Appendix A

2050 LANCASHIRE BALANCED SCENARIO

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

NOVEMBER 2020

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CONTEXT

Lancashire is currently set to achieve carbon neutrality by 2050. This pathway provides a view on how its 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 Lancashire from 34.5TWh in 2018 to 22TWh in 2050 on the back of improvements in energy efficiency
   a) Buildings will switch to new heating technologies including hybrid heating systems (54% of all dwellings), hydrogen boilers (24%) and all-electric heat pumps (18%).
   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 Lancashire will be decarbonised through electrification and the replacement of natural gas with hydrogen.

2. Given significant renewable potential, Lancashire will be able to locally generate (at distribution grid level) over half of the electricity it requires. Abundant 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 strategy will help make the right carbon-neutral investment decisions that will impact the long-term.

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EVOLUTION OF ENERGY CONSUMPTION

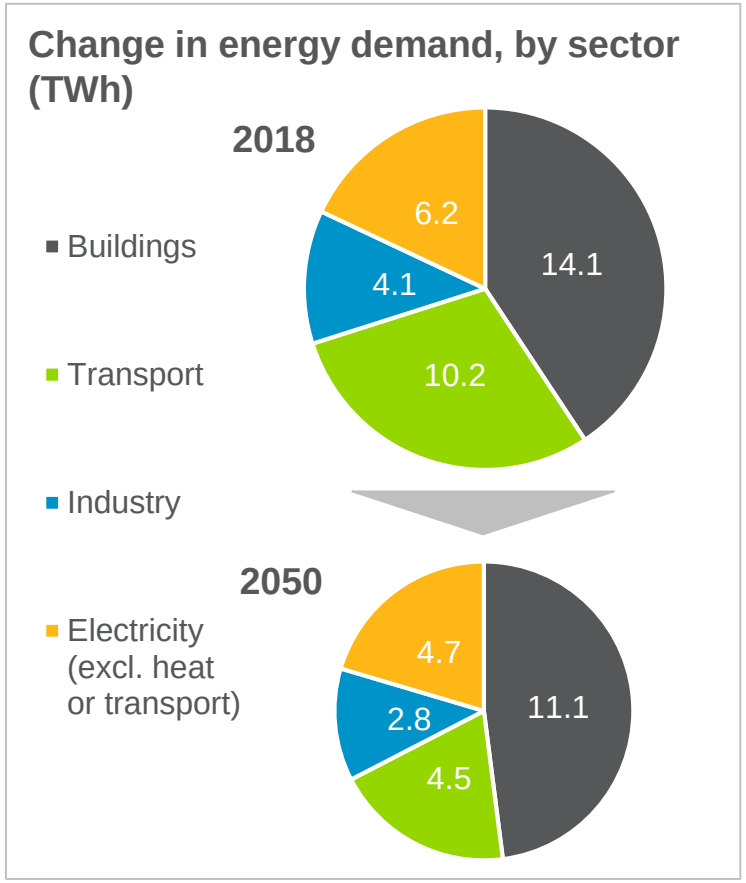
Total energy demand will fall from 34.5TWh to 22TWh in 2050 on the back of improved energy efficiency.

