

ASTATINE

Your Decarbonisation Partner

Heat Pumps in Agriculture

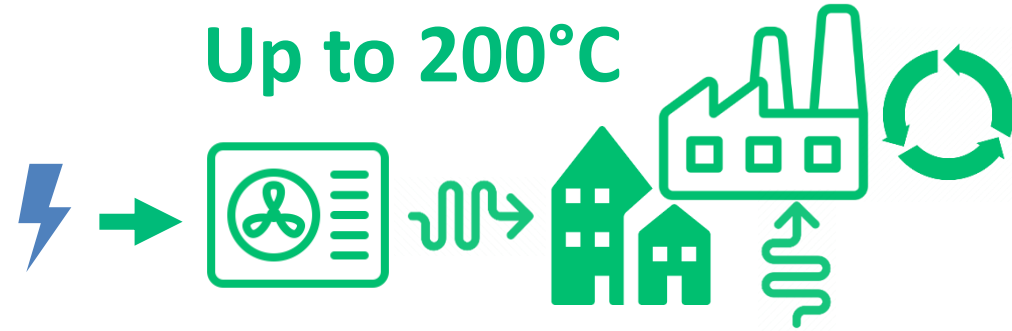
David Connolly, PhD

22 February 2022

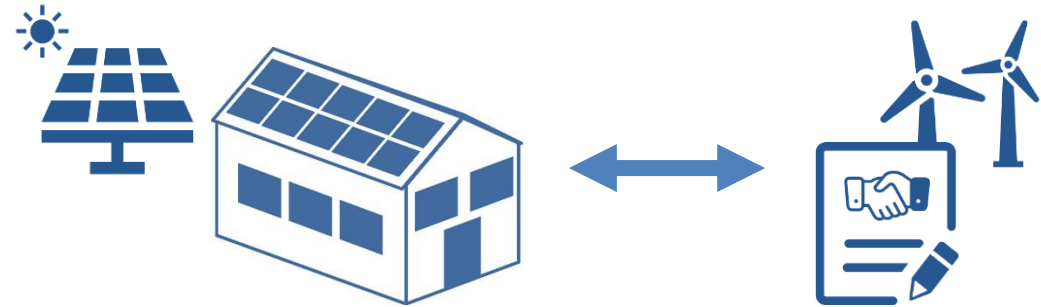


What We Do

Renewable Heat (High-temperature heat pumps)



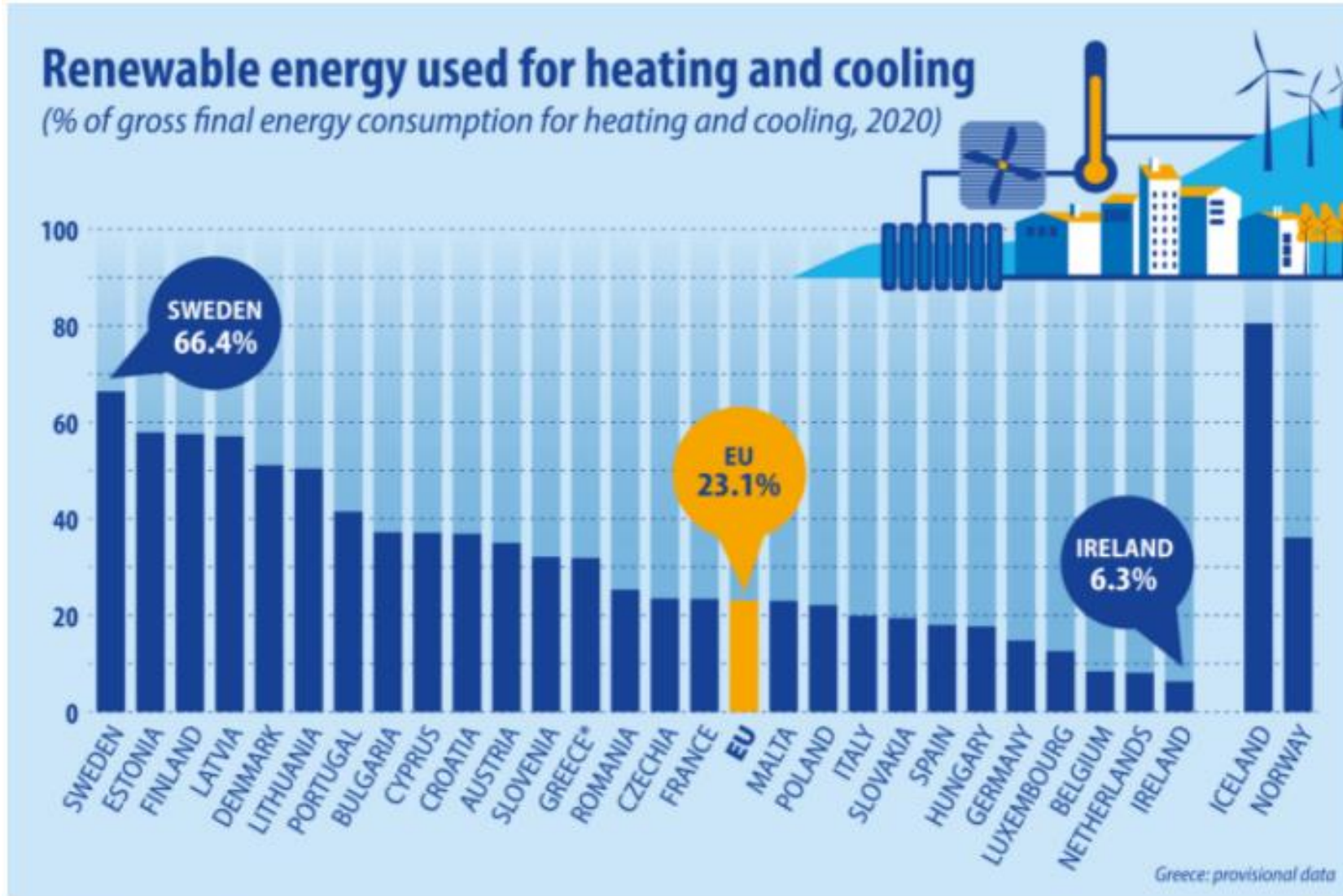
Renewable Electricity (Onsite Solar Power, Corporate PPAs)



