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LOW-CARBON CITIES CONFERENCE

20 FEBRUARY 2018 EDINBURGH



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Enabling Low-Carbon Cities: Transforming Concept into Reality for Scotland




Claire Mack, Chief Executive, Scottish Renewables

Councillor John Alexander, Leader of Dundee City Council & Chair of Scottish Cities Alliance


Richard Bellingham, Director, Institute for Future Cities, University of Strathclyde

Kate Turner, Legal Director, Pinsent Masons LLP



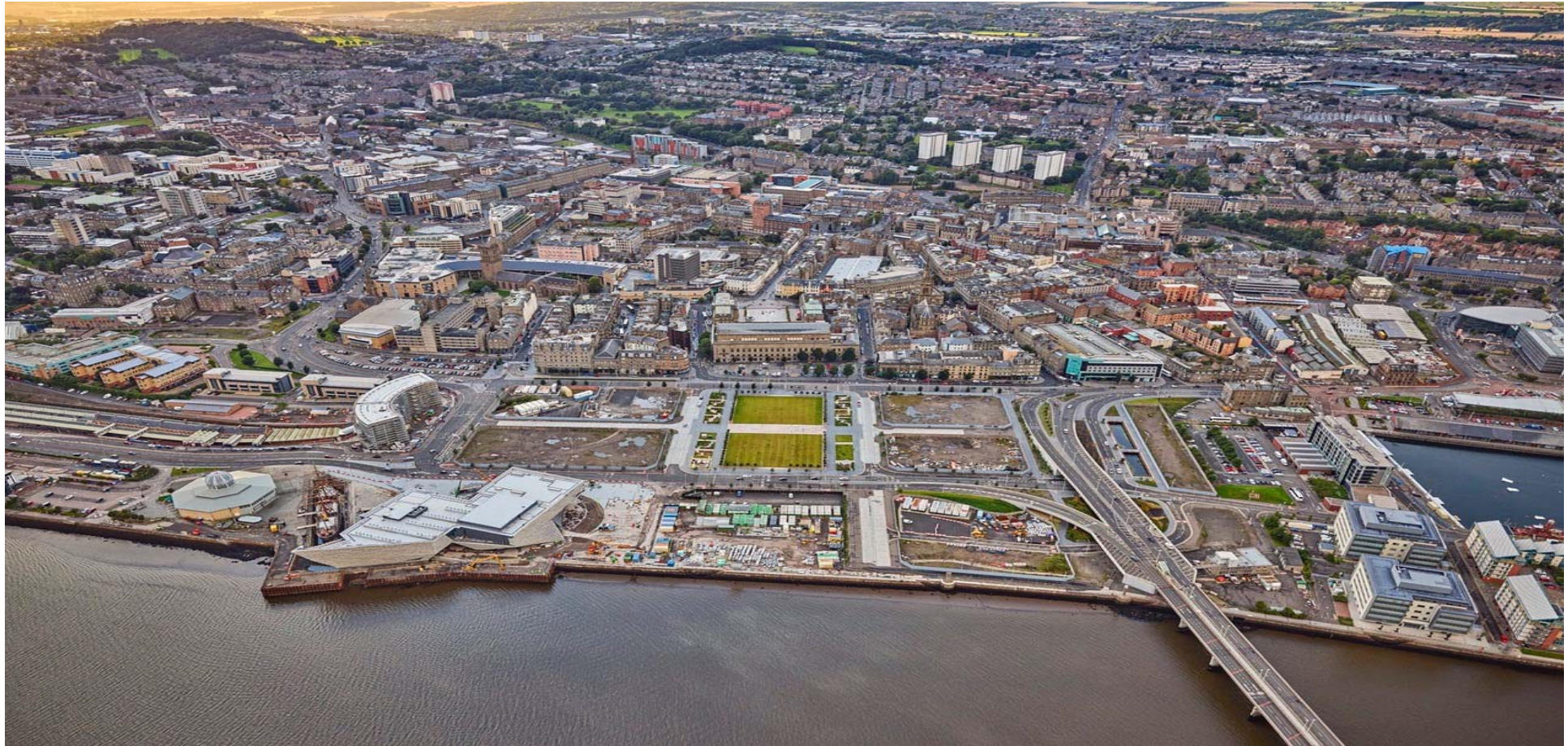


Councillor John Alexander
Leader of Dundee City Council
& Chair of Scottish Cities Alliance



Councillor John Alexander

Leader of Dundee City Council
Chair, Scottish Cities Alliance

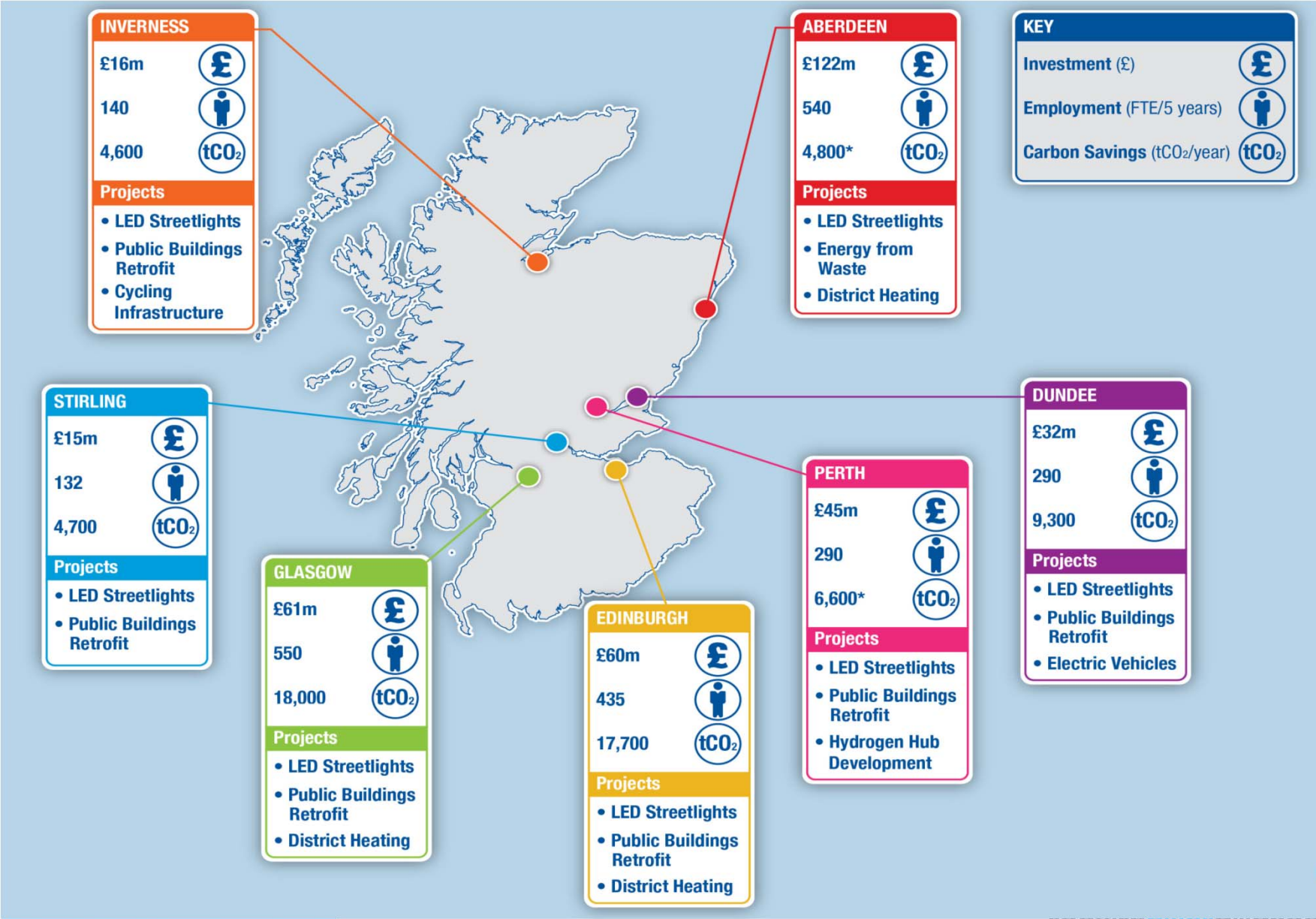


Scottish Cities Alliance (SCA)

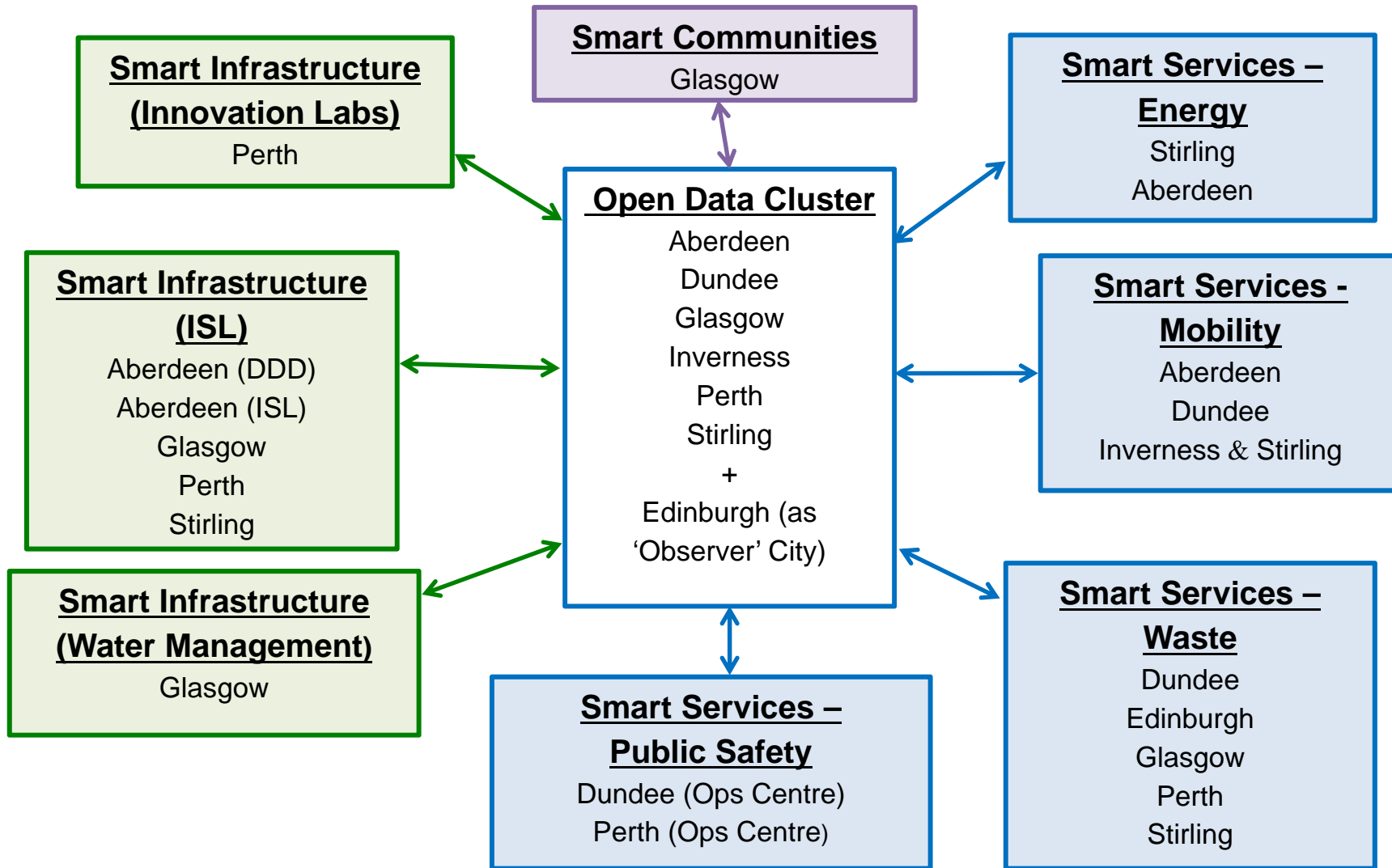
- Partnership of the 7 Scottish Cities and Scottish Government.
- Delivering the Scottish Government's 'Agenda for Cities'.
- Collaborative working to maximise economic potential.
- Focus on innovative solutions and attracting investment.
- Environment to test out new ideas and business models.
- 4 Operational plan priorities: Low Carbon; Hydrogen; Smart Cities & Infrastructure .



Low Carbon Cities



Smart Cities



3rd

Climate Change Plan

>66%
emissions by
2032

Low Carbon: Strategic Context

• **Climate Change (Scotland) Act 2009.** Scottish Government is in the process of finalising its **third Climate Change Plan**

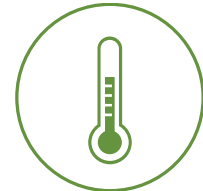
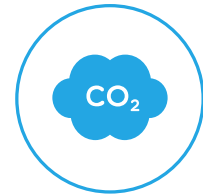
• **Scotland's Agenda For Cities (2016)**

• Scottish Government is in the process of finalising its **third Climate Change Plan**, setting out proposals and policies to drive emissions down by 66% by 2032. The final Plan is expected in early 2018.

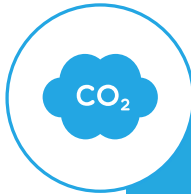
• **National Infrastructure Priority for Energy Efficiency**
Scotland's Energy Efficiency Programme (SEEP)

• **Scotland's Energy Efficiency Programme:** Second Consultation on Local Heat & Energy Efficiency Strategies, and Regulation of District and Communal Heating

• **Low Carbon Resilient Cities: Investment Opportunities for 'Better' Growth (Jacobs, January 2015)**



Low Carbon: Delivery to date



Low Carbon Heat

- **LHEES:** Atkins are developing the LHEES pilot project with 5 cities.
- **District heat policy,** energy statements and skills assessments.
- **Collaborative procurement** associated with low carbon heat .



Circular Economy

- **Zero Waste Scotland Scan:** appointed phase1 will deliver a CE scan for each city.
- **CivTech Challenge:** SCA is supporting the development of an innovative cross city CE challenge
- **Interreg bid:** Develop alternative routes to urban organic waste valorisation.



Integrated Energy Systems

- **NCWFST (Non Conventional Wind Feasibility Study):** city focused reports to identify a possible pilot project.
- **Smart Meter Implementation Programme (SMIP):** data extracted from Smart Meters will help inform the LHEES.

Cross Cities Working

- **Low Carbon Vision** and development of the **SCA pitch book** to include smart and sustainable
- **Under 2 MOU:** cities signed up to the Under2 coalition under the SCA banner to share the goal of limiting warming to below 2° Celsius.



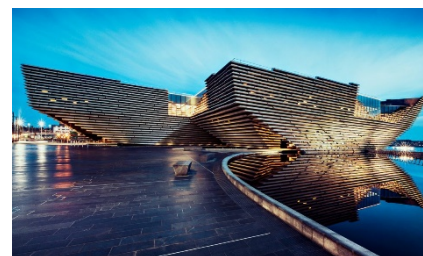
Dundee

Role

- Reducing greenhouse gas emissions
- Adapting to the affects of climate change
- Re-asserting our low carbon credentials

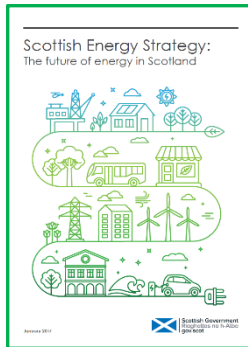
Challenge

- Inward investment
- Business growth
- Energy security
- New jobs





sustainabledundee



Renewables

Energy Efficiency

District Heating

Adaptation & Resilience

Sustainable Transport

Resource Efficiency

SECCAP

energy dundee

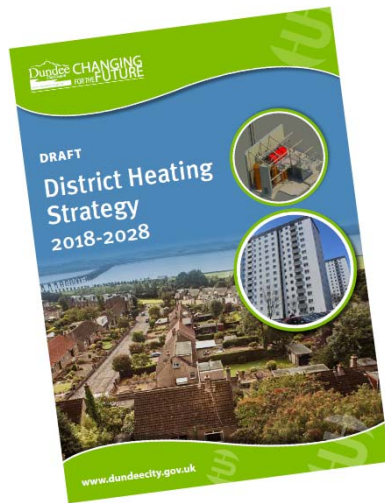
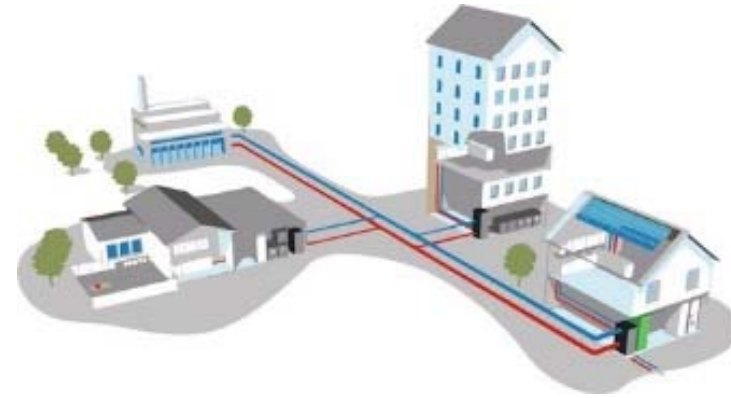
The universities and colleges of Tayside have formed an alliance - creating a unique combination of training and research & development expertise to support the energy sector.



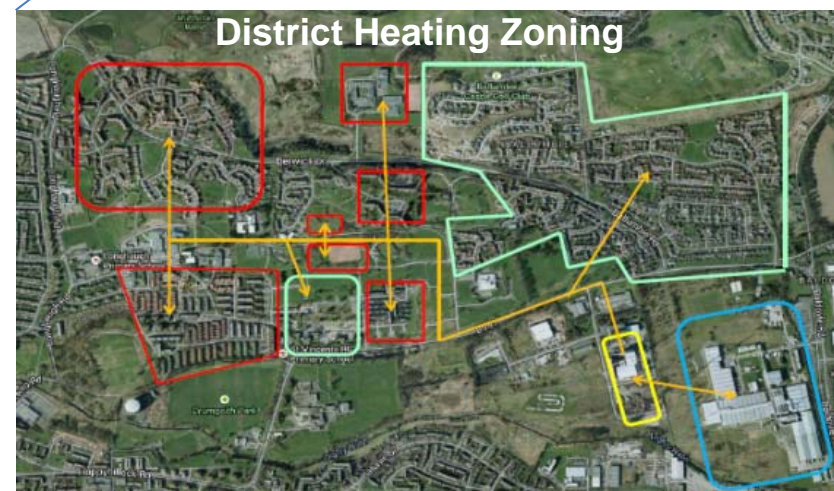
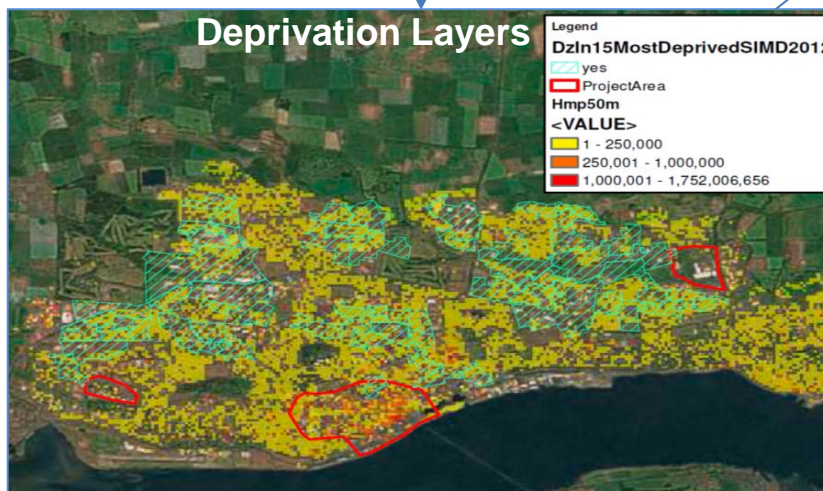
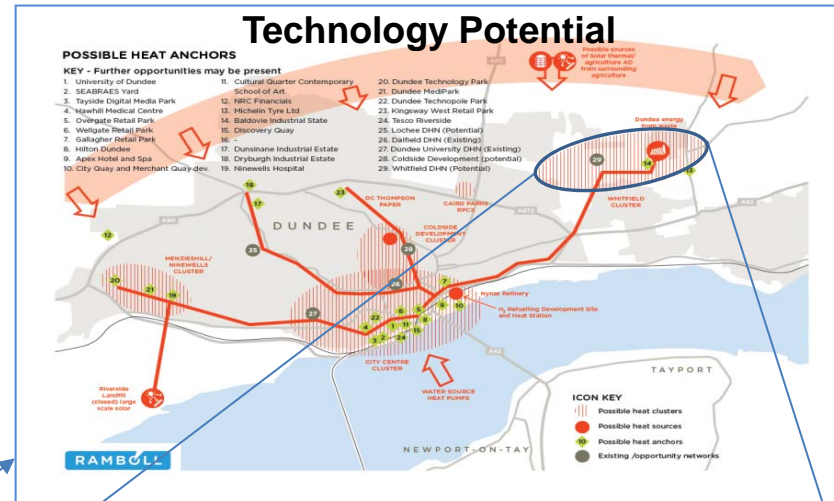
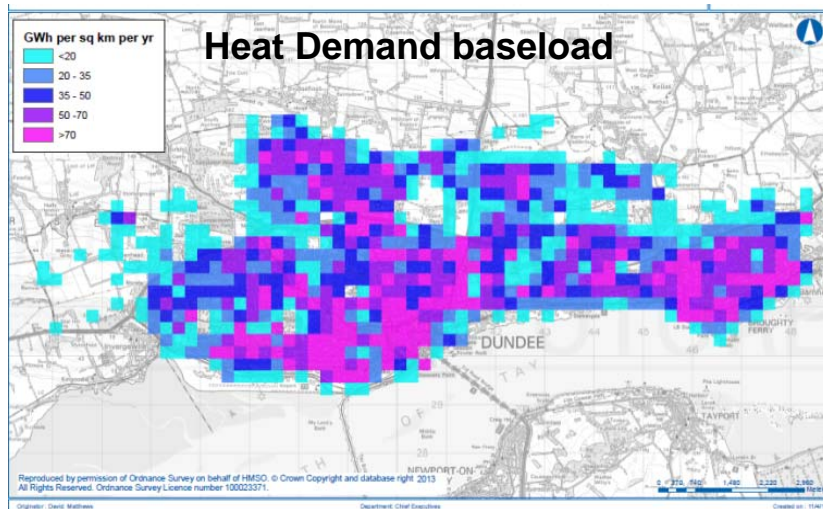
energydundee.com

