2050 CUMBRIA BALANCED SCENARIO

A VIEW ON THE REGION'S FULLY DECARBONISED LOCAL ENERGY SYSTEM

JUNE 2020

Cadent
Your Gas Network

electricity north west
Bringing energy to your door

NAVIGANT
A Guidehouse Company

TABLE OF CONTENTS

Cadent Your Gas Network

electricity north west Bringing energy to your door

NAVIGANT A Guidehouse Company

INTRODUCTION AND KEY TAKEAWAYS

In the context of the UK's objective to achieve carbon neutrality by 2050, this document provides a view on how Cumbria's energy system could be decarbonised through a balanced used of renewable electricity and low-carbon gas.

Key takeaways:

1. Total energy demand is expected to fall in Cumbria from 15.5TWh in 2018 to 9.5TWh in 2050 on the back of expected improvements in energy efficiency
   a) Buildings will switch to new heating technologies including hybrid heating systems (48% of all dwellings), hydrogen boilers (24%), all-electric heat pumps (14%) and bio-LPG (13%).
   b) Road transport will predominantly be electrified, although there will be a role for hydrogen and biomethane, particularly in the heavy goods vehicle segment.
   c) Industry in Cumbria will be decarbonised through electrification and the replacement of natural gas with hydrogen.

2. Given significant renewable potential, Cumbria will be able to generate locally (at distribution grid level) 80% of the electricity that it will require in 2050. Abundant dedicated and curtailed low-carbon electricity can also be used for local production of green hydrogen.

3. Planning for a net-zero energy system needs to start as soon as possible including coordination between local authorities, utilities, business and residents. A clear long-term strategy will help make the right carbon-neutral investment decisions that will impact the long-term.

Cadent Your Gas Network | electricity north west Bringing energy to your door | NAVIGANT A Guidehouse Company

BUILDINGS – ENERGY DEMAND IN CUMBRIA

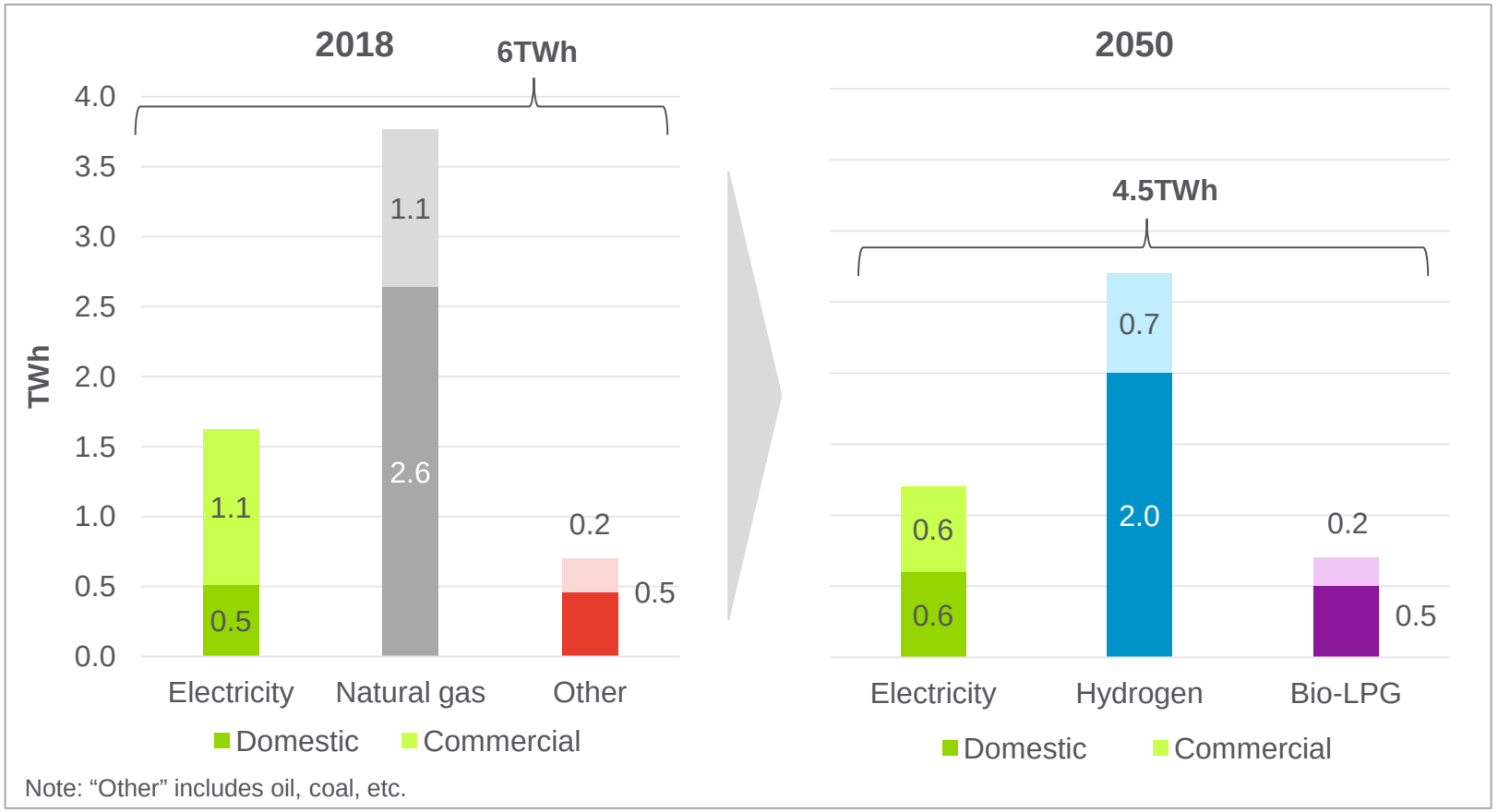
Total energy demand is expected to fall from 6TWh in 2018 to 4.5TWh by 2050. The 2050 residential heating mix will consist of hybrid heating systems (48%), hydrogen boilers (24%), all-electric heat pumps (14%) and bio-LPG (13%).

