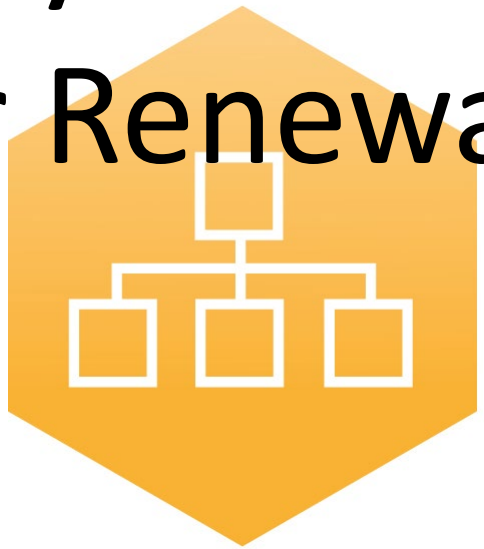
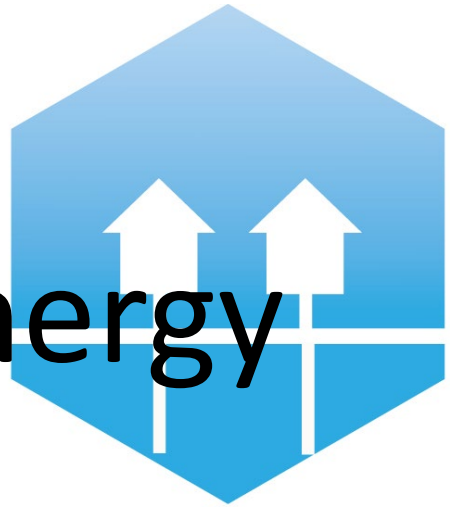
4th International Conference on Smart Energy Systems and 4th Generation District Heating
Aalborg, 13-14 November 2018

DHN vs 5th Gen

David Pearson
Nicky Cowan
Star Renewable Energy





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Scotland at a Glance

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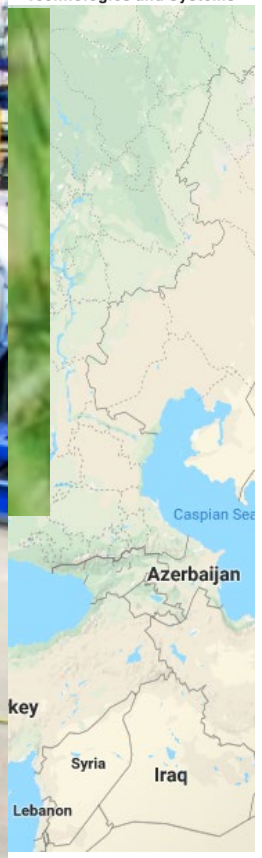
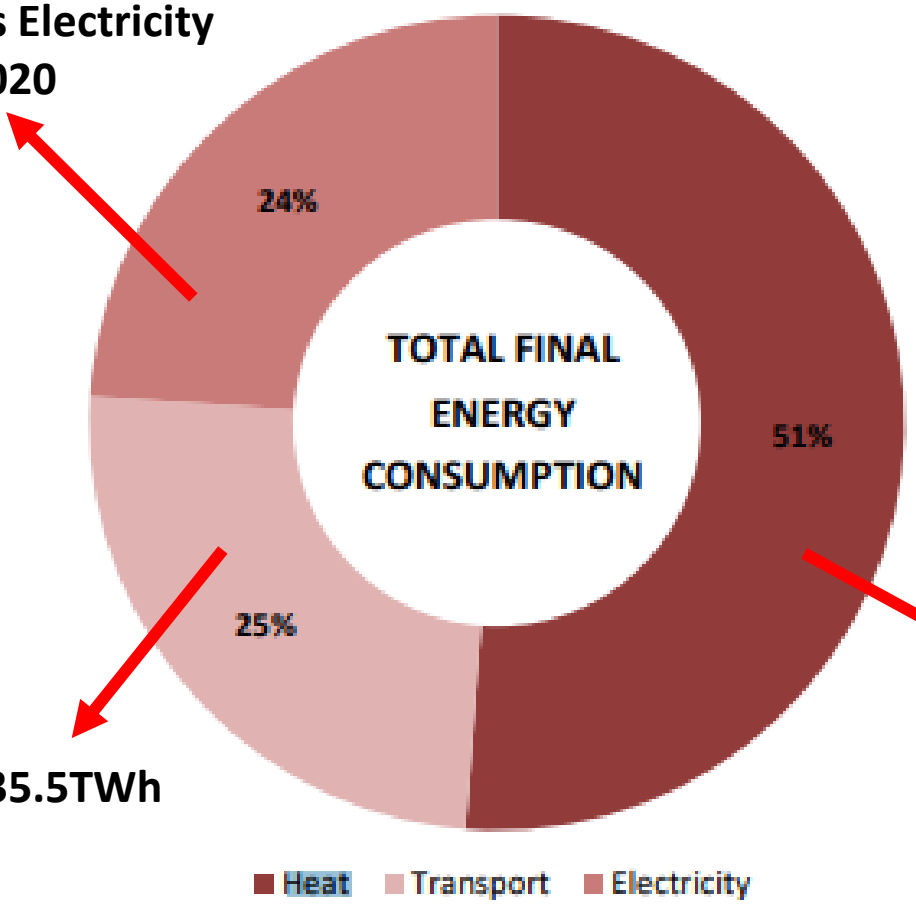