District Heating

Dallfield Multi-storey development



Spatial Planning for heat decarbonisation







JIVE: Joint Initiative for hydrogen Vehicles across Europe

Objectives

Deploy 142 FC buses across nine cities

Achieve 30% cost reduction versus state of the art

Operate 50% of the vehicles for at least 36 months

Deploy the largest capacity HRS in Europe

Achieve near 100% reliability of HRS

Demonstrate technological readiness of FC buses and HRS

Encourage further uptake

UK – 56 FC buses



Italy – 15 FC buses



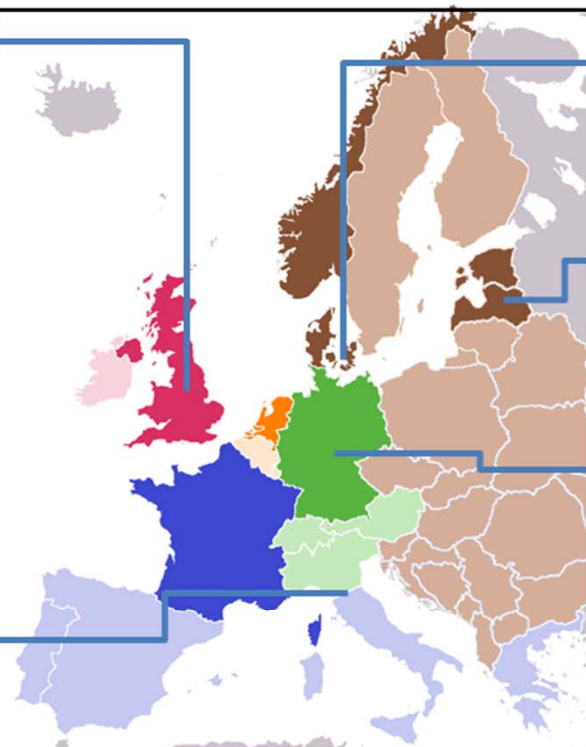
Denmark – 10 FC buses



Latvia – 10 FC buses



Germany – 51 FC buses



Fuel cell buses in cities participating in JIVE

- Current FC buses
- Future FC buses (other projects)
- Future FC buses (Project JIVE)
- Articulated bus (Project JIVE)

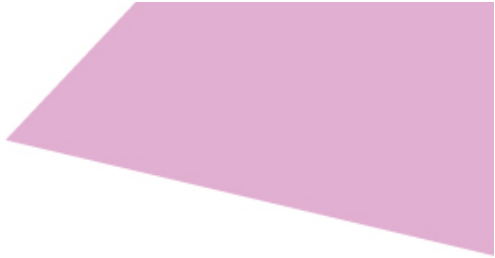
✉ john.alexander@dundeecity.gov.uk

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🌐 www.CouncillorAlexander.com





Richard Bellingham

Director, Institute for Future Cities,
University of Strathclyde





University of
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Glasgow





Institute for Future Cities

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richard.bellingham@strath.ac.uk

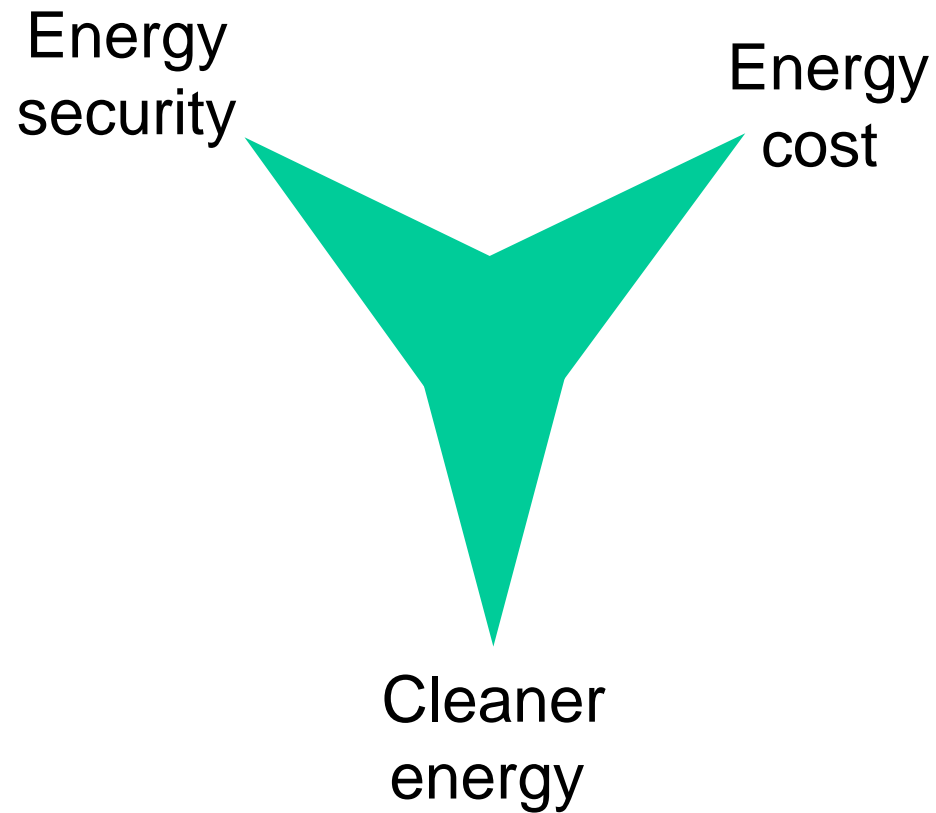
Scottish Cities

- Around 2.2 million people
- Two-thirds of the Scottish economy

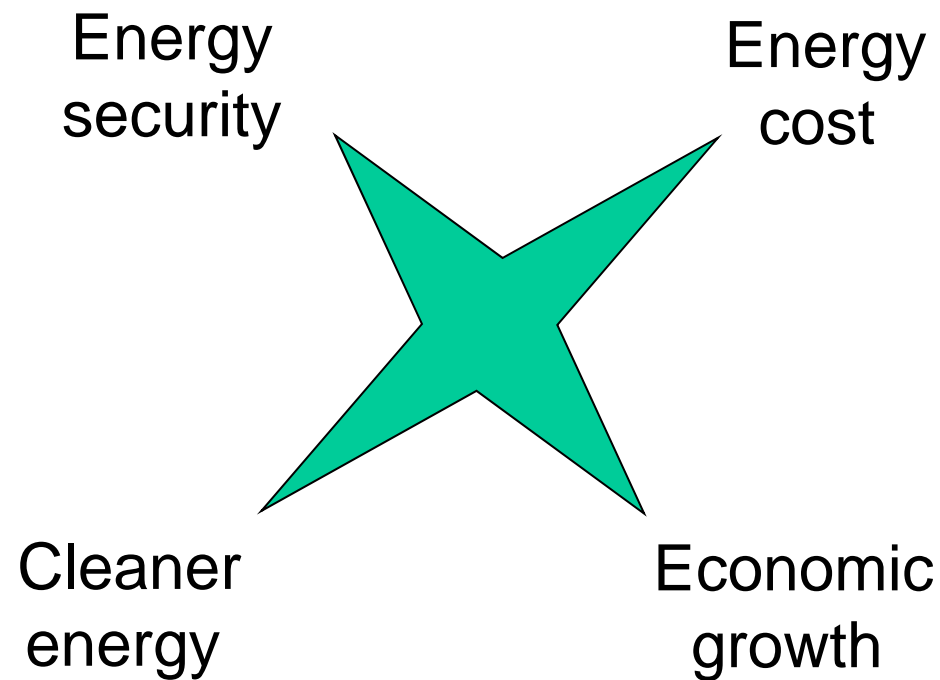


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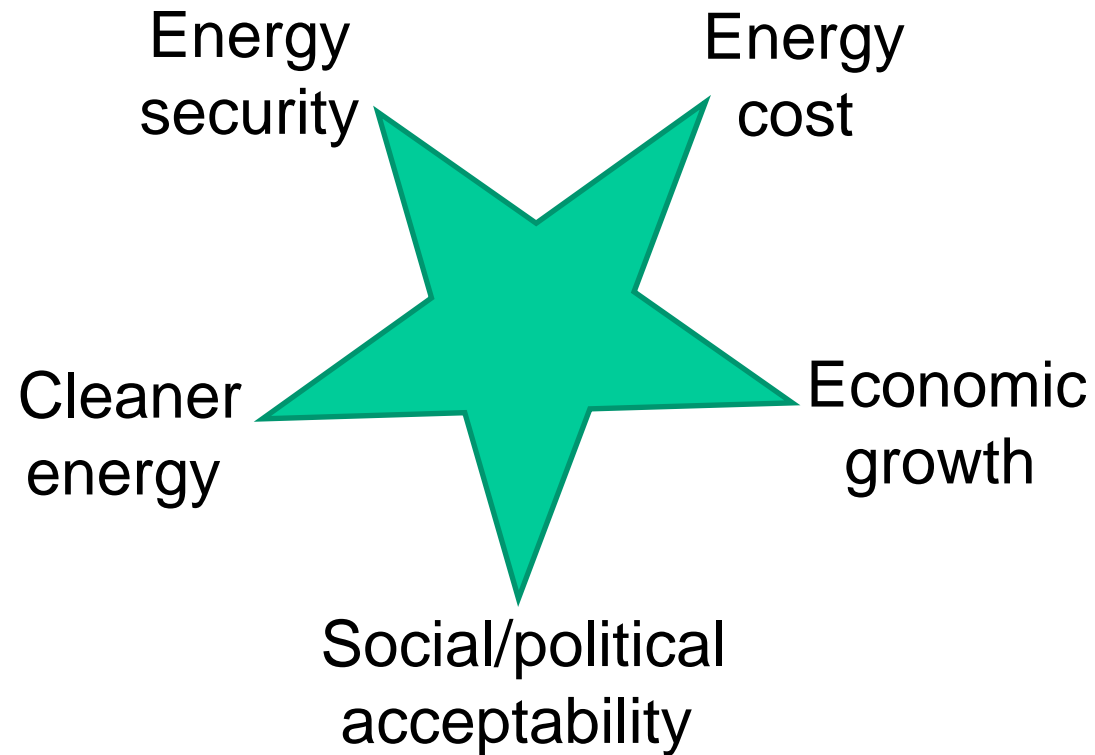
Energy Policy Objectives



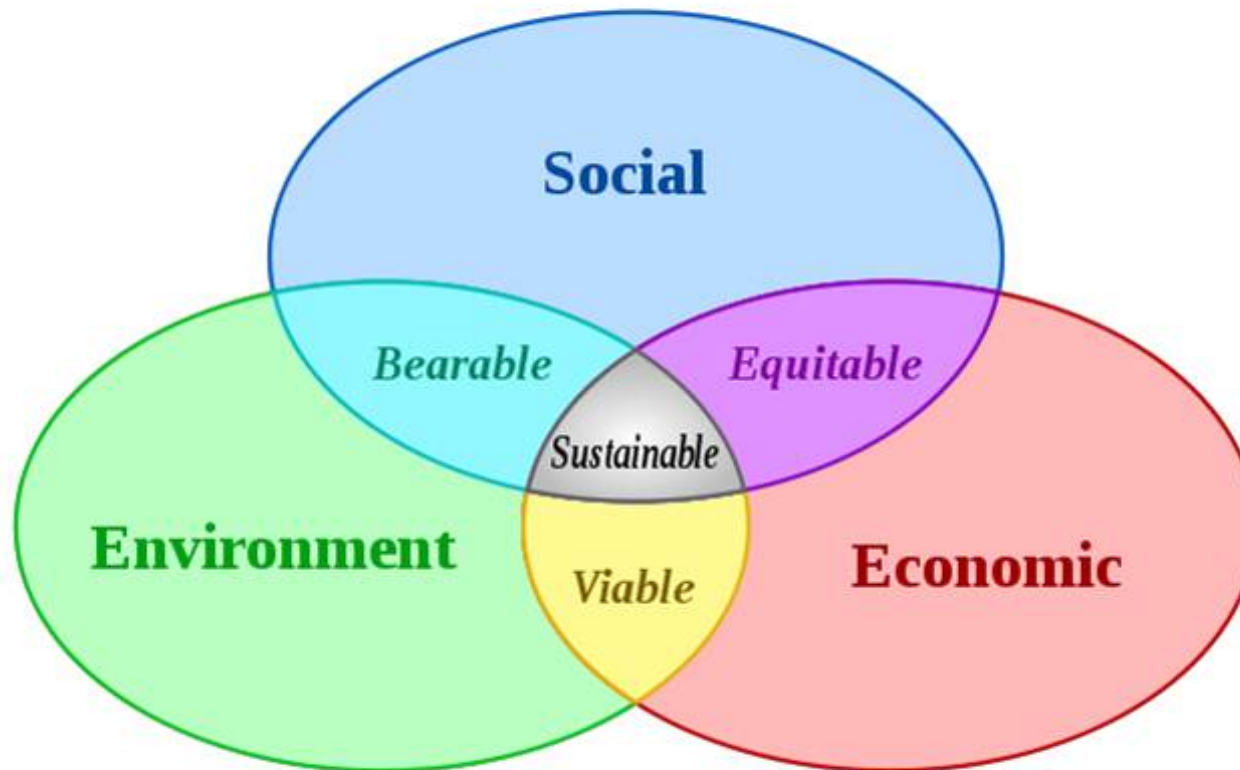
Policy Objectives



Policy Objectives



Sustainability must balance different policy objectives



A holistic approach

The whole city

Evidence based

Technology neutral

Long term strategic view

Create supportive public policies and business models

Understand your city

- **Energy demand**
- **Energy resources**
- **Infrastructure**
- **Investment**
- **Economic change**
- **Environmental issues**
- **Social and political drivers**