Cumbria has a relatively high number of households that are off the gas grid. This results in a relatively low number of dwellings heated with gas as seen in the current heating mix:

- Gas – 73%
- Electricity -13%
- Coal – 1%
- Oil – 9%
- Other – 5%

The projected growth rate of net dwellings in Cumbria is very low – only 1% over the period 2018-2050. This means new heating systems will be installed mainly in existing buildings.

To accommodate low-carbon heating technologies the energy efficiency of the existing building stock will have to be improved – 48% of buildings will need to see “moderate” upgrades (e.g. install high-performance glazing or improve loft insulation), whilst 14% will have to see “extensive” upgrades (e.g. underfloor insulation and heating or solid wall insulation cladding).



Note: “Other” includes oil, coal, etc.

Cadent Your Gas Network · electricity north west Bringing energy to your door · NAVIGANT A Guidehouse Company

TRANSPORT – ENERGY DEMAND IN CUMBRIA

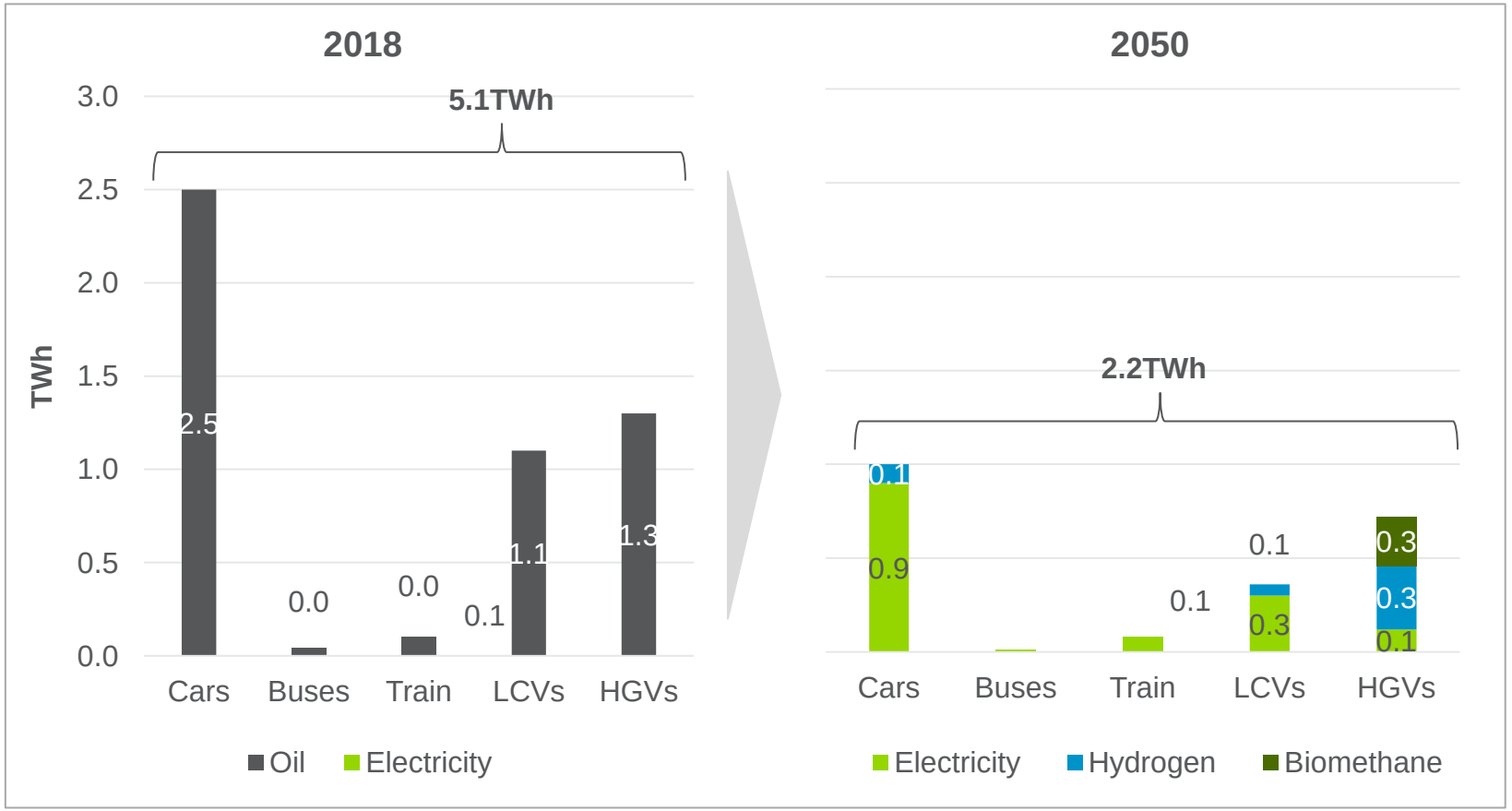
Total energy demand is expected to fall from 5.1TWh in 2018 to 2.2TWh by 2050 on the back of high fuel efficiency of low-carbon vehicles. HGVs are expected to see the most diverse mix of fuels including hydrogen and bio-CNG/LNG.