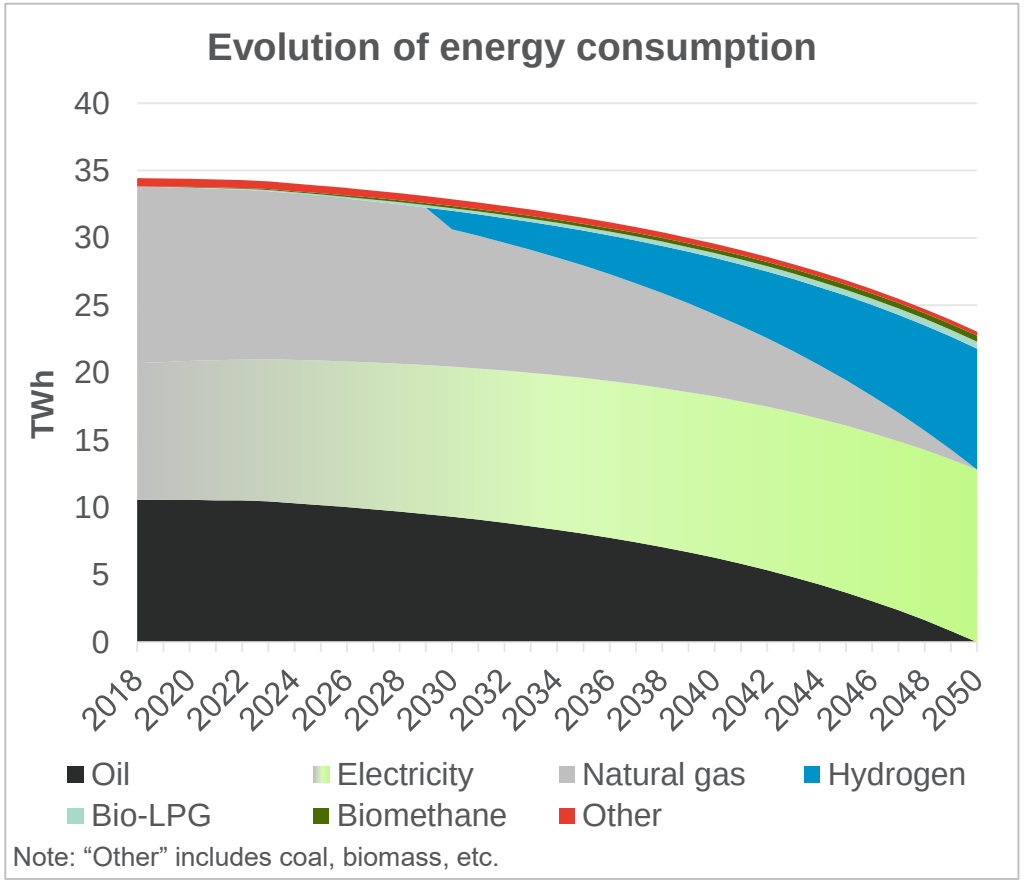
Buildings will increase from 41% today to 51% of total demand in 2050

Transport will fall from 30% currently to 21% of total demand in 2050.

Fossil fuels will diminish completely
Zero-carbon electricity and hydrogen will become key

Lack of local blue hydrogen production capacity suggests hydrogen may materialise later than in other areas of the NW





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

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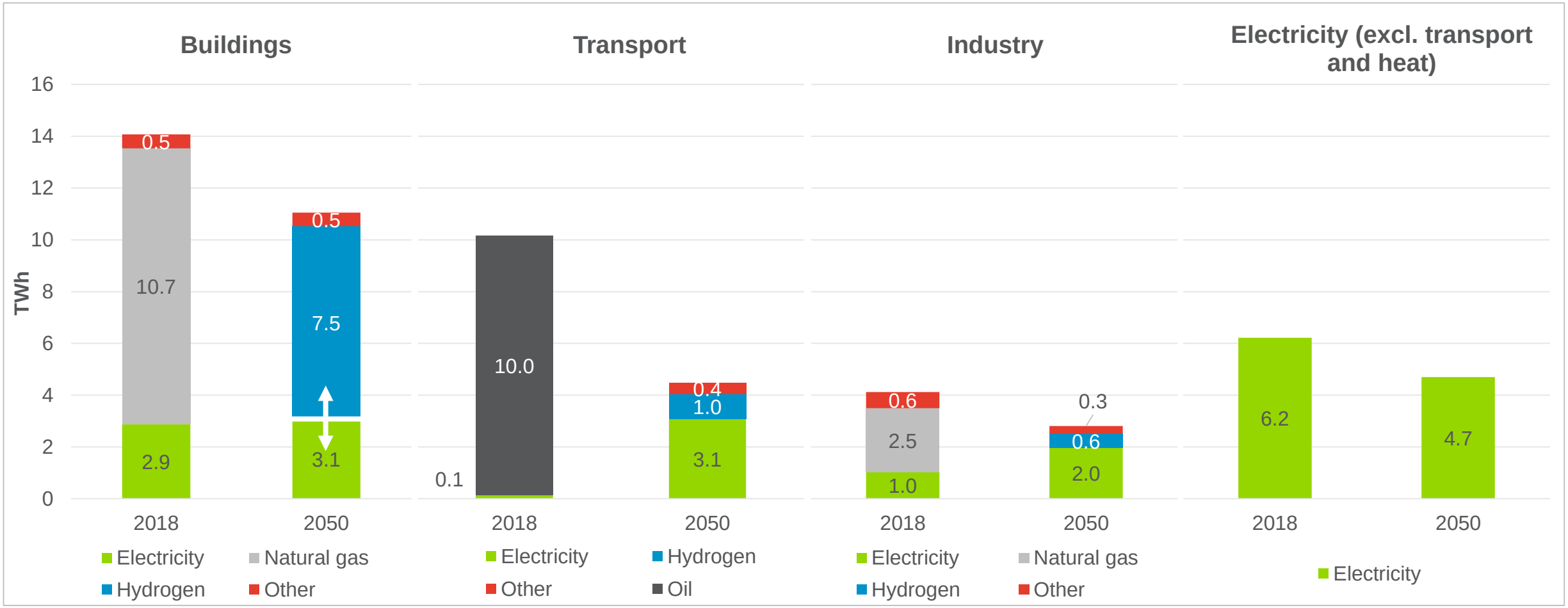
EVOLUTION OF DEMAND – OVERVIEW