You Fund Or We Can Fund (Heat & Power As A Service)



IRELAND BOTTOM OF THE PILE FOR RENEWABLE HEAT



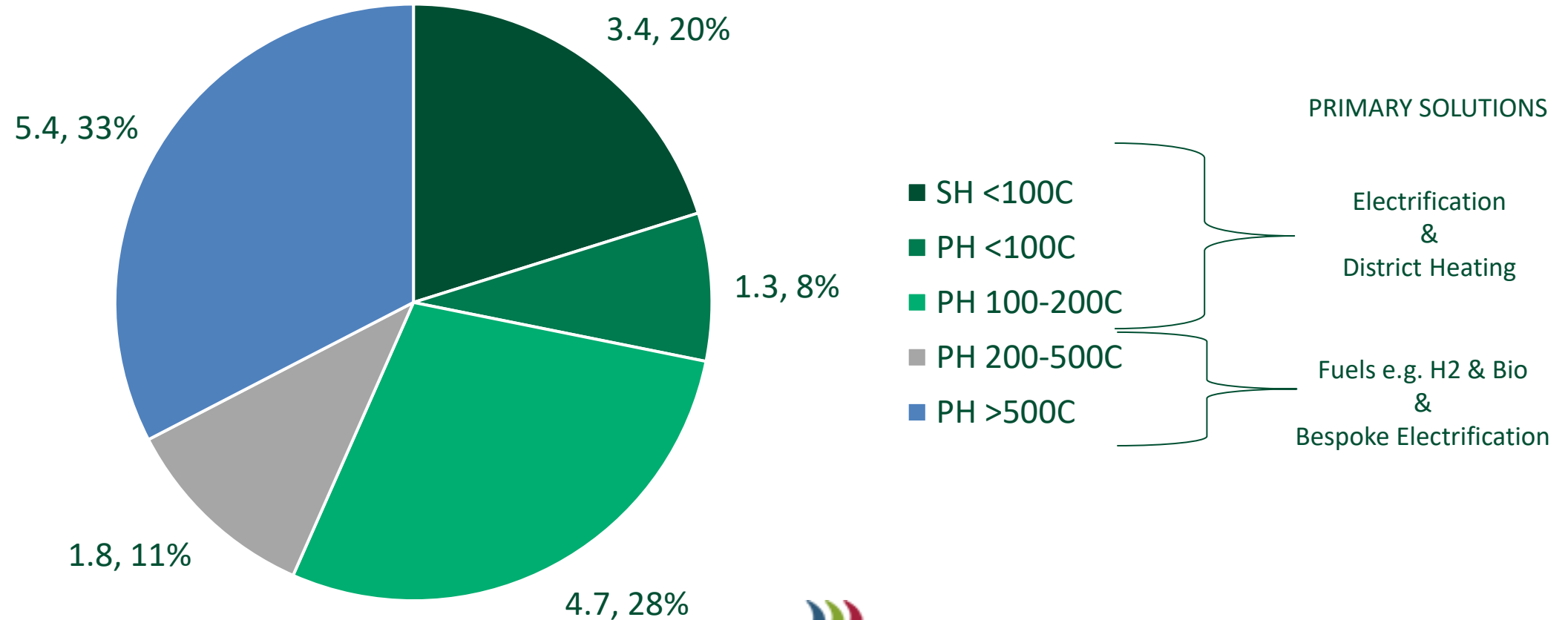
#EUIndustryDays

ec.europa.eu/eurostat

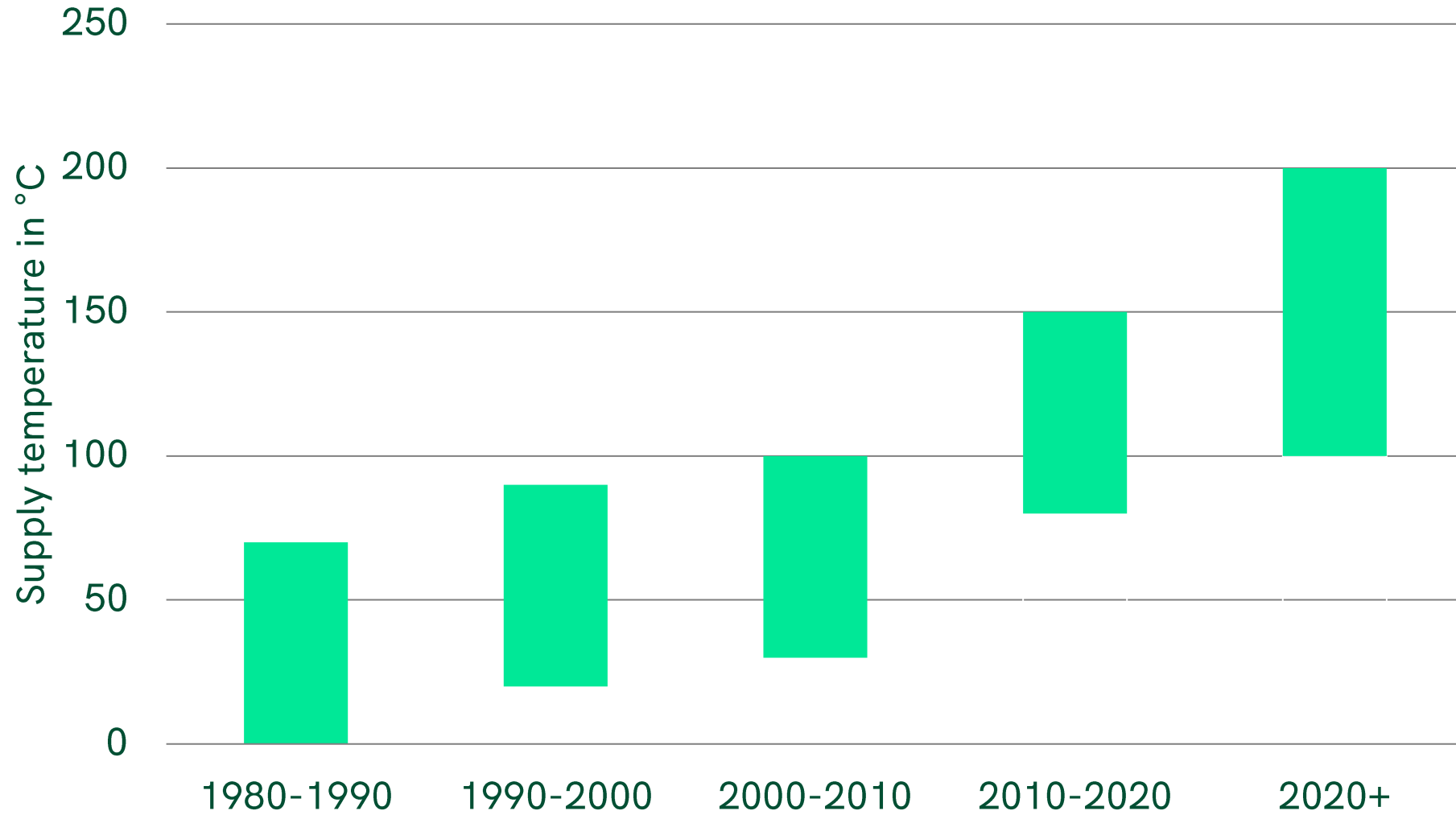
Decarbonising Heat in for Food Processers

Almost 10 TWh of Industrial Heat Demands are <200°C Represents ~50% of industry & ~25% of total heat demands

Industrial Heat Demand in Ireland: 16.6 TWh



High Temperature Heat Pumps Evolving Rapidly (Approximate Values Only)