All road transport is expected to be decarbonised by 2050 with a ban on the sale of internal combustion engine (ICE) light vehicles starting in 2035.

The number of vehicle-kilometres driven in the UK is expected to increase by 2050 for passenger cars (by 35%) and light commercial vehicles (LCVs) (by 70%). The expected increase is less pronounced for heavy goods vehicles (HGVs) (7% increase by 2050).

The impact of increased road traffic on energy demand from road transport is offset by the high fuel efficiency of electric vehicles, which are around 70% more efficient than internal combustion engines. This results in an overall drop in energy demand from road transport by 2050.

The drop is the lowest in the HGV category which is expected to see the most diverse fuel mix in the long-term: 50% hydrogen, 30% battery-electric and 20% running on bio-CNG/LNG.



Cadent Your Gas Network · electricity north west Bringing energy to your door · NAVIGANT A Guidehouse Company

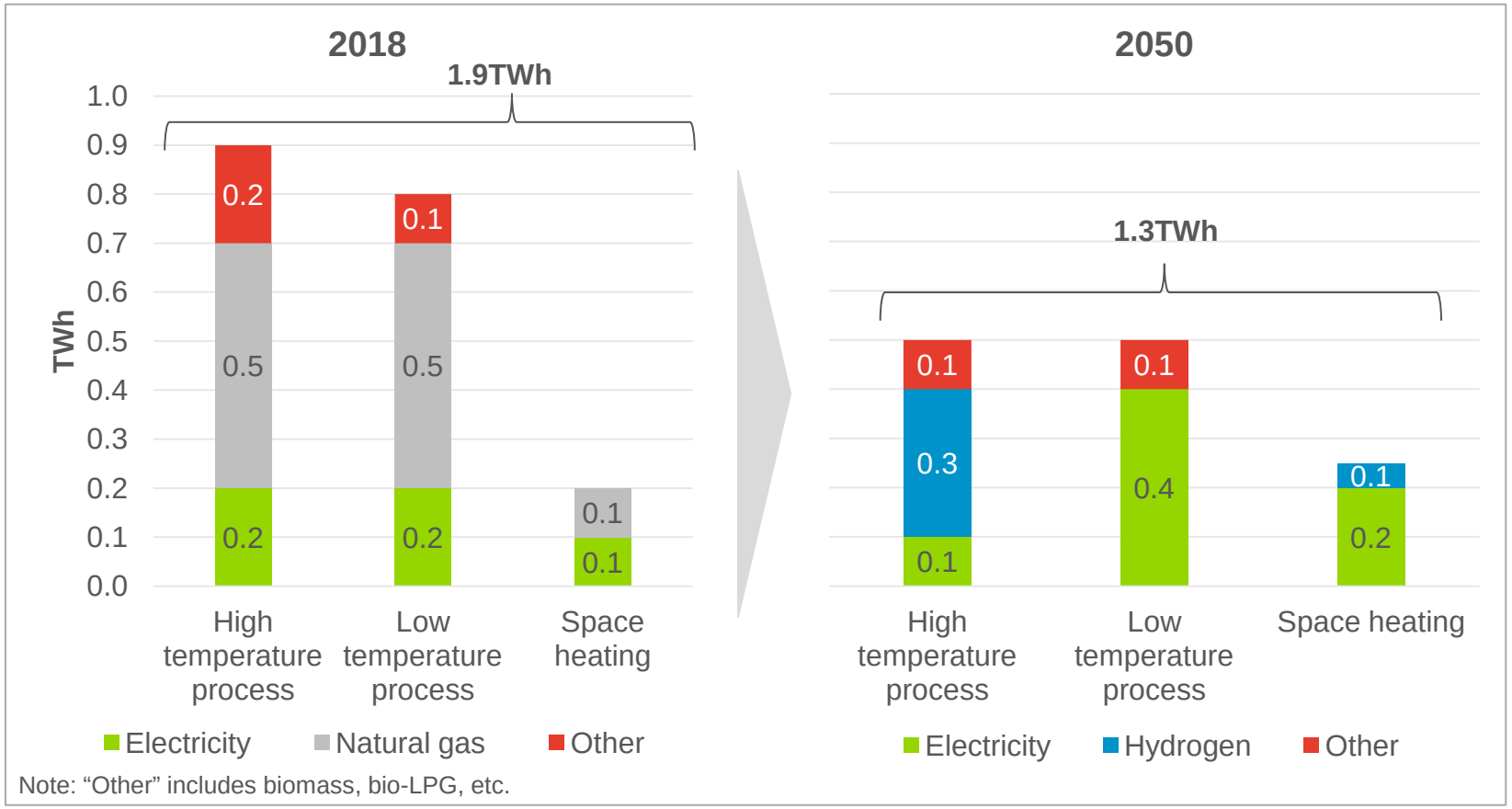
INDUSTRY – ENERGY DEMAND IN CUMBRIA

Total energy demand is expected to fall from 1.9TWh in 2018 to 1.3TWh by 2050. As industry decarbonises, the share of electricity will increase from 26% to 60% over this timeframe.

