AURORA

ENERGY RESEARCH

What will decarbonising home heating mean for Great Britain's energy markets?

Breakout Speakers

What will decarbonising home heating mean for Great Britain’s energy markets?

CHAIR

Ben Collie
Principal
Aurora Energy Research

AURORA

Spring Forum
London 2021

PANELLIST

Joanna Campbell
Assistant Director
National Infrastructure Commission

PANELLIST

Nina Skorupska
CEO
Renewable Energy Association

PANELLIST

Matthew Hart
Head of UK Strategy
E.ON

PANELLIST

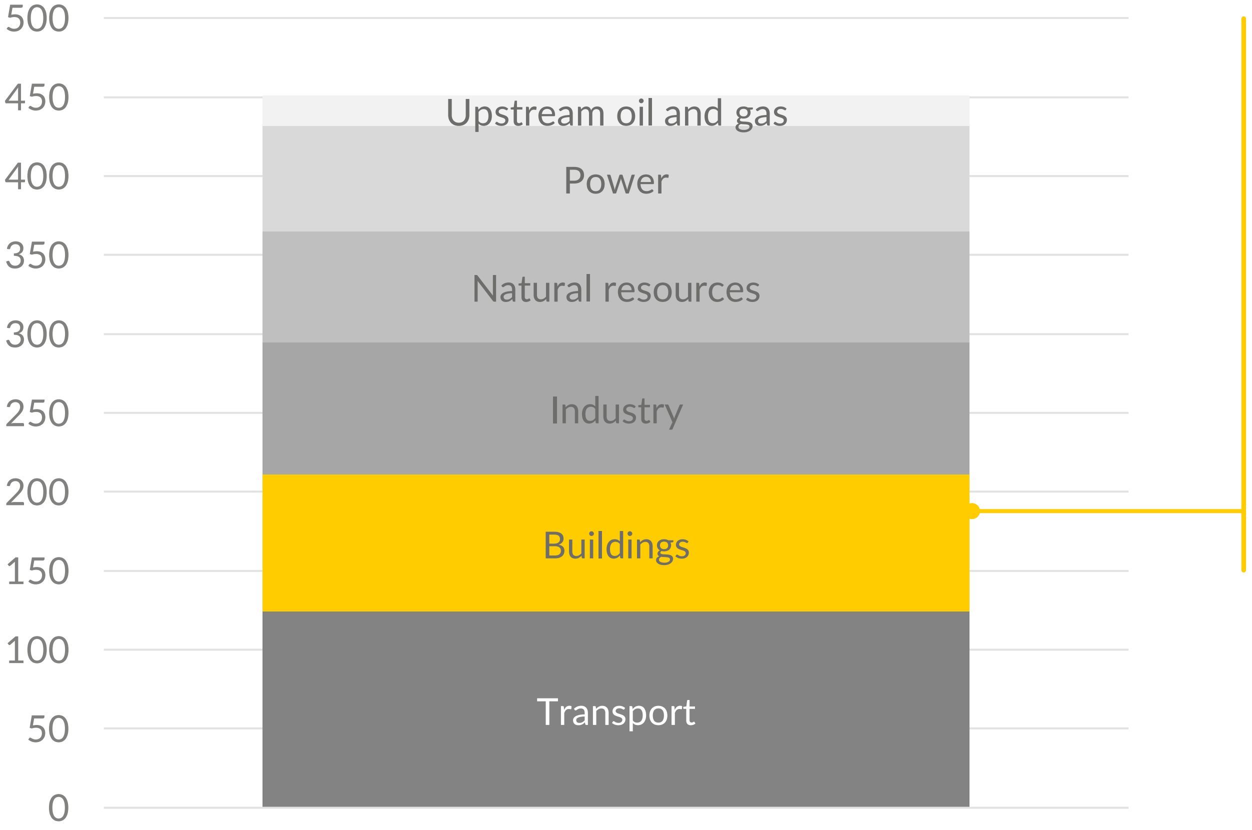
Mike Hawkins
Deputy Director Clean Heat Analysis
BEIS