ng 2018

Electricity at 24% = 34.08TWh
How Much Renewable Electricity?
68.1% in 2017
Target is 100% Gross Electricity by renewables by 2020



Transport at 25% = 35.5TWh

The 51% is made up from

43% Domestic
57% Non Domestic

77,976 GWh in 2015

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Scotland In Numbers

How much renewable heat?

4.8-5.0% in 2016

Target is 11% by 2020

	2008	2009[10]	2010	2011	2012	2013	2014	2015	2016
Renewable Heat (GWh)	863	-	1,363	1,690	2,045	2,266	3,071	4,205	3,752
Heat Demand (non-electrical, GWh)	97,053	89,155	91,156	88,269	86,447	83,805	79,207	77,976	-
% Renewable Heat	0.9%	-	1.5%	1.9%	2.4%	2.7%	3.9%	5.4%	-

Sources: EST, BEIS, Scottish Government

WE'RE ACTUALLY GOING BACKWARDS!!

Targets

2020 Reduce Emissions by 42%

2030 Reduce Emissions by 50%

2032 Reduce Emissions by 66%

2050 Reduce Emissions by 90%

AYE RIGHT!

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rict Heating
d Systems

PARIS AGREEMENT

The Government's Standar
Procedure for Energy Ratin

2012 edition

This document describes SAP 2012 version 9.92, dated Octobe
users should ensure that they are using the latest version of the
any updates will be published on the website below.

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rev February 2014 to include TER calculation for Wales
rev June 2014 to include RdSAP 2012

UNITED NATIONS
2015

The Clean
Growth Strategy

Leading the way to
a low carbon future

Building our
Industrial Strategy

January 2017

Scottish Governm
Riaghaltas na h-A
gov.scot

2018

Scottish Government
Riaghaltas na h-Alba
gov.scot

So what does it all mean?

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We know the destination – ZERO CARBON

How will we get there??????????????????????