Cumbria has a relatively energy-intensive industry reflected by a high share of industrial demand for energy used in high temperature industrial processes. Key industries in Cumbria are nuclear (e.g. fuel reprocessing), shipbuilding, wood, paper and pulp, rubber and plastics and food and drink manufacturing.

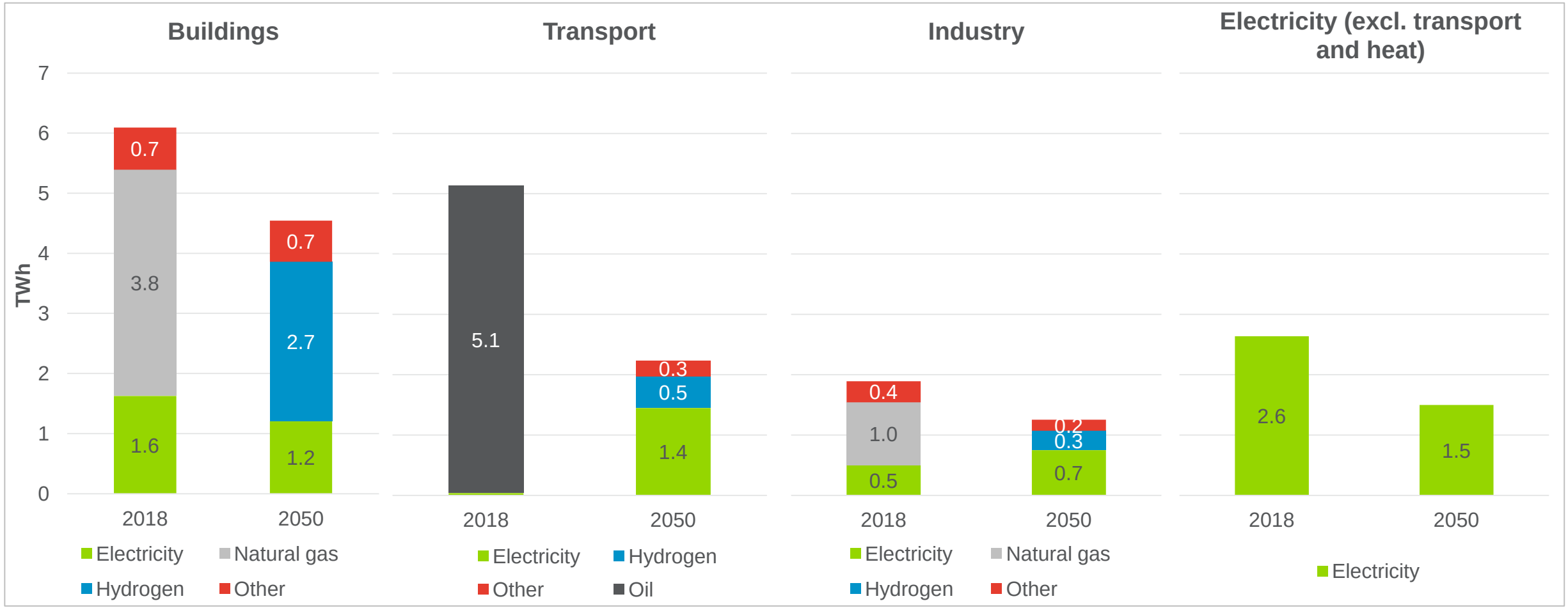
The regional economy (measured in GVA) is expected to increase by 1% per annum until 2033 which slightly below the 1.2% UK average. This is reflected by slightly lower growth in industrial demand for energy. In the long-term, demand growth is offset by significant improvements in industrial energy efficiency.

In principle, low temperature processes are expected to be electrified in the future. Conversely, the electrification of high temperature processes can be challenging due to the high volumes of electricity required. It is most likely that such processes will switch from natural gas to hydrogen.



Note: "Other" includes biomass, bio-LPG, etc.

EVOLUTION OF DEMAND – OVERVIEW



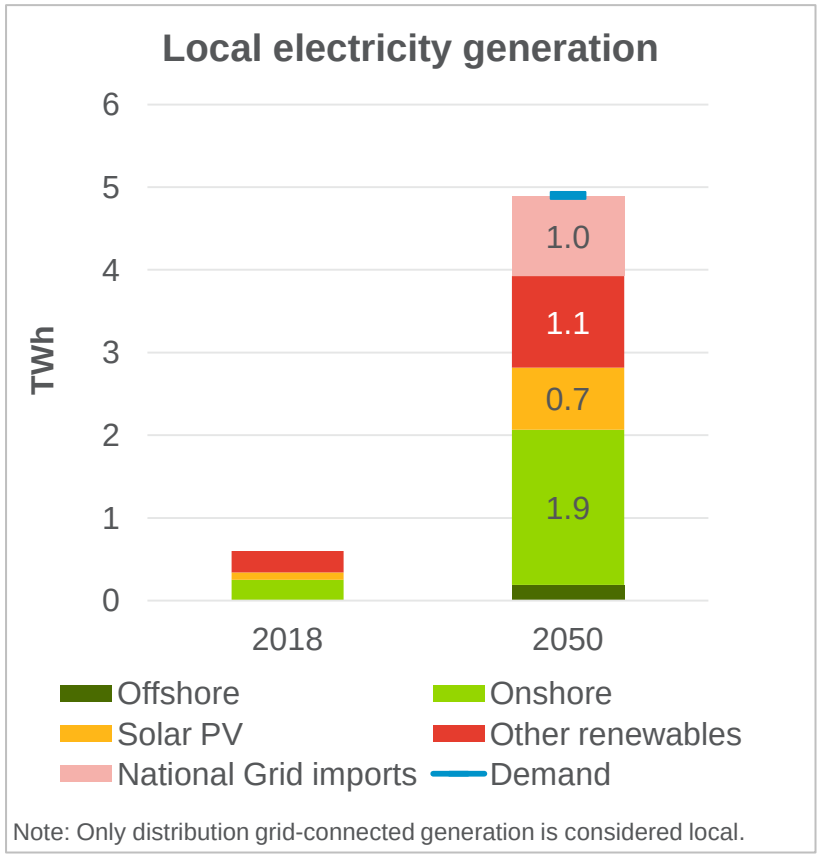
Cadent Your Gas Network
electricity north west Bringing energy to your door
NAVIGANT A Guidehouse Company

