SMART HEAT NETWORK DISPATCH BASED ON REAL-TIME MARGINAL EMISSIONS

ALL-ENERGY – 12 May 2022

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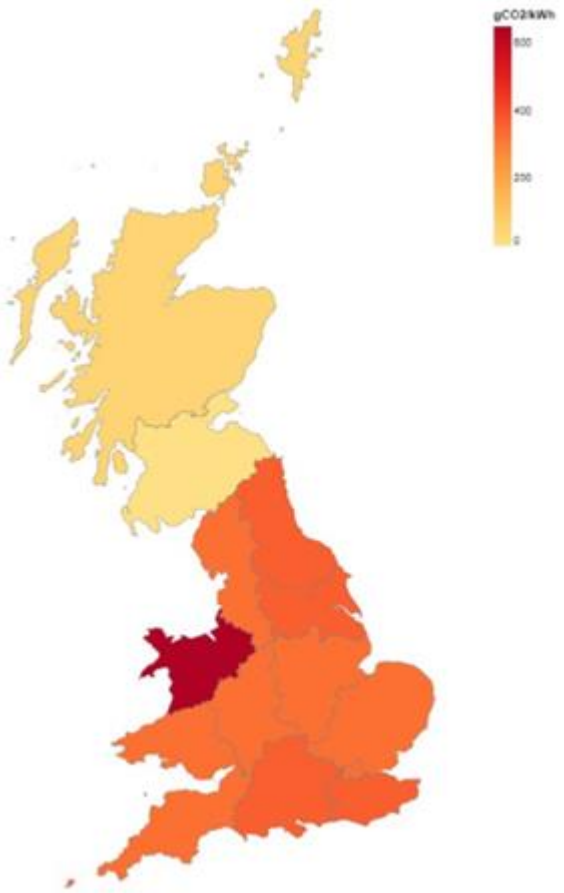
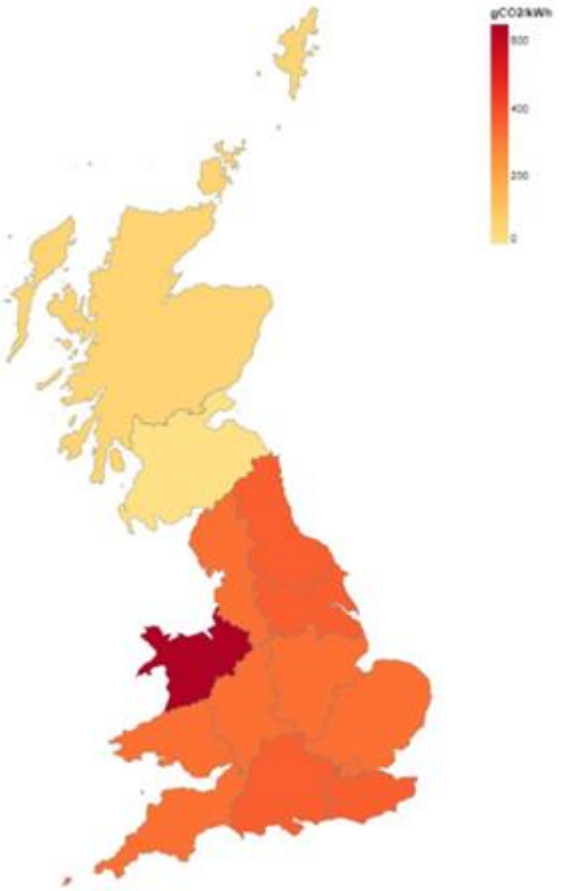
IS RUNNING A HEAT PUMP ALWAYS BETTER FOR THE ENVIRONMENT THAN A CHP?

- **No.** When decarbonising large heat networks with existing CHPs, the dynamic dispatch of CHPs and heat pumps could be the optimal approach.
- The actual impact on total carbon emissions of opting to run a heat pump or a CHP varies with time and location, frequently and significantly.
- There are many apps that can provide you with the average electricity grid carbon intensity (g/kWh) in real-time, even on a regional basis, but…
- **This is the first real-time marginal emission factor app for the British national grid!**



PRESENTATION PLAN

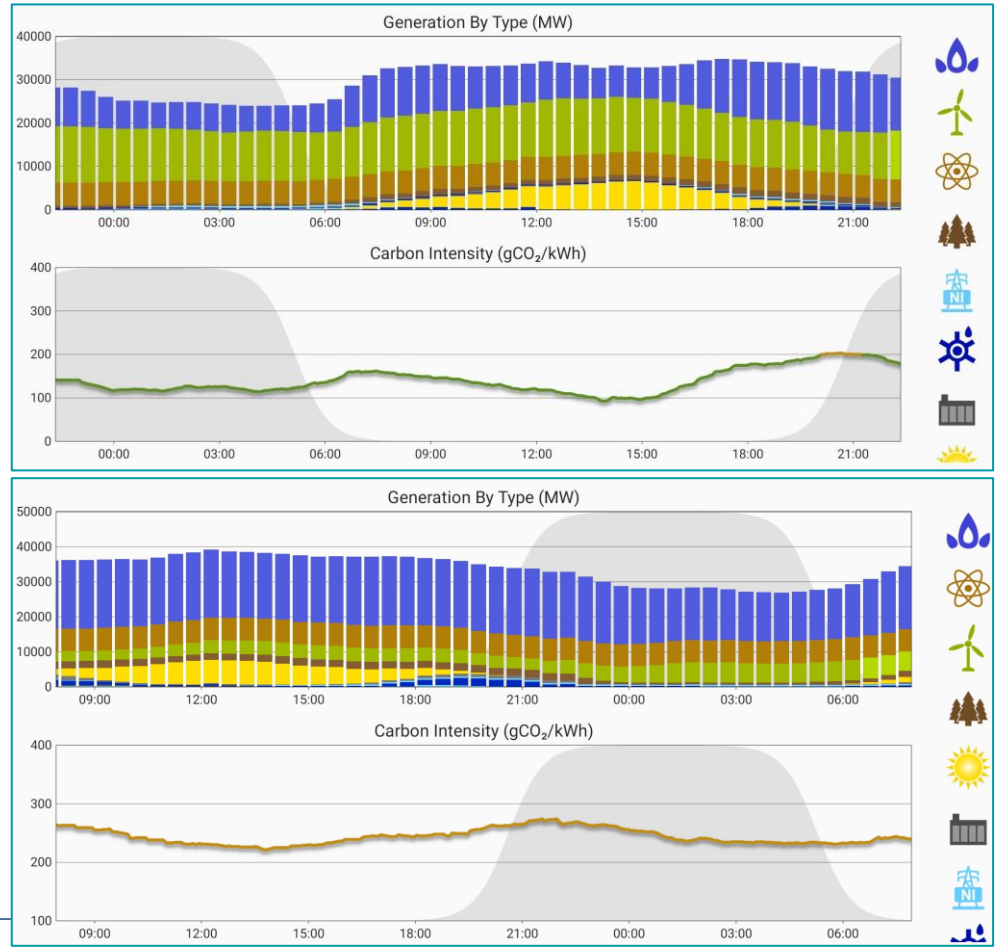
- Overview of marginal emissions concept
- The decarbonisation opportunity of hybrid heat networks
- Generation types and frequency of marginality
- Network constraints and algorithm methodology
- Demonstration of web application
- Key and anomalous marginal emission scenarios
- Potential impact on heat network decarbonisation
- Wider applications