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2050 BALANCED SCENARIO FOR LANCASHIRE

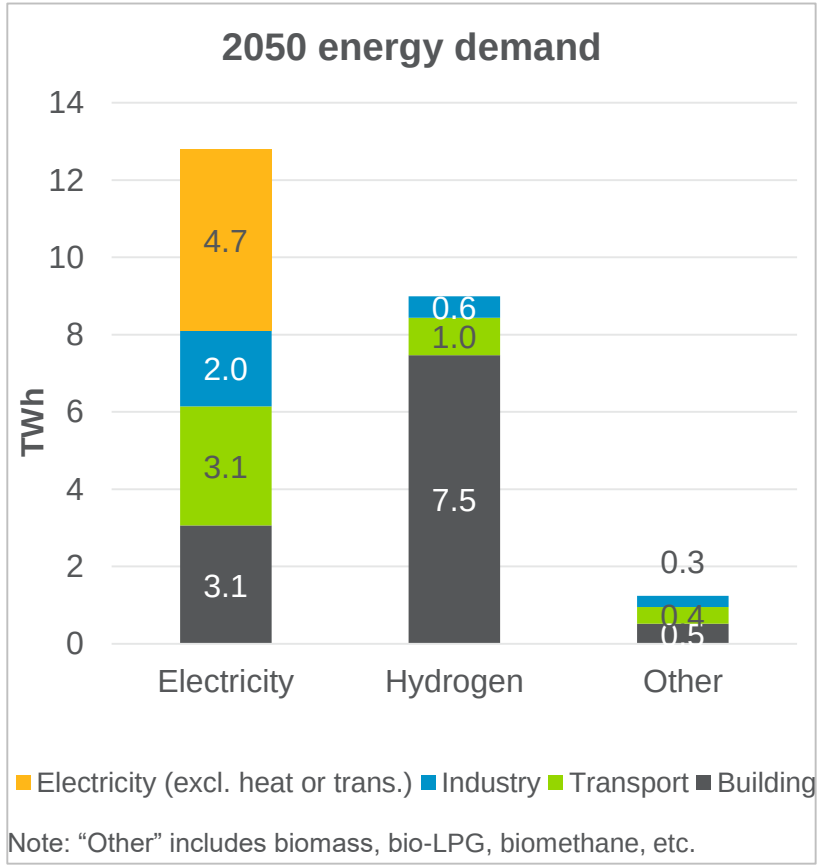
By 2050, Lancashire will require 13TWh of electricity and 9TWh of hydrogen. It will rely on electricity imports from the National Grid and will be a net-importer of hydrogen.

The majority of energy consumed in a 2050 will be electricity, then hydrogen.