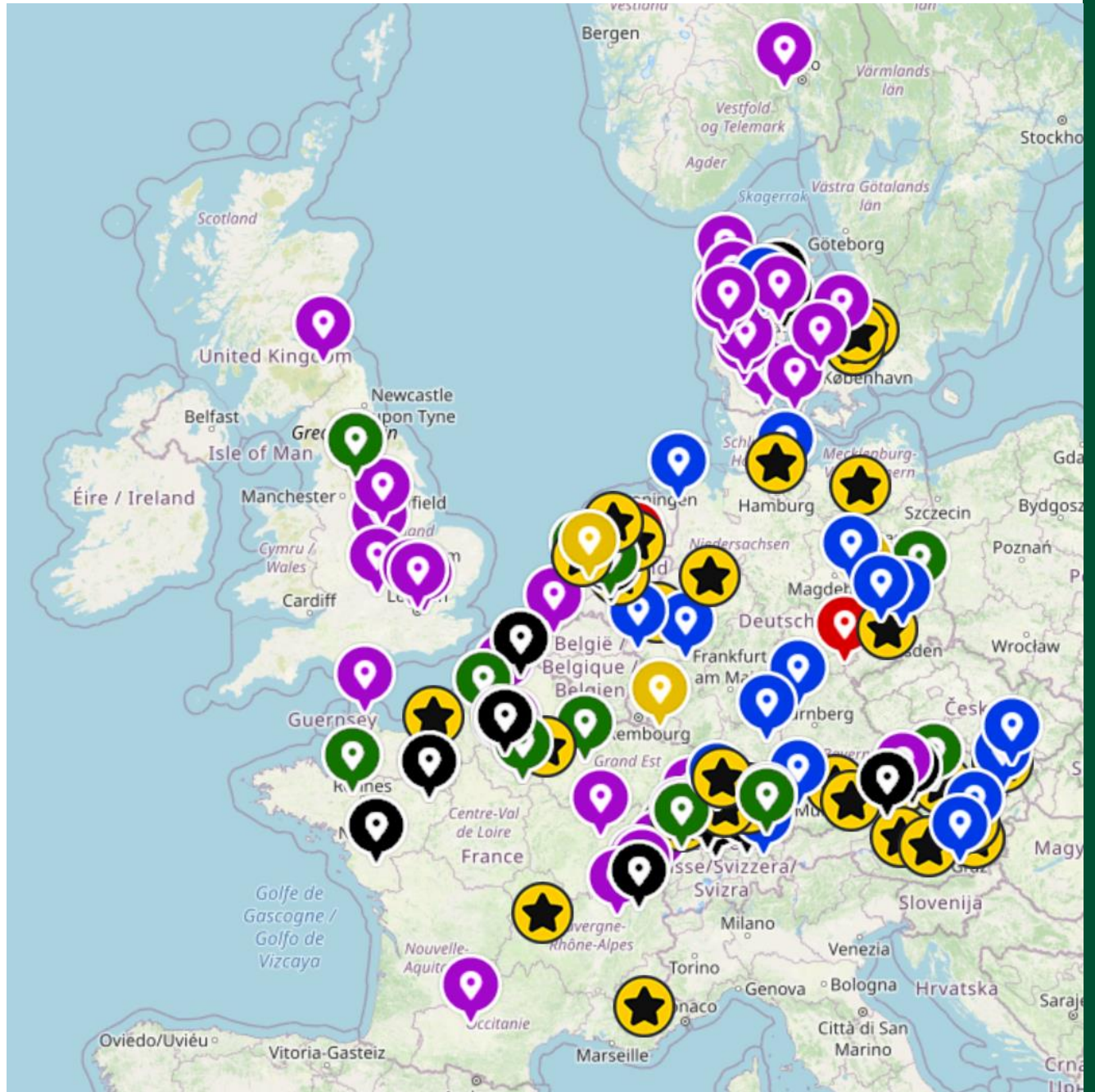


*Many thanks to Dr. Cordin Arpagaus for his inputs to this graphic

Approximately 20,000 industrial heat pumps installed in Europe each year

- We are bringing a proven high-temperature heat pump technology widely used in the rest of Europe to Ireland
- 1000s of installations across Europe (examples on map)
- Ireland now has abundance of renewable electricity to utilise – enough to power all of Galway city is currently thrown away
- Combining heat pumps with thermal storage can take advantage of low-cost electricity during windy days when this electricity is wasted

■ Miscellaneous ■ Chemicals ■ Textile ■ Best Practise ■ Machinery ■ Food ■ District Heating



Case Study in the Metals Industry

Application	Process Heat
Country	Sweden
Year of Installation	2020
Heat Capacity	> 2000 kW
Supply Temperature	110°C (120°C if required)
Source Temperature	45°C
Efficiency (COP)	4
Energy Savings	n/a
Financial Savings	n/a
Payback	n/a



Case Study in the Dairy Industry

Application	Milk & Cream Production
Country	Norway
Year of Installation	2019
Capacity	0.9 MW
Supply Temperature	95°C (returns at 73°C)
Source Temperature	67°C (returns at 60°C)
Efficiency (COP)	5.5
Energy Savings	4.2 GWh
Financial Savings	--
Payback	--