ENERGY SUPPLY IN CUMBRIA

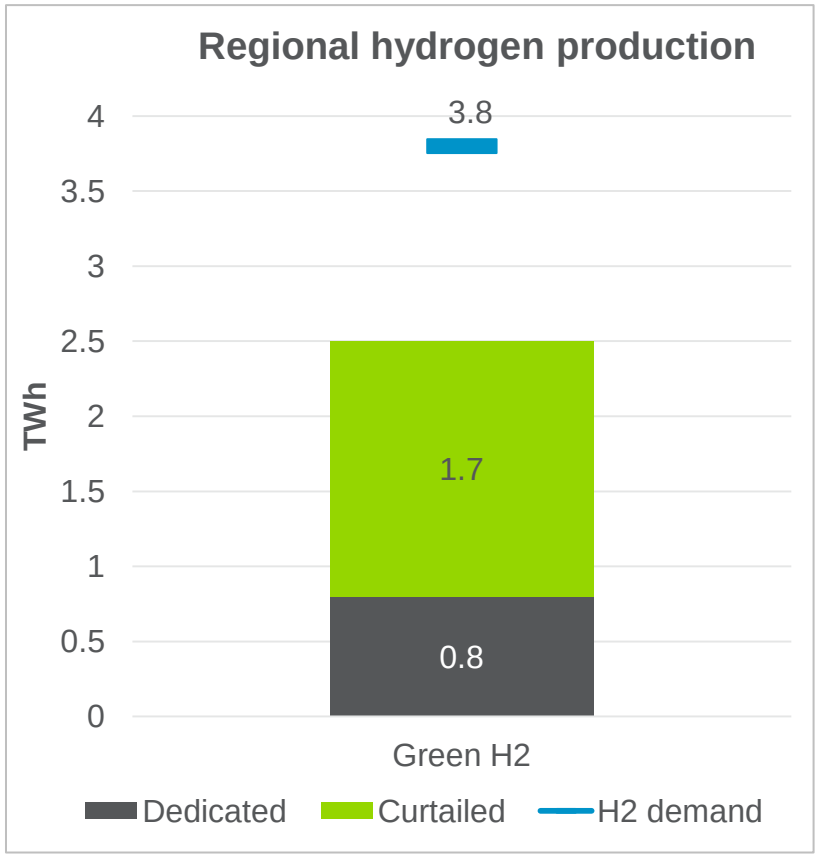
Cumbria will be able to meet 80% of electricity demand though local distribution grid-connected generation. The strong wind resources can be used to generate significant amounts of green hydrogen by 2050.

Electricity generation potential is expected to increase significantly in Cumbria. The region has abundant space to accommodate both onshore and offshore wind farms. The region is also a potential location for future nuclear new build. The existing nuclear ecosystem makes Cumbria a likely location for the UK government's planned nuclear development.

From the mid-2030s, Cumbria has the potential to produce significant quantities of green hydrogen from dedicated wind generation, curtailed electricity or, if available, nuclear power. The lack of large industrial clusters makes Cumbria an unlikely location for large-scale blue hydrogen production in the future. In the long-term, Cumbria will be part of the expected North of England Hydrogen Zone which will give the region access to various sources of low-carbon hydrogen.



Note: Only distribution grid-connected generation is considered local.



Cadent Your Gas Network · electricity north west Bringing energy to your door · NAVIGANT A Guidehouse Company