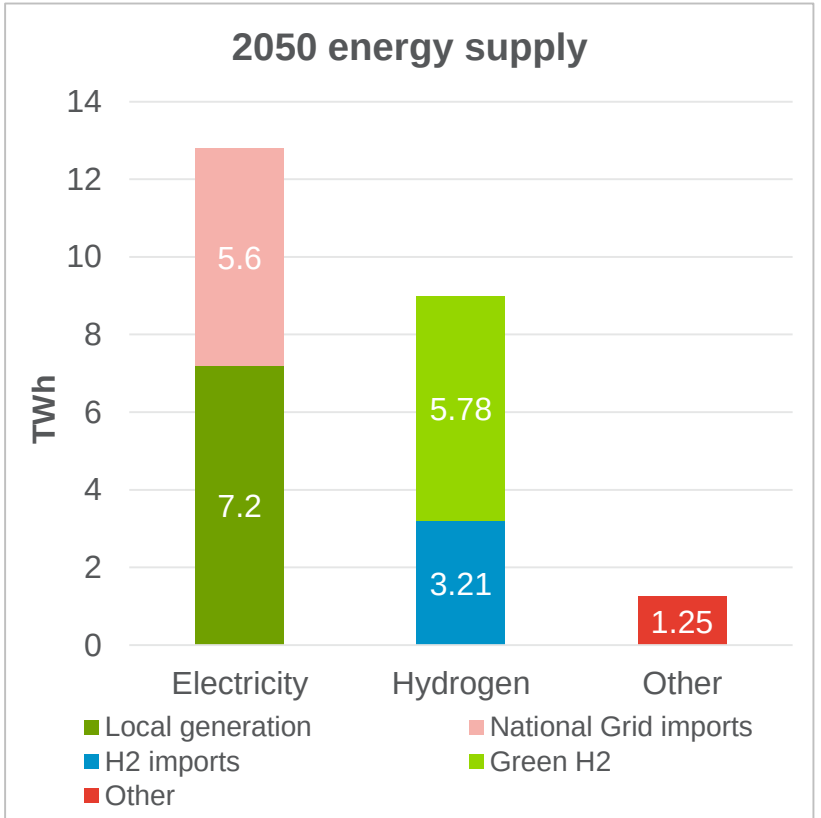
Other sources of energy in 2050 will include bio-LPG for off-grid home heating, bio-CNG/LNG for heavy goods transport and biomass in industry.

Lancashire has the potential to become a generator of electricity for the rest of the UK thanks to its large renewable power potential.

Around 60% of hydrogen consumed by 2050 in the region will be green hydrogen – considerably more than the 20% expected for the whole of the UK.



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



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

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ENERGY SUPPLY IN LANCASHIRE

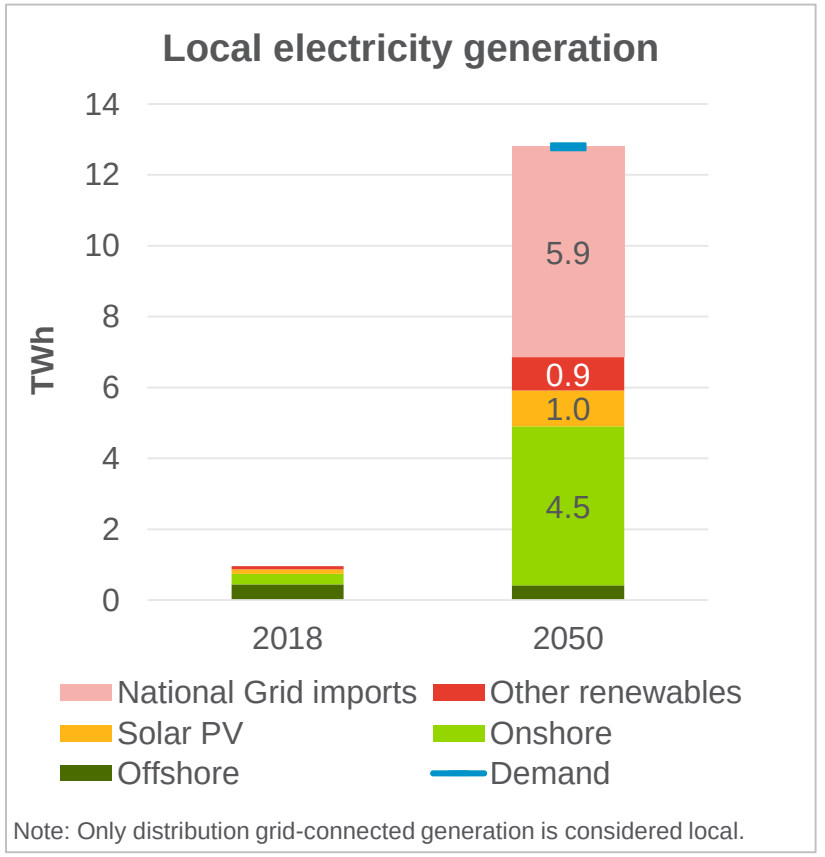
Due to its onshore wind potential, more than half of electricity demand can be met with local distribution-level generation. Abundant wind resources can also be used to generate significant amounts of green hydrogen by 2050.