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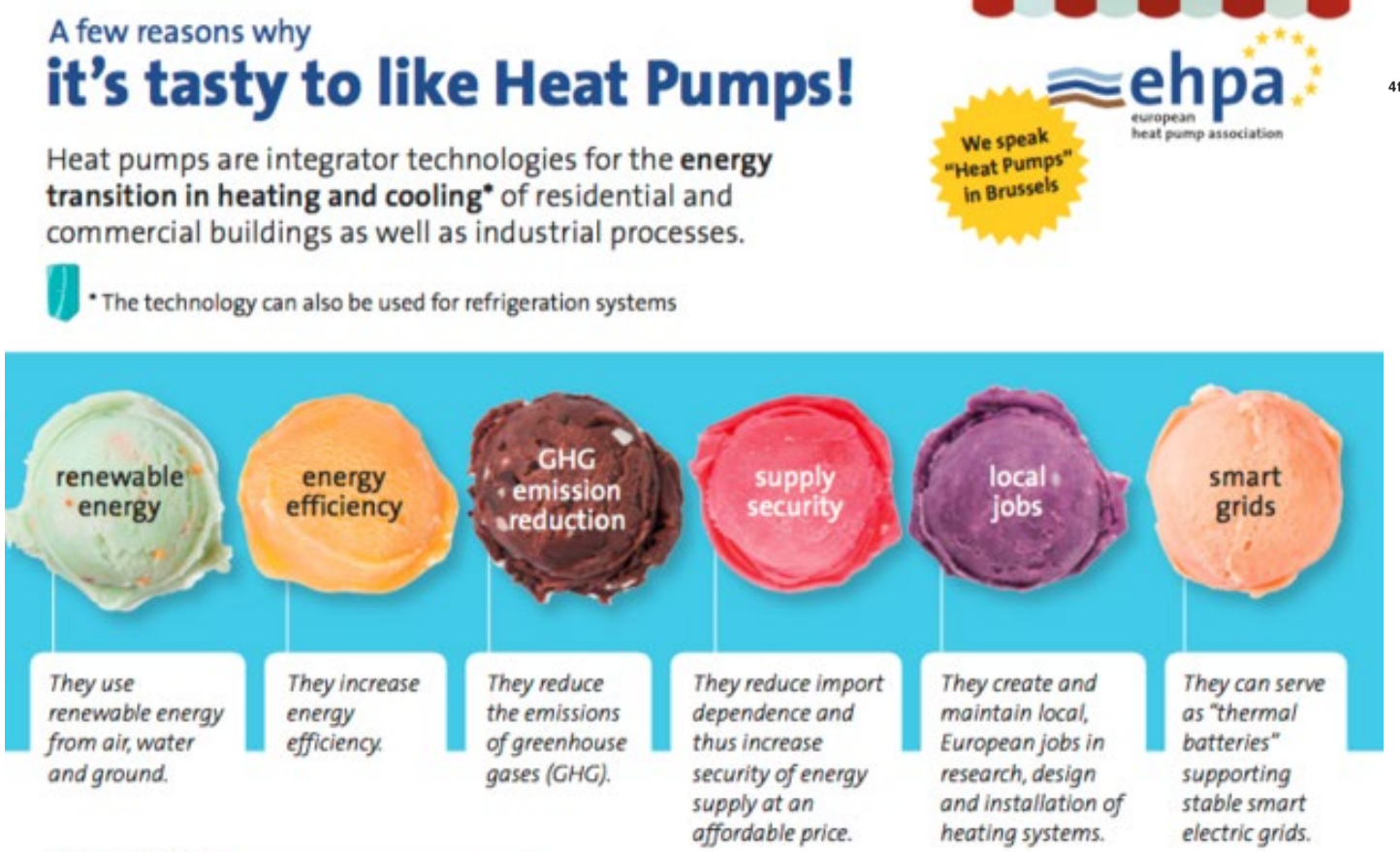