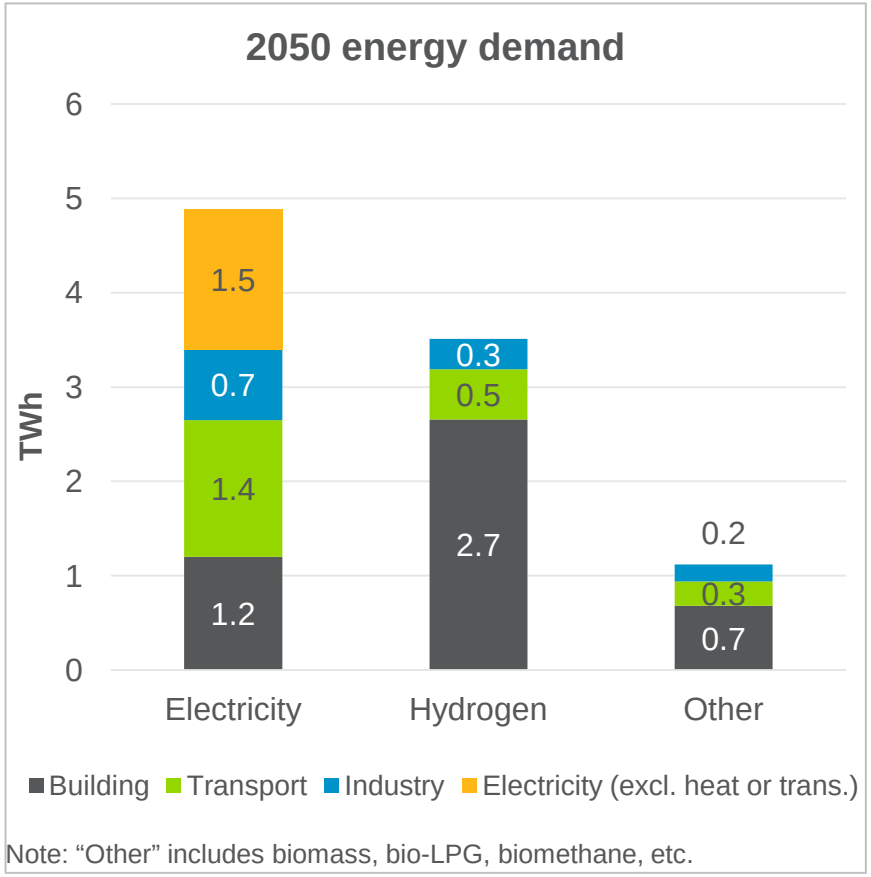
2050 BALANCED SCENARIO FOR CUMBRIA

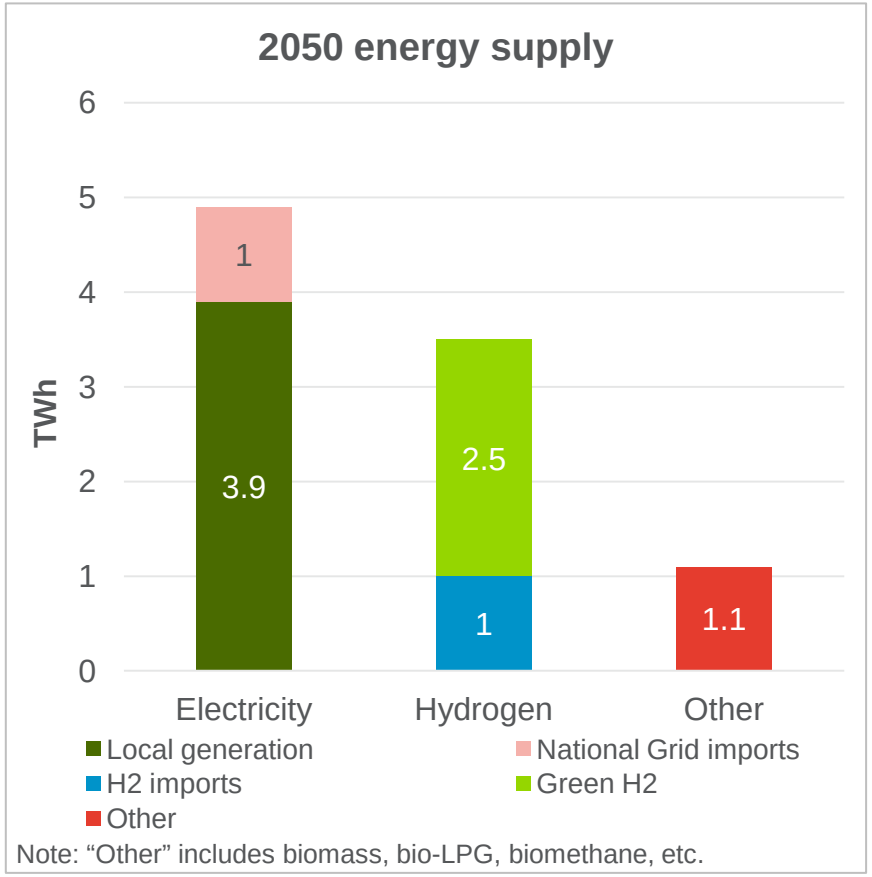
By 2050, Cumbria will require 4.8TWh of electricity and 3.5TWh of hydrogen. The region will be close to self-sufficiency for electricity and will be a net-importer of hydrogen.

The majority of energy consumed in a 2050 decarbonised energy system will be electricity, followed by hydrogen. Other sources of energy in 2050 will include bio-LPG for off-grid home heating, bio-CNG/LNG for heavy goods transport and biomass in industry.

Cumbria has the potential to become a significant generator of electricity thanks to its renewable and nuclear power potential. Transmission-level electricity can be used to produce green hydrogen.

Around 2/3 of hydrogen consumed by 2050 in the region is projected to be green hydrogen – considerably more than the 20% expected for the whole of the UK.