Renewable electricity generation will increase considerably.
Potential for far more onshore and offshore wind.

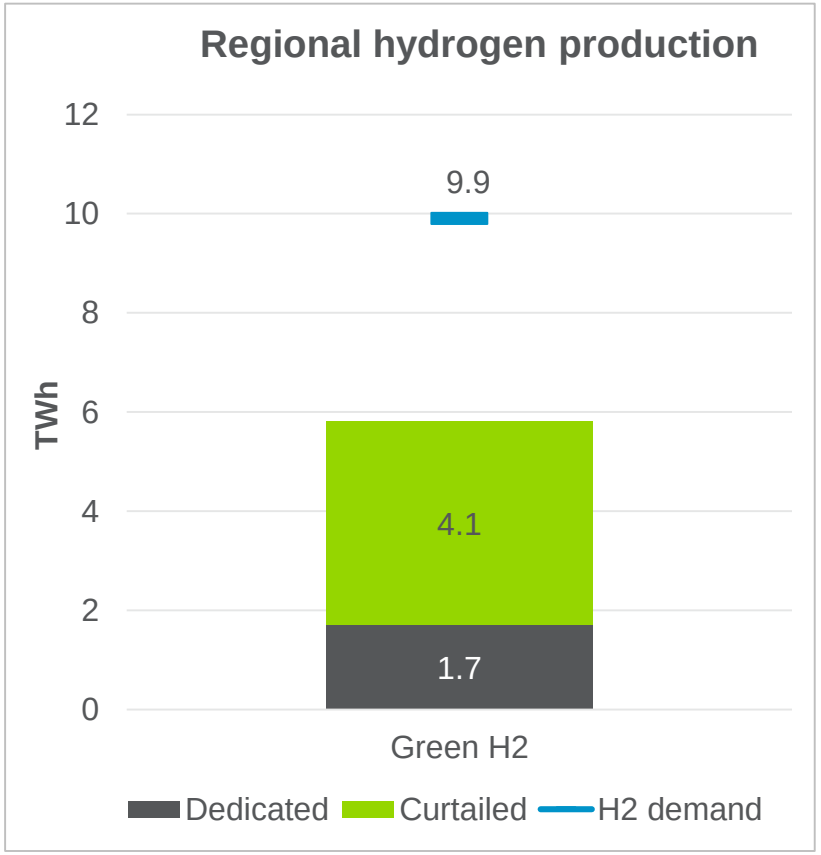
Nuclear is unclear. Reactors in Heysham are to decommission in 2024 and 2030.
It's likely the lifetime of these reactors will be extended, new nuclear reactors would have to be built for nuclear to play a role by 2050.

From the mid-2030s, there's the potential to produce significant quantities of green hydrogen from dedicated wind generation or curtailed grid electricity.

Long-term, Lancashire will be part of the North of England Hydrogen Zone providing access to various sources of low-carbon hydrogen.



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



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A HIGH-LEVEL ROADMAP FROM 2020 TO 2050

A high-level roadmap of actions that need to be taken to achieve carbon neutrality in Lancashire 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 • 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)	• 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. Samlesbury or Hillhouse) 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	• 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	• Nuclear decommissioning at Heysham (if plant lifetime extended) • 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	• Expansion of the HyNet network to Lancashire • 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