MARGINAL EMISSIONS CONCEPT

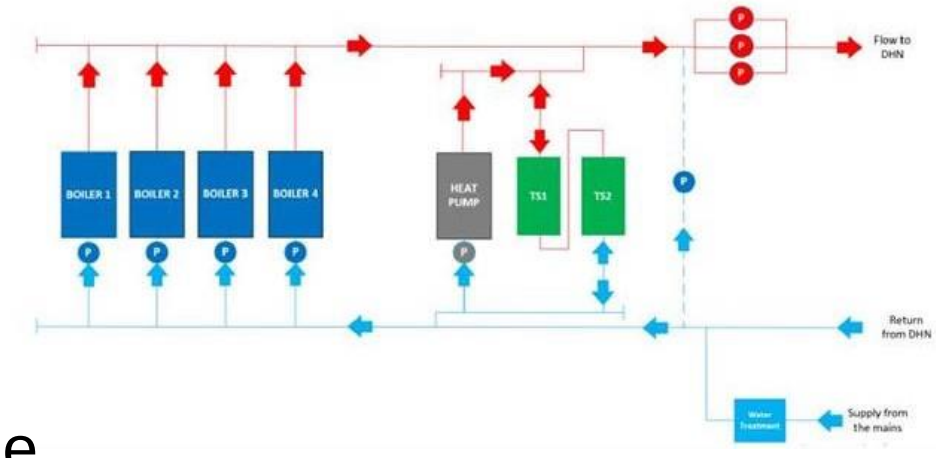
- Using the concept of the grid's marginal emissions to determine the impact of one's elective electrical consumption or generation is not new.
- SAP now calls for the use of the Long-Run Marginal Emissions Factors from the government's Greenbook
- But the Greenbook's values are the average for the year.
- The variability of the marginal emitter on the grid is in fact fairly extreme.

From GridCarbon app:

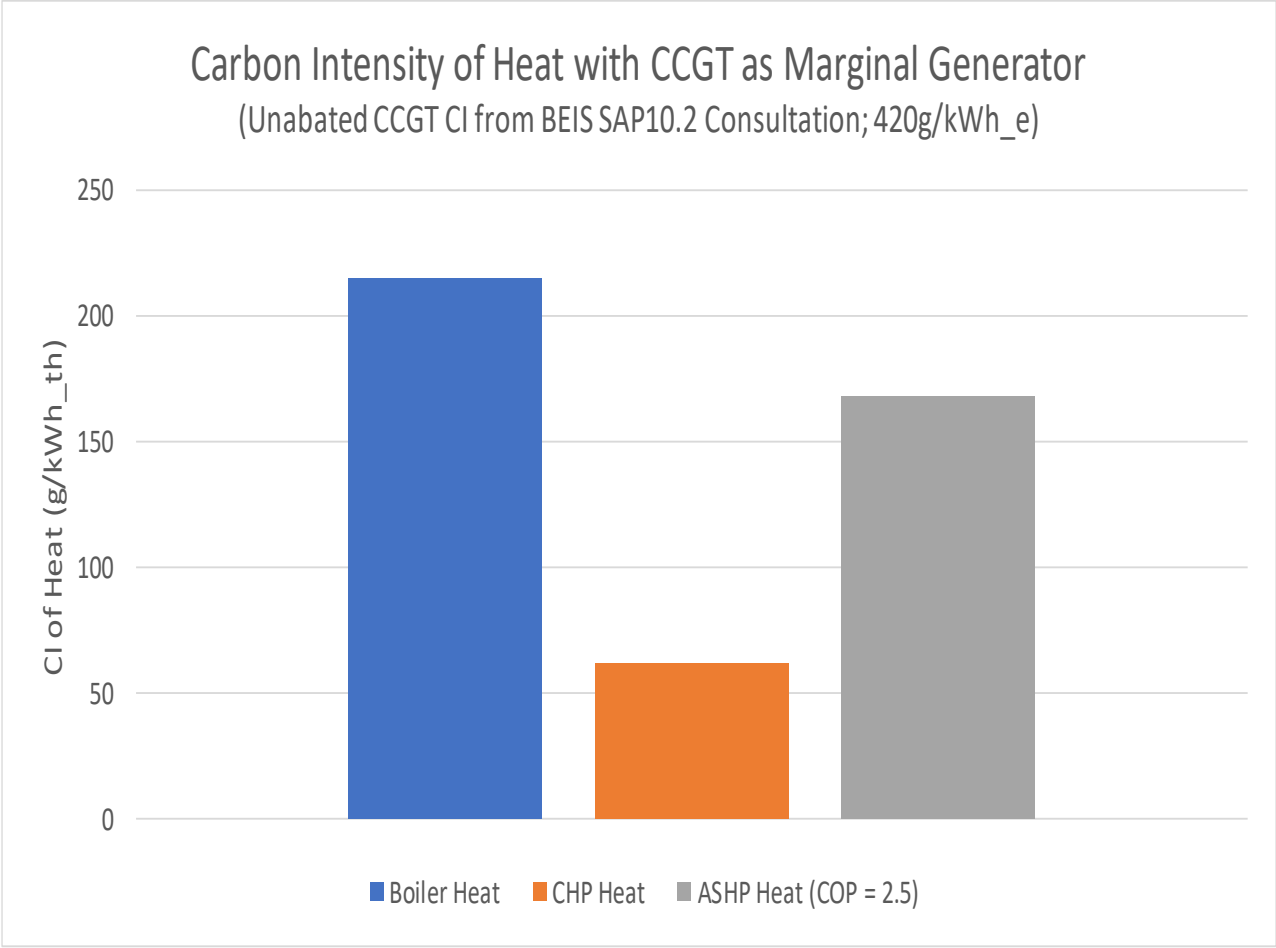


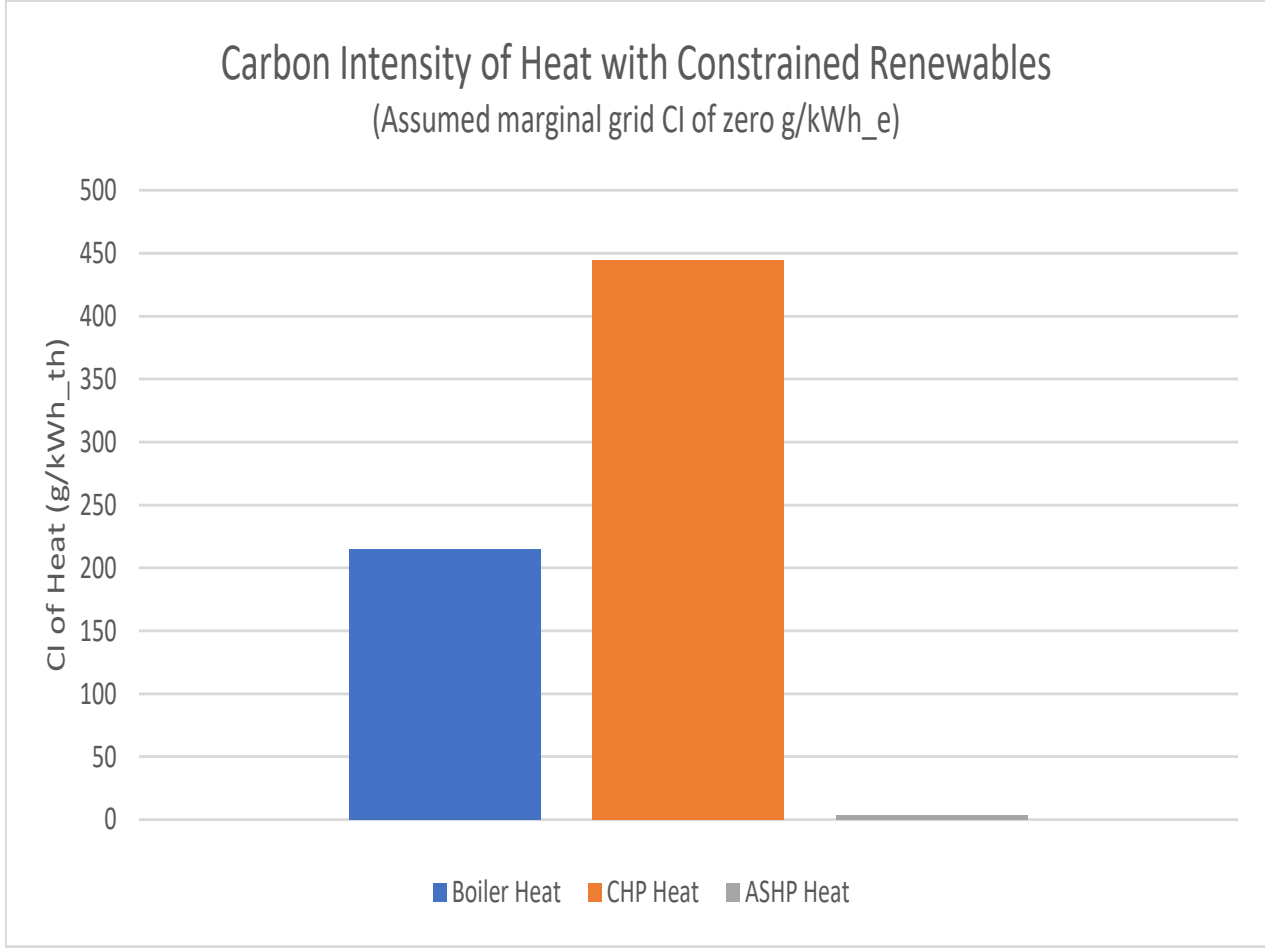
HEAT NETWORKS' UNIQUE OPPORTUNITY

- Large heat networks have typically consisted of gas boilers, gas CHPs and thermal stores.
- As decarbonisation is planned, the addition of heat pumps are most commonly considered.
- Preserving a heat network's capability of switching between heat-generating sources and of time-of-use shifting with thermal storage is advantageous.
- Dynamic and smart dispatch of the assets within the HN energy centre can provide significant total carbon emission savings.