Case Study in a Meat Processing Plant

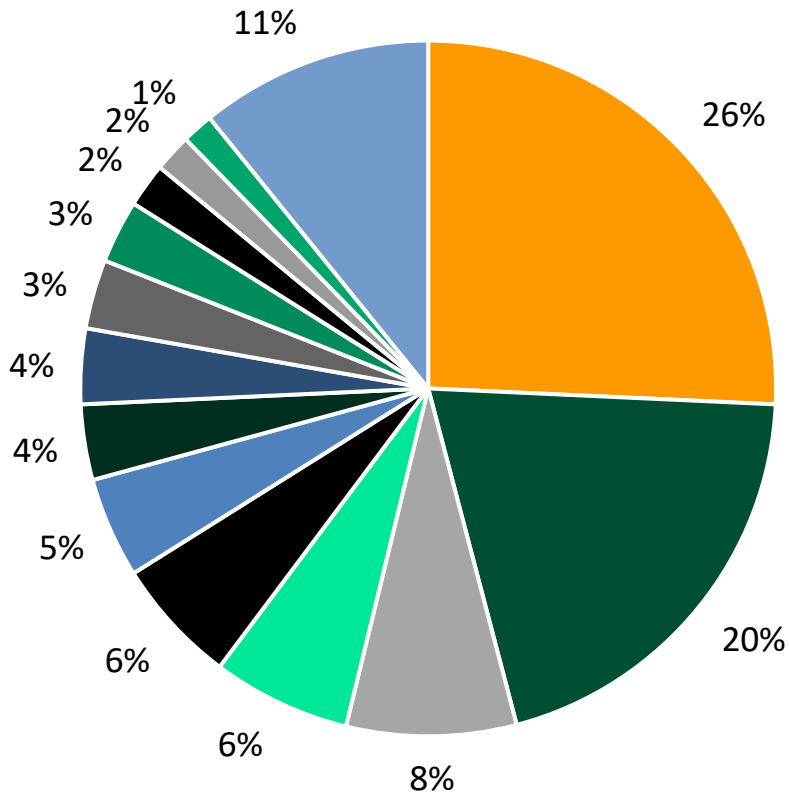
Application	Hot Water
Country	Norway
Year of Installation	2007
Capacity	0.75 MW
Supply Temperature	87°C (returns at 55°C)
Source Temperature	49°C (returns at 42°C)
Efficiency (COP)	> 5
Energy Savings	3.4 GWh
Financial Savings	--
Payback	24 Months



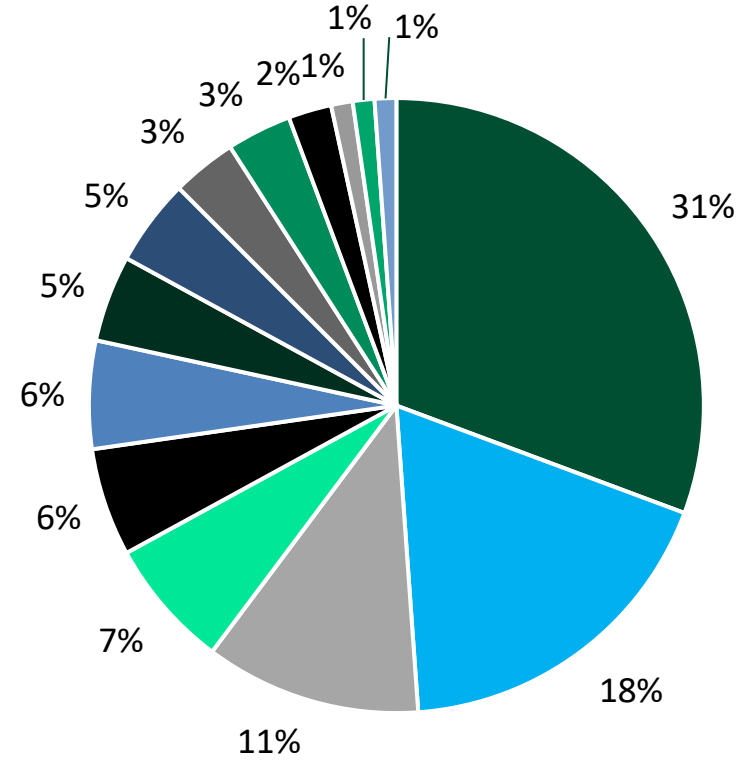
TYPICAL INDUSTRIAL HEAT PUMP APPLICATIONS