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APPENDIX

BUILDINGS – ENERGY DEMAND IN LANCASHIRE

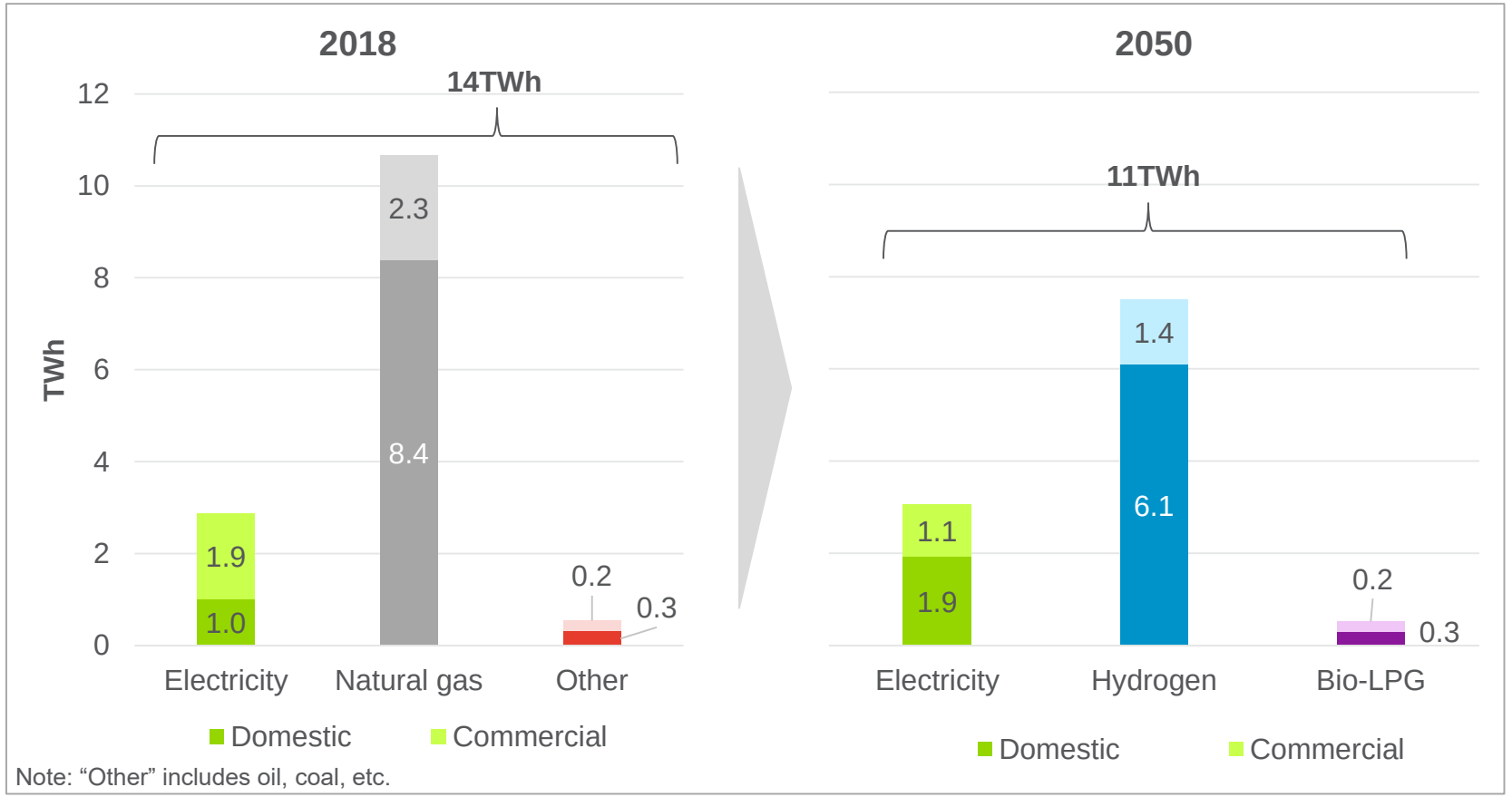
Total energy demand is expected to fall from 14TWh in 2018 to 11TWh by 2050. The 2050 residential heating mix will consist of hybrid heating systems (54%), hydrogen boilers (24%) and all-electric heat pumps (18%).

The majority of households in Lancashire are connected to the gas grid and currently use gas for space heating. The current residential heating mix in Lancashire is:

- Gas – 87%
- Electricity - 10%
- Oil – 1.5%%
- Other – 1.7%

The projected growth rate of net dwellings in Lancashire is relatively low – around 9% over the period 2018-2050. These new buildings are expected to be highly energy-efficient and be heated with all-electric heat pumps.

To accommodate low-carbon heating technologies the energy efficiency of the existing building stock will have to be improved – 54% of buildings will need to undergo “moderate” upgrades (e.g. install high-performance glazing or improve loft insulation), whilst 18% will have to see “extensive” upgrades (e.g. underfloor insulation and heating or solid wall insulation cladding).