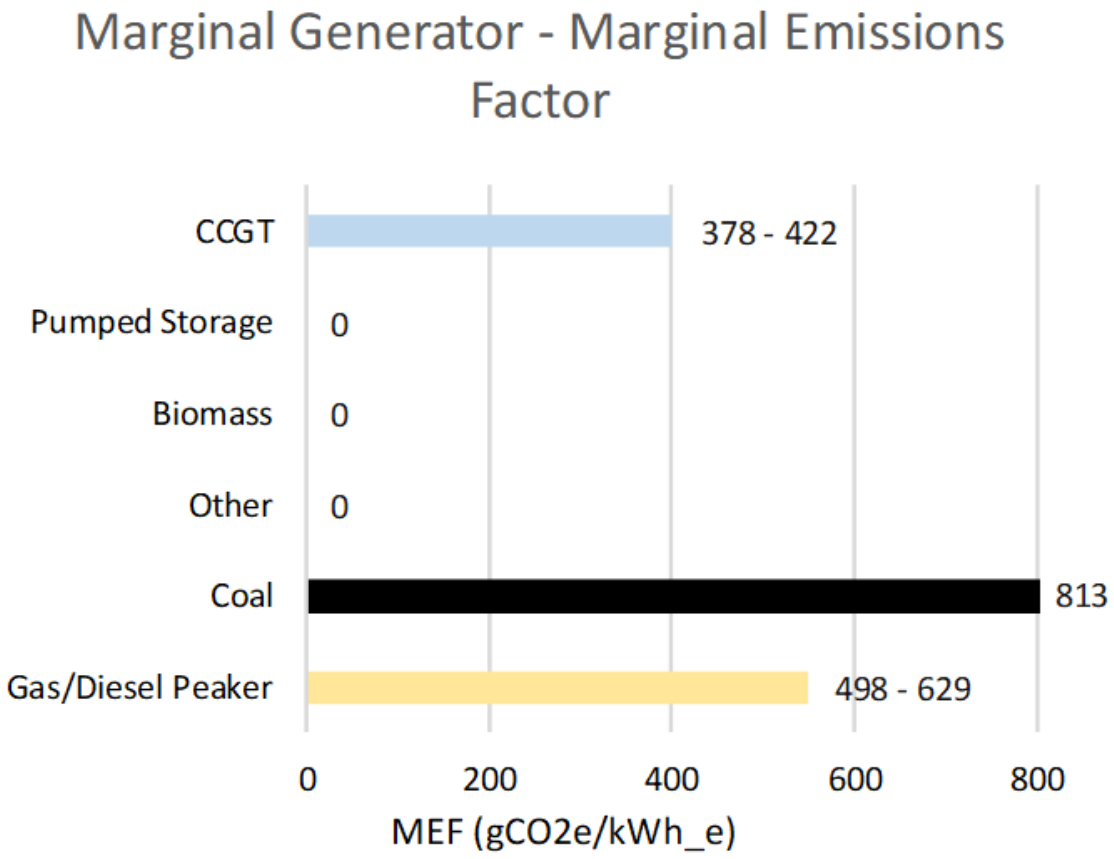


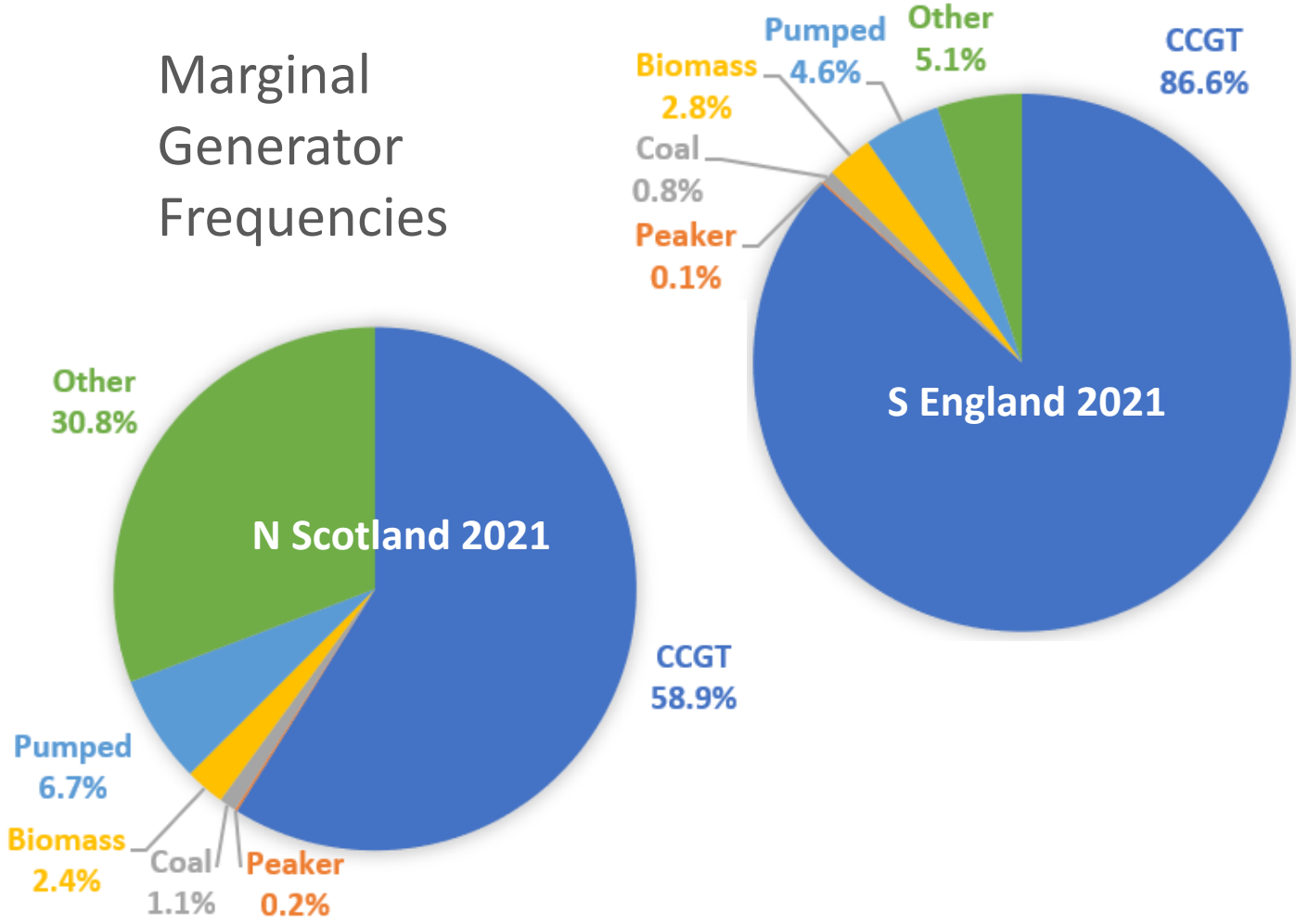
HEAT NETWORKS' UNIQUE OPPORTUNITY



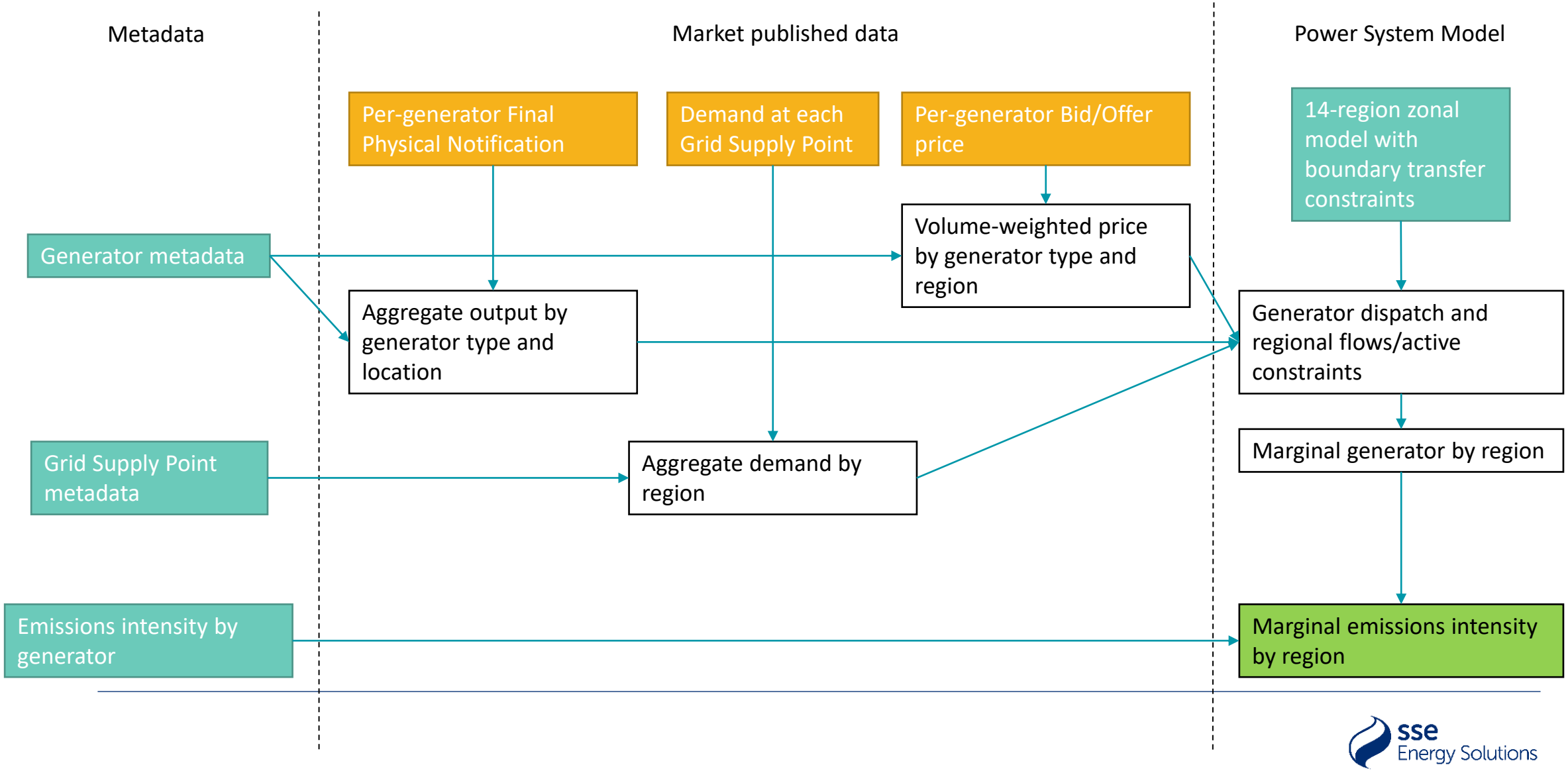


GENERATION TYPES AND MARGINALITY