City of
Gothenburg



GLASGOW

GOTHENBURG

RIGA

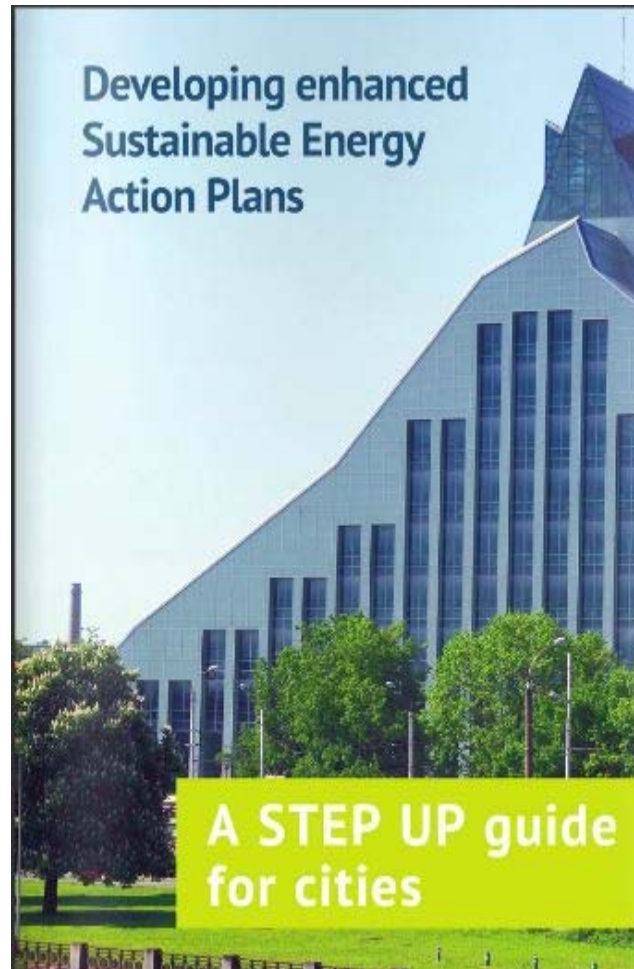


Swedbank



GHENT







STEP UP cities

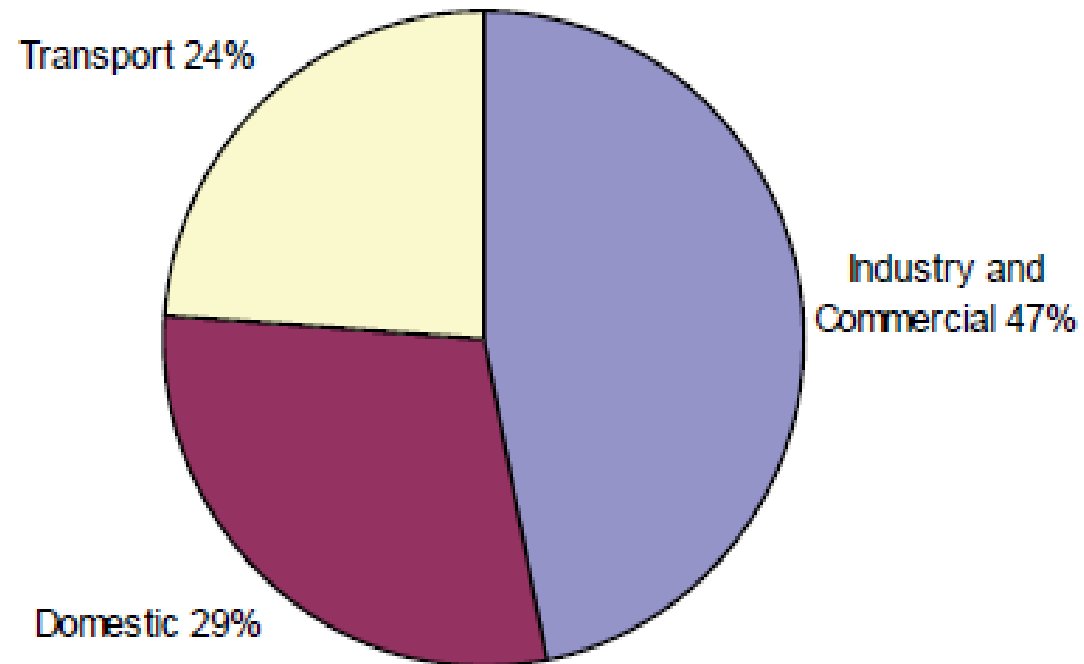


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Glasgow

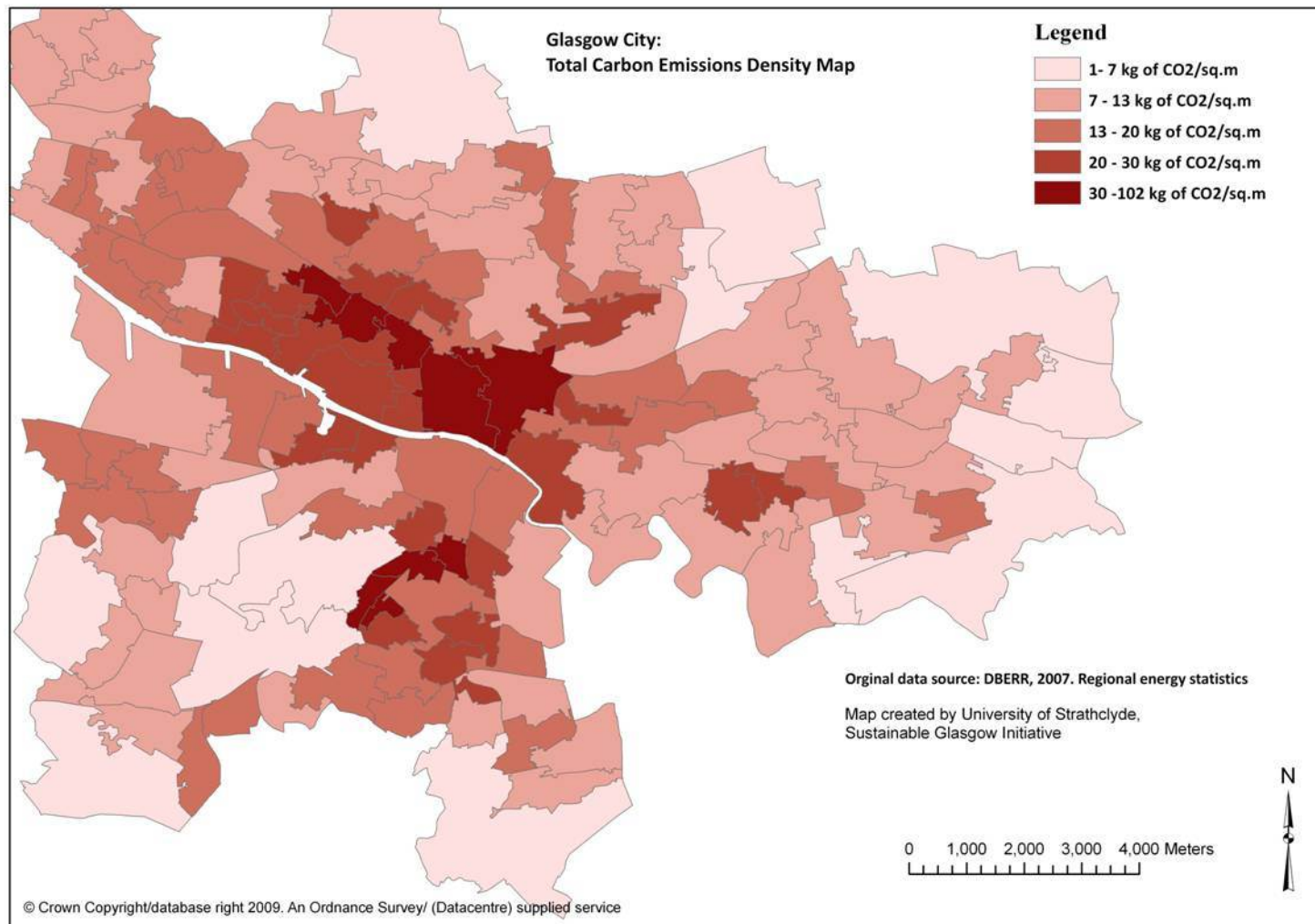
Energy demand



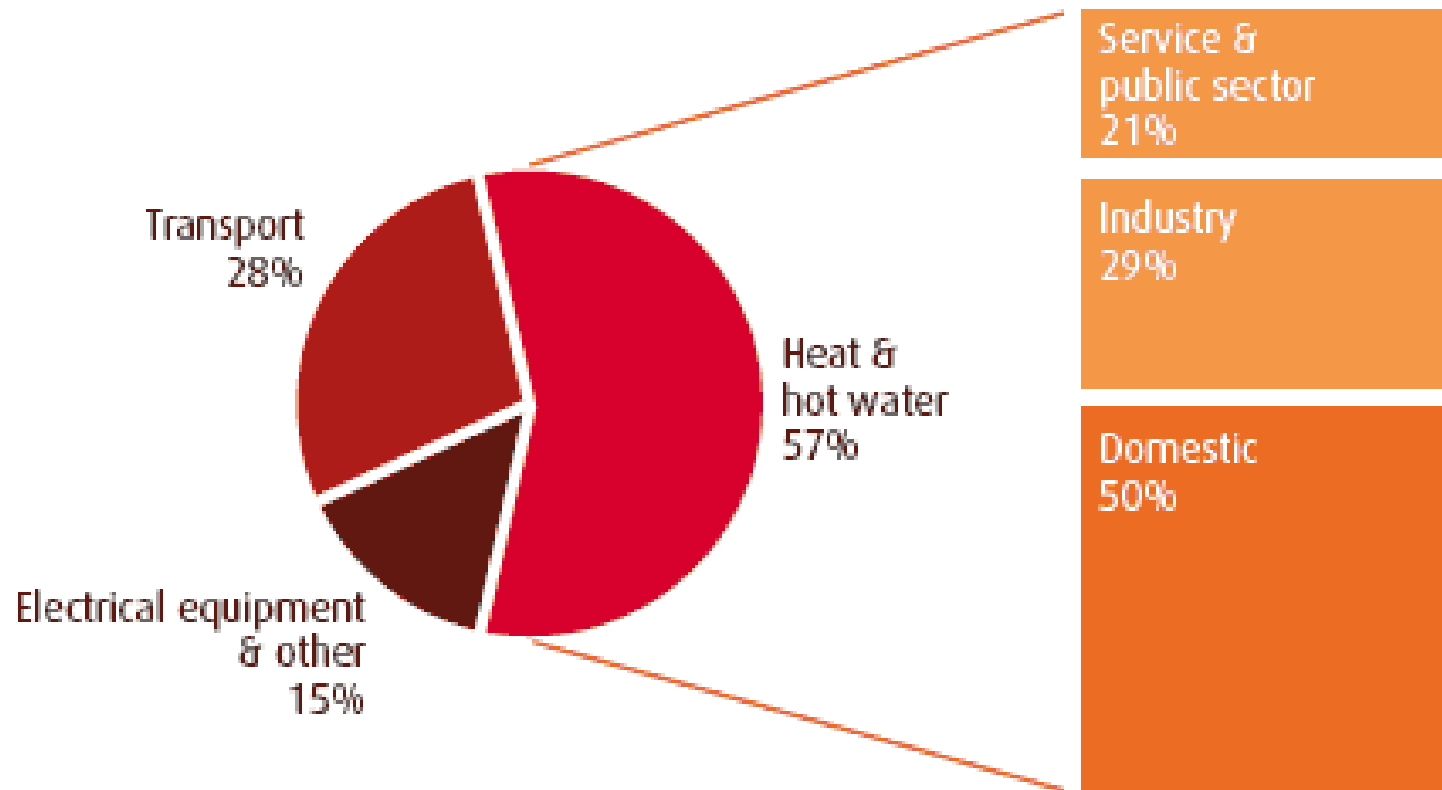
The pattern of energy use



A New Approach



The Role of Heat

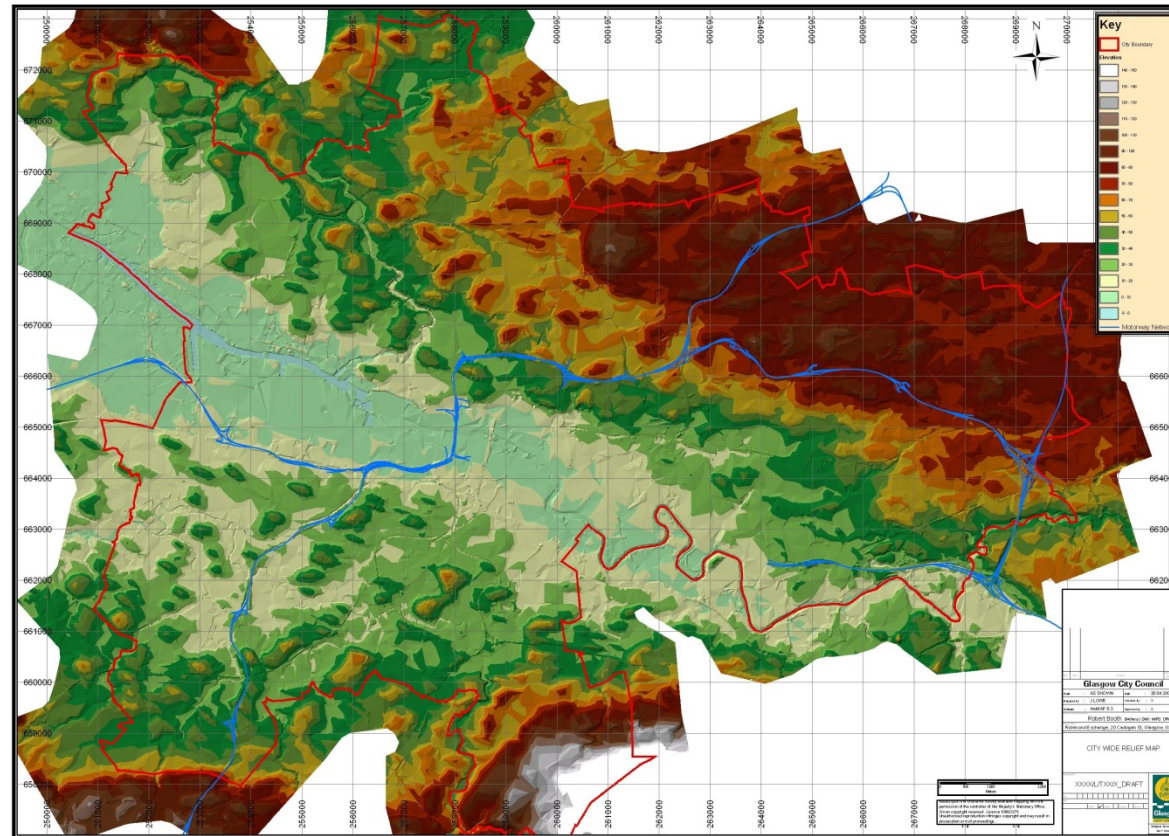




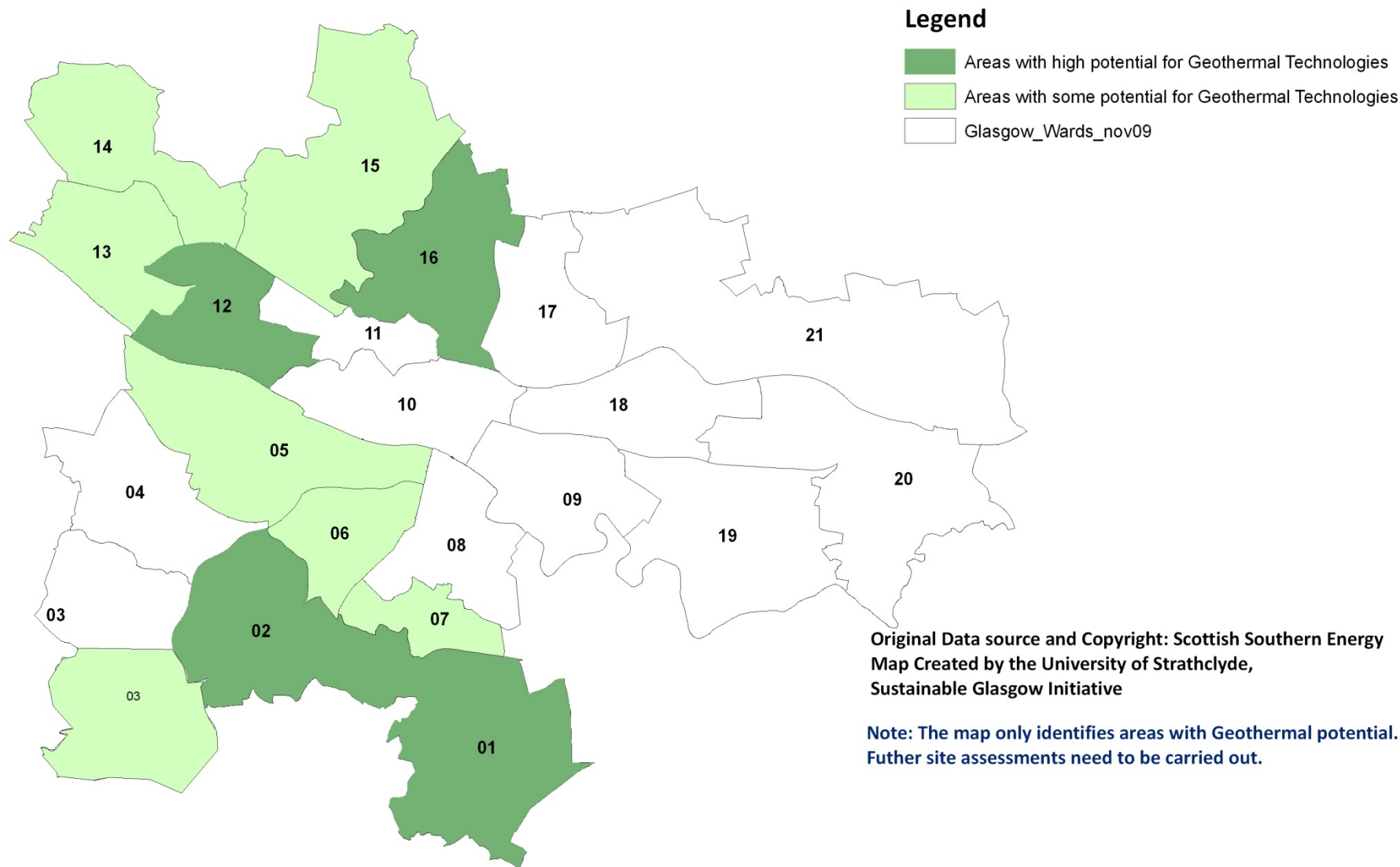
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Energy resources

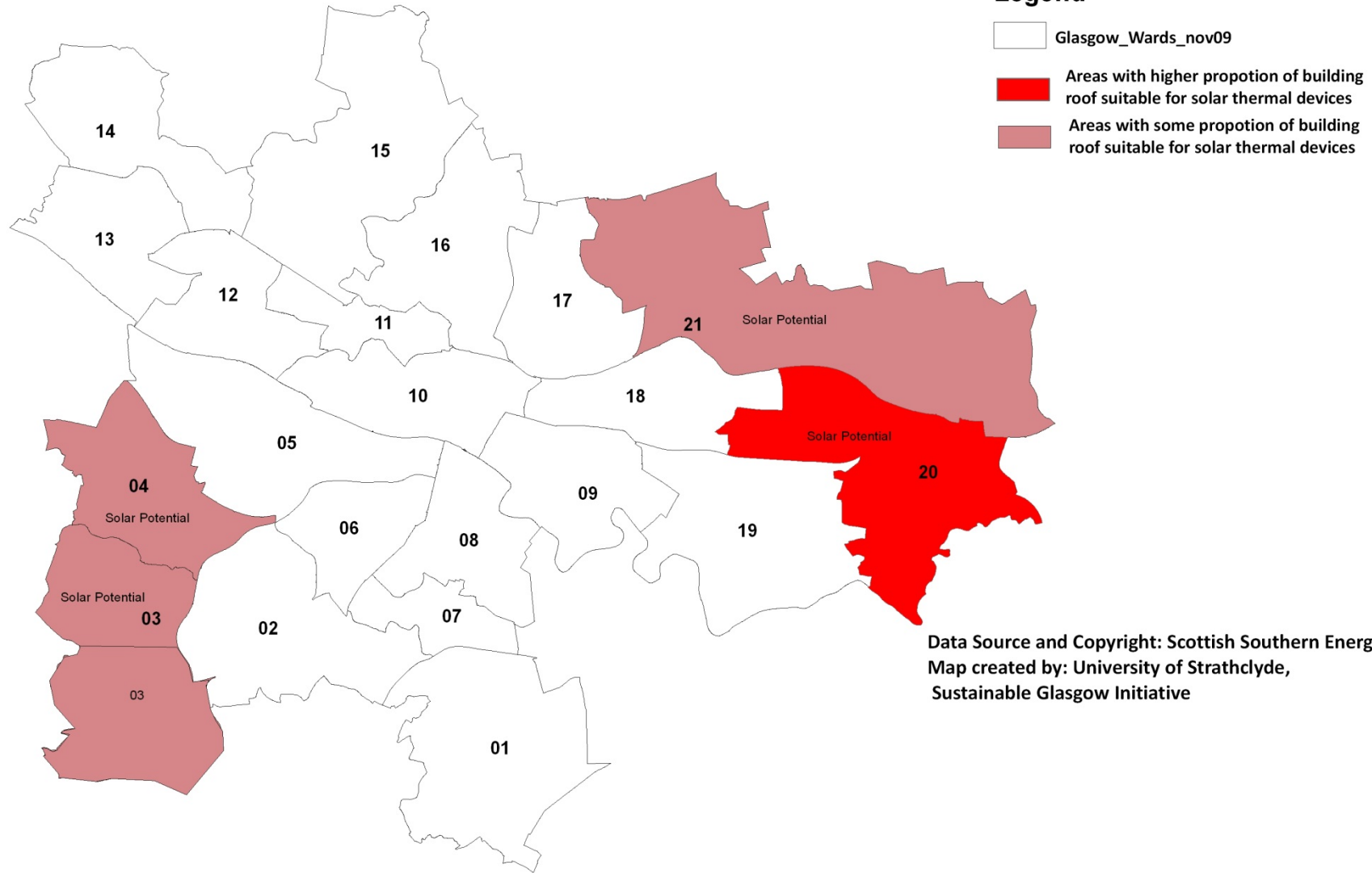
Hydro potential



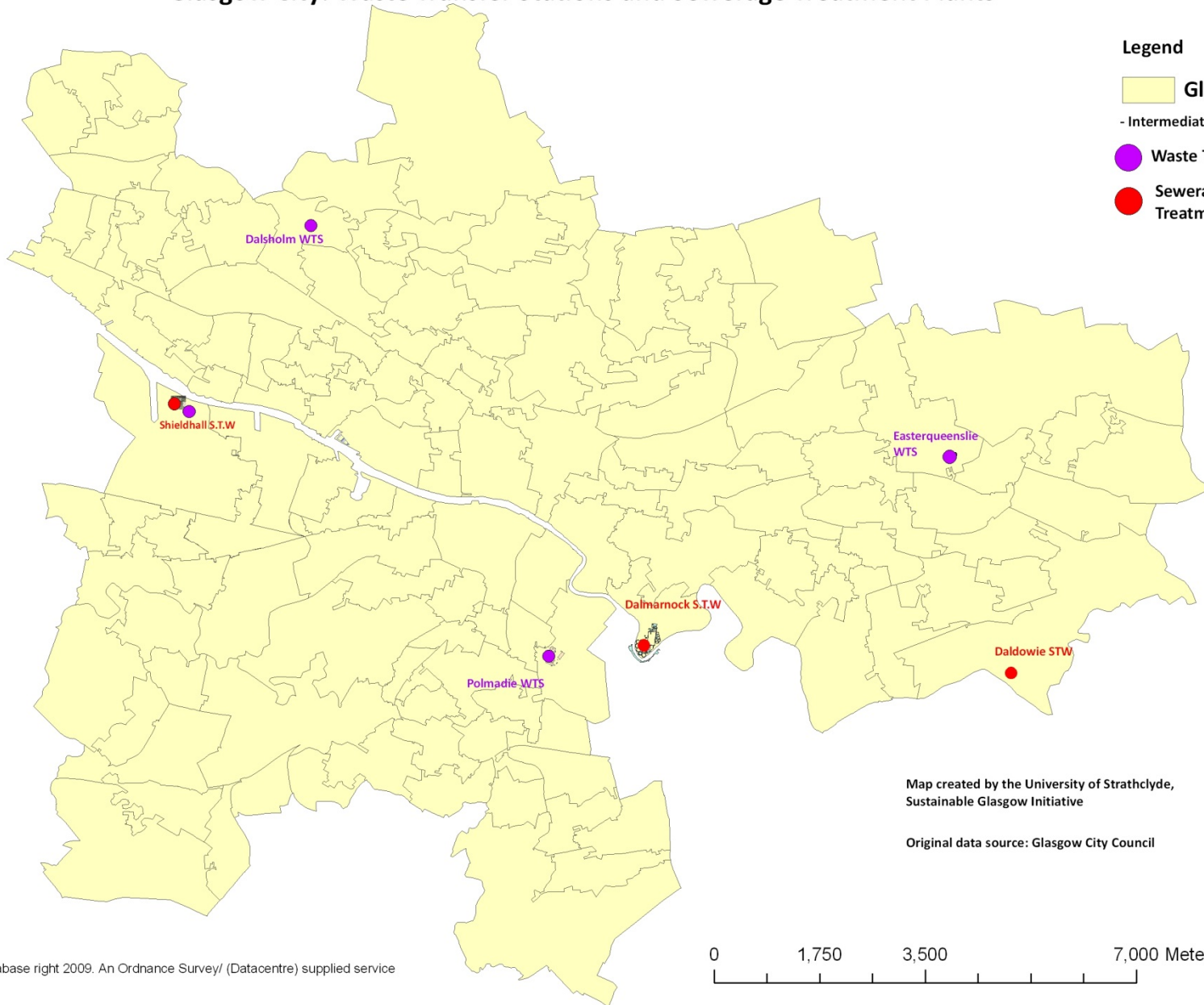
Glasgow City: Areas with Geothermal Potential



Glasgow City: Solar Thermal Potential- based on availability of building roof space.