Decarbonising heat will be essential to reduce emissions from buildings, which accounted for 19% of UK territorial emissions in 2018

AURORA

UK territorial emissions 2018

$MtCO_2e$



- Buildings accounted for 87Mt, 19% of the total of 451Mt
- Residential buildings accounted for 68Mt, more than the whole power sector
- Heating accounts for the great majority of residential buildings emissions
- Almost 90% of homes in England currently use fossil fuels
- About 85% of these are connected to the gas grid

Sources: Aurora Energy Research, BEIS Analysis of “Final UK GHG emissions national statistics” cited in Energy White Paper, December 2020

Decarbonising heat represents a major challenge, requiring millions of decisions at the local or household level

AURORA

Characteristics of residential heating that make it difficult to decarbonise

Consumer engagement

- Many decisions needed: 28m homes in Great Britain
- Behavioural patterns and non-cost barriers make change difficult

Complexity

- Differences in decision structures: owner occupiers, private landlords, social housing
- Differences in homes: insulation, space, type of building

Opportunities for change

- Low replacement rate for building stock: fewer than 200k new homes per year
- Long heating system lifetimes: typically 15 years or more

Costs

- Challenging economics: low carbon solutions are more costly today
- Network infrastructure needs to change at scale

Aurora recently completed a study examining the potential economics of deploying a range of low-carbon heating technologies

AURORA

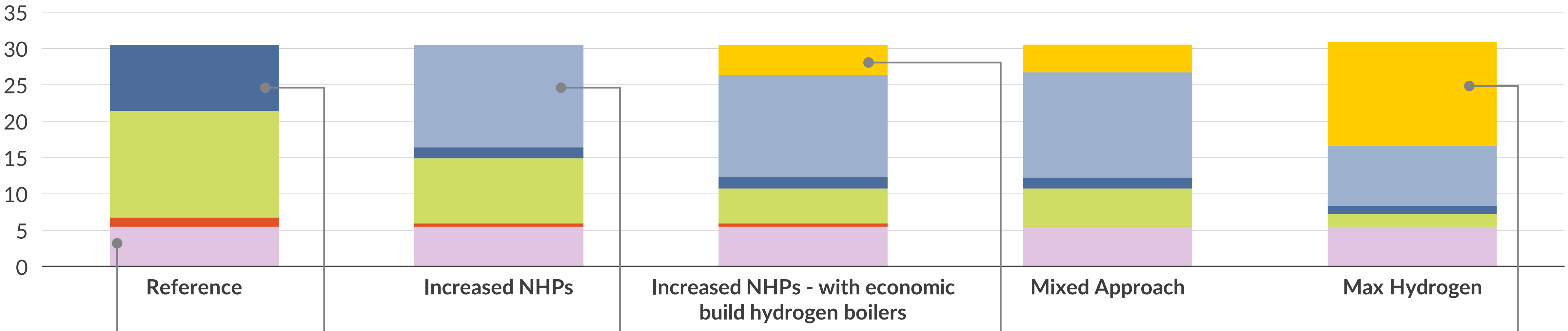
Heating technologies analysed

- Gas boilers
- Air source heat pumps
- Ground source heat pumps
- “Networked” heat pumps
- Hydrogen boilers
- Electric resistive heating
- Heat networks

We modelled a range of assumptions for costs and policy, resulting in different mixes of heating technologies by 2050

Homes with each technology installed in 2050

Millions of homes



In all scenarios, we **assume** a fixed deployment trajectory for heat networks, reaching ~18% of homes in 2050

In our reference scenario, the mix of ASHP and GSHP deployment depends more on assumed build limits than economics

NHP deployment may be lower than in our **economic modelling** because of practical and infrastructure constraints that we have not modelled

In this scenario, we assume any home can choose a hydrogen boiler if the in-home **economics** look favourable, regardless of network deployment

In the final two scenarios, deployment of hydrogen is **assumed**

Heat network | Electric resistive | ASHP | GSHP | NHP | Hydrogen

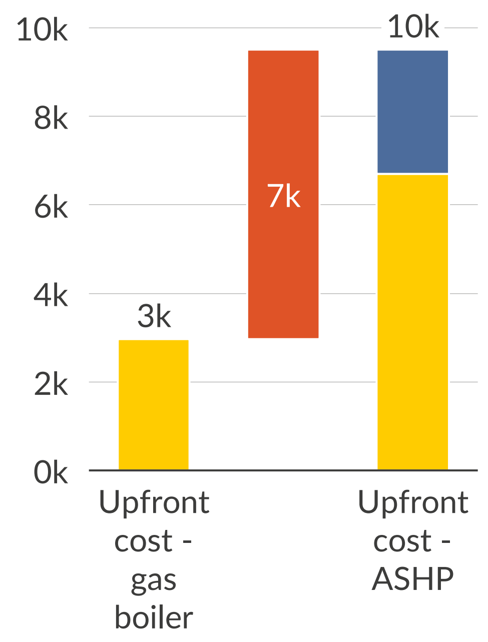
Source: Aurora Energy Research

Heat pump technology is ready for deployment today, but heat pumps are currently more costly to buy, fit and run than replacement gas boilers

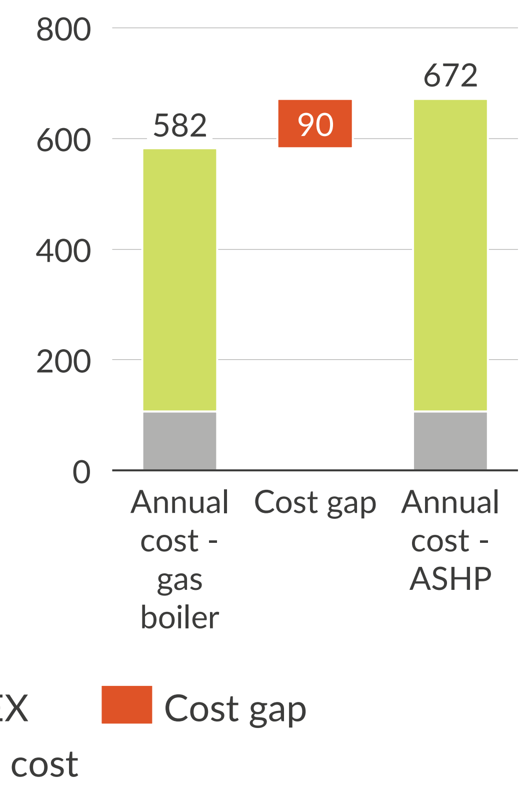
Example costs for air source heat pumps compared with gas boilers in 2021

Costs for an efficient, owner-occupied house, £ (real 2020) – note costs vary widely between home types

Up-front costs



Annual running costs[1]



- The difference in running costs reflects current policy design
  - Heat pumps are typically over 3 times as efficient as gas boilers
  - However, retail prices per MWh are about 4 times higher for electricity than for gas
  - Electricity prices incorporate carbon prices paid by generators and the cost of subsidies to renewables; gas prices do not
- Examples of policy options to close the cost gap :
  - A carbon tax on fossil-fuel-fired home heating
  - Shifting policy costs from electricity bills onto gas bills
  - Shifting policy costs from electricity bills to general taxation
  - A grant to help with the cost of a new heat pump
- It may be more effective to use separate policy measures to address the up-front costs and the running costs
- For measures that raise costs of gas boilers, distributional effects and impacts on low-income households need to be treated carefully

1) These are based on our April forecast for 2021 prices, and do not reflect recent rises in wholesale prices.

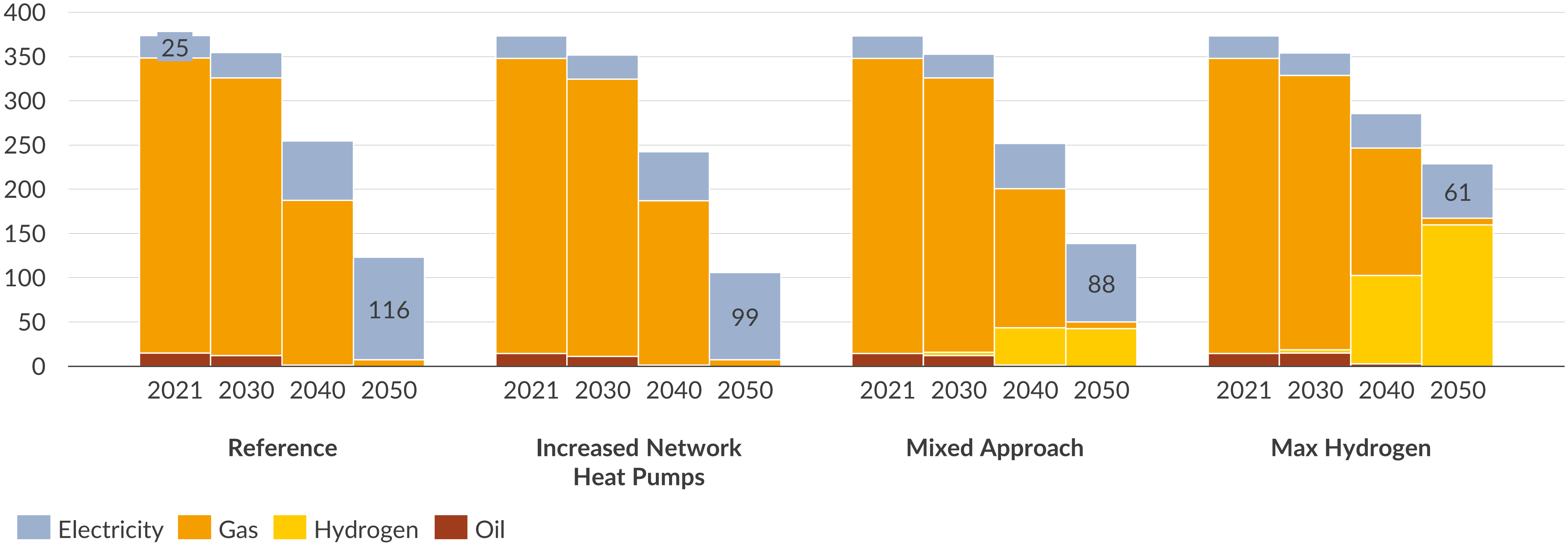
Sources: Aurora Energy Research, Ofgem, BEIS,

In all our scenarios, electricity demand for heat increases in the decades ahead, but total energy demand for heat falls

AURORA

Fuel demand for heating

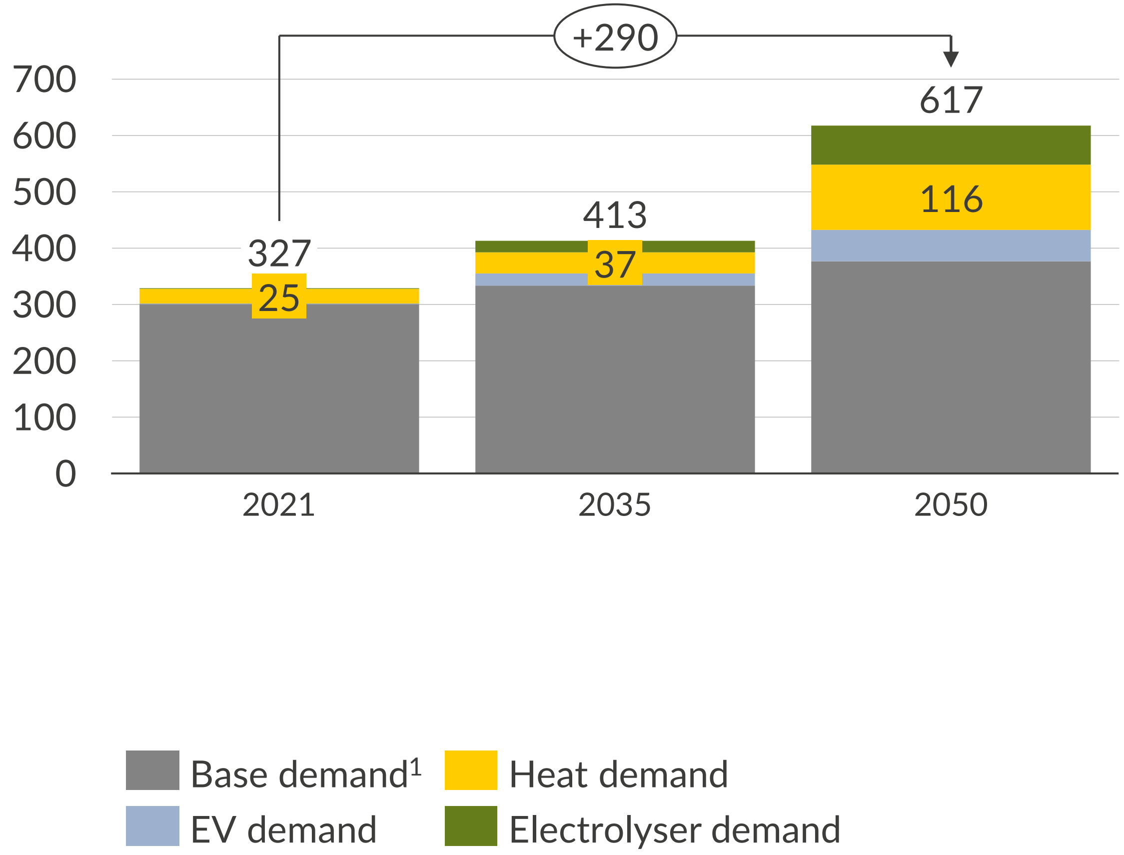
TWh



Demand from heat could drive almost a third of the growth in electricity demand by 2050 in a net zero scenario

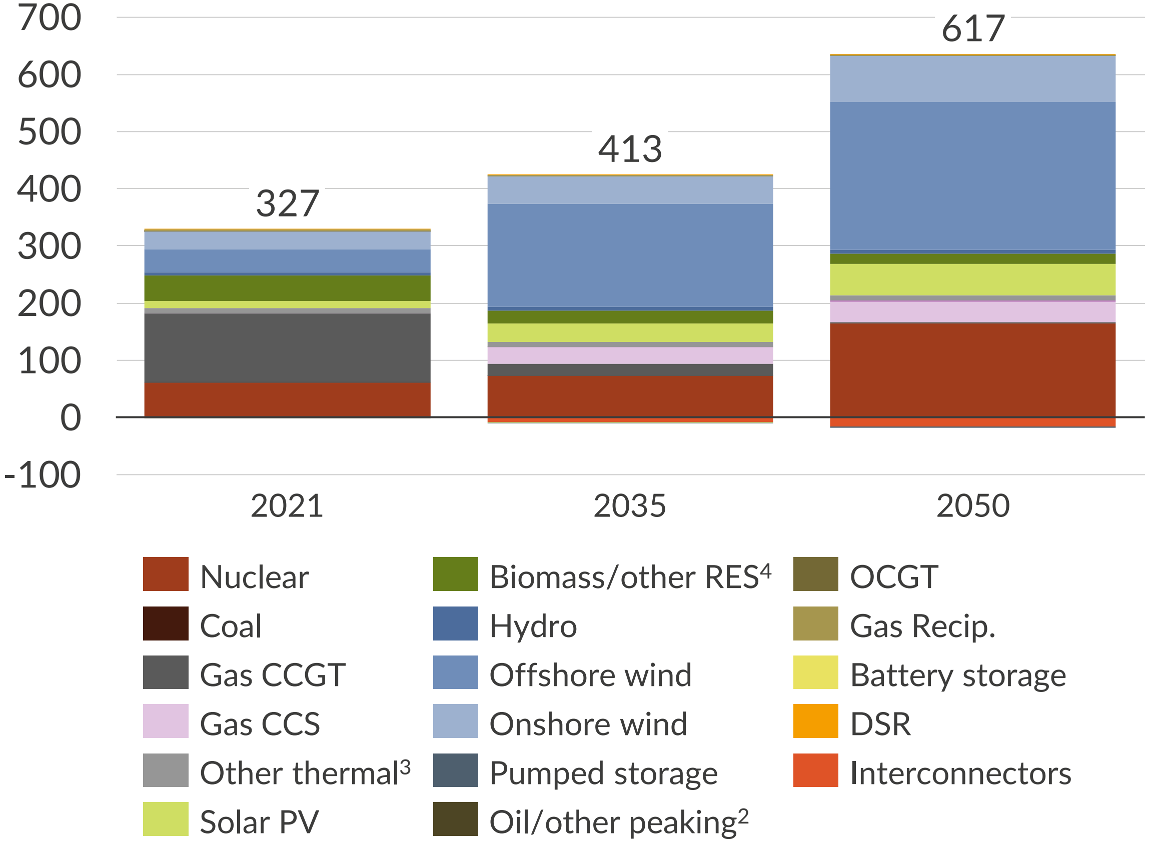
Electricity Demand

Net zero power scenario, reference heat scenario, TWh



Electricity Generation

Net zero power scenario, reference heat scenario, TWh



1) Base demand includes industrial and domestic non-heat demand 2) Peaking includes OCGT and reciprocating engines. 3) Other thermal includes embedded CHP. 4) Other RES includes biomass, BECCS, EfW, hydro, and marine.

Source: Aurora Energy Research

AURORA

Any further questions?

Benjamin Collie
Principal, Aurora Energy Research
Benjamin.Collie@auroraER.com

Disclaimer and Copyright

AURORA

General Disclaimer

This document is provided "as is" for your information only and no representation or warranty, express or implied, is given by Aurora Energy Research Limited and its subsidiaries Aurora Energy Research GmbH and Aurora Energy Research Pty Ltd (together, "**Aurora**"), their directors, employees agents or affiliates (together, Aurora's "**Associates**") as to its accuracy, reliability or completeness. Aurora and its Associates assume no responsibility, and accept no liability for, any loss arising out of your use of this document. This document is not to be relied upon for any purpose or used in substitution for your own independent investigations and sound judgment. The information contained in this document reflects our beliefs, assumptions, intentions and expectations as of the date of this document and is subject to change. Aurora assumes no obligation, and does not intend, to update this information.

Forward-looking statements

This document contains forward-looking statements and information, which reflect Aurora's current view with respect to future events and financial performance. When used in this document, the words "believes", "expects", "plans", "may", "will", "would", "could", "should", "anticipates", "estimates", "project", "intend" or "outlook" or other variations of these words or other similar expressions are intended to identify forward-looking statements and information. Actual results may differ materially from the expectations expressed or implied in the forward-looking statements as a result of known and unknown risks and uncertainties. Known risks and uncertainties include but are not limited to: risks associated with political events in Europe and elsewhere, contractual risks, creditworthiness of customers, performance of suppliers and management of plant and personnel; risk associated with financial factors such as volatility in exchange rates, increases in interest rates, restrictions on access to capital, and swings in global financial markets; risks associated with domestic and foreign government regulation, including export controls and economic sanctions; and other risks, including litigation. The foregoing list of important factors is not exhaustive.

AURORA

ENERGY RESEARCH