Cadent Your Gas Network · electricity north west Bringing energy to your door · NAVIGANT A Guidehouse Company

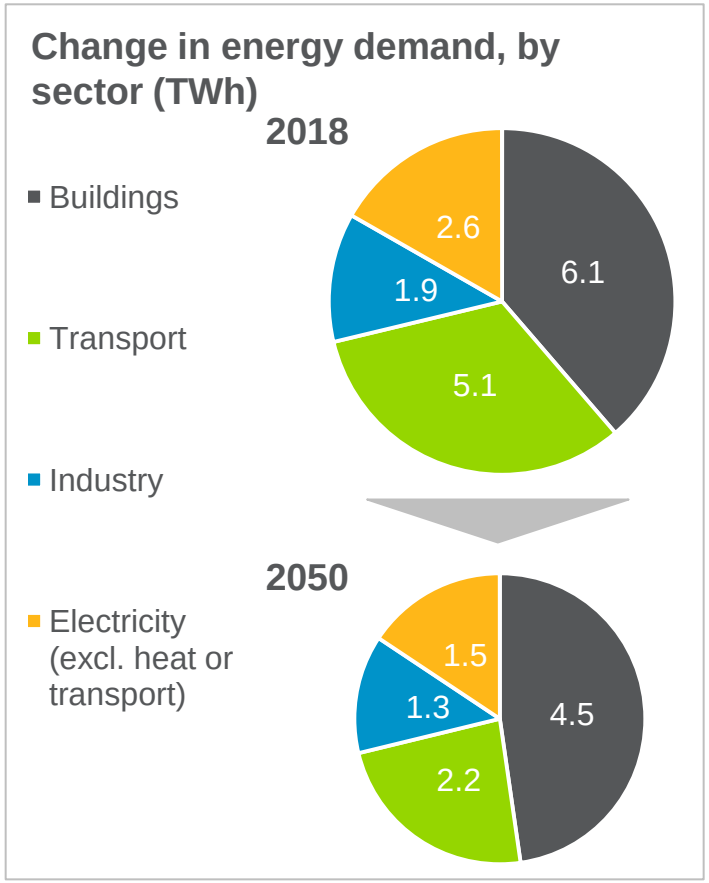
EVOLUTION OF ENERGY CONSUMPTION

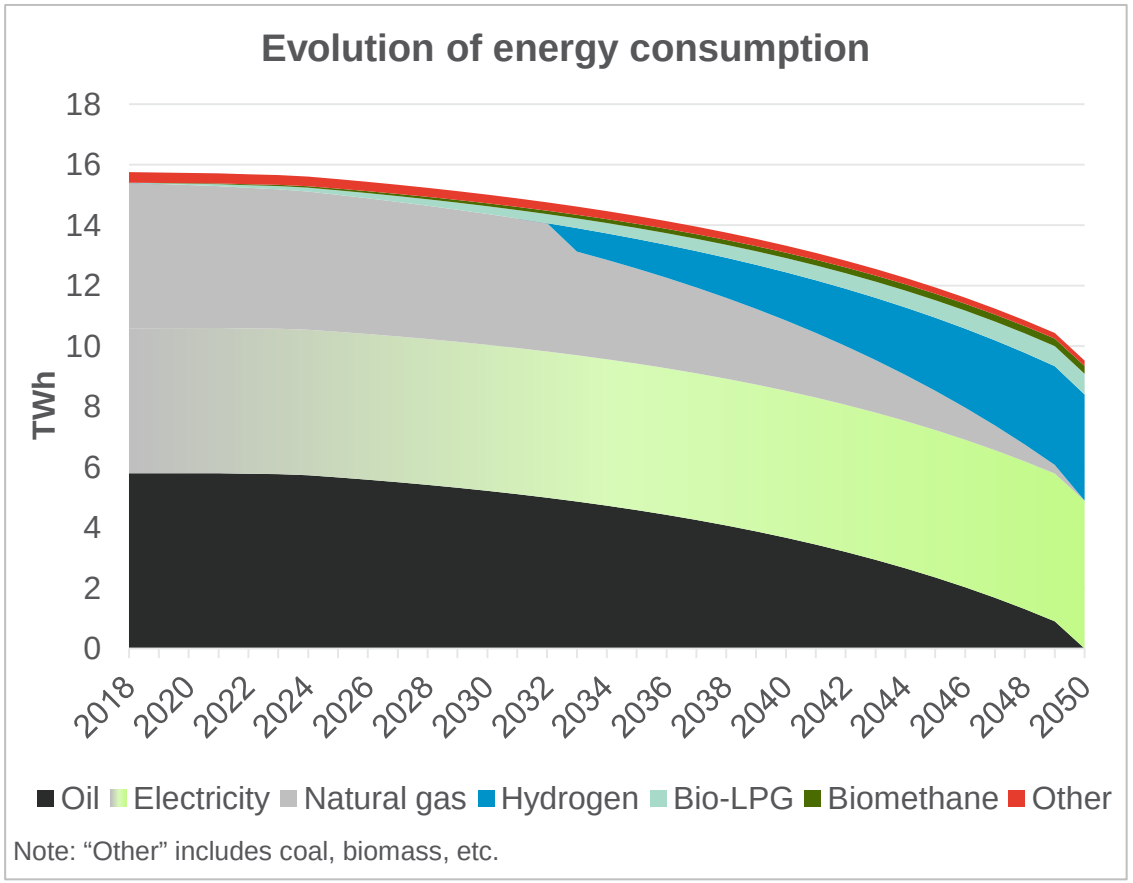
Cumbria's local energy system is expected to undergo a profound transformation as it is decarbonised by 2050. Total energy demand will fall from 15.5TWh to 9.5TWh in 2050 on the back of improved energy efficiency.