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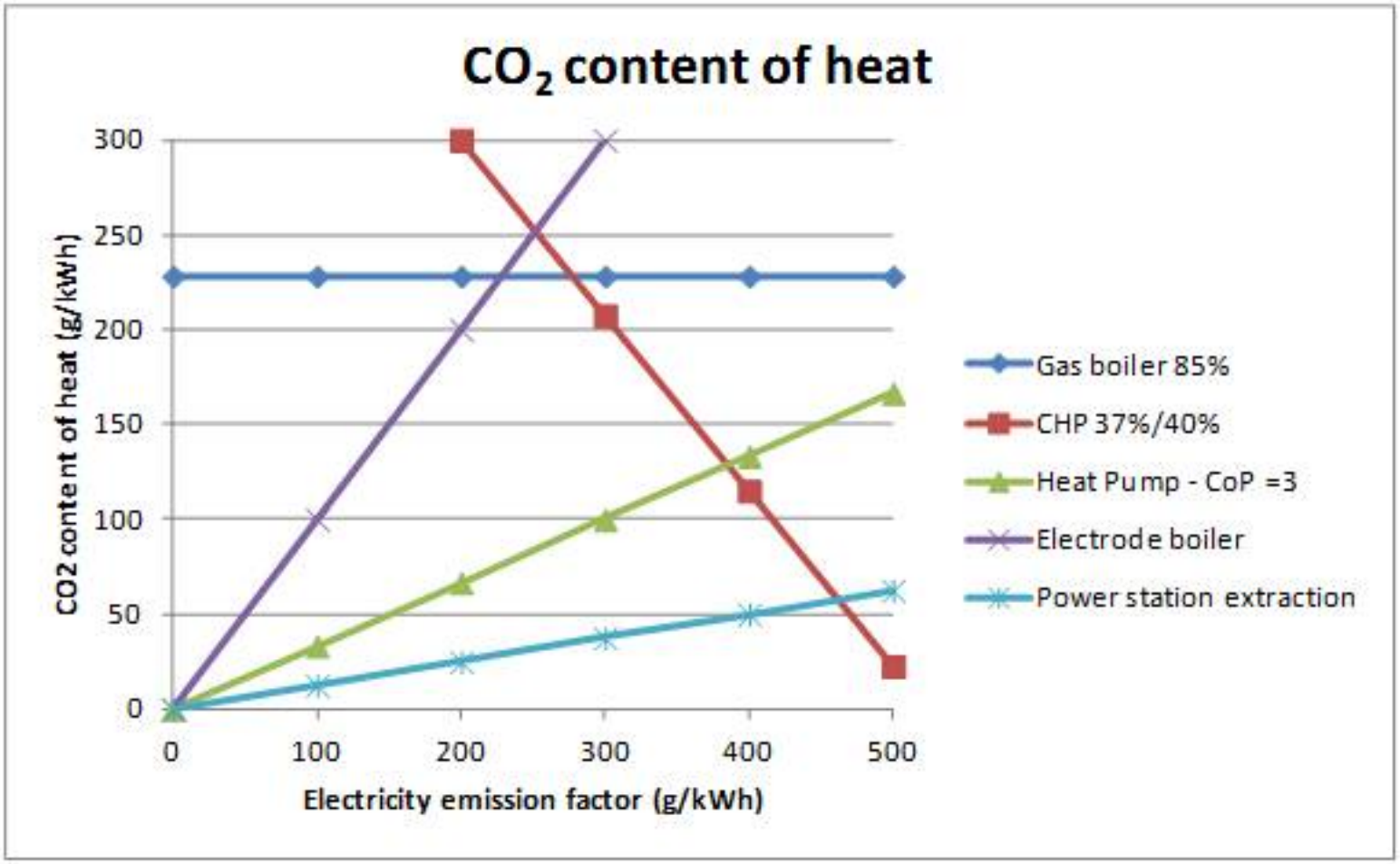

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4th Gen Vs 5th Gen

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Large heat pump sending