals below?** Please explain the impact (positive and negative) you expect, together with suggestions of how to mitigate negative impacts or better contribute to the goal.

Well Being Goal	**Does the proposal contribute to this goal? Describe the positive and negative impacts.**	**What actions have been/will be taken to mitigate any negative impacts or better contribute to positive impacts?**
A prosperous Wales Efficient use of resources, skilled, educated people, generates wealth, provides jobs	The energy vision work sets out a clean growth agenda – the potential to safeguard planetary life support systems whilst growing regional income.	The vision has bene stakeholder informed and analysis of issues independently informed by data, evidence and insights. To optimize potential for impact this will be incorporated into a full action plan with a resultant 'energy mission'.
A resilient Wales Maintain and enhance biodiversity and ecosystems that support resilience and can adapt to change (e.g. climate change)	The report goes to the heart of the sustainability and resilience mandate.	More work needs to be done to show sustainability and economic growth are not mutually exclusive and CCR has the opportunity to demonstrate this.

Well Being Goal	Does the proposal contribute to this goal? Describe the positive and negative impacts.	What actions have been/will be taken to mitigate any negative impacts or better contribute to positive impacts?
A healthier Wales People's physical and mental wellbeing is maximized and health impacts are understood	Direct impact in terms of health, wellbeing and environmental benefits.	Climate crisis is causing worry and concern. More work will be needed in future to understand the link between anxiety and mental health and the state of the environment.
A Wales of cohesive communities Communities are attractive, viable, safe and well connected	Safeguarding environment and world key to ensuring communities can thrive	ROI assessments need social and environmental dimension and 'clean growth' aims to be more clearly understood. Work ongoing with Prof Max Munday to draw this out as part of wider approach to alternative economic intelligence.
A globally responsible Wales Taking account of impact on global well-being when considering local social, economic and environmental wellbeing	The report is a demonstration of CCR-wide responsibility to the planet	
A Wales of vibrant culture and thriving Welsh language Culture, heritage and Welsh language are promoted and protected. People are encouraged to do sport, art and recreation	Our City Deal is uniquely Welsh – but pitches towards being world leading in areas of competitive strength. This enables a strong reflection on our rich culture and heritage which is drawn from our natural environment and resources.	
A more equal Wales People can fulfil their potential no matter what their background or circumstances	The environment and climate crisis is a leveler – we are all responsible – we can all make a difference.	

2. How has your proposal embedded and prioritized the sustainable governance principles in its development?

Sustainable Development Principle	Does your proposal demonstrate you have met this principle? If yes, describe how. If not explain why.	Are there any additional actions to be taken to mitigate any negative impacts or better contribute to positive impacts?
 Balancing short term need with long term and planning for the future	This is both a short, medium and long term goal and a golden thread running through all projects and programmes.	Continued work on data/ evidence and generating in equal measure, insight and foresight.
Working together with other partners to deliver objectives	The report sets out the different partners and sectors engaged in this work and the challenge process is about collective endeavor- civil society, business, HE, public services and community sectors.	More work to develop, align and promote shared purpose on this agenda.
Involving those with an interest and seeking their views	The report sets out the different partners and sectors engaged in this work	
Putting resources into preventing problems occurring or getting worse	Report and resultant action plan should create conditions for this to happen – at scale.	
Considering impact on all wellbeing goals together and on other bodies	This will be undertaken on a case by case basis through the new assessment process.	

3. **Are your proposals going to affect any people or groups of people with protected characteristics?** Please explain the impact, the evidence you have used and any action you are taking below.

Protected Characteristics	Describe any positive impacts your proposal has on the protected characteristic	Describe any negative impacts your proposal has on the protected characteristic	What has been/will be done to mitigate any negative impacts or better contribute to positive impacts?
Age	As with all those categories below – the impacts will relate to specific delivery that underpins the execution and operation of this Plan	None arising at this time.	
Disability	As above	As above	
Gender reassignment	As above	As above	
Marriage or civil partnership	As above	As above	
Pregnancy or maternity	As above		
Race	As above		
Religion or Belief	As above		
Sex	As above		.
Sexual Orientation	As above		
Welsh Language	As above		

4. Safeguarding & Corporate Parenting. Are your proposals going to affect either of these responsibilities?

	Describe any positive impacts your proposal has on safeguarding and corporate parenting	**Describe any negative impacts your proposal has on safeguarding and corporate parenting**	**What will you do/ have you done to mitigate any negative impacts or better contribute to positive impacts?**
Safeguarding	Not directly relevant –however, building the future economy in a sustainable way should have a profoundly positive impact on ability to safeguard the future of our residents		
Corporate Parenting	Not directly relevant – however building strength in the economy should create opportunities for all of the young people entrusted in our care – in particular in safeguarding the environment for their futures.		

5. What evidence and data has informed the development of your proposal?

- Analysis of energy consumption
- Mazzucato work on energy mission for GMA and UN
- Collaboration with Energy Services catapult
- Collaboration with GMA CA

6. SUMMARY: As a result of completing this form, what are the main positive and negative impacts of your proposal, how have they informed/changed the development of the proposal so far and what will you be doing in future?

As above, the main implications will be in the delivery of this work.

7. MONITORING: The impacts of this proposal will need to be monitored and reviewed. Please specify the date at which you will evaluate the impact, and where you will report the results of the review.

The impacts of this proposal will be evaluated on:	Quarterly 2020/21 and beyond