Sample of **88 Food & Beverage** Industrial Heat Pumps Globally by Application

Sample of **342 Industrial Heat Pumps** Globally by Application



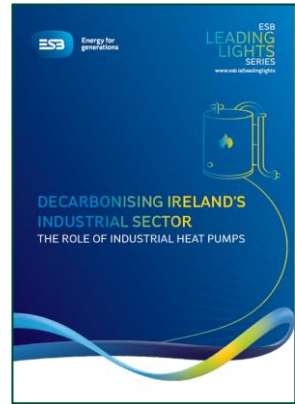
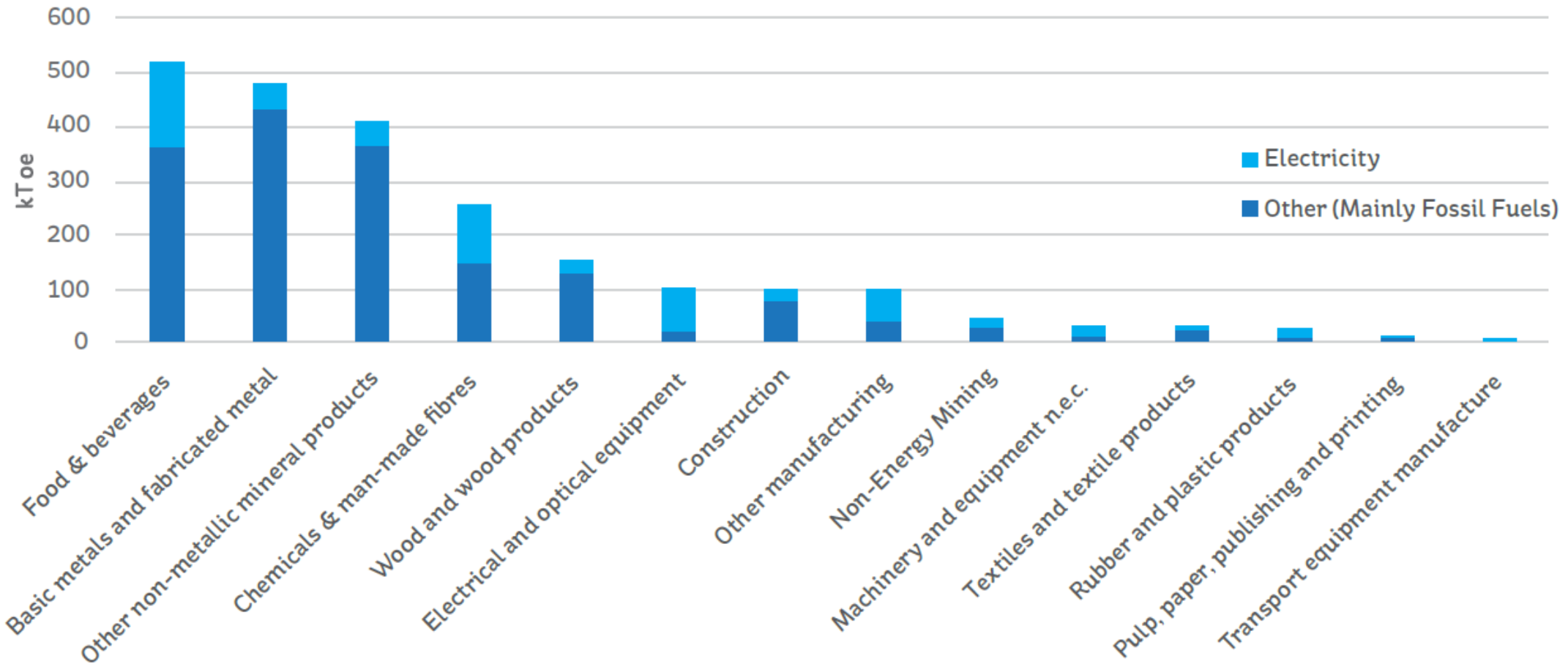
- Food & Beverage
- District heating
- Large Buildings
- Machinery
- Chemicals
- Electronics
- Agriculture/Fishing
- Metal industry
- Utility
- Health & Tourism
- Plastics
- Metal Processing
- Paper/Pulp
- Others



- Others
- Dairy (milk, cheese, etc)
- Brewery & Malt
- Chocolate
- Meat Processing
- Noodle
- Beverage
- Slaughter House
- Fruit juice
- Deep freeze
- Bakery
- Winery
- Sugar
- Tabacco

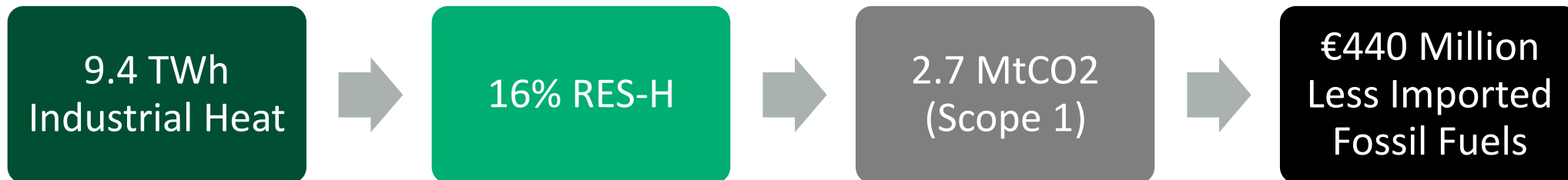
Very Suitable Demands in Ireland for Large-Scale Heat Pumps

Industrial Final Energy Demand by Application



Potential Using Existing Technology

- Total Heat Demand = 41 TWh
- 1% Renewable Heat = 0.41 TWh
 - Equates to 3.5% renewable heat for industry sector
 - If oil = ~100 kt CO2 per year
- Concerting industrial heat demand <200°C (9.4 TWh) to heat pumps will:
 - Increase renewable heat to ~16%!
 - Reduce CO2 emissions by 2.7 MtCO2
 - Save ~€440 million of imported fossil fuels