Temperatures around 70/75°C to a district network = 4th Gen

Ambient loop (around 15°C) with individual Heat Pump at each building = 5th Gen

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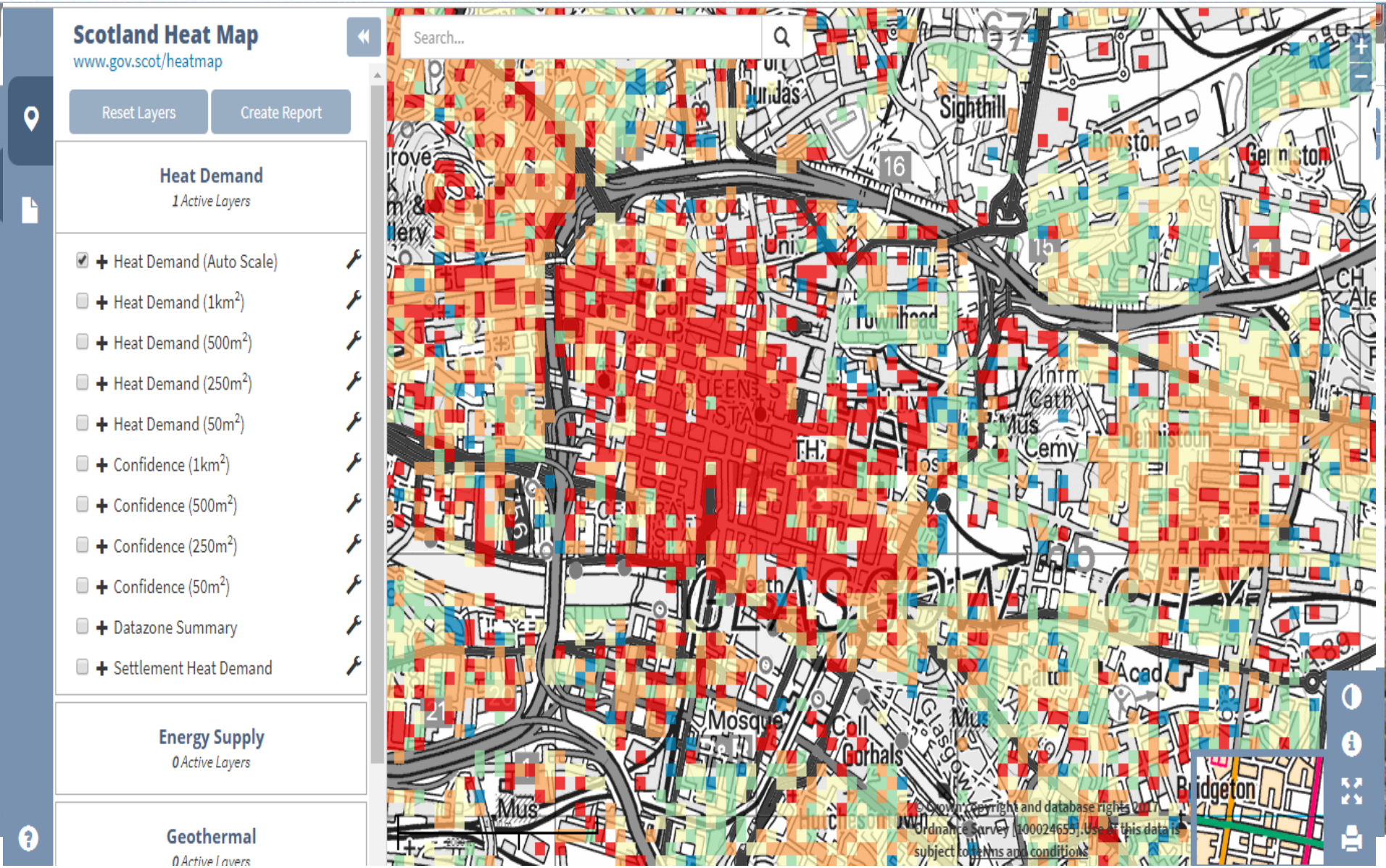
R717 vs R134a