On the demand-side, the "buildings" segment will increase from 39% today to 47% of total demand in 2050, whilst the share of transport will fall from 33% currently to 23% of total demand in 2050.

The role of fossil fuels such as oil and natural gas will diminish completely as demand sectors are decarbonised. Instead, zero-carbon electricity will become key along with hydrogen which will become the dominant gas.

The lack of local blue hydrogen production capacity and the distance from other hydrogen-based industrial clusters suggests hydrogen supply to the region may materialize later than in other regions in the North of England.





Note: "Other" includes coal, biomass, etc.

Cadent Your Gas Network · electricity north west Bringing energy to your door · NAVIGANT A Guidehouse Company

A HIGH-LEVEL ROADMAP FROM 2020 TO 2050

A high-level roadmap of actions that need to be taken to achieve carbon neutrality in Cumbria by 2050:

	2020-2030	2030-2040	2040-2050
Planning	• Campaign to communicate change and raise social awareness • Development of energy transition skills and resource pool • Creation of an energy transition monitoring and resource hub		
Buildings	• Regional building stock survey • Demonstration projects for building upgrades followed by a planned building stock upgrading programme • Planning long-term supply of bio-LPG for off-grid buildings • Pilots for Building Energy Management Systems	• Large-scale upgrading of the existing building stock • Deployment of demand side management in buildings • Adoption of hydrogen-ready devices (e.g. boilers) • Incentivize switching from oil to bio-LPG	• Expand building stock upgrading to include most challenging and difficult to reach buildings
Transport	• Develop walking, cycling and public EV charging infrastructure • Adoption of low-carbon public transport (e.g. electric buses) • Planning long-term supply of bio-methane for heavy goods vehicles (HGVs) at key transport hubs	• Public EV charging network is complete by 2035 (national ICE sale ban) • Electrify all remaining rail links or adopt hydrogen trains • Develop charging/refuelling infrastructure for HGVs	• Development of charging/refuelling infrastructure for HGVs is complete
Industry	• Drive energy efficiency and fuel recycling in industry • Industrial clusters (e.g. Barrow Island or Sellafield) assess most optimal decarbonisation options • Industrial electrification where technically feasible and lowest cost	• Hydrogen-ready equipment (e.g. boilers) and processes • Continued industrial electrification as costs decline • First facilities switch to hydrogen	• Completion of hydrogen switching • Remaining carbon emissions are captured and utilized or stored e.g. in Morecombe Bay
Electricity	• Development of best onshore wind sites (best wind resource, grid connection, least local opposition) is supported by local authorities • Local uptake of rooftop and ground-mounted solar PV • LV grid monitoring is expanded	• Potential nuclear new build • Electricity network is reinforced, especially for electric heating for off-gas-grid buildings • Local Energy Markets, behind-the-meter storage and demand response is expanded	• Continued electricity network reinforcement
Hydrogen	• Detailed planning for rollout of local hydrogen grid • Natural gas grid is converted street by street to a hydrogen grid	• Potential expansion of HyNet network to Cumbria • Local green hydrogen from dedicated wind power • Industry starts gradual switch from natural gas to hydrogen • Localized hydrogen storage near anchor users	• Local green hydrogen becomes dominant source • Large-scale hydrogen storage, e.g. in salt caverns

Cadent Your Gas Network · electricity north west Bringing energy to your door · NAVIGANT A Guidehouse Company

APPENDIX

NAVIGANT
A Guidehouse Company

APPENDIX

MODELLING APPROACH AND MAIN ASSUMPTIONS

Modelling Approach

- Navigant's modelling for the balanced scenario in ENA's *Pathways to Net Zero* report forms the basis for the work presented here.
- Demand and supply per sector or energy carrier were estimated using a bottom-up approach leveraging local data and analyses reflected in various strategy and policy documents
- In case where (insufficient) local data was available, national level data was scaled down to the regional level.
- Based on the demand and supply analysis, a balanced scenario for Cumbria in 2050 was created.

Main Assumptions

- Grid-connected buildings will be heated either through hybrid heat systems or boilers fueled by hydrogen, depending on building insulation level, type and size.
- Off-grid buildings switch to purely electric heat pumps or bio-LPG (if currently heated by oil)
- Energy efficiency EPC data can be scaled to model full building stock
- Energy consumption for each mode of transport was calculated using the fuel mix used in the analysis done for the ENA
- Energy demand in industry was assessed using BEIS data on fuel mix for industrial processes

Key documents

1. Pathways to Net Zero, ENA
2. ONS forecasts for new dwellings until 2040
3. Cumbria Renewable Energy Capacity and Deployment Study
4. Cumbria Local Industrial Strategy
5. Developing networks for the future, Cadent
6. Distribution Future Electricity Scenarios, ENWL
7. Future Energy Scenarios 2019, National Grid

Cadent Your Gas Network | electricity north west Bringing energy to your door | NAVIGANT A Guidehouse Company

CONTACTS

RICHARD BASS
Director
+44 207 661 7716
richard.bass@guidehouse.com

MARK LIVINGSTONE
Director
+44 207 661 0651
mark.livingstone@guidehouse.com

MARCEL VOLKERTS
Associate Director
+31 (0)6 29119963
marcel.volkerts@guidehouse.com

ARTUR LENKOWSKI
Senior Consultant
+44 207 661 0583
artur.lenkowski@guidehouse.com