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

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TRANSPORT – ENERGY DEMAND IN LANCASHIRE

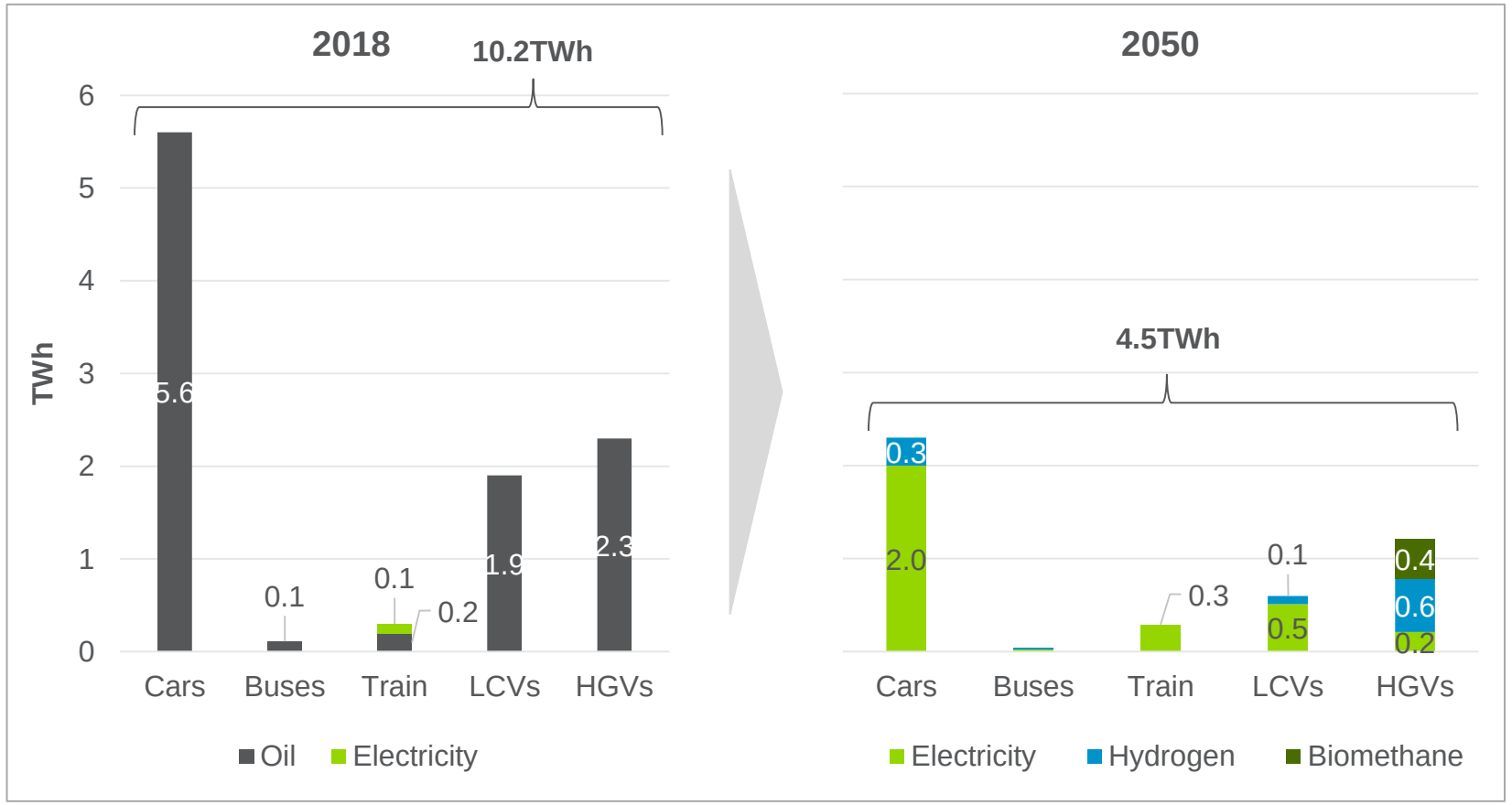
Total energy demand will fall from 10.2TWh in 2018 to 4.5TWh by 2050 on the back of high fuel efficiency of low-carbon vehicles. HGVs are expected to see the most diverse mix of fuels including hydrogen and bio-CNG/LNG.

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.