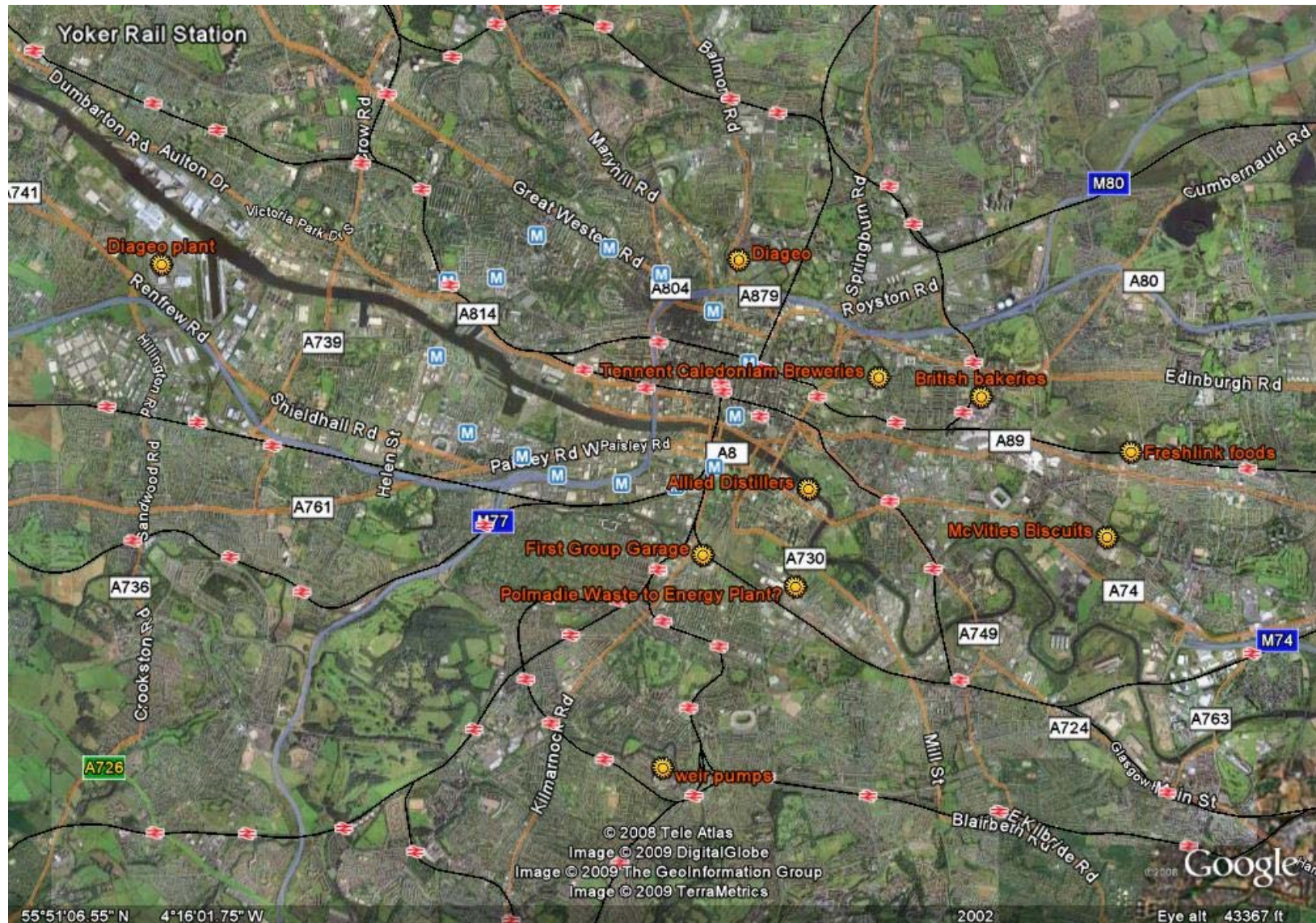


Glasgow City: Waste Transfer Stations and Sewerage Treatment Plants





Possible heat suppliers

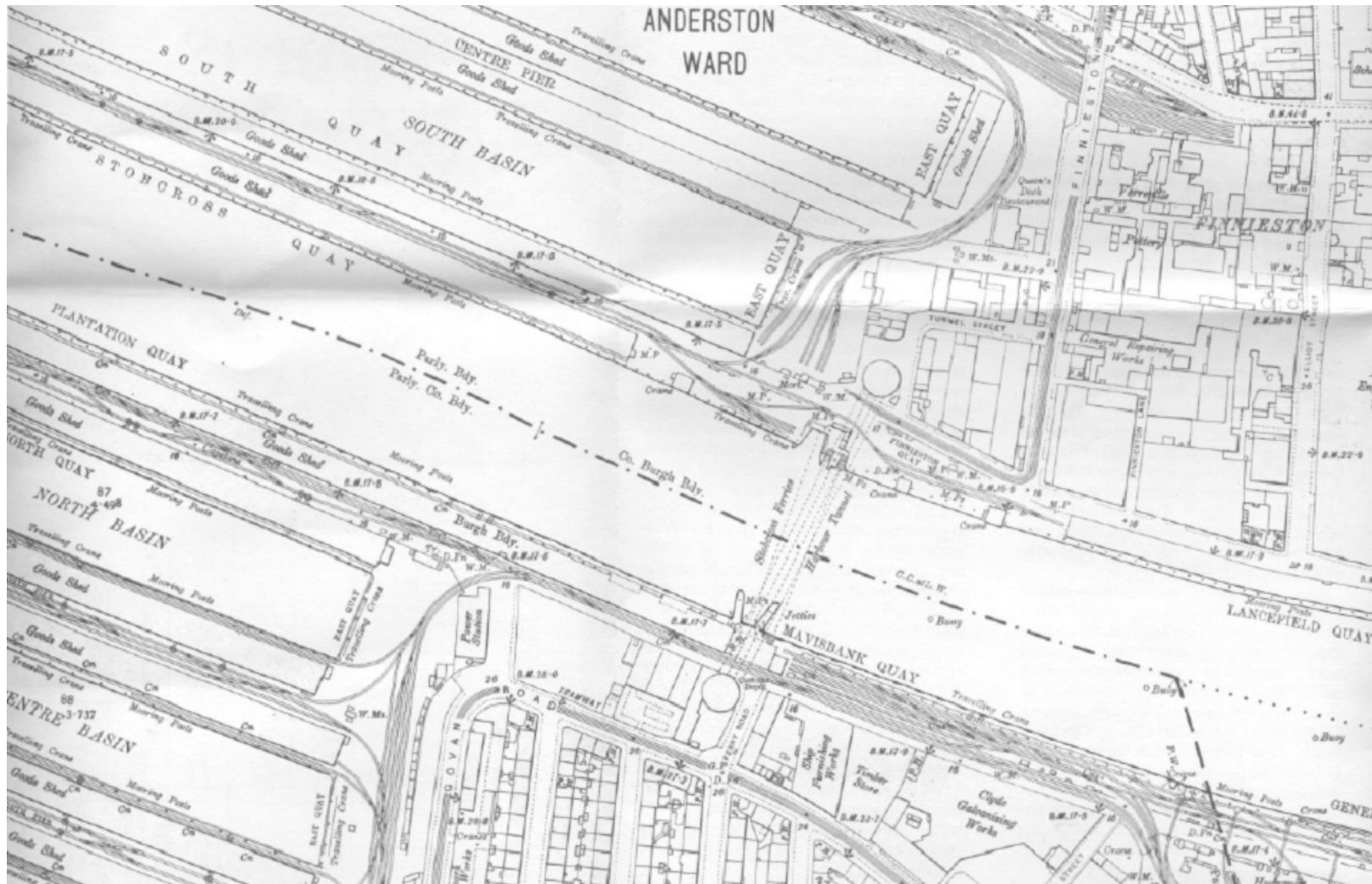




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Infrastructure

Glasgow's harbours 1913

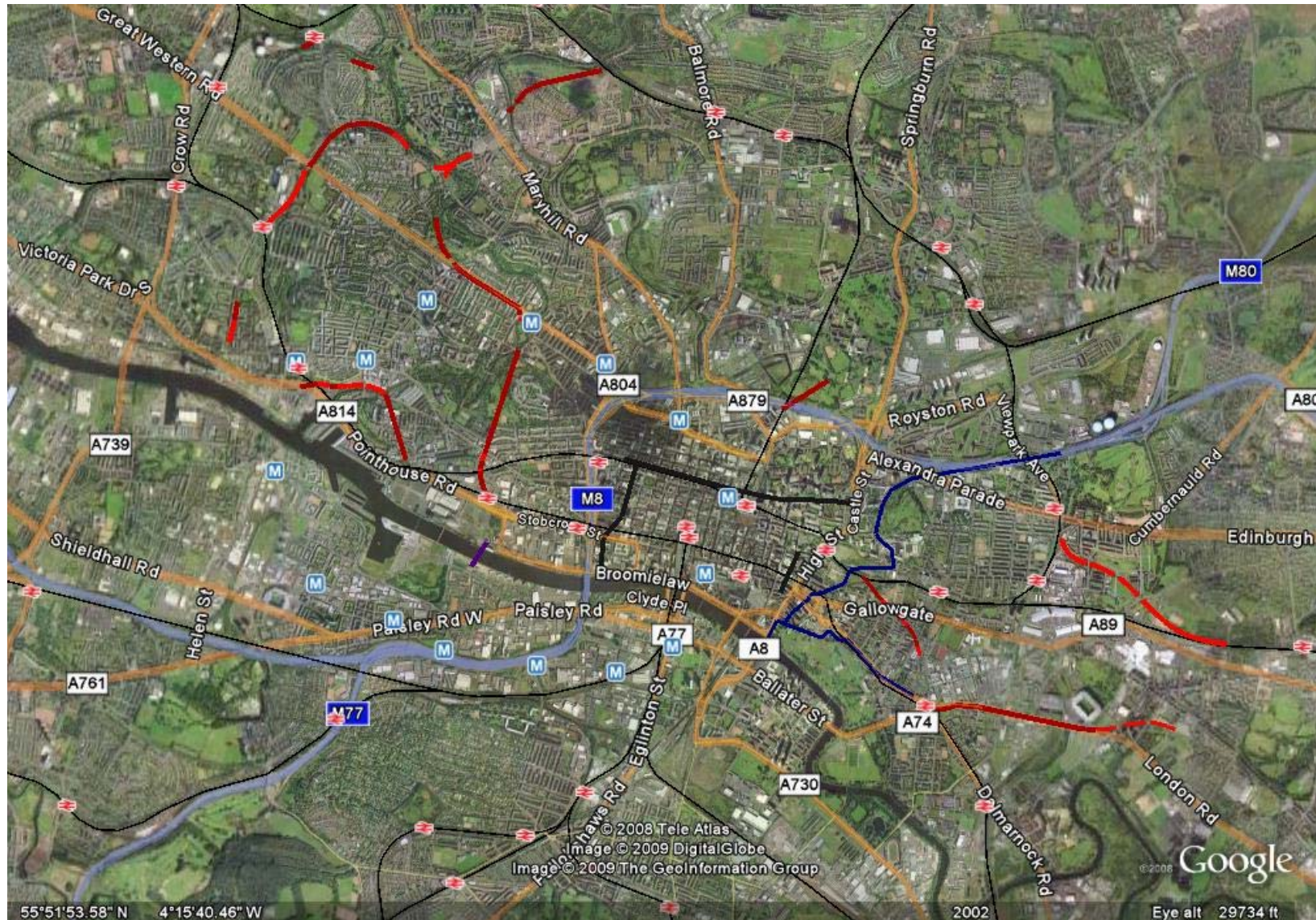


The Rotunda

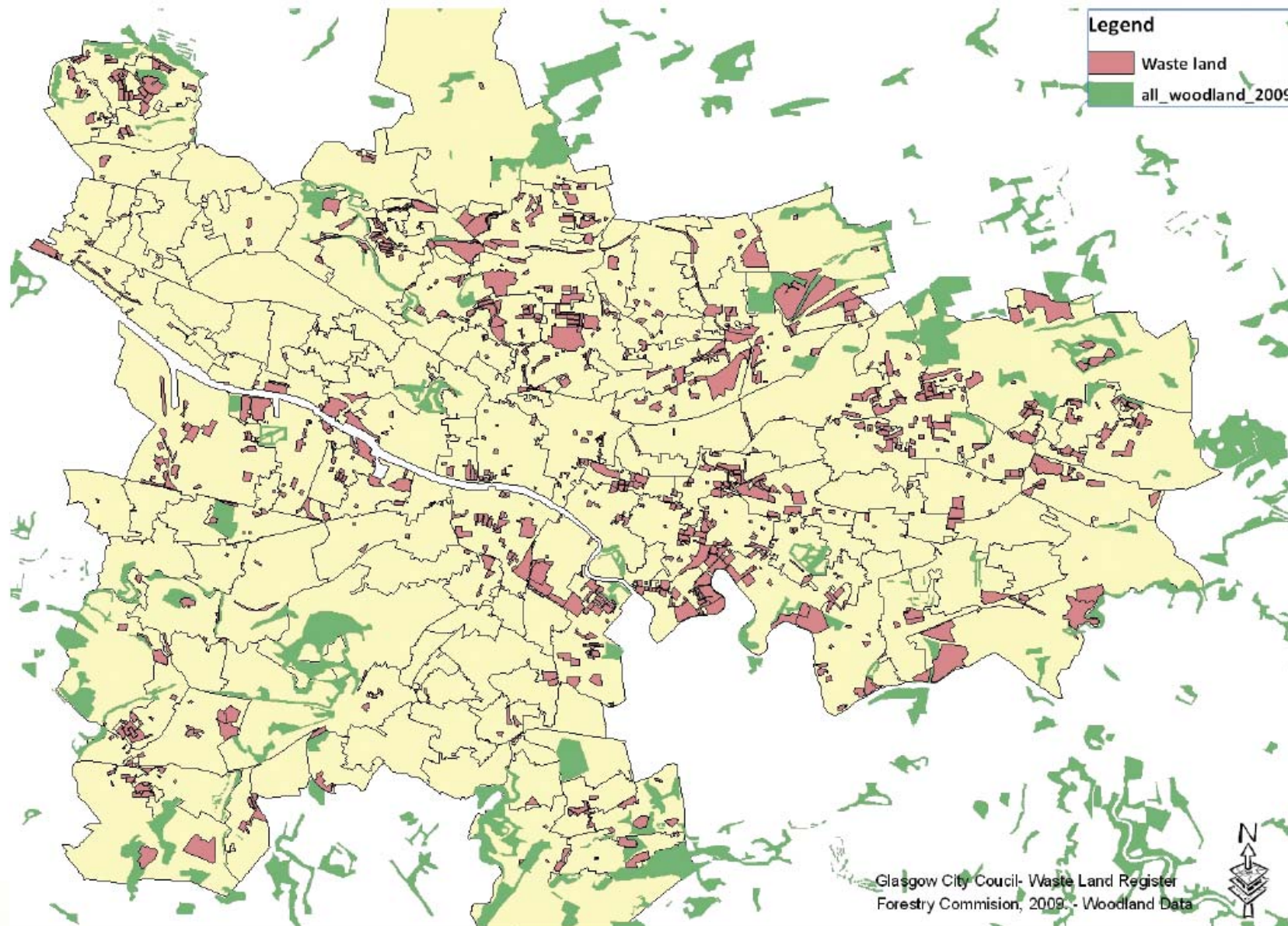




Tunnels



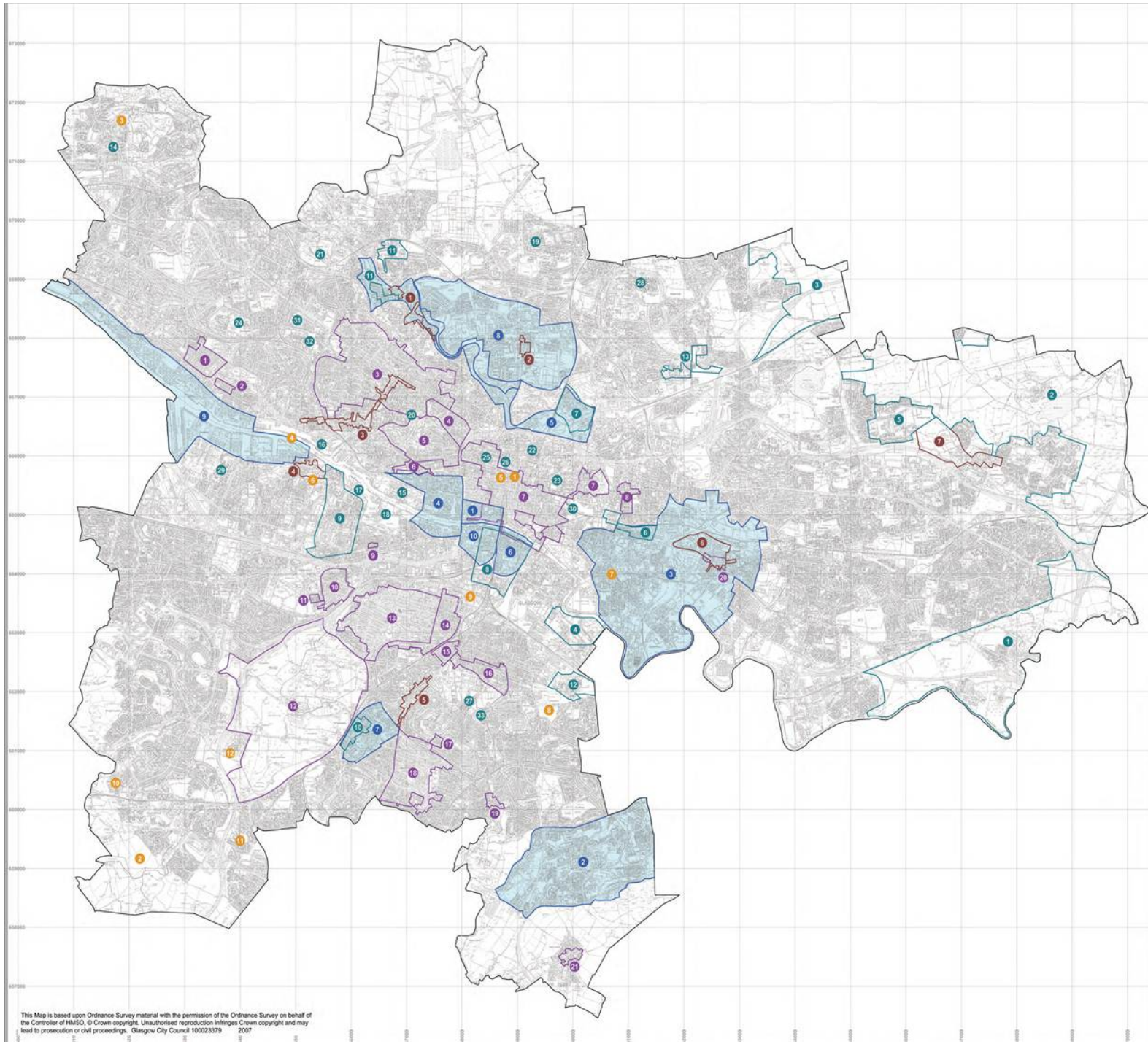
Woodland and Vacant Land in Glasgow





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Glasgow

Investment



- Local Development Strategies**
- Part 2 Ref. 3.74
 1. Broomielaw
 8.5 2. Castlemilk
 7.118 3. East End
 7.74 4. Finnieston/Anderson/Springfield
 7.186 5. Forth & Clyde Canal
 7.72 6. Laurieston
 6.23 7. Pollokshaws
 7.188 & 3.32 8. Ruthin/Keeppoch
 7.74 9. Shewhall North Bank
 7.74 10. Tradeston
- Town Centre Action Plans**
- Part 2 Ref. 6.90
 1. Maryhill
 2. Parkhead
 3. Partick/Blyres Road
 4. Govan
 5. Shawlands
 6. Parkhead
 7. Easterhouse
- Masterplans/Campus Plans**
- Part 2 Ref. 3.29
 1. Broomhouse/Ballicorn/Carmyle CGA
 3.29 2. Easterhouse/Gartloch CGA
 3.29 3. Robroyston/Millerston CGA
 3.22 4. Ostlands New Neighbourhood
 3.22 5. Garthscrook New Neighbourhood
 3.44 6. GHA Restructuring - Colinton
 3.44 7. GHA Restructuring - Sighnail
 3.44 8. GHA Restructuring - Laurieston
 3.44 9. GHA Restructuring - East Govan/Worx
 3.44 10. GHA Restructuring - Shawbridge
 3.44 11. GHA Restructuring - Maryhill
 3.44 12. GHA Restructuring - North Torgyen
 3.44 13. GHA Restructuring - Red Road
 6.7 14. Drumchapel Town Centre
 7.80 15. DECC Campus Plan
 7.81 16. Glasgow Harbour
 7.82 17. Govan Graving Docks
 7.79 18. Pacific Quay
 7.191 19. Milton
 6.18 20. Glasgow University Campus Plan (Glasgowhill)
 6.18 21. Glasgow University Campus Plan (Garscube)
 7.07 22. Caledonian University Campus Plan
 7.07 23. Strathclyde University Campus Plan
 6.20 24. Strathclyde University Jordanhill Campus Plan
 7.07 25. Exposed Campus Plan for Glasgow School of Art
 7.07 26. Expected Campus Plan for the Royal Scottish Academy of Music and Drama
 6.193 27. Victoria Infirmary Campus Plan
 6.193 28. Stobhill Hospital Campus Plan
 6.193 29. Southern General Campus Plan
 7.06 30. College Lands Master Plan
 6.176 31. Arnotwell College Campus Plan
 6.193 32. Gartnavel Hospital Campus Plan
 6.176 33. Langside College Campus Plan
- Conservation Area Appraisals**
- Part 2 Ref. 5.9
 1. Scotstoun
 2. Victoria Park
 3. Glasgow West
 4. Woodlands
 5. Park
 6. St Vincent Crescent
 7. Central Area
 8. Dennistoun
 9. Warner Crescent
 10. Dumbreck
 11. Hazlewood
 12. Pollok Park
 13. West Pollokshields
 14. East Pollokshields
 15. Strathbungo
 16. Crosshill
 17. Milnbrae
 18. Newlands
 19. Struth Miln
 20. Parkhead Cross
 21. Carmunnock
- Others**
- Part 2 Ref. 7.13
 1. City Centre Action Plan
 3.30 2. Parkhouse/Deaconsburn Comprehensive Planning Study
 3.22 & 6.6 3. Drumchapel New Neighbourhood Development Briefs
 5.44 4. River Clyde Flood Management Strategy
 Supplementary Development Guide
 6.50 5. City Centre Traffic Management Review
 7.73 6. Central Govan Action Plan
 6.90 7. Planning Study for Bridgeton
 1.7 8. Hampden/Torgyen Planning Study
 6.22 9. East Pollokshields/Port Eglinton Planning Study
 6.10 10. North Development Framework
 6.10 11. Arden Development Framework
 6.10 12. Cowglen Planning Study