Refrigerant	R717	R134a
Condensing (°C)	72	72
Evaporating (°C)	0	0
Capacity	2130.5	1158.7
COP	3.25	3.07


Scotland Heat Map
www.gov.scot/heatmap
Reset Layers
Create Report
Heat Demand
1 Active Layers
Heat Demand (Auto Scale)
Heat Demand (1km²)
Heat Demand (500m²)
Heat Demand (250m²)
Heat Demand (50m²)
Confidence (1km²)
Confidence (500m²)
Confidence (250m²)
Confidence (50m²)
Datazone Summary
Settlement Heat Demand
Energy Supply
0 Active Layers
Geothermal
0 Active Layers
Search...
Dundas
Sighthill
Townhead
Mosque
Gorbals
Bridgeton
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Scotland Heat Map

www.gov.scot/heatmap

Reset

Select report area by predefined geo

Scotland | Local Authoritie

Settlements | Data Zones

Generate Report

Export to CSV | Export to

Heat Demand Results

Total Heat Demand	52 GWh/
Public Building Heat Demand	0 kWh/y
Number of Energy Sources	0

Summary Information

Area	0.069 kr

scot/heatmap

Scotland Heatmap

Heat Demand

Total Heat Demand: 3 GWh/yr
Public Heat Demand: 0 kWh/yr
Energy Supply: 0

Summary Information

Area: 0.002 km2
Report Centre: X: 664919 | Y: 258823

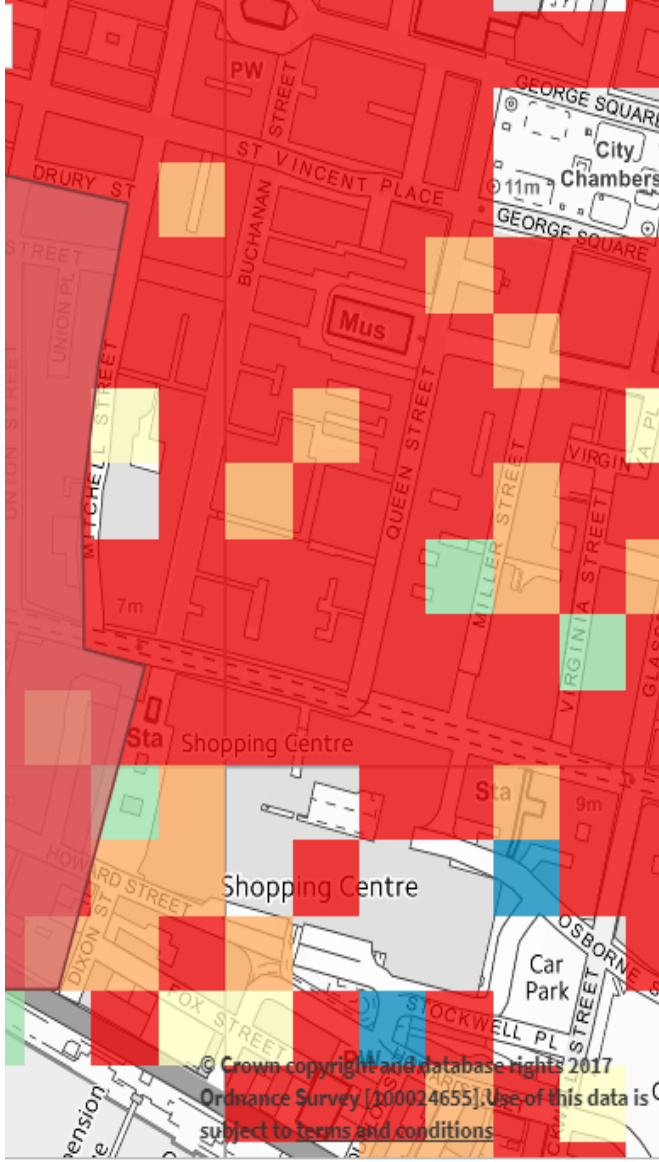
Additional Information

Local Authorities Covered:
Glasgow City

Data Zones Covered:
S01010274

Reporting Area

thinkWhere



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THE NUMBERS

	Solution 1	Solution 2
Style	District Heating Network	Ambient loop
Number of Buildings	58	58
Number of Heat Pumps	3	2
Distribution Heat Pump Flow Temp (°C)	75	15
Distribution Heat Pump Return Temp (°C)	45	10
Source Side (Sea Water in Winter) Flow Temperature (°C)	5	5
Source Side (Sea Water in Winter) Return Temperature (°C)	2	2
Thermal Capacity (kW)	13000	13000
Heating COP	3.18	11.61
Electrical Power Required (kW)	4082	1119
Distribution Flowrate (kg/s)	108.78	639.27
Distribution Pump Power Required	59.51	263.01
Distribution Pipe Size (Inch)	10	24
Source Side (Sea Water) Flowrate (kg/s)	743	970
Source Side Sea Water Pump Power (kW)	703	920

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MORE NUMBERS

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	Solution 1	Solution 2
Style	District Heating Network	Ambient loop
Secondary Heat Pump Heating Flow Temperature (°C)	n/a	75
Secondary Heat Pump Heating Return Temperature (°C)	n/a	45
Source Side Flow Temperature (°C)	n/a	15
Source Side Return Temperature (°C)	n/a	10
Secondary Side Circulation pump power required (kW)	7.5	7.5
Number of Secondary Heat Pumps Required	n/a	58
Average Heat Pump Capacity (kW)	0	287
COPt Of Secondary Heat Pump	0	3.5
Electrical Power Required for Secondary Heat Pumps (kW)	0	82
Total Electrical Power Required for Secondary Heat Pump (kW)	0	4756
Number Of Heat Interface Units Required	58	0
Average Heat interface Capacity (kW)	287	0

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.....Numbers

	Solution 1	Solution 2
Style	District Heating Network	Ambient loop
Total Heat Pump Electrical Consumption per system (kW)	4082	5875
Total Electrical Load Including Source and Distribution Pumps(kW)	4851	7066
Final System COP	2.68	1.84
Cost of Distribution Water Source Heat Pumps (£)	4,550,000.00	3,900,000.00
Cost of Distribution Pump Skid (£)	20000	60000
Cost Of Source Water Pump Skid(£)	100000	100000
Cost of Seconday Water Source Heat Pumps (£)	0	4350000
Cost of Heat Inter Face Units (£)	783000	0
Total Cost (£)	5,453,000.00	8,410,000.00

Conclusion

In this instance District Heating with Big Heat Pumps

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Some thoughts??

- Dispersed Electrical Load
- Pipe Size (Space)
- Maintenance (OPEX)
- Customer Control
- Cooling
- Efficiency
- ESCO?

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Conclusion

In other areas?

Whatever is right as long as it complies with the targets set and is a "No Regret" solution…… but most likely heat pumps.

P.S Don't forget the ice creams