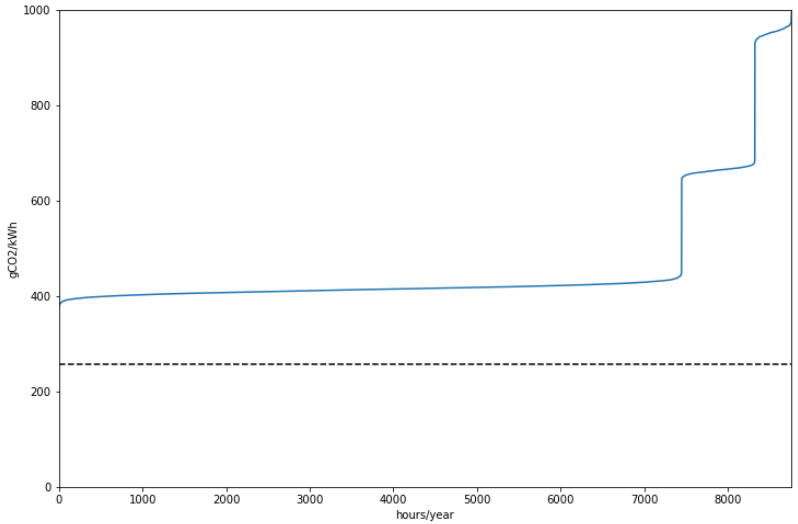




MEF DETERMINATION



MARGINAL EMISSION SCENARIOS



Coal/Oil/Diesel

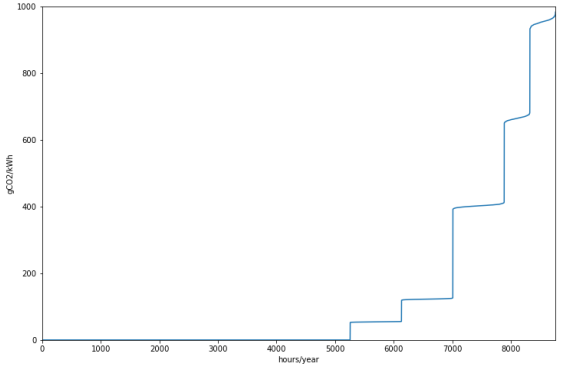
OCGT

CCGT

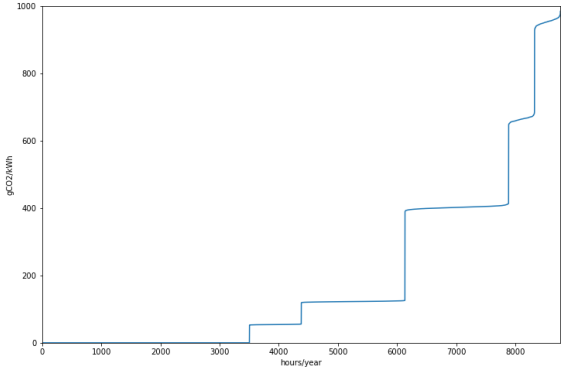
Average intensity (2019)