The eHeat opportunity – €1.58n annual economic benefit for Ireland

The decarbonisation of energy use, especially heat, remains a significant challenge for companies. Electrification is a sustainable, efficient and economic, means of generating heat, and in recent years many countries within Europe have found it to be highly effective way to decarbonise industrial heat. Electric heat (eHeat) is also a flexible demand that can be controlled to respond to variation in renewable electricity supply. eHeat is the most realistic, practical means of decarbonising heat and will deliver significant benefits to Irish business and the wider economy.

eHEAT Ireland
Decarbonising heat through electrification

Unlocking the eHeat opportunity

Ireland's total heat demand 41 TWh	Ireland's industry heat demand		MtCO₂ 14
	Total demand 16.6 TWh	% of total demand 40%	

Electrification potential
Heat demand <200°C = 9.4TWh

Source: <https://heatroadmap.eu/heating-and-cooling-energy-demand-profiles/>

Electrification of 9.4 TWh (heat) displaces 12.5 TWh fossil

Creating 3 TWh additional RES-E demand

Carbon saving = 2.7 MtCO₂
Avoided penalty €270M/yr
*based on a cost of carbon of €100/tonne

€440M per annum reduction in fossil fuel imports

Increased security of supply
*based on fossil fuel price of €35/MWh

80% Utilisation of 3TWh surplus renewable electricity delivers an economic benefit of €200M/yr to wind developers

Greater utilisation of the electricity network could generate €36M/yr additional revenue based on UoS approx. €15/MWh

Benefits for Irish business

Cost to generate 9.4TWh heat with fossil €820M	Cost to generate 9.4TWh heat with eHeat €300M	Economic benefit to Irish business €520M
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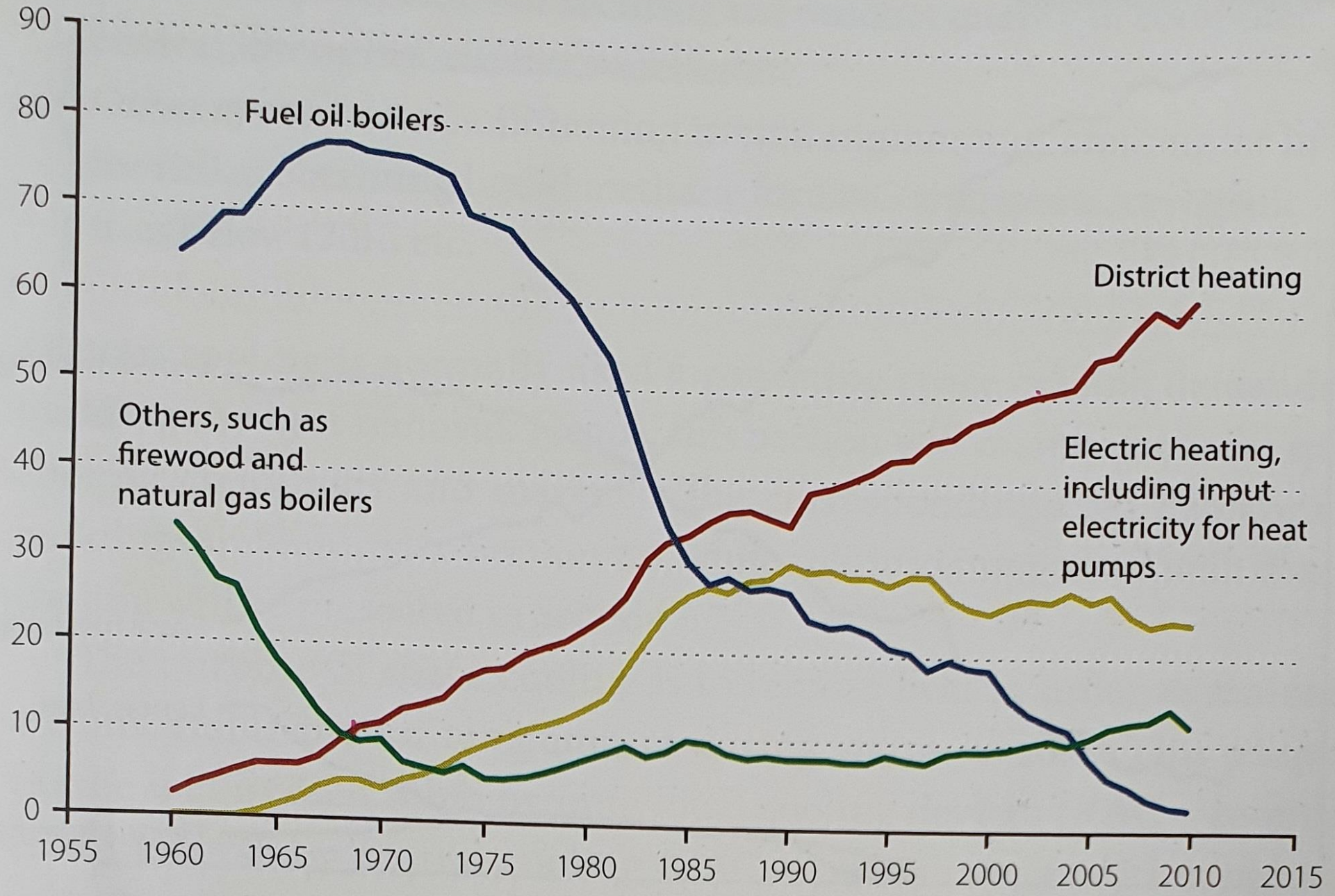
*based on fossil fuel price: €35/MWh, electrical generation price €80/MWh & UoS €15/MWh

Additional national benefits
eHeat utilises indigenous renewable resources to create est. 10,000 jobs.
Less emissions improves air quality, health and well-being and has an economic advantage for Ireland

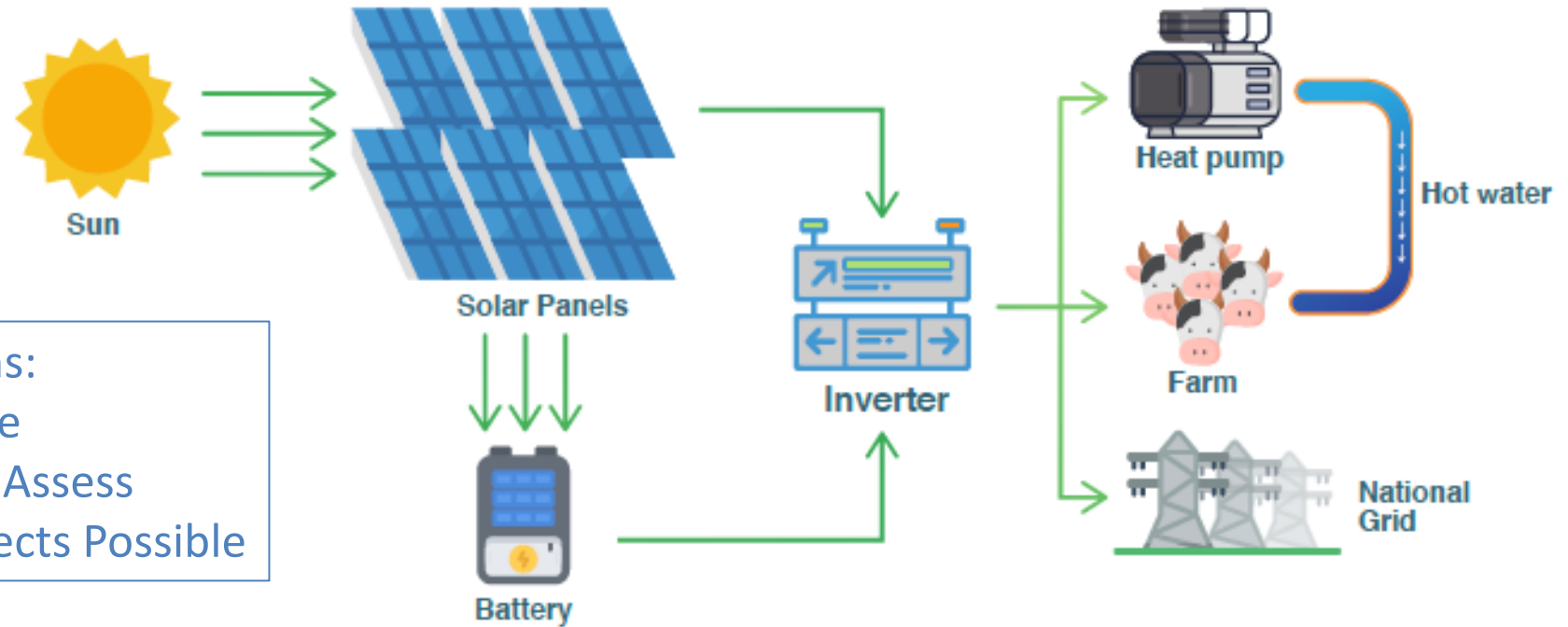
Farm Smart Utility: A Solution for Farm Level



Market share (%), Sweden



Combination of Solar Electricity, a Heat Pump & a Battery for Dairy Farms



High-Level Guide on Options:

- <100 Cows = FSU for scale
- 100-250 Cows = Need to Assess
- >250 Cows Bespoke Projects Possible

Example of a System

Solar Installed	kWp	20
Battery Installed	kWh	10
Electric Heat Pump Installed	Unit	1

Renewable Heating is About More than CO2: Energy Prices Increasing Rapidly

Gas Spot Price



Source: Intercontinental Exchange, US Energy Information Administration, ERC E Estimates



**Gas x45 Increase in
21 months
Average Increase
~x5**



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