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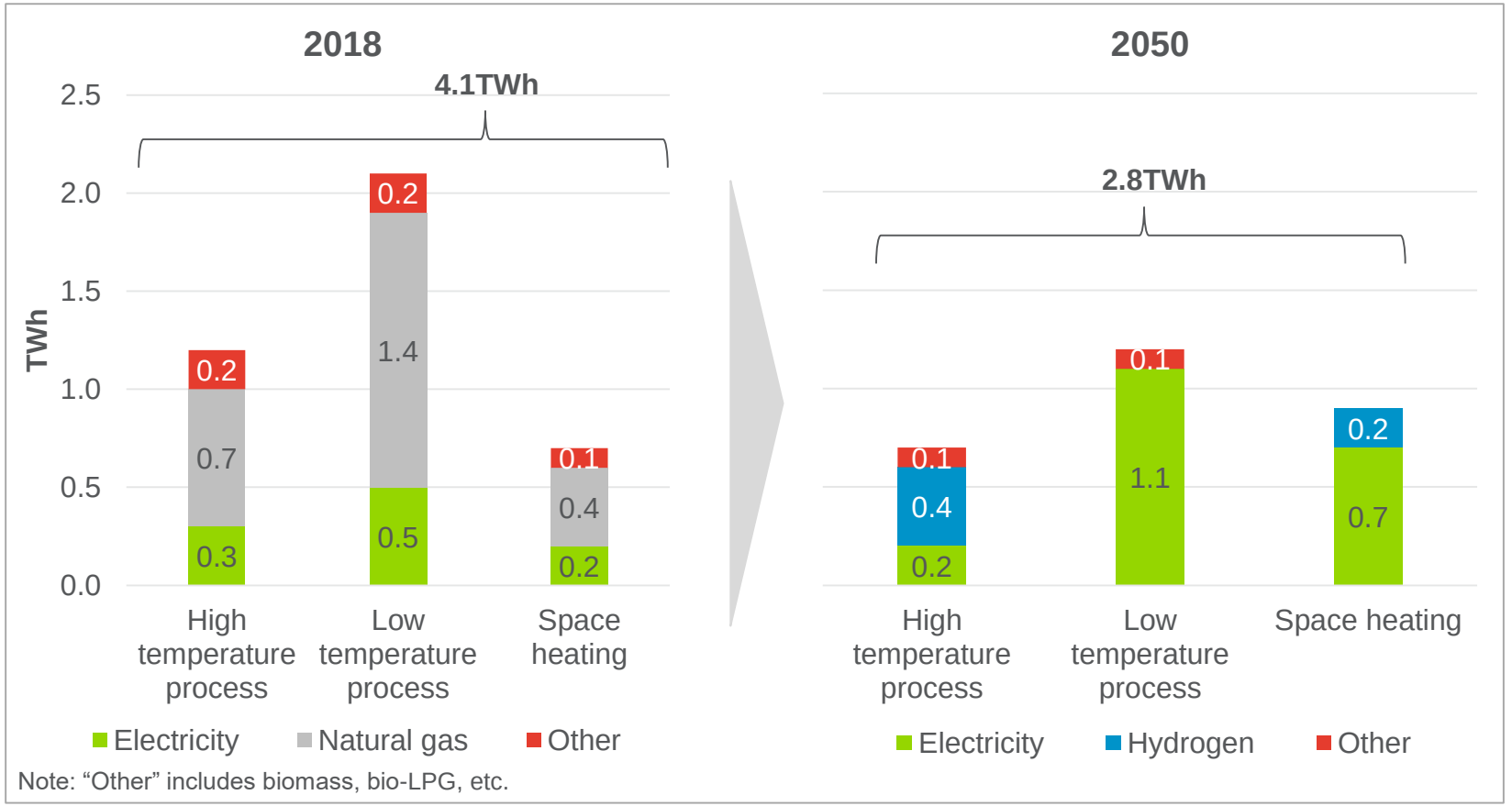
INDUSTRY – ENERGY DEMAND IN LANCASHIRE

Total energy demand is expected to fall from 4.1TWh in 2018 to 2.8TWh by 2050. Given the relatively low heat intensity of Lancashire industry, the role of electricity will increase substantially from 25% to 70% over this time period.

Lancashire has a relatively light industry reflected by a high share of industrial demand for energy used in low temperature industrial processes. Key industries in Lancashire are advanced manufacturing and engineering, aerospace, textiles and energy (nuclear ecosystem in Heysham and range of renewable businesses).

The regional economy (measured in GVA) is expected to increase by 0.8% per annum until 2033 which is clearly below the 1.2% UK average. This is reflected by 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.

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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 Lancashire 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
- 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. Lancashire Sustainable Energy Study
4. Lancashire Local Industrial Strategy (Draft)
5. Developing networks for the future, Cadent
6. Distribution Future Electricity Scenarios, ENWL
7. Future Energy Scenarios 2019, National Grid

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