Glasgow
CITY PLAN 2

Development Planning Framework



Proposals map is on the reverse



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Commonwealth Games



GLASGOW 2014

XX COMMONWEALTH GAMES



Commonwealth Games Village



Environmental issues

Environmental issues

- City centre air pollution
- Noise pollution
- GHG emissions



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Social and Political issues

Social and Political issues

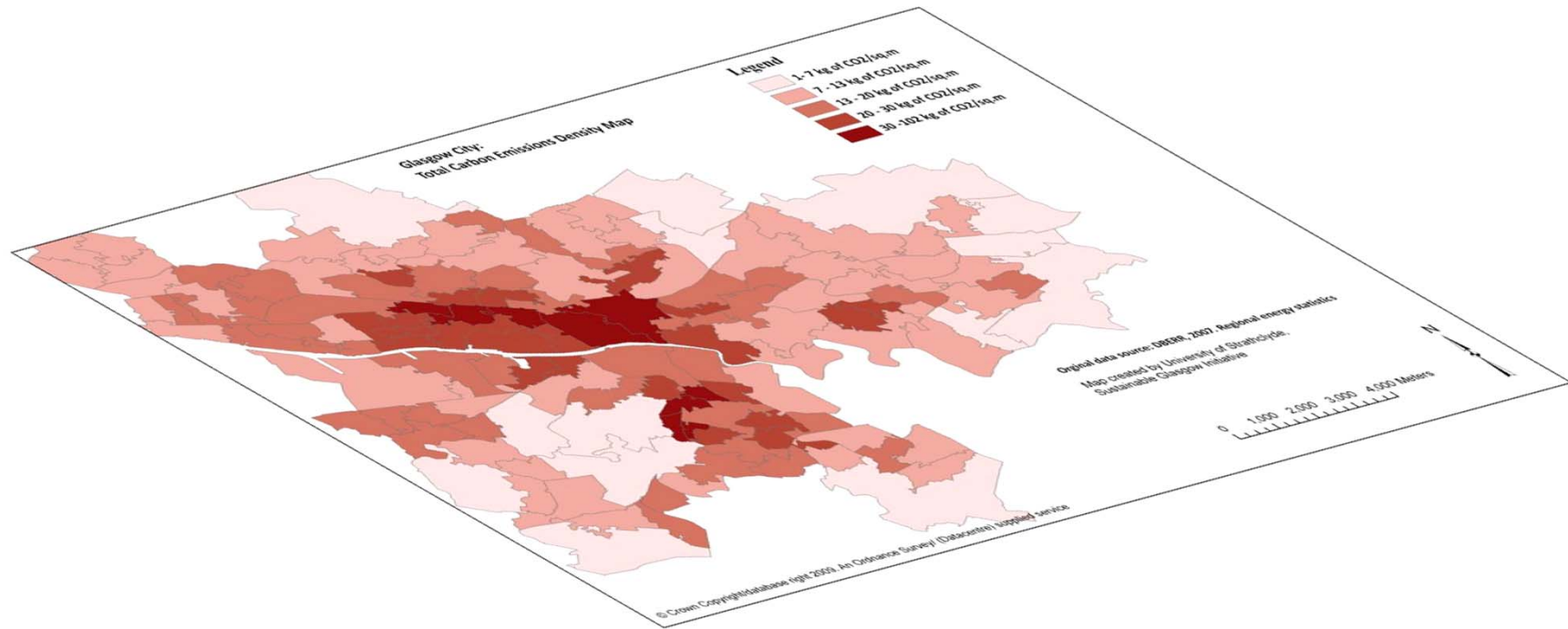
- Poverty
- Jobs
- Aging populations
- Crime

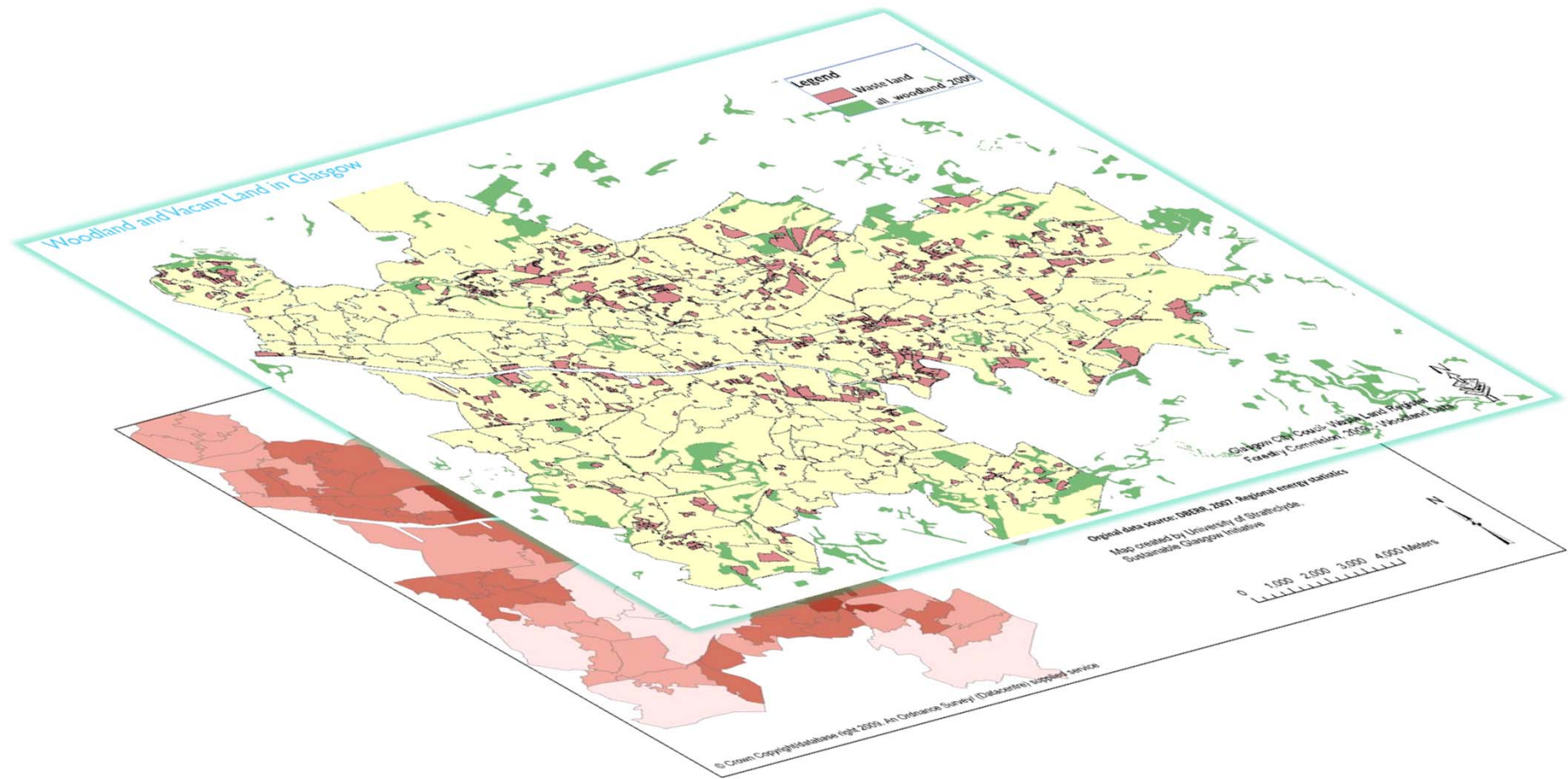
A New Approach



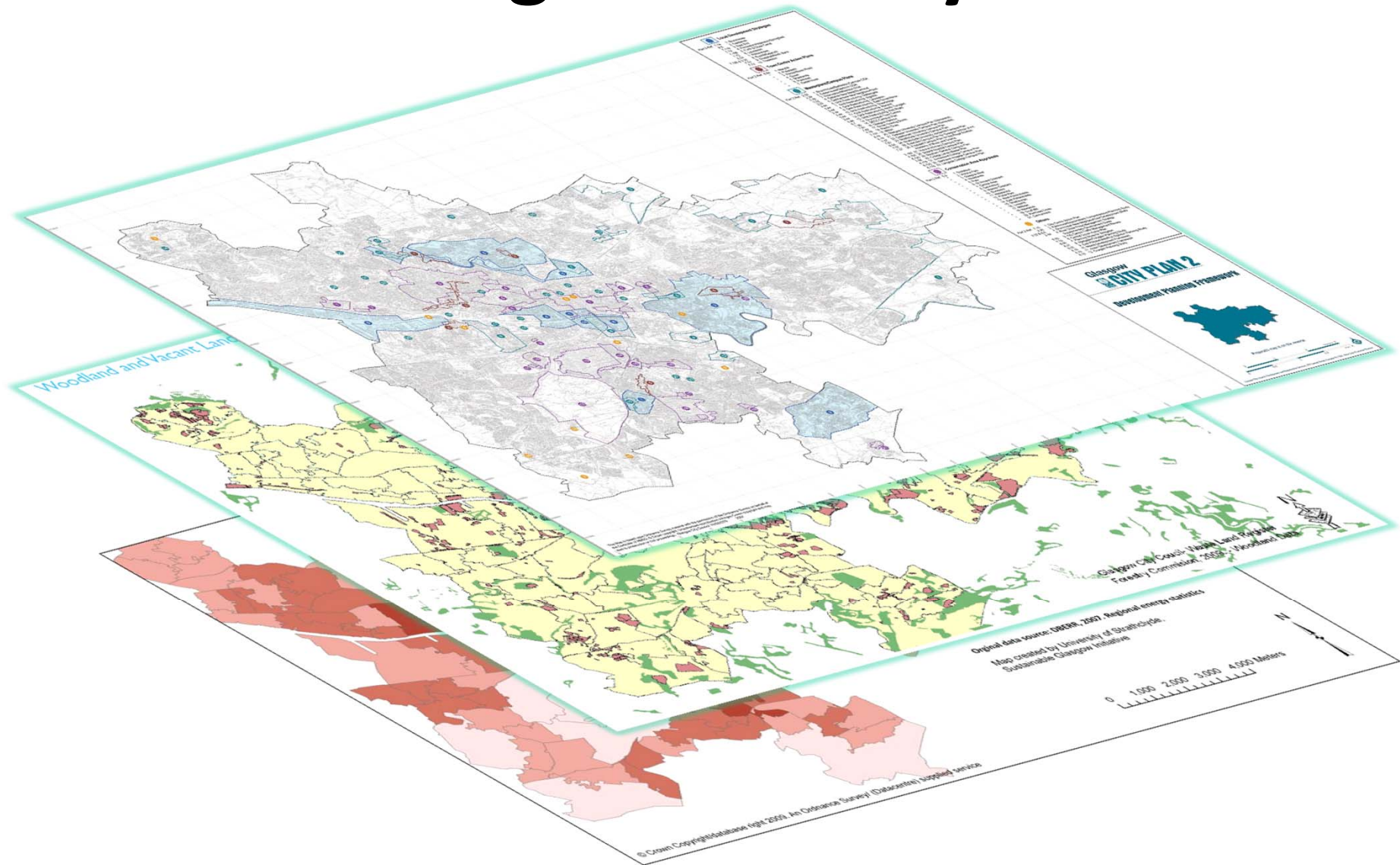
A New Approach



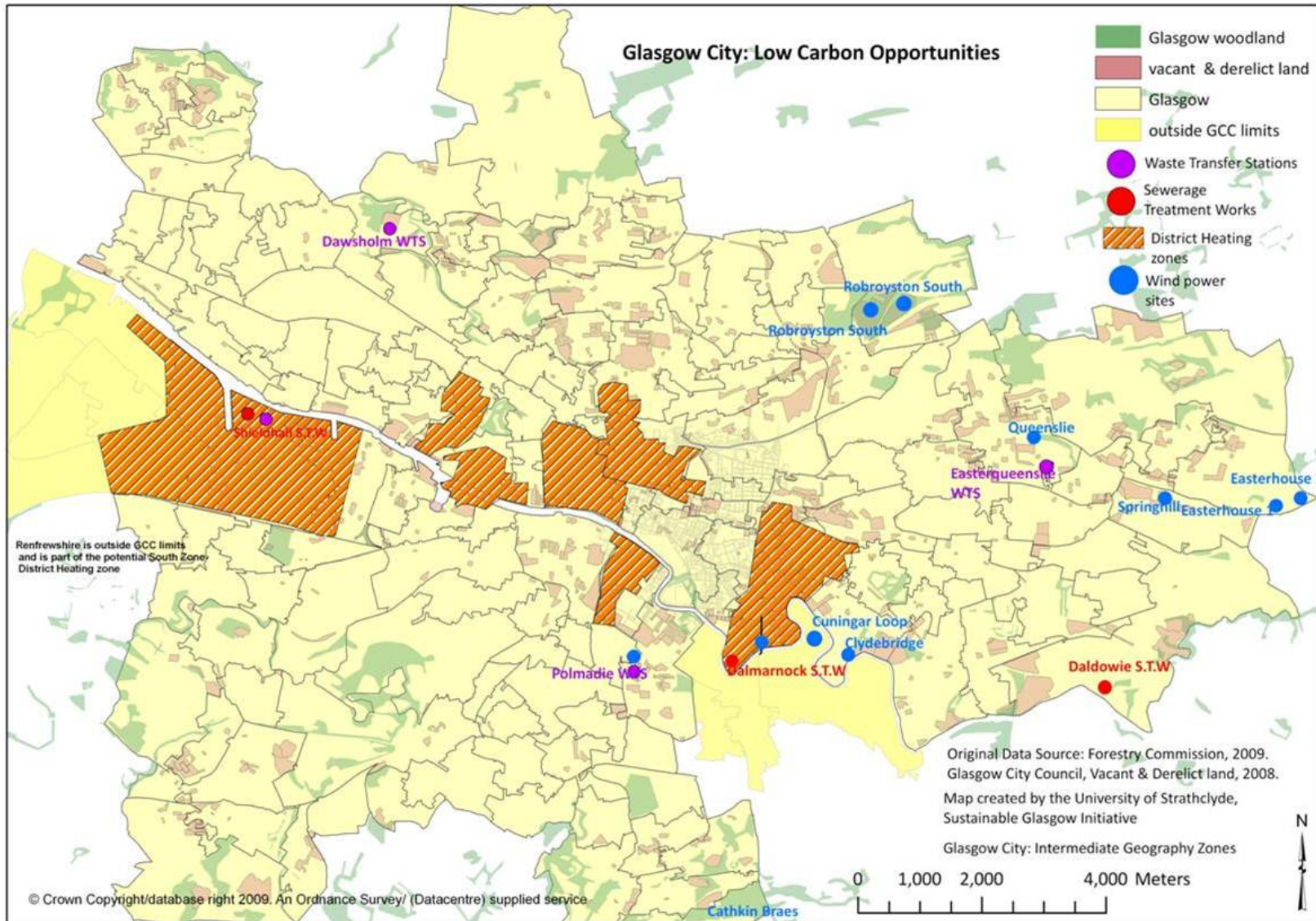




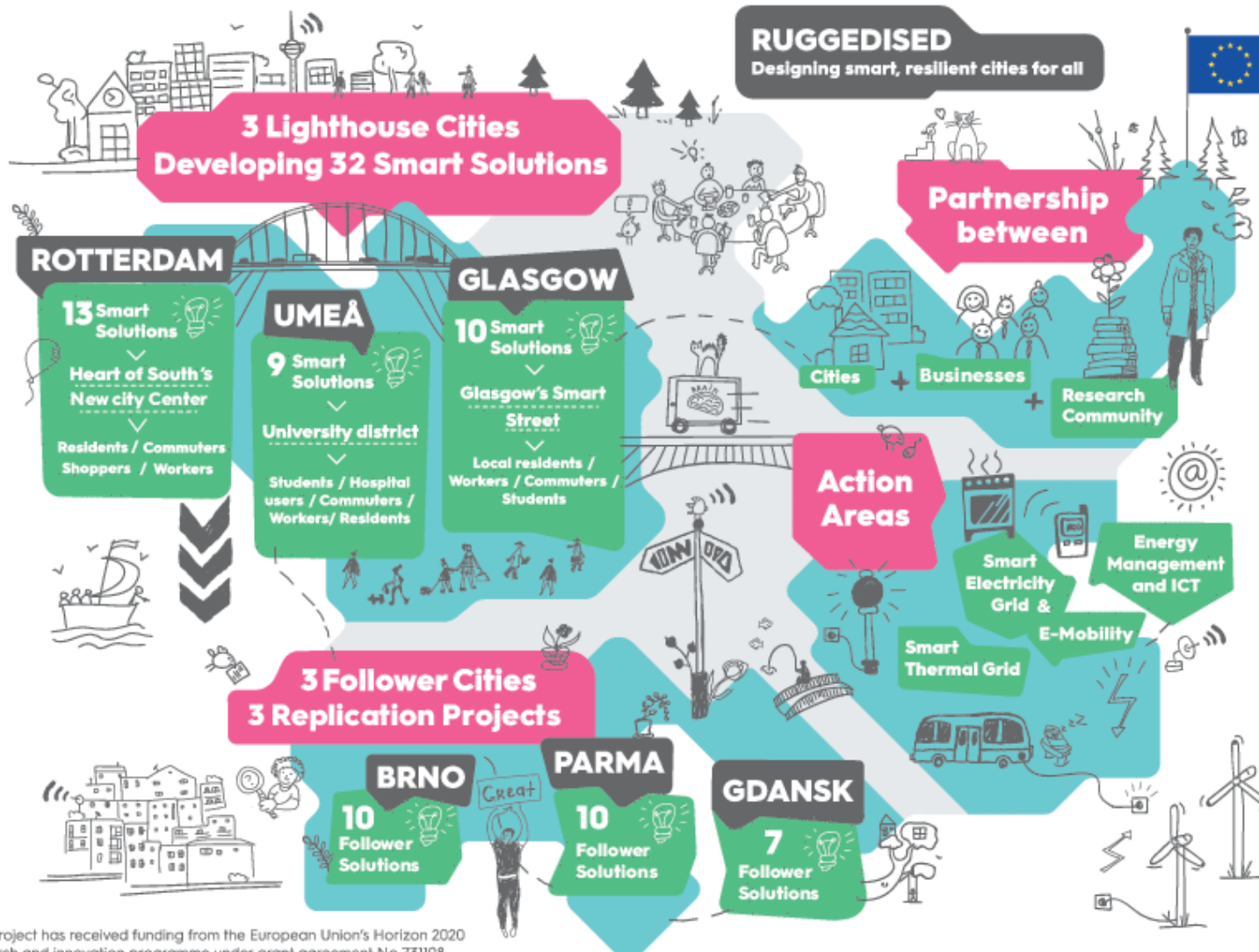
An Integrated Analysis



Combined Map of Opportunities



Sustainable Cities: Ruggedised

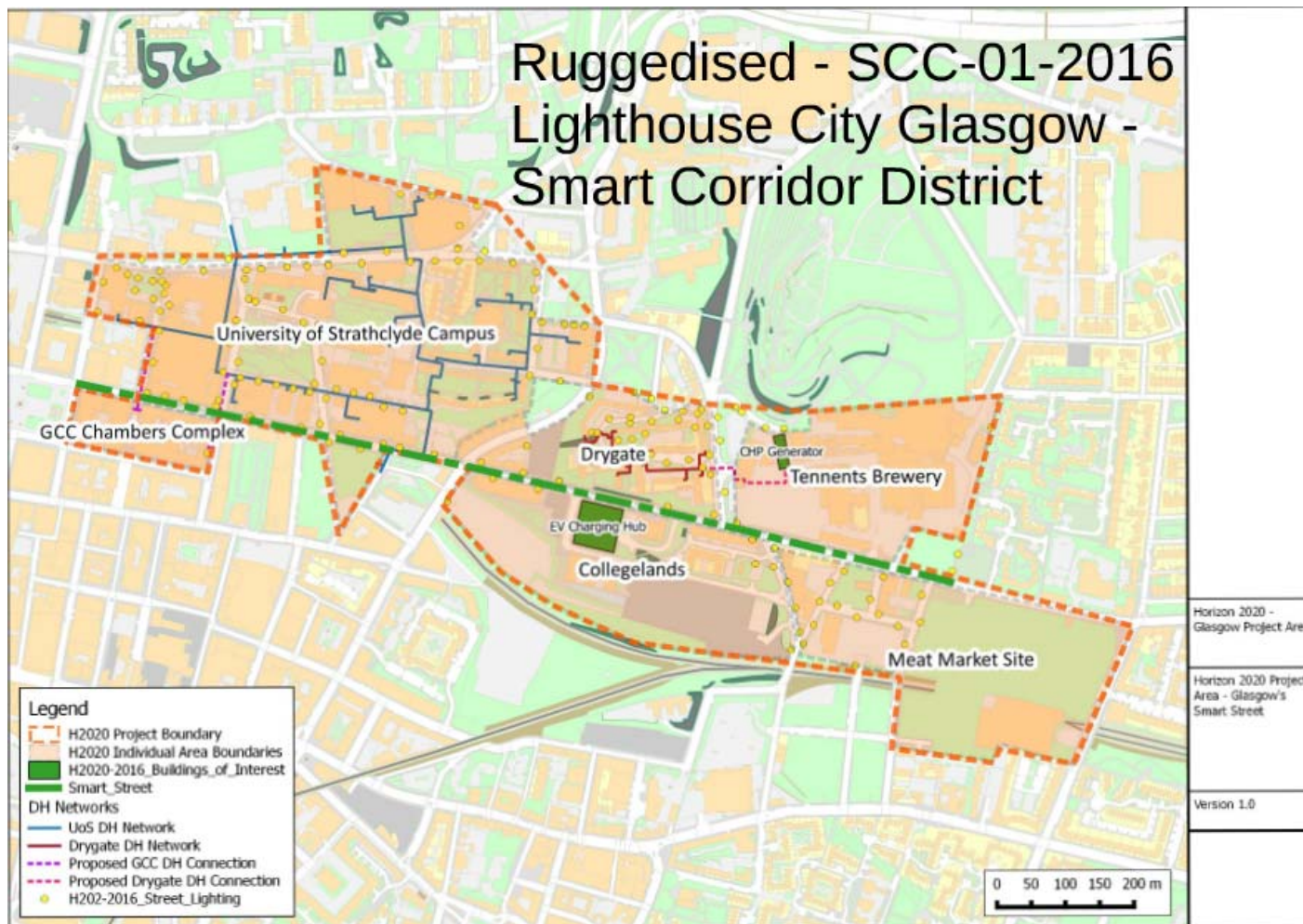




Ruggedised

Sustainability & Resilience

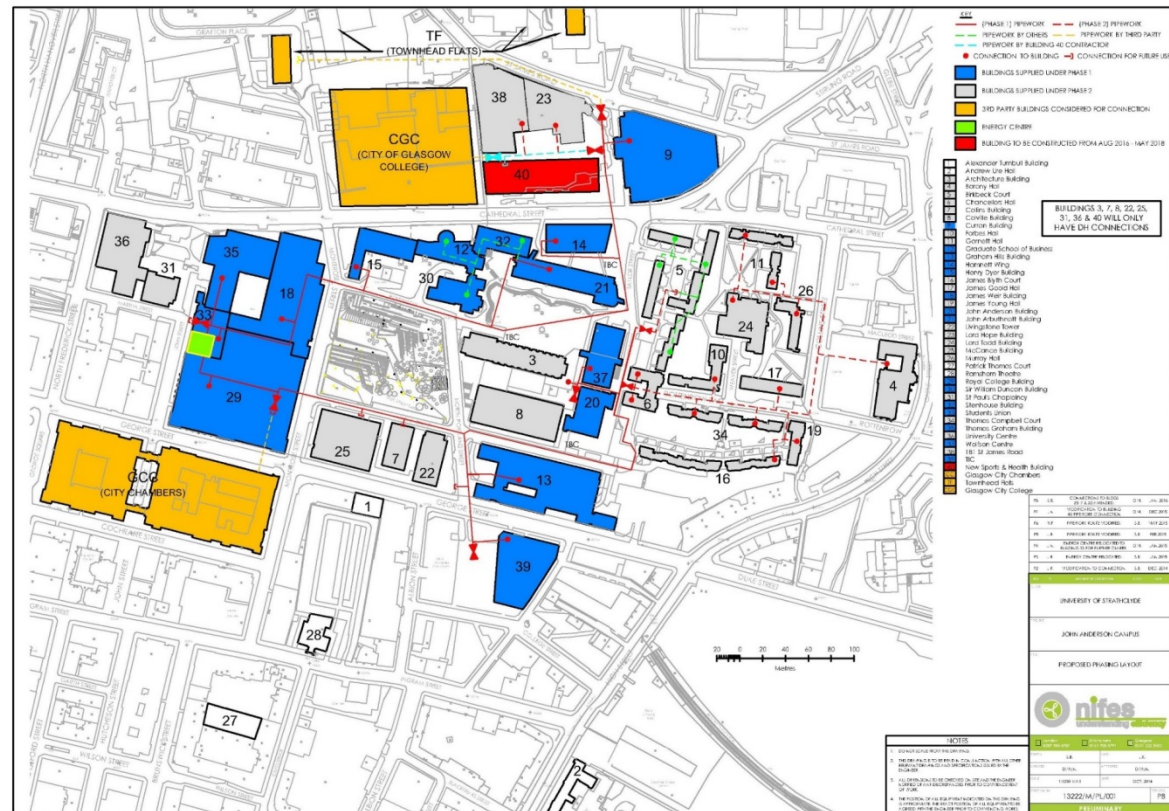
- Integrating Transport, Energy and ICT within an Innovation zone



Strathclyde District Heating Scheme



- A £20 million investment
- Reducing Strathclyde's CO₂ Emissions by 50%





Creating change

- **No instant transformation of the economy and society**
- **No single technological “magic bullet”**
- **Need multiple solutions working together**

- **Need a strategic approach**
- **Need to balance efficiency and fairness**
- **A phased long term transformation**
- **Underpinned by sustained behavioural change**
- **Supported by public policy changes**

Transport issues









Deliver tangible benefits

- Create investment**
- Deliver jobs**
- Attract and grow businesses**
- Help tackle fuel poverty**
- Reduce carbon emissions**
- Create new revenue streams**
- Create a cleaner city**
- Help develop communities**
- Develop and transfer new knowledge**
- Be a leader in sustainable urban living**
- transform your image on a world stage**

Key Messages

- **Understand your city first**
 - Energy use, infrastructure, energy resources, future development, social issues, key stakeholders
- **Partnership will increase access to information, expertise, finance, opportunities – and deliver better solutions**
- **Need technical and financial viability**
- **Political support is vital**
- **Create positive social outcomes**
- **Major carbon reductions require major change**
- **Integrated approach**
 - Reduces risks – increases successful outcomes
 - Creates win/win projects

Key Messages

- **Grasp your windows of opportunity**

More than technology

**Engage the enthusiasm and talent of people,
communities, and businesses**

Create a supportive public policy environment

Develop business models

Draw in investment

Change attitudes and behaviours

Successful Future Cities

- **Easy**
 - Transport
 - Safety
 - Connectivity
 - Tailored Information Services

Successful Future Cities

- **Equitable**
 - living conditions
 - access to services
 - health
 - education
 - jobs

Successful Future Cities

- **Distinctive**
 - Location
 - Natural resources
 - People and culture
 - Economic legacy

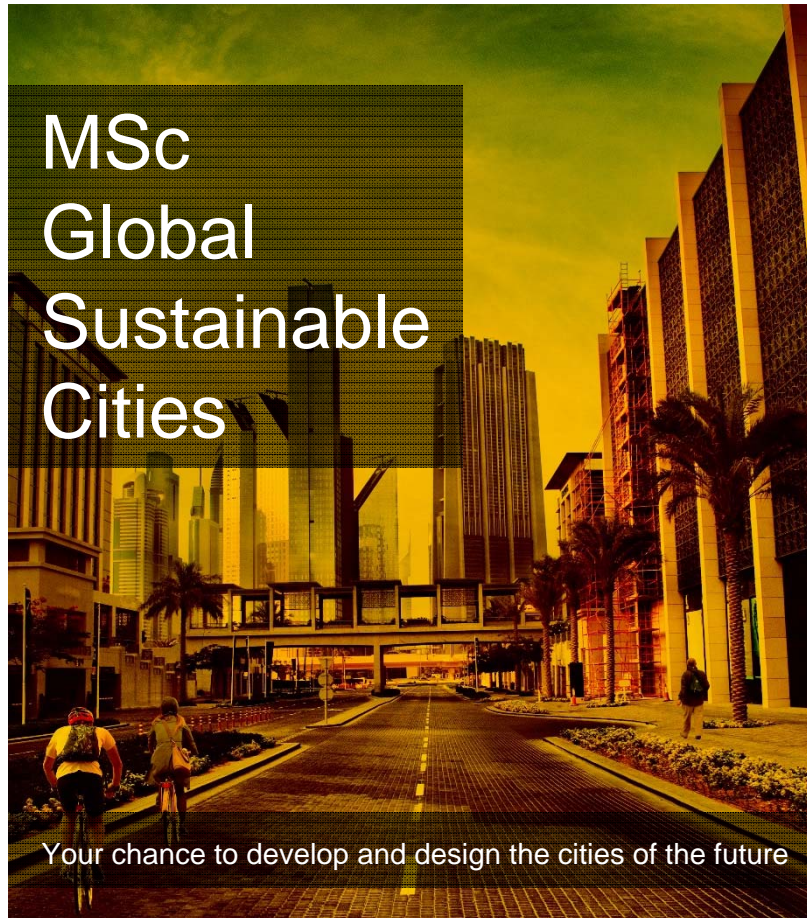
Successful Future Cities

- **Flexible**

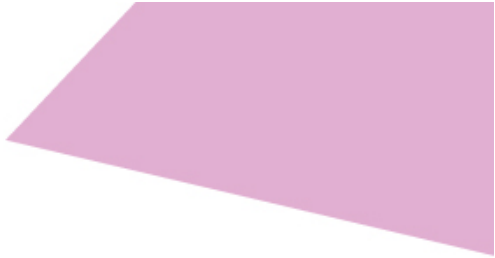
- Economies
- Infrastructure
- Social structures

Successful Future Cities

- **Delightful**
 - Fun
 - Entertaining
 - Surprising
 - Creative



Thank you



Kate Turner

Legal Director, Pinsent Masons LLP





Hungry for change

Investing in a smarter energy future

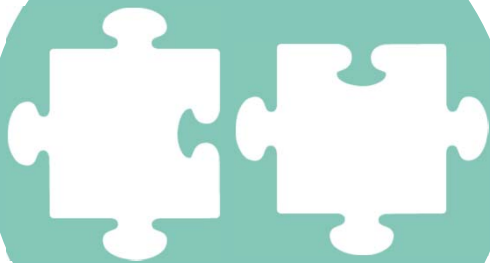
Kate Turner
Legal Director

Overview

- Low carbon developments - where are we now?
- Key findings - "Hungry for Change" report
- Perspective - what does this mean for Scotland's low carbon ambitions?

90%

of utilities are on the lookout for a joint venture, Acquisition or both to take their next step in smart energy technology





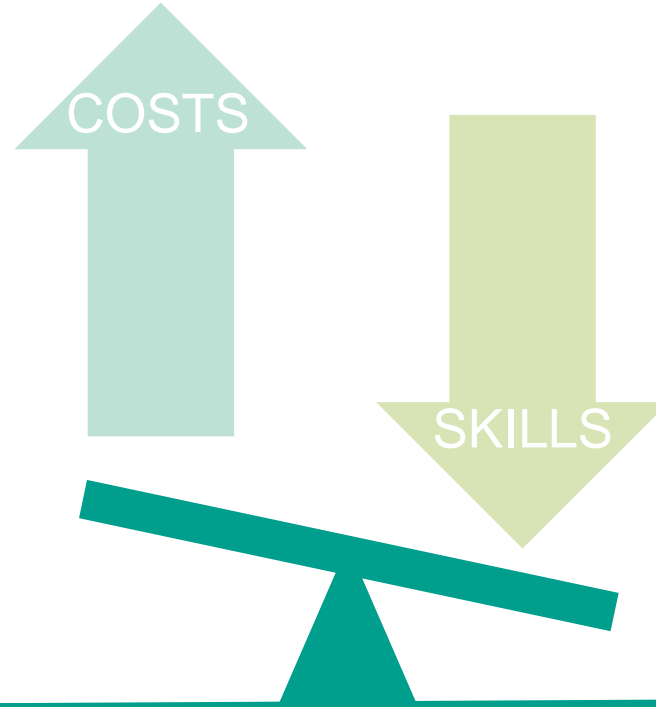
85%

of respondents expect
M&A in the utilities
sector to increase
over the next 12 months

62%



of energy companies
say they will not opt
for in-house
development
of smart energy
solutions



due to high start-up
costs and a lack of
expertise



46%

of investors and

30%



of utilities cite
access to new technology
as the biggest driver for
their
smart energy investments

28%
of investors

cite a lack of cohesive
energy policy and legislation
as an obstacle to investment
in the smart energy sector
whilst

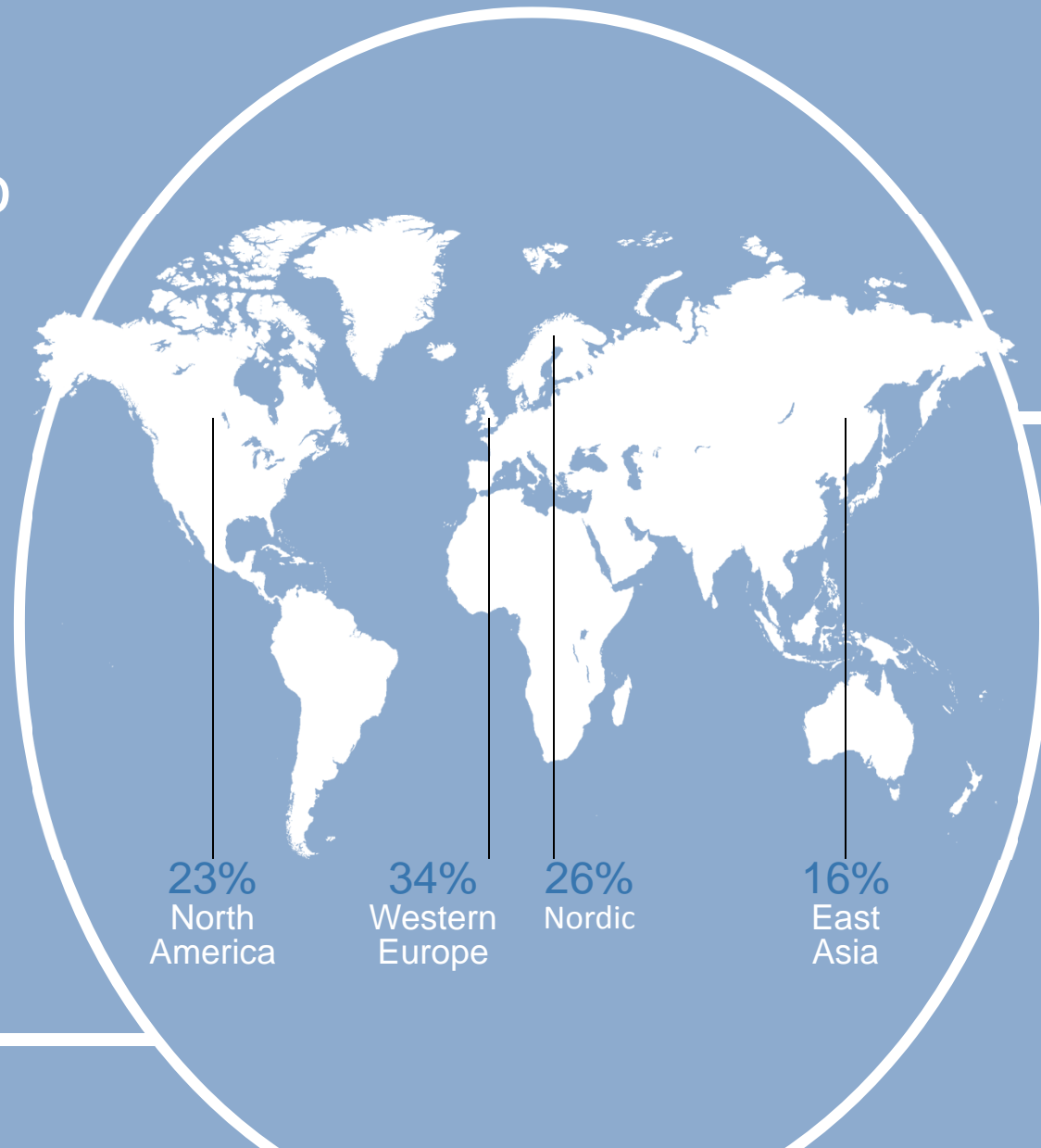
24%
of utilities

worry about
monopolised
Electricity markets

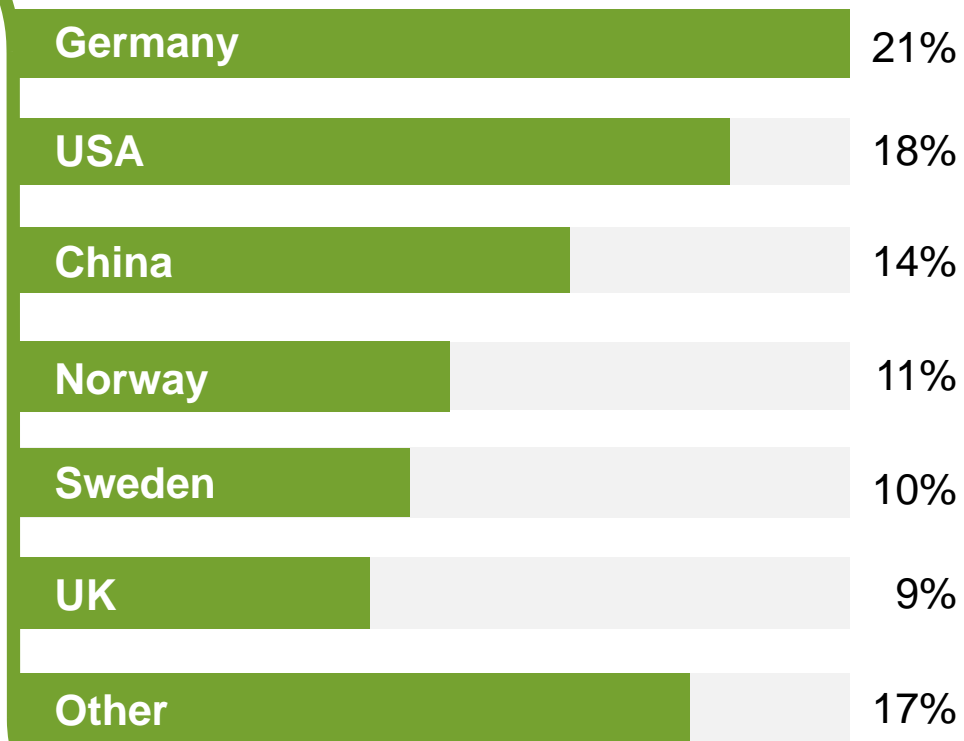
Top 5 target countries for smart energy investment



Which region do you consider to be leading in smart energy technology?



Which country do you consider a leader in implementing smart energy technology



Perspective

- What does this mean for Scotland's low carbon ambitions?
- What are the challenges? – solutions?

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For a full list of the jurisdictions where we operate, see www.pinsentmasons.com



Claire Mack, Chief Executive, Scottish Renewables

Councillor John Alexander, Leader of Dundee City Council & Chair of Scottish Cities Alliance

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Kate Turner, Legal Director, Pinsent Masons LLP



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Low-Carbon Transport: Are We Nearly There Yet?



**Jenny Hogan, Deputy Chief Executive,
Scottish Renewables**

**Humza Yousaf MSP, Minister for Transport
and the Islands, Scottish Government**

**Rick Symington, Commercial
Director, Argent Energy**

Bill Ireland, Chief Executive, Logan Energy





Humza Yousaf MSP
Minister for Transport and the Islands,
Scottish Government



Rick Symington
Commercial Director, Argent Energy









Low Carbon Transport Are we nearly there yet?

SR Low Carbon Cities Conference
Edinburgh
20 February 2018



Argent Energy - The Sales Pitch



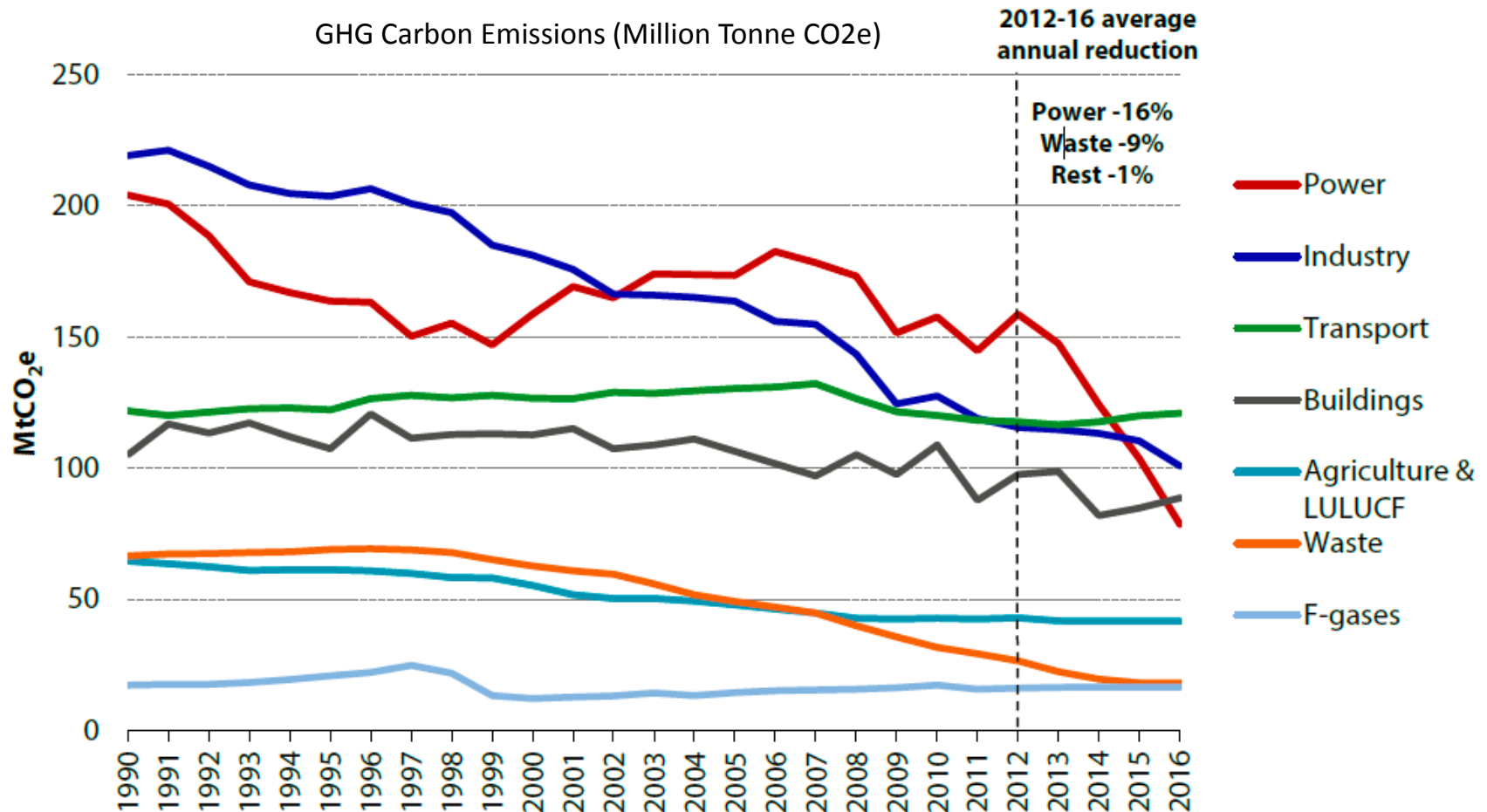
-  Biodiesel refinery based in Motherwell since 2005 – 100% waste-based feedstocks
-  £100m investment in refinery & terminal in Ellesmere Port to take the most degraded wastes
-  >60 million litres of biodiesel produced in 2015, up to 150m in 2018
-  Annual fuel supply of over 250m blended litres to blue-chip customers
-  Carbon savings of >90,000mt CO₂e for our customers in 2017

Are we nearly there yet?

- Where are we right now?
- National & local legislation
- Available Technologies
- What can be done to get there?



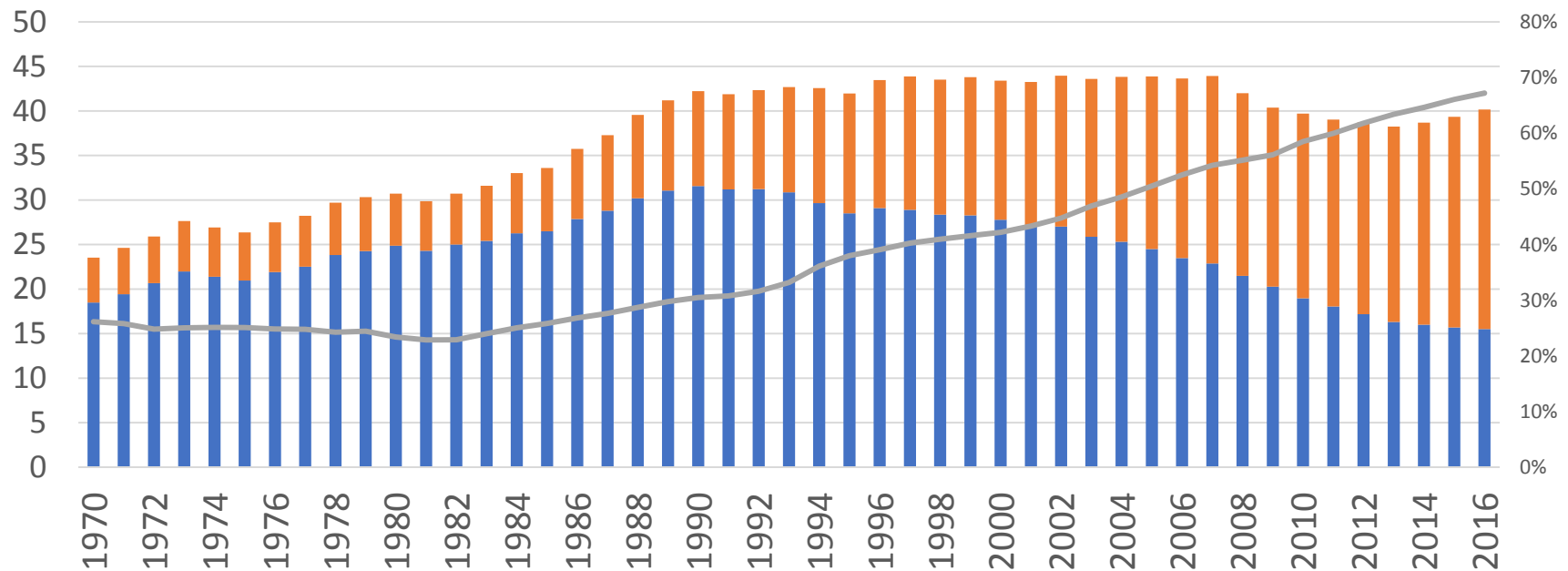
How does transport compare to other sectors?



- Climate Change Act commits government to reduce emissions by 80% of 1990 levels by 2050
- Carbon budgets set through to 2032 – requires 44% reduction in transport emissions...

Long term UK Fuel Consumption Trends

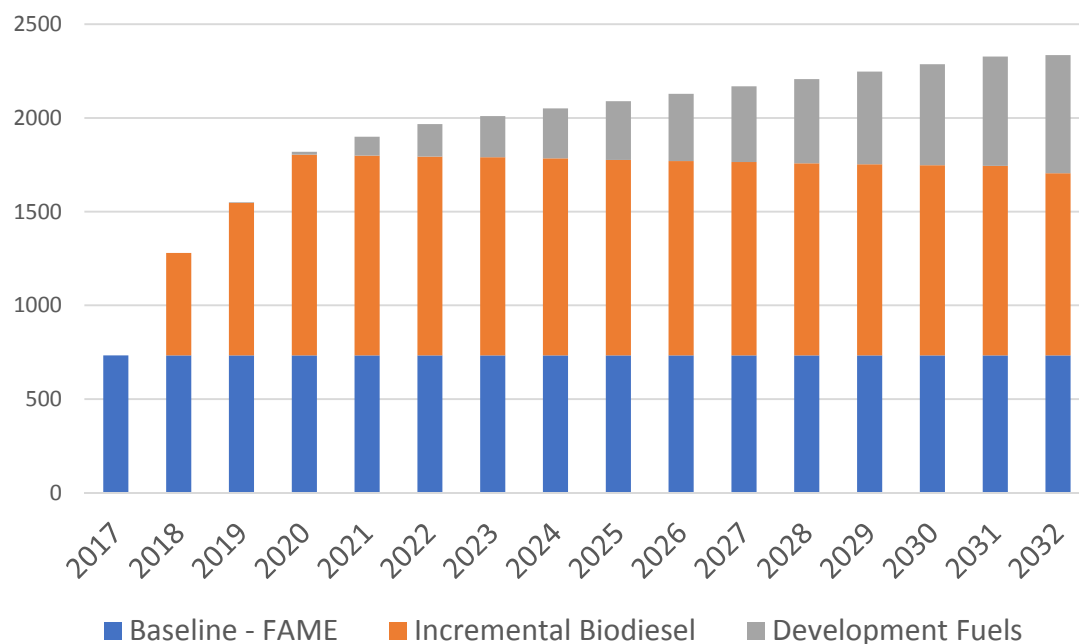
Consumption of Petrol / Diesel 1970-2016 (bn Lt)



- Overall fuel consumption in UK has remained broadly stable since early 90's
- The share of diesel has grown from 30% to 67% over the last 50 years
- The infrastructure is built up around liquid fuels
- Electric vehicles only ~1.5% of new car sales
- Bus / trucks account for 1/3 of diesel demand

National Legislation - UK Road Transport Fuel Obligation (RTFO)

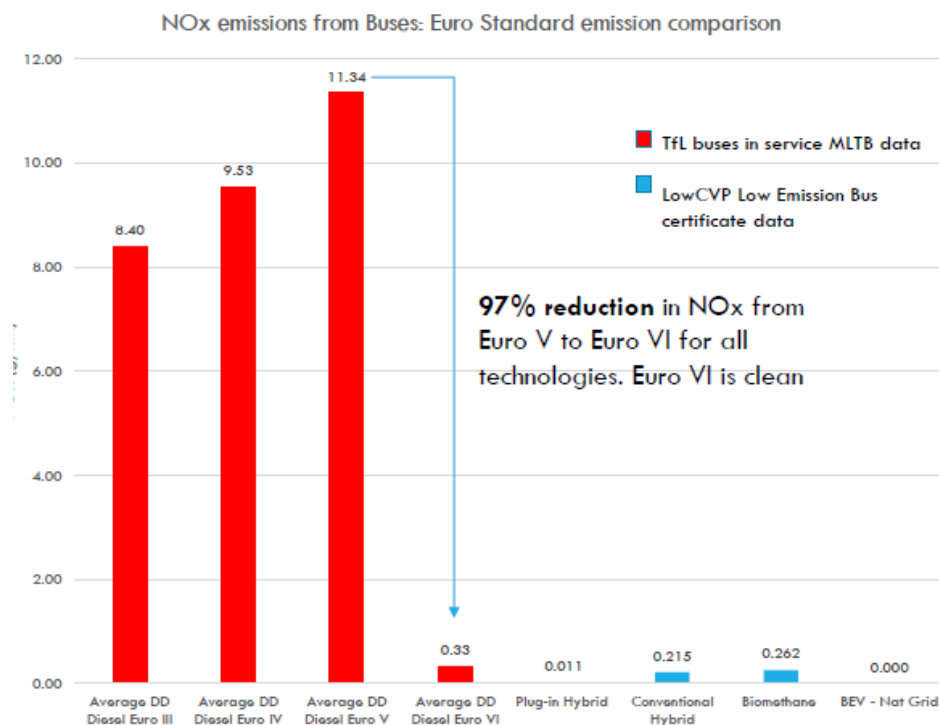
UK Biodiesel & Development Fuel Demand to 2032 (million litres)



- Total renewable fuel 2016/17, 1.5 billion litres or 3% by volume of total fuel usage
 - 50% bioethanol
 - 46% biodiesel
 - 4% biomethanol
- The current mandate had been stagnant at 4.75% for several years
- Doubling to 9.75% by 2020, and to 12.4% by 2032
- New development fuel category
- Similar mandates in Europe driving demand
- Duty rebate for natural gas (18.6ppl vs 57.95ppl)

Local Legislation - Air Quality (and public transport) focused

- Air quality vs decarbonisation
- Low & Ultra Low Emissions Zones / Clean Air Zones / Scottish Air Quality Management Areas
- New Metro Mayors responsible for transport
- Long term electrification aims
- Funding Opportunities
 - DfT GBP40m retrofit fund to Euro VI Standard
 - Scottish Emissions Abatement Retrofit Programme
 - Scottish Bus Service Operators Grant (BSOG)
- Decarbonisation of freight? What's the plan?



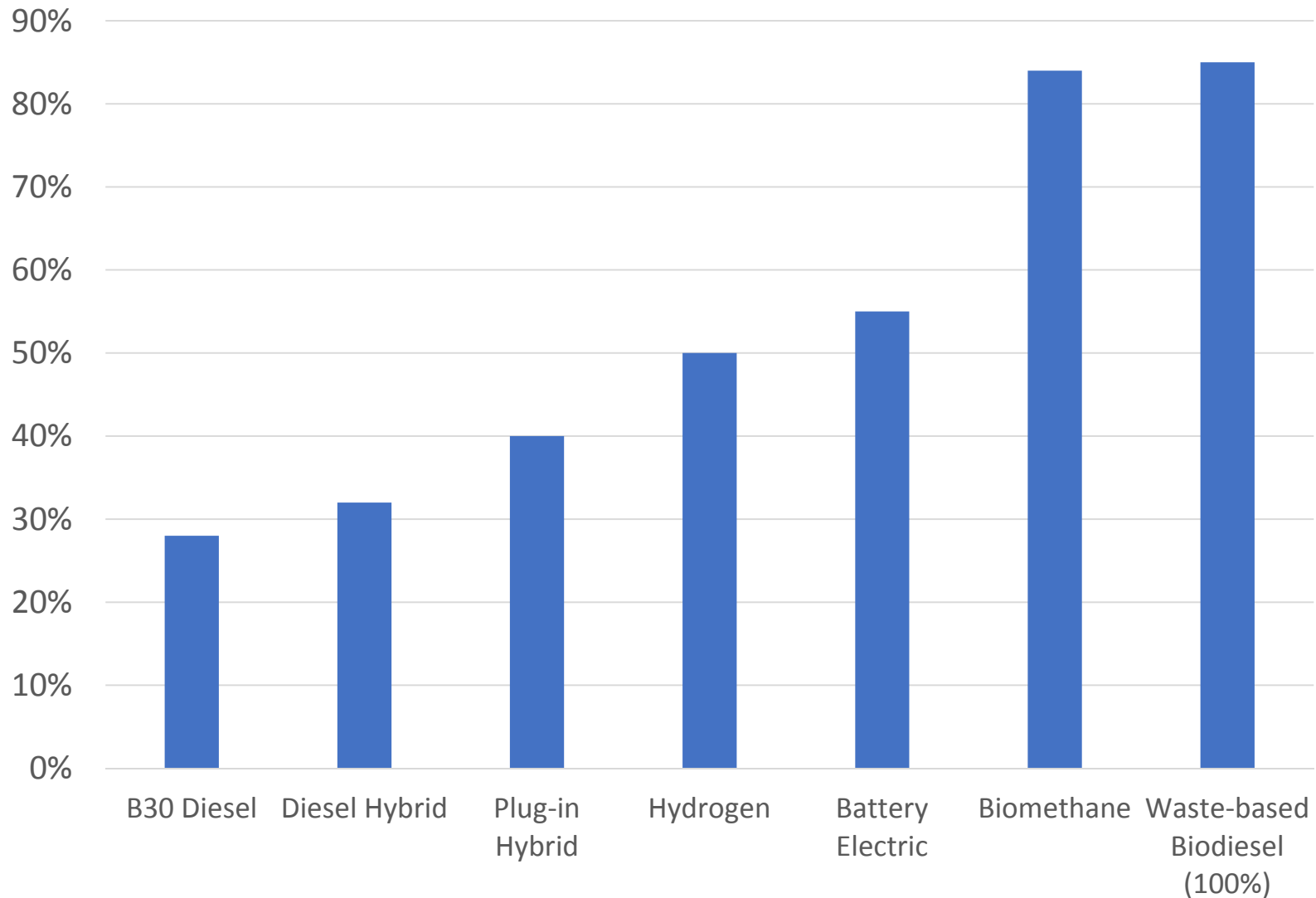
Source: LowCVP National Policy Outlook Autumn 2017

Technologies Available – Horses for Courses



- Multiple new technologies out there – electric, hybrid, natural gas, bio-gas, hydrogen fuel cells, biodiesel, retrofit
- Near-term infrastructure constraints
- Retraining of engineering skills
- Competition for renewable resources
- Well-to-wheel carbon savings vs air quality savings / tailpipe emissions

Well to Wheel Carbon Savings vs Average Double Deck bus



Data courtesy of LowCVP from Low Emission Bus Certificates, except battery electric (in-service data), hydrogen (LCVP workings), biodiesel (RTFO), B30 (Government conversion figures)

What can regional/national authorities do?

- Not a one-size fits all solution – all low carbon/low emission technologies required to meet carbon targets
- Regulation will drive market behaviour – through mandates, incentives or duty rebates linked to carbon intensity
- Near term as well as long term legislation in place for decarbonisation



Thank You

rick.symington@argentenergy.com





Bill Ireland
Chief Executive, Logan Energy





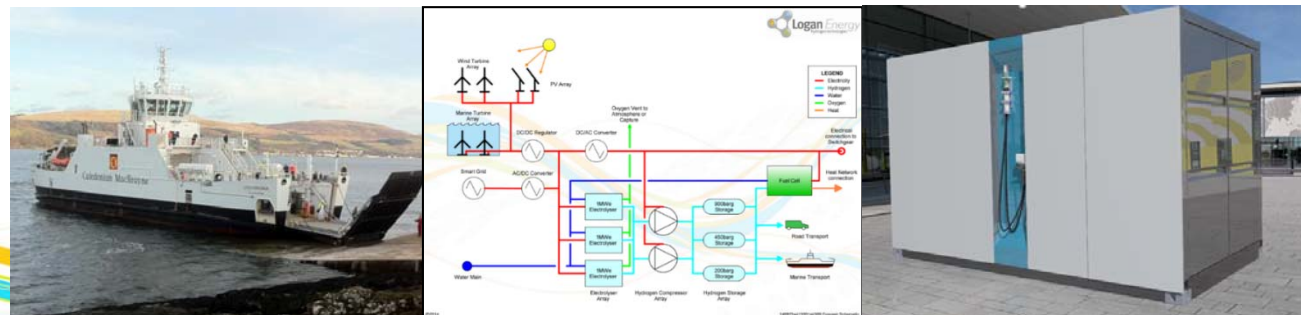
Low Carbon Transport Are we nearly there yet?

Bill Ireland – CEO

Logan Energy Limited

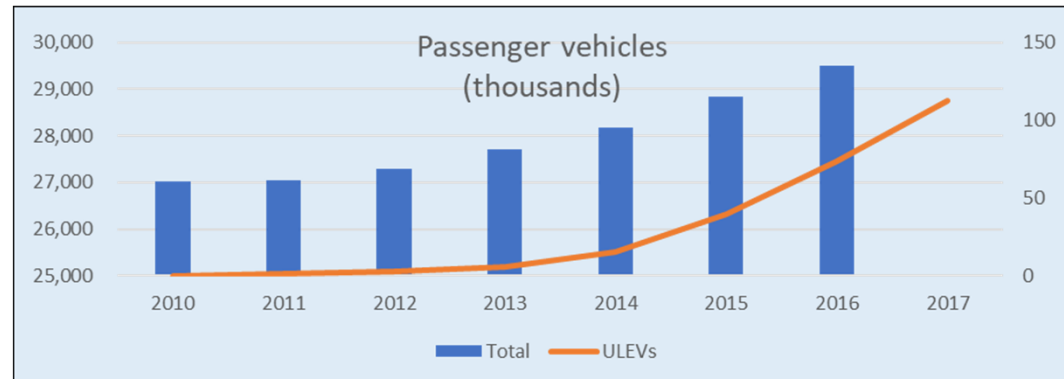
Logan Energy

- Edinburgh based Independent Energy Solutions Provider
- Manufacturer independent
- Over 1.1MWe of fuel cell CHP, CCHP
>98% installed capacity
- 2013/5 - Hyseas
- 2015 - DECC H₂ Town
- 2017 - Levenmouth
- 2018 – HyTIME
- 2018 - SEAFUEL

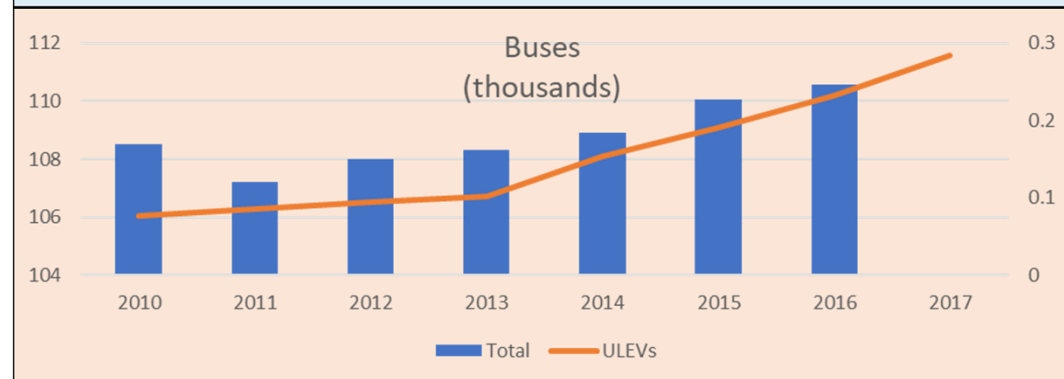


Are we nearly there yet?

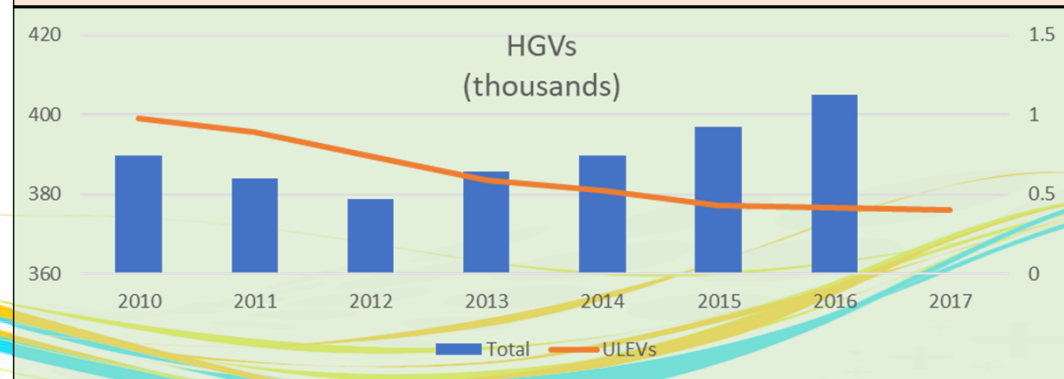
- Passenger vehicles
0.39%



- Buses
0.26%



- HGVs
0.10%



Are we nearly there yet?

- Trains
 - CAPEX of electrification
 - Disruption
 - Fuel cell economic alternative



- Marine
0%



The death of the internal combustion engine

Fossil fuel omission

- 2040 France, UK, et al
- 2032 Scotland
- 2030 GLA

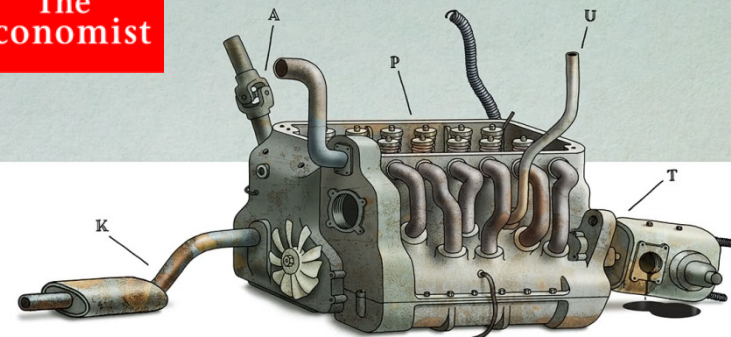
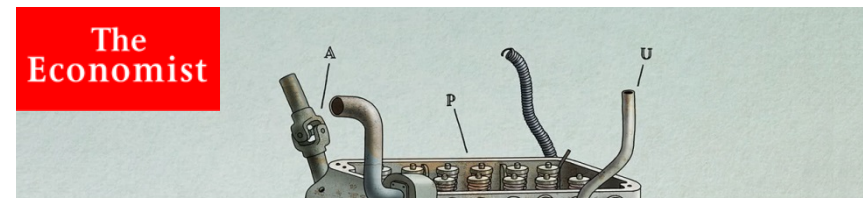


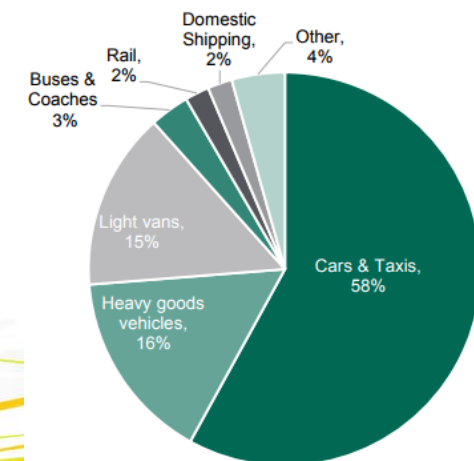
Fig.1 The Internal Combustion Engine

Jon Berkeley

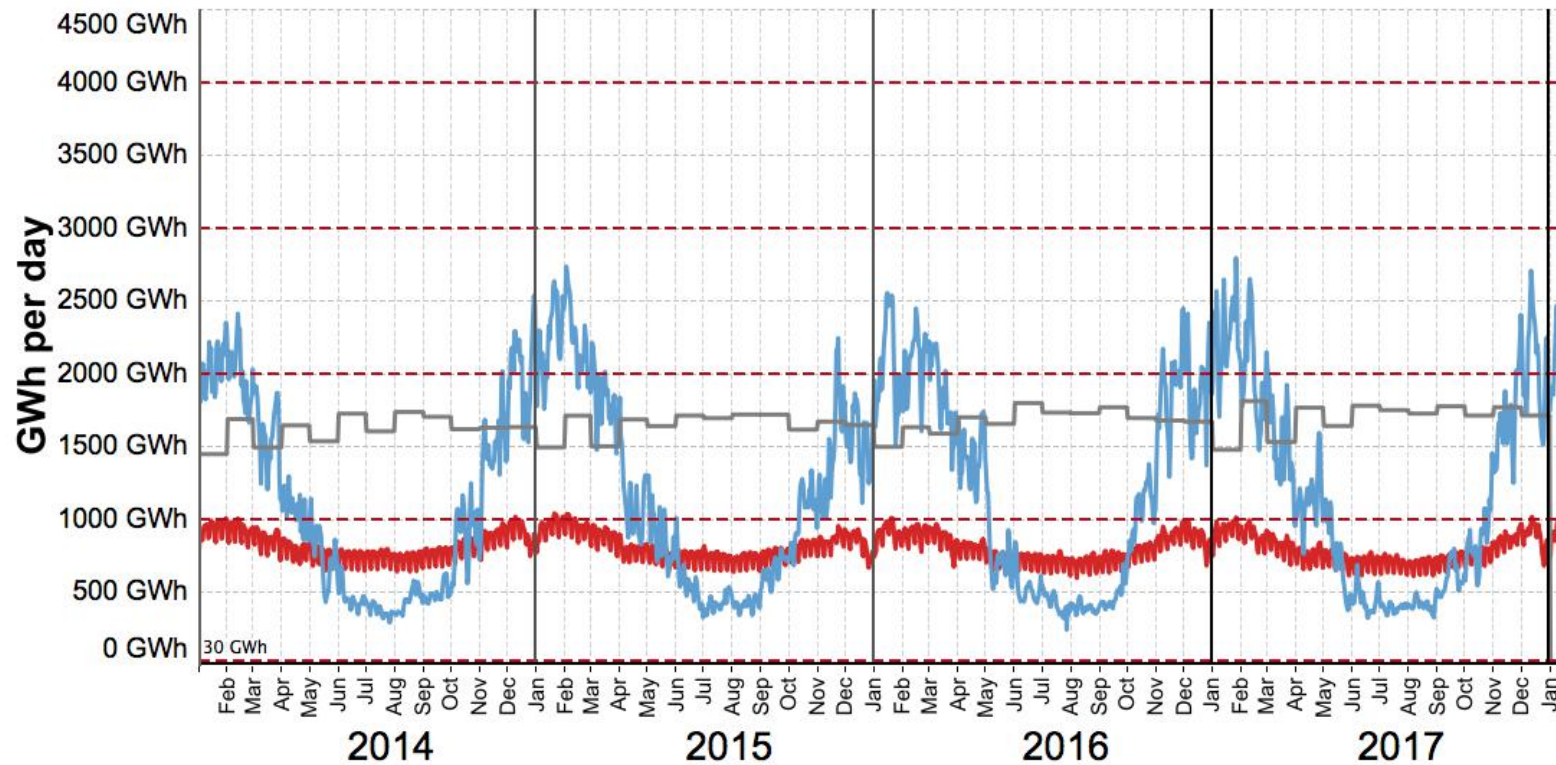
London breaches annual air pollution limit for 2017 in just five days

Brixton Road in Lambeth has already broken legal limits for toxic air for the entire year, with many other sites across the capital set to follow

- Pollution



Current GB Energy Consumption



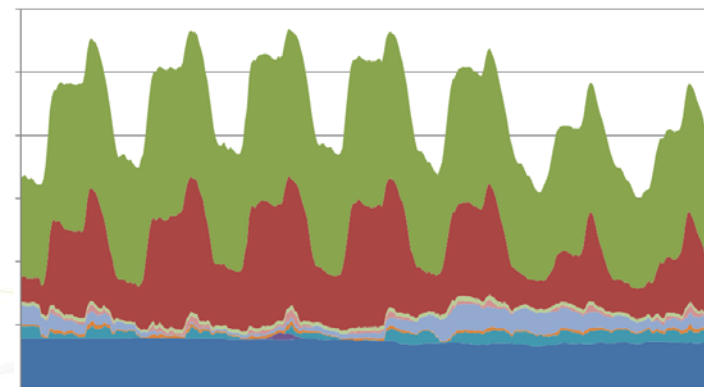
Data are from National Grid, Elexon and BEIS. Charts are licensed under an Attribution-NoDerivatives 4.0 International license
 Charts can be downloaded from <http://bit.ly/energycharts>



by Dr Grant Wilson grant.wilson@sheffield.ac.uk

Energy Profiles – supply/demand

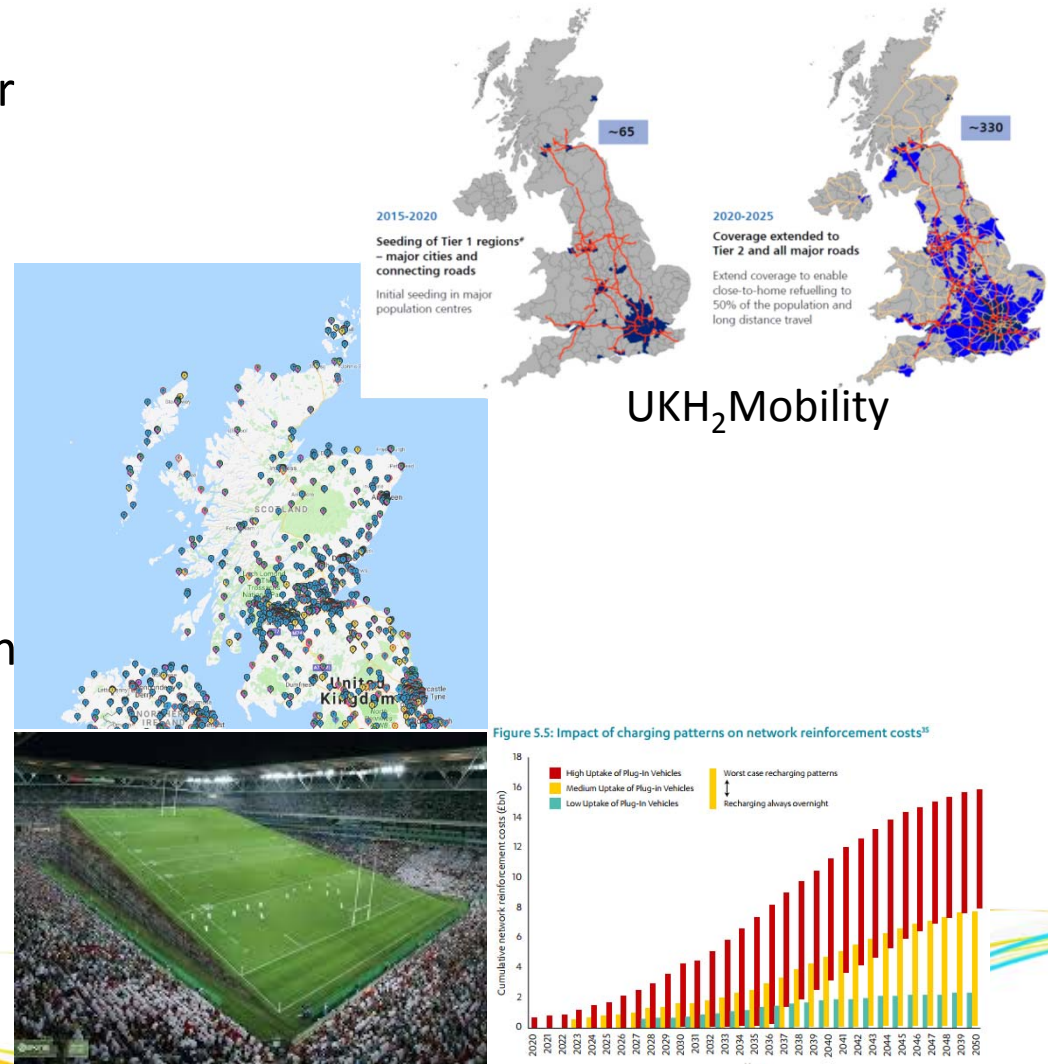
- Potential to balance annual wind and solar
- Different periods of variation
 - Sub-second
 - Seconds/minutes
 - Hours/days
- Different solutions for different situations



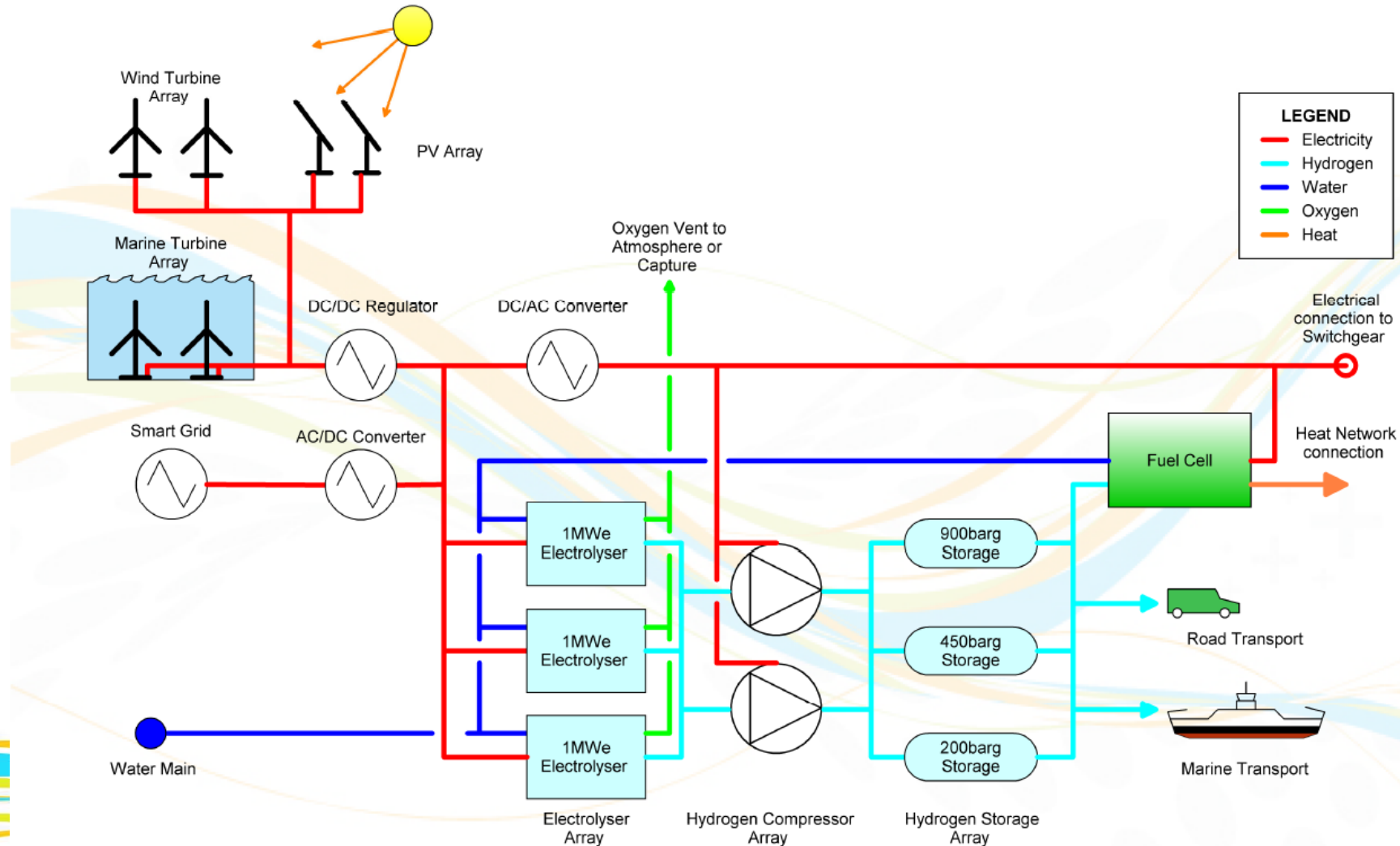
Grid Load

Policy, legislation and delivery

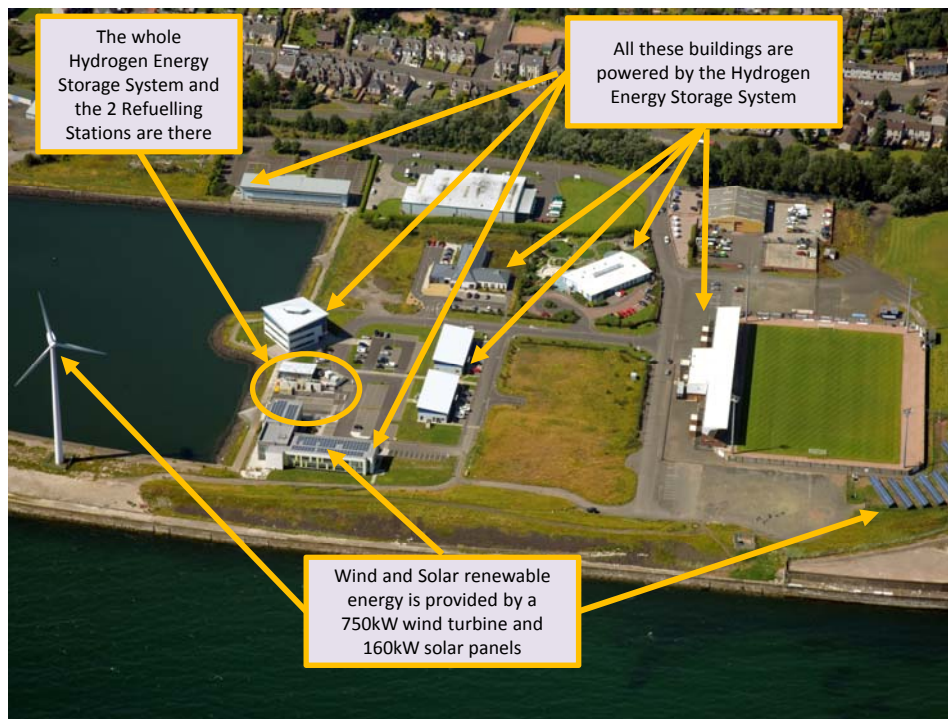
- Workable transport strategy for **Scotland**
- Coordinated legislation
- Level playing field??
 - Offshore wind – subsidy
 - Biofuel - subsidy
 - O&G no penalties for carbon emissions
 - EVs - £5000 subsidy/vehicle
 - H₂ – **nothing yet...**
- Grid reinforcement costs £16bn for EVs alone?
- H₂ – recognised as a solution but no reliable support
CAPEX – 700bar vs 350bar
- Available vehicles?



Large Hydrogen Community



Levenmouth Community Energy Project



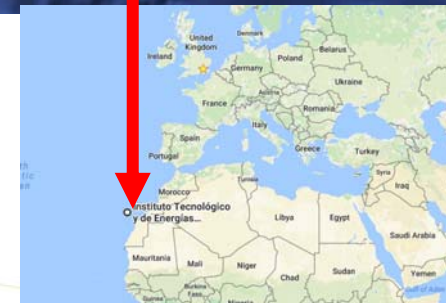
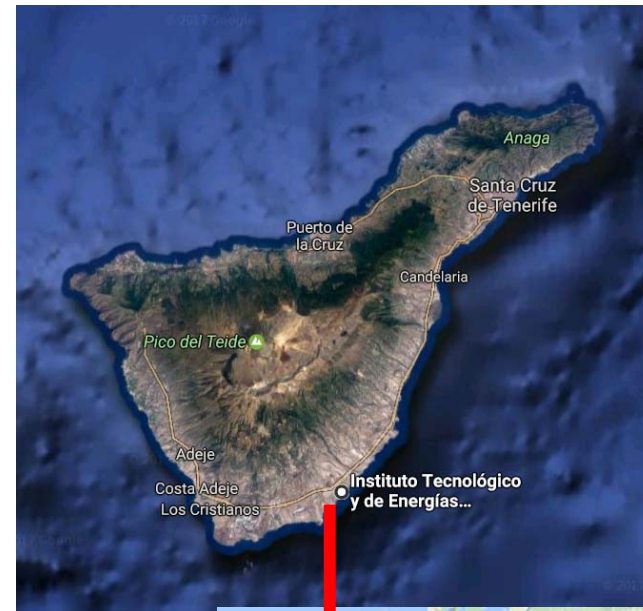
- Increase generation to 910kW
- Increase microgrid network
- Hydrogen energy storage system
- Two hydrogen refuelling stations – PEM and Alkaline
- Energy management system
- Fleet of 17 vehicles
- Investigation into Rural hydrogen
- Fully operational since April 2017

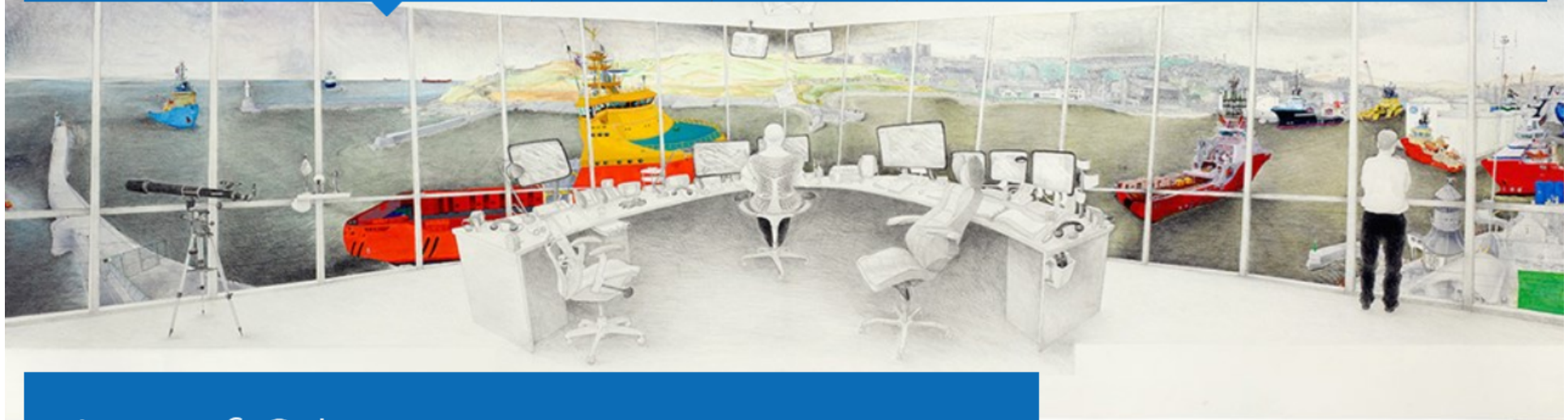
Vehicle refuelling



SEAFUEL: Tenerife

- EU funded Interreg community energy
- Sea water to transport fuel
- Energy balancing system
- Economic HRS for local fleet of FCEVs
- Designed, built, commissioned in **Scotland**
Installed and operated in Tenerife





Age of Oil



Thank you

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**Jenny Hogan, Deputy Chief Executive,
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Energy in Buildings: Green Heat and Power





Viv Cockburn, Director of Corporate Services and
Low Carbon, Scottish Futures Trust

Andy Maybury, Consultant, Community Energy
Scotland

Ian Dunsmore, Project Manager, Scottish Water
Horizons

Eddie Boyd, Energy & Sustainability Manager, The
Highland Council

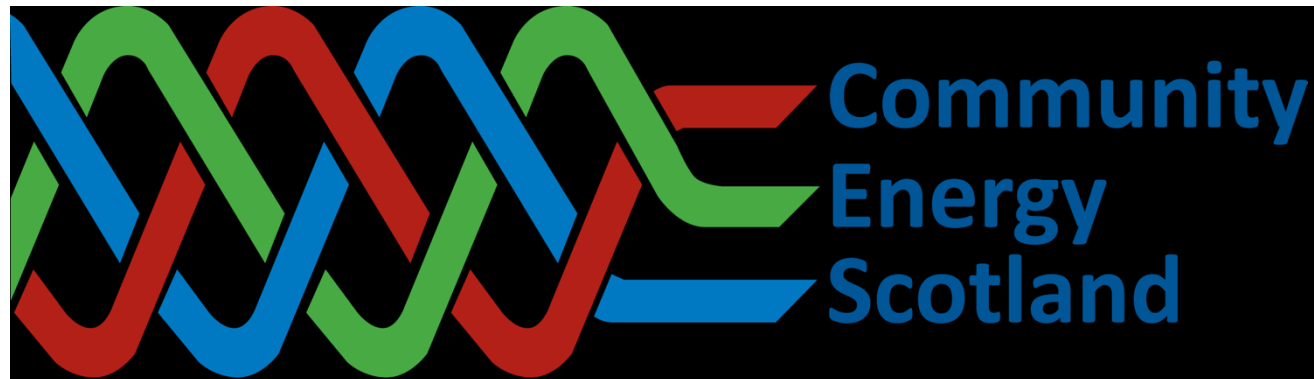
Dave Pearson, Director, Star Renewable Energy





Andy Maybury
Consultant, Community Energy Scotland





Empowering Communities

Energy in Buildings—Tower Power

Inclusive approaches to energy solutions

Andy Maybury MA