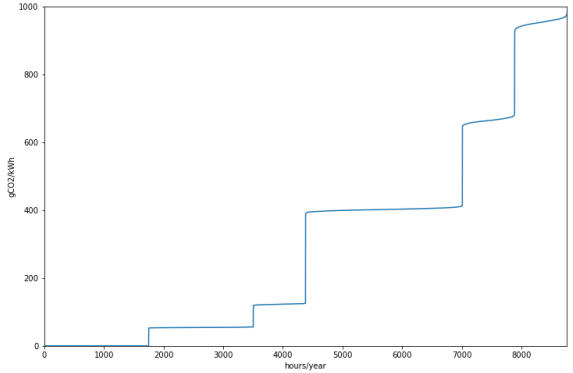
Emissions intensity of marginal system-level balancing action, 2019/20

N Scotland

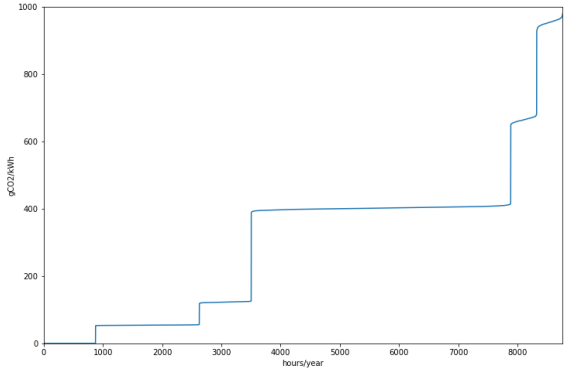


S Scotland





N England



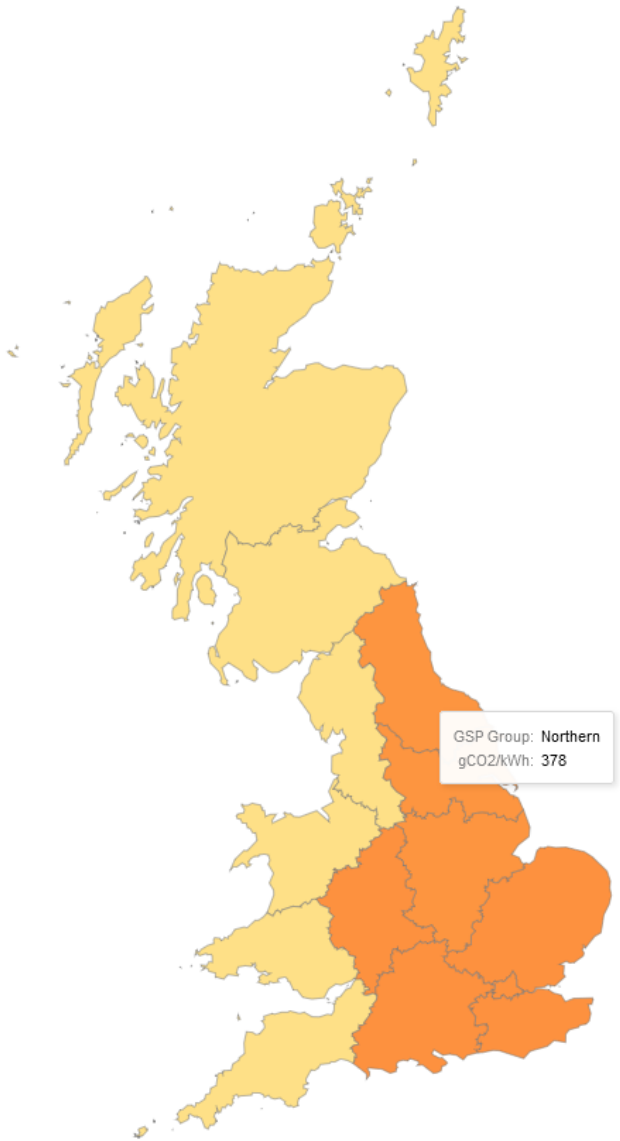
S England

Emissions intensity of marginal regional balancing action, 2019/20

Marginal Emissions Calculator

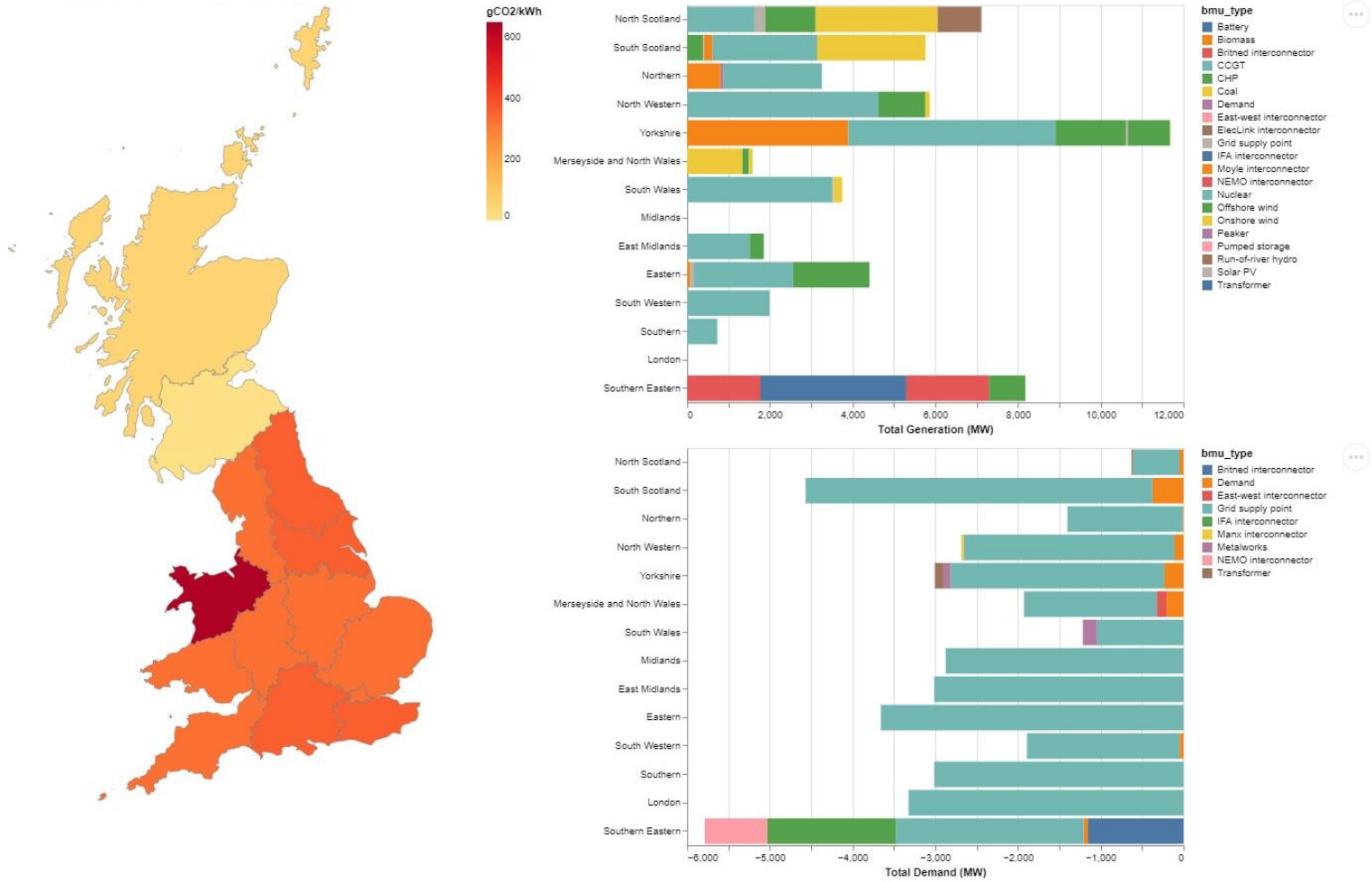
University of Strathclyde Engineering

Live | Historical | Future Scenarios | Site Admin

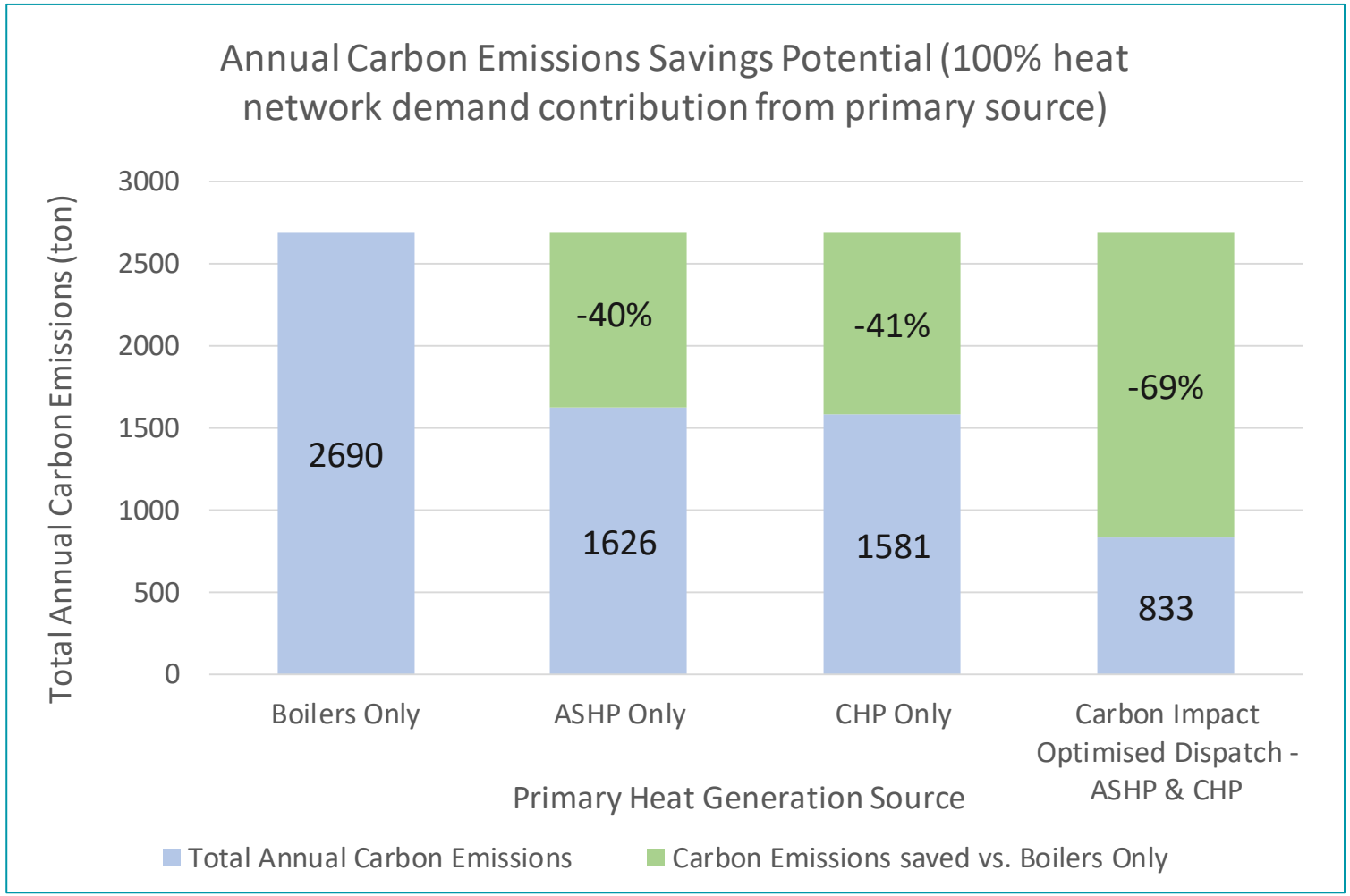


GSP Region	Marginal Region	Marginal BMU	Name	Type	Emissions (gCO2/kWh)
North Scotland	North Scotland	T_BDCHW-1	Bad a Cheo Wind Farm	Wind (Onshore)	0.0
South Scotland	South Scotland	V__NFLEX001	South Scotland GSP Group - Flexitricity Limited	Virtual parties	0.0
North West England	North West England	2__GANGE004	North Western GSP Group - Limejump Energy Limited	GSP: North West England	0.0
North East England	East Midlands	T_STAY-3	Staythorpe Unit 3	CCGT	378.0
Yorkshire and the Humber	East Midlands	T_STAY-3	Staythorpe Unit 3	CCGT	378.0
Merseyside and North Wales	Merseyside and North Wales	2__DSTAT001	Merseyside and North Wales GSP Group - Statkraft Markets Gmbh	GSP: Merseyside and North Wales	0.0
South Wales	South Wales	2__KANGE001	South Wales GSP Group - Limejump Energy Limited	GSP: South Wales	0.0
West Midlands	South East England	T_MEDP-1	Medway	CCGT	394.9
East Midlands	East Midlands	T_STAY-3	Staythorpe Unit 3	CCGT	378.0
South West England	South West England	2__LSTAT001	South Western GSP Group - Statkraft Markets Gmbh	GSP: South West England	0.0
South England	South East England	T_MEDP-1	Medway	CCGT	394.9
East England	South East England	T_MEDP-1	Medway	CCGT	394.9
London	London	T_EECL-1	Enfield Energy	CCGT	391.4
South East England	South East England	T_MEDP-1	Medway	CCGT	394.9

Marginal Emissions Calculator



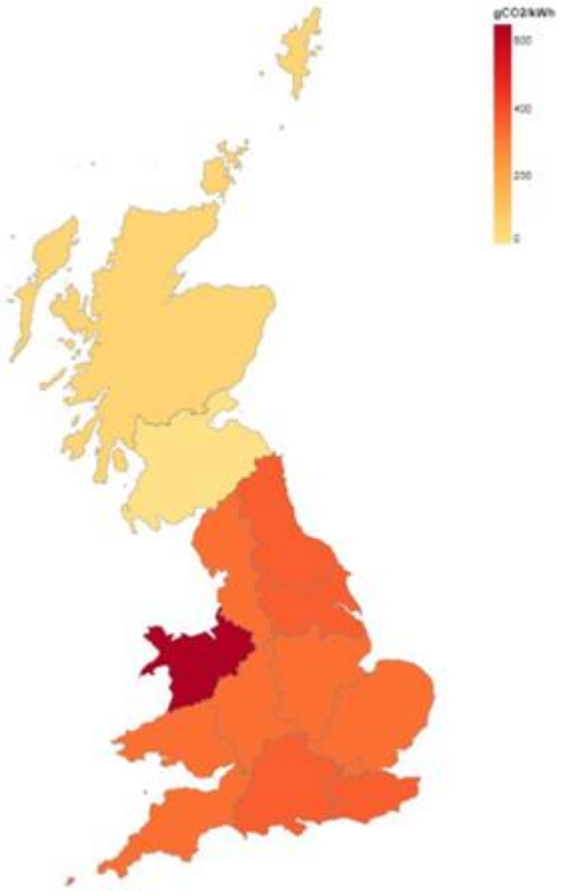
IMPACT ON HN DECARBONISATION



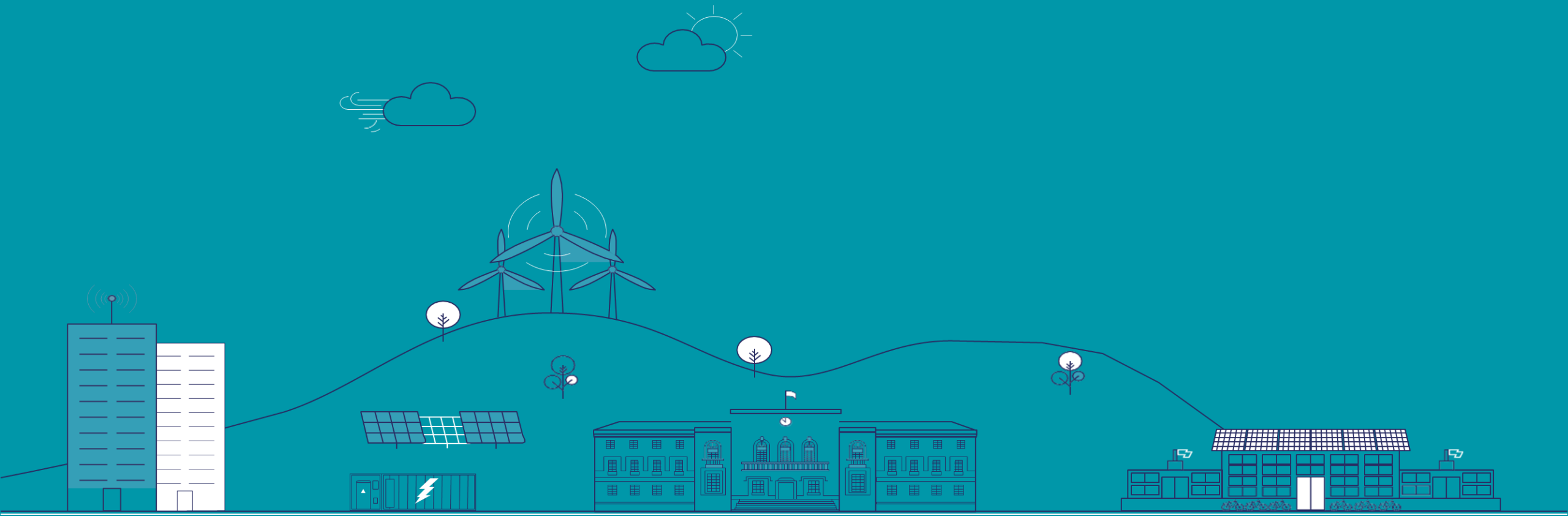
- For S England in 2019 (12.5GWh/a scheme)

WIDER APPLICATIONS

- Significant genuine carbon reduction could be realised with minimal infrastructural changes in many sectors.
- All flexible demand (and generation) should consider the real-time MEF where economically achievable:
  - Electric domestic heating with thermal storage
  - Chilling plant with thermal storage
  - EV charging
  - Battery charging
  - Pumped storage
  - Smart appliances



THANK YOU



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