National Heat Study

CCAC – 21st June 2021

Dr. Matthew Clancy, SEAI

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What are the project goals?

- To deliver a comprehensive assessment of the options to decarbonise the heating and cooling sectors in Ireland to 2050 by end of June 2021.
  - Develop a detailed understanding of heating and cooling demand in the residential, services and industrial sectors and the opportunities to reduce this.
  - Assess the potential and costs of the low-carbon technologies and fuels that can decarbonise heat generation.
  - Explore pathways for technology and fuel deployment to reach net-zero by 2050.
  - Understand the perspectives of various stakeholders and seek to include data and information from a wide range of sources in the analysis.
  - Understand how far current policy measure will take us and what additional policy effort may be required

- Provide detailed analysis and useful insights to policymakers, stakeholders, and the public.
  - Plan to publish series of 8 technical reports July to September

- Build capacity within SEAI to support further work on policy development.
  - NEMF tool – least cost as well as policy and consumer simulation

Project team – cross directorate expertise

Project lead:
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Project secretariat:
Ciaran Murphy

Heat sector data:
Dr. Denis Dineen

Energy system modelling:
Dr. Emer Dennehy

Heat generation technologies:
Paul Martin

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elementenergy

District heating:
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RICARDO

Hydrogen and Hydrogen carriers:
Dr. Lucy Corcoran

Bioenergy:
PJ McLoughlin

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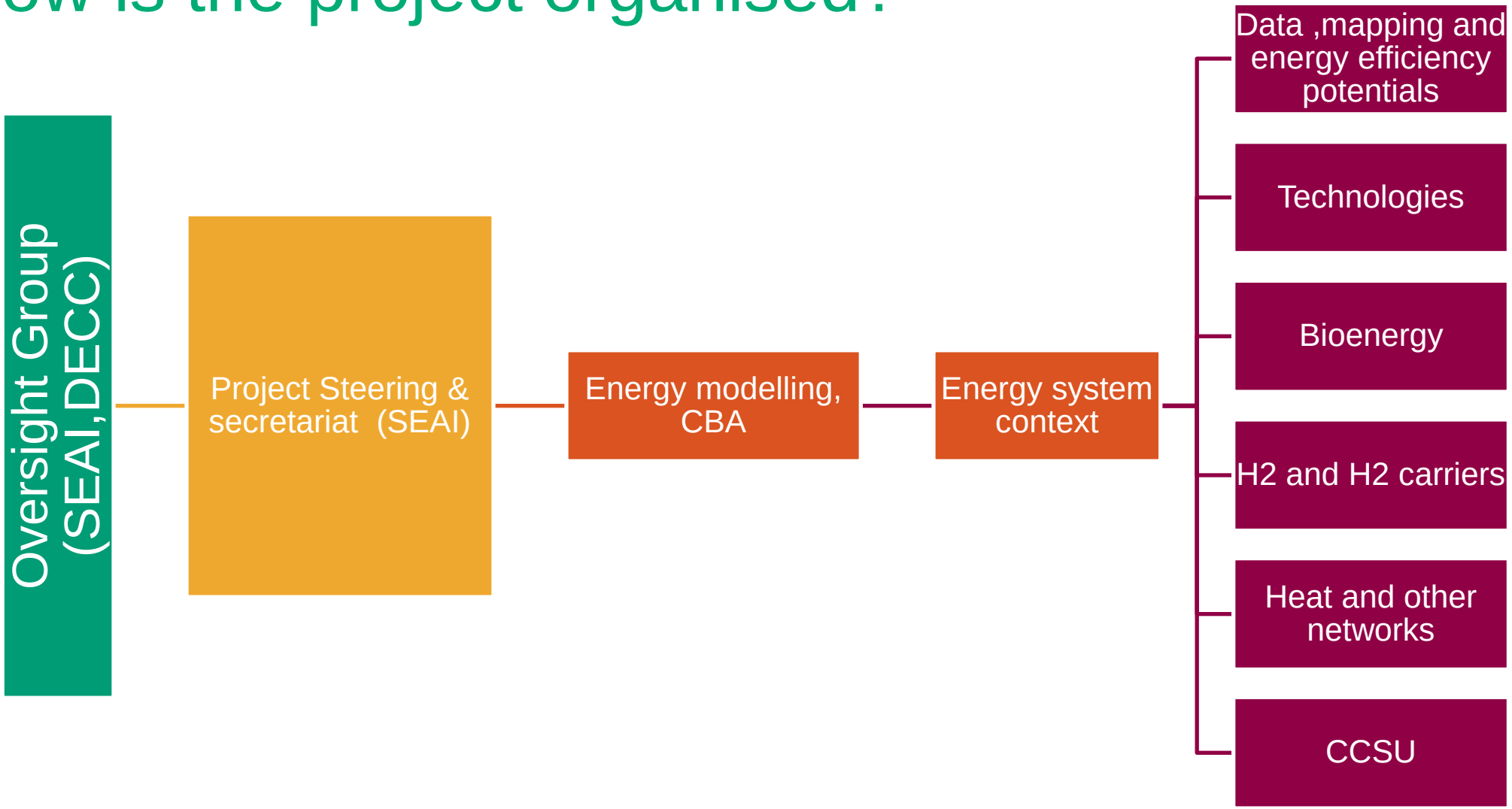
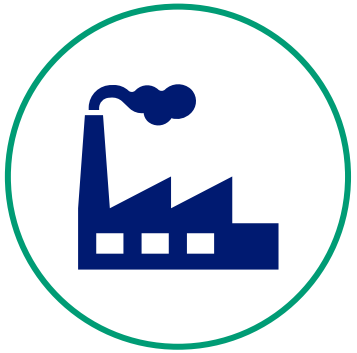
How is the project organised?



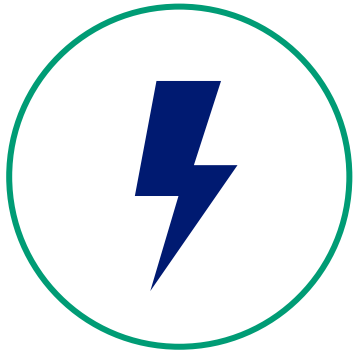
Overview of scenarios for detailed modelling and CBA

Baseline



- Business as usual.
- All sectors continue to use carbon-intensive practices.
- Limited deployment of heat networks, new technologies or fuel switching.
- Does not meet net zero by 2050.

High Electrification



- Weighted towards electrification of low-T applications, coupled with minimal (if any) bio-derived gases, CCS, and/or H_2 use for high-T cases.
- High levels of heat networks deployment and significant efficiency uptake.
- Net zero by 2050.

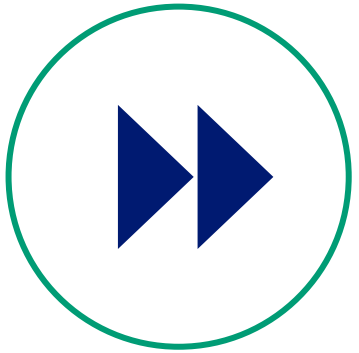
Decarbonised Gas

- Weighted towards bio-derived gases, CCS infrastructure, and/or H_2, coupled with domestic and commercial fuel switching to bio-derived gases and/or H_2.
- Low level of heat networks deployment or efficiency uptake.
- Net zero by 2050.

Balanced

- Steady progress.
- Mix of cost-effective deployment of low-carbon technologies (electricity, bio-derived gases, and/or H_2).
- Medium level of industrial CCS, heat networks, and energy efficiency deployed.
- Net zero by 2050.

Rapid Progress



- Accelerated progress.
- Driven by policy targets; all low-T applications are quickly electrified, while bio-derived gases and/or H_2 are taken up to decarbonise the grid.
- High levels of heat networks deployment and efficiency uptake.
- Net zero by 2050.

Overview of policy modelling to 2030

- Policies and targets relating to building decarbonisation, as outlined in the 2019 Climate Action Plan and the National Development Plan 2018 – 2027 (part of Project Ireland 2040) are incorporated into the modelling in two ways:

1

Bottom-up policy drivers via direct incorporation: policies are embedded within the modelling.

- E.g. Home Energy Grants are treated this way, which provide a fixed grant amount for residential properties installing various energy efficiency measures and low carbon heating technologies.

2

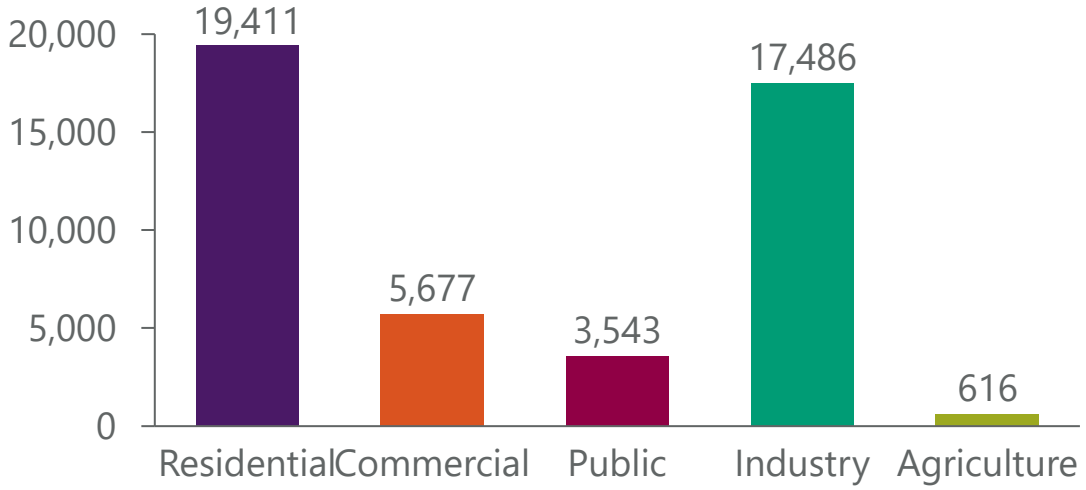
Top-down policy targets via indirect incorporation: modelling outputs are compared against policy targets, with iteration carried out where necessary to give insight into the conditions required to meet various targets.

- E.g. The 600,000 installed heat pumps in residential homes by 2030 is a target that we have explored in this work.

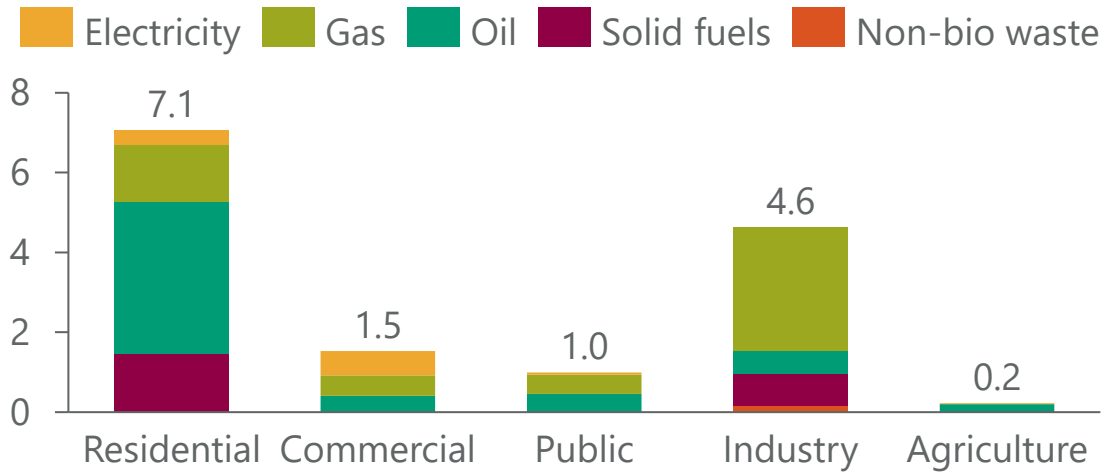
Initial insights – focus on 2030

Archetype breakdown – heating demand and emissions

Total heating demand (GWh) by sector



Total emissions ($MtCO_2$) from fuel use for heating by sector, broken down by fuel type



- The residential and industrial sectors account for the bulk of heating demand and associated emissions in Ireland, and are responsible for a combined 79% of total heating demand.
  - The total heating demand of the residential and industry sectors is roughly equivalent, despite the number of residential buildings far exceeding the number of industrial sites.
  - The emissions from heating in the industrial sector is significantly lower than in the residential sector, due to a higher proportion of natural gas use for heating in industry (compared to oil in residential).
- The agriculture sector is a minor contributor (~1%) to total Irish heating demand from buildings and industry.

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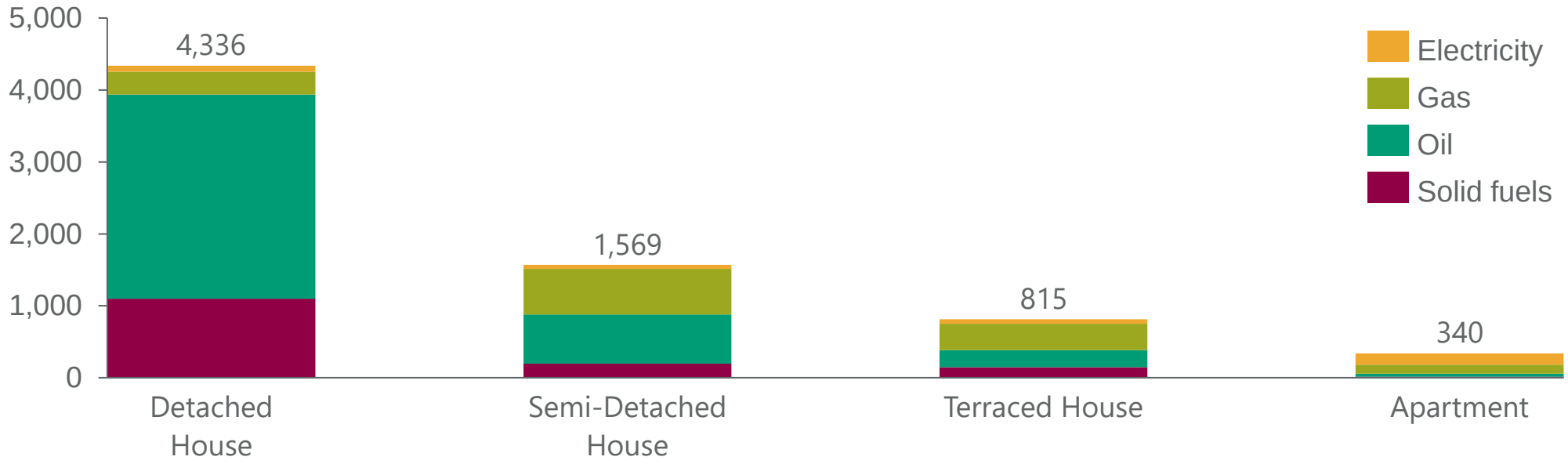
Residential emissions – heating

Total emissions ($ktCO_2$) from fuel use for heating in the residential sector, broken down by building and fuel types



- In the Irish residential sector, 62% of fuel-based emissions for heating come from detached houses (which make up only 42% of the residential stock).
  - Within detached houses, the majority of emissions (65%) result from consumption of oil (with this segment emitting more than the sum of all fuel types across all other property types).
- Apartments are the only type of residential buildings that have a significant proportion of emissions resulting from consumption of electricity for heating purposes.

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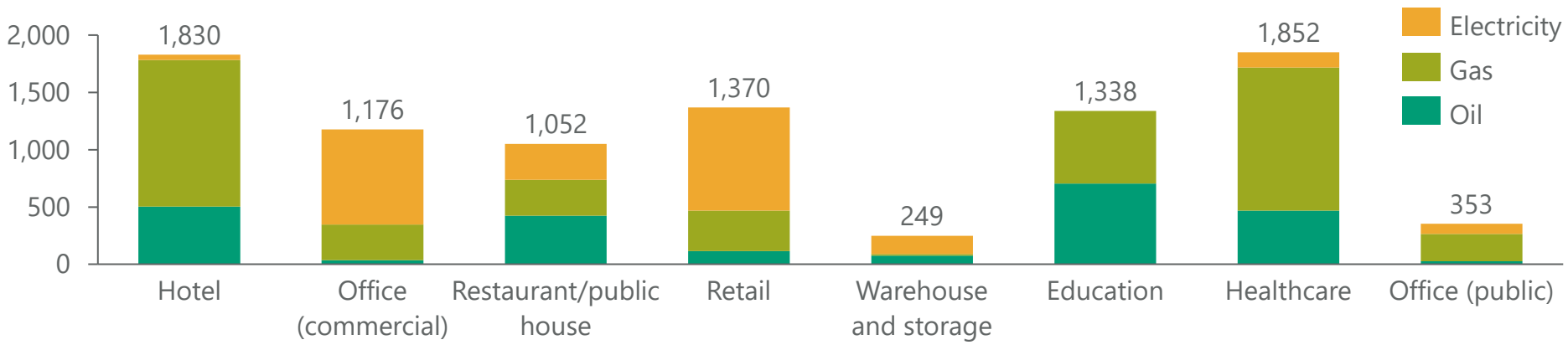
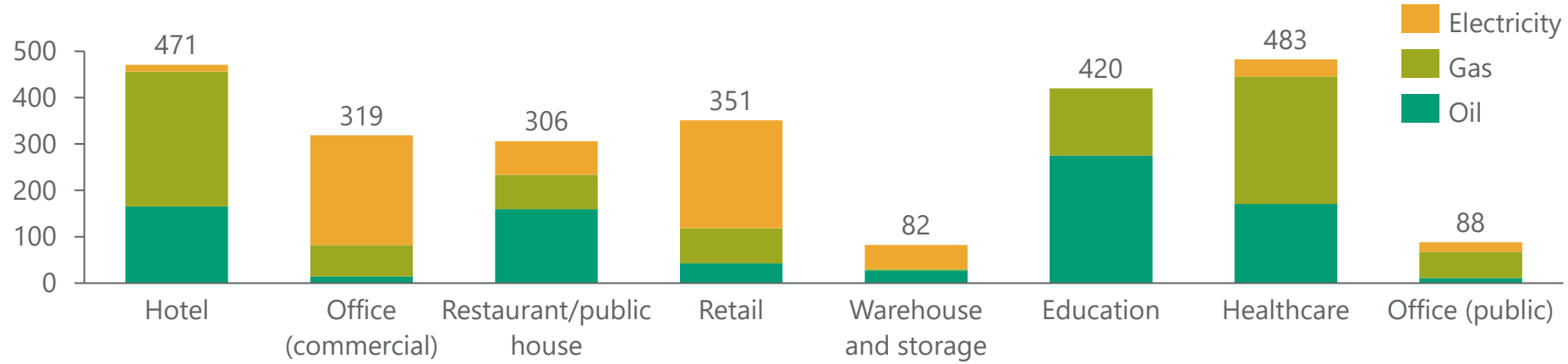
Commercial & public services heating demand & emissions

Total annual heating demand (GWh) of commercial & public buildings by building type and main heating system



Total annual emissions ($ktCO_2$) from fuel consumption for heating in commercial & public buildings by building type and main heating system



- The dominant heating system in the commercial and public sectors varies by building type, with electricity dominating in commercial offices and retail buildings, and gas dominating in most other building types.
- Gas and oil based emissions are the majority contributor to emissions for heating in commercial and public buildings (86%).
  - Exceptions: commercial offices and retail buildings, where electricity has the highest total emissions.

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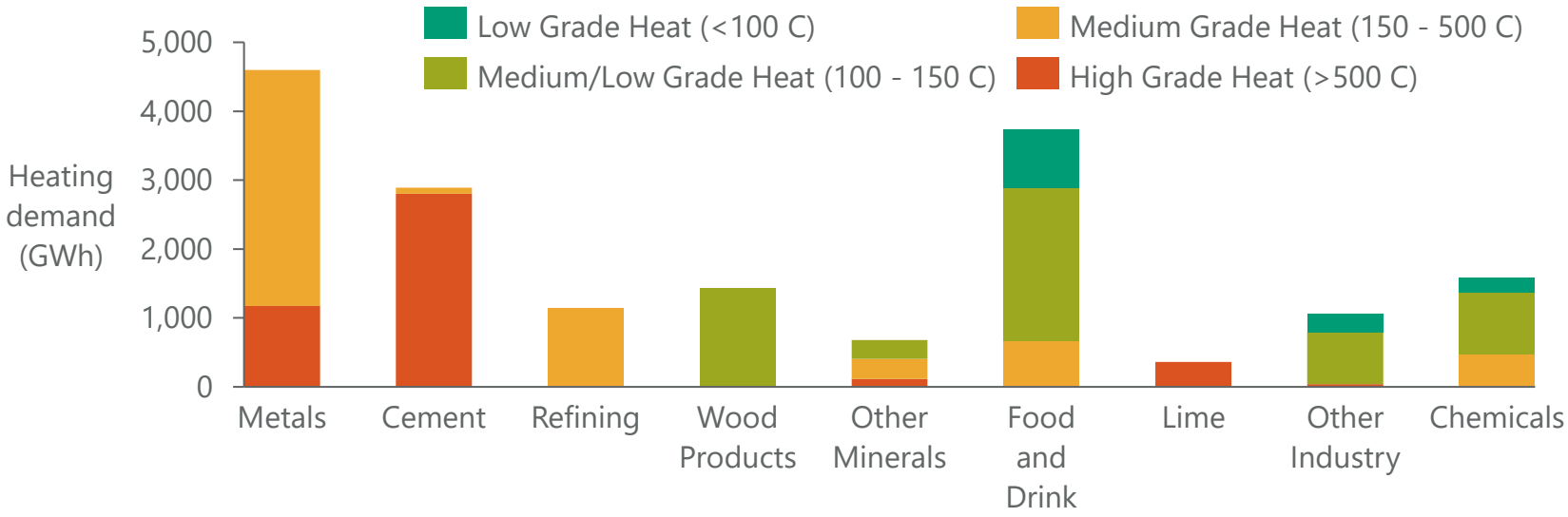
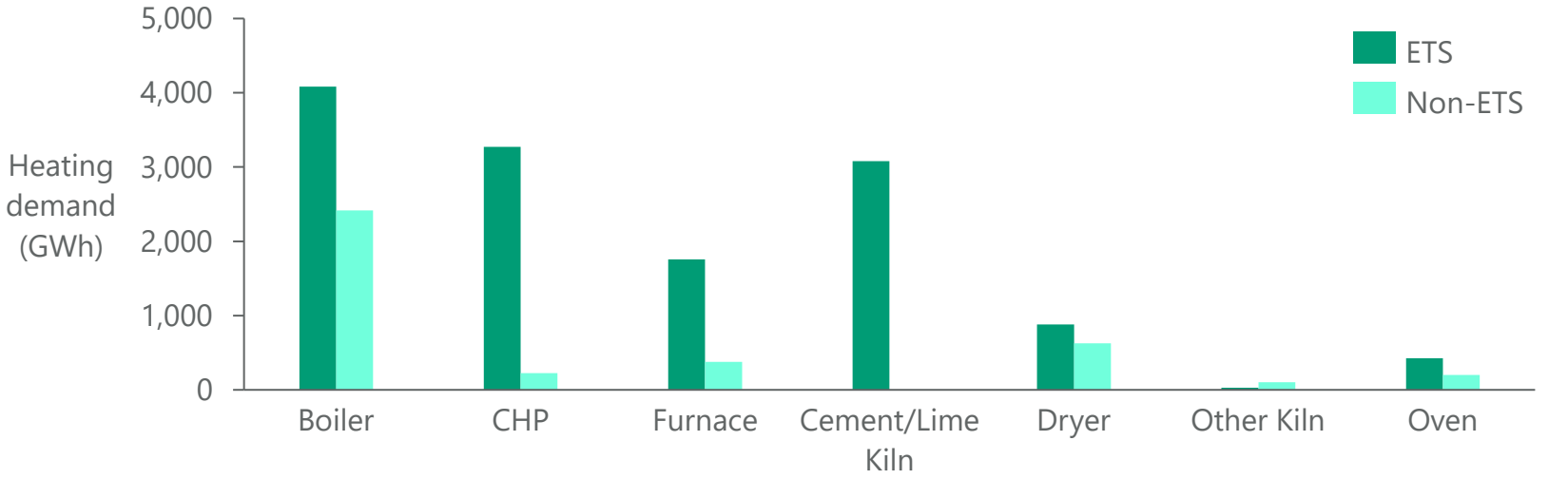
New Industry demand data – heat and heat grades





- Each industrial subsector has a unique profile of required grades of heat.
  - This means that there is no one solution to decarbonise industrial heat demand; each subsector will require a different solution.
  - Some subsectors will be harder to decarbonise (i.e. Cement, which mainly has high-grade heat demand).

- The Emissions Trading Scheme covers the majority of heating demand met by each equipment type.
- There is a significant industrial heating demand provided by non-ETS boilers.

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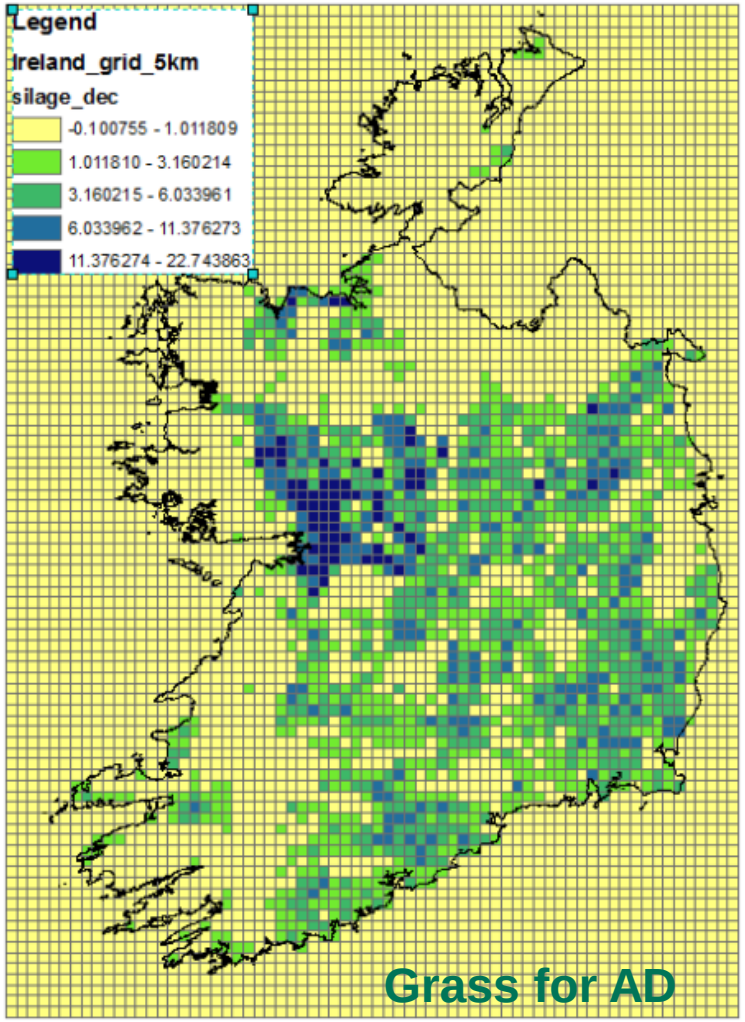
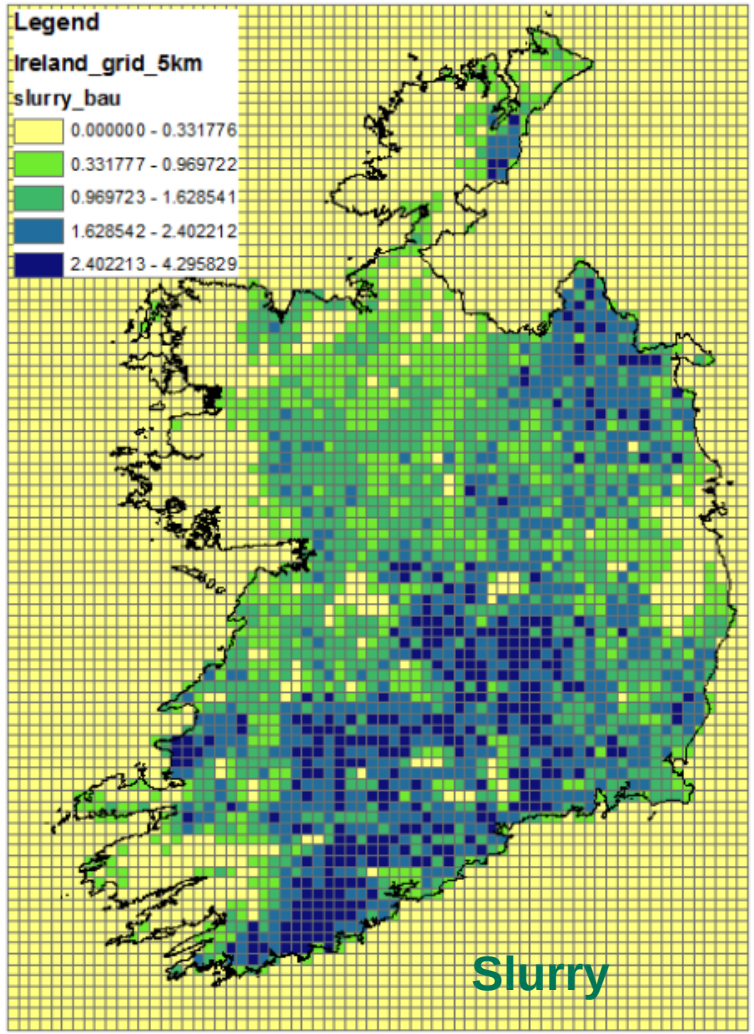
Results all scenarios

	Baseline	High electrification	Decarbonised gas	Balanced	Rapid Progress
Agricultural scenario	'Stable herd'	'Stable herd'	'Stable herd'	'Stable herd'	'Changing land use'
Include land released due to					
Changes in suckler herd size	Yes	Yes	Yes	Yes	Yes
Additional productivity improvements	No	Yes	Yes	Yes	Yes
Released land used for					
Grass/clover production for AD	100%	0%	100%	50%	100%
Energy crops (SRC)	0%	100%	0%	50%	0%
	Resource estimates for 2030 (TWh of biogas)				
Grass for AD	1.11	0	2.69	1.34	4.12
Slurry codigested with grass in AD	0.16	0	0.39	0.19	0.60
Domestic and commercial food waste	0.37	0.37	0.37	0.37	0.37
Industrial food waste	0.10	0.10	0.10	0.10	0.10
Pig slurry	0.52	0.52	0.52	0.52	0.52
Total	2.26	0.99	4.06	2.52	5.70

* Stable herd: 10% increase in the dairy herd and a 23% reduction in suckler herd by 2030 so overall herd size remains relatively stable. Changing land use: suckler herd declines by an additional 20% by 2030 leading to a net reduction of about 600,000 head in the national herd

Agri Biomethane potential more limited. Land constraints reduces available land. Productivity a key challenge.





Key points:

- Only suitable land considered:
  - protected areas,
  - environmentally sensitive areas (incl. permeant pasture)
  - slope, elevation,
  - soil type
- Land becomes available via:
  - Beef herd changes
  - Productivity improvements excluding additional N application
- Red clover grown on available land
  - Dowth and Teagasc estimates on yield
- An additional uptake factor is applied to reflect other barriers to making the switch to this new type of grass cultivation

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District heating analysis explored potential in detail

GIS datafiles of thermal demand at the SA level produced to form basis for new heat map

Highest heat demand around cities and industrial clusters as expected

- Modelling at the SA level shows that 2.5% of heat demand has **high viability** for district heating
- Our analysis shows that at heat densities >1000 MWh/km, the heat density has less of an effect on DH capital costs
- **With measures to close the viability gap, up to 54% of the building heat demand could be served by heat networks**
- Due to a low demand in Ireland, district cooling is not feasible.

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Eight Reports from seven workstreams:

Demand	• **State of play: Profiling heating and cooling demand in Ireland today (July 2021)**
Technology	• Evaluating low carbon heating and cooling generation technologies
Infrastructure	• Potential for district heating and cooling infrastructure in Ireland • Electricity infrastructure costs for scenario modelling in Ireland
Fuels	• The potential for hydrogen fuel in Ireland • An evaluation of the resource, costs and greenhouse gas impacts of sustainable bioenergy
CCS & BECCS	• Suitability and costs of Carbon Capture Utilisation and Storage and Bioenergy with Carbon Capture and Storage in Ireland
Modelling	• **Net zero by 2050: An exploration of the decarbonisation pathways for heating and cooling in Ireland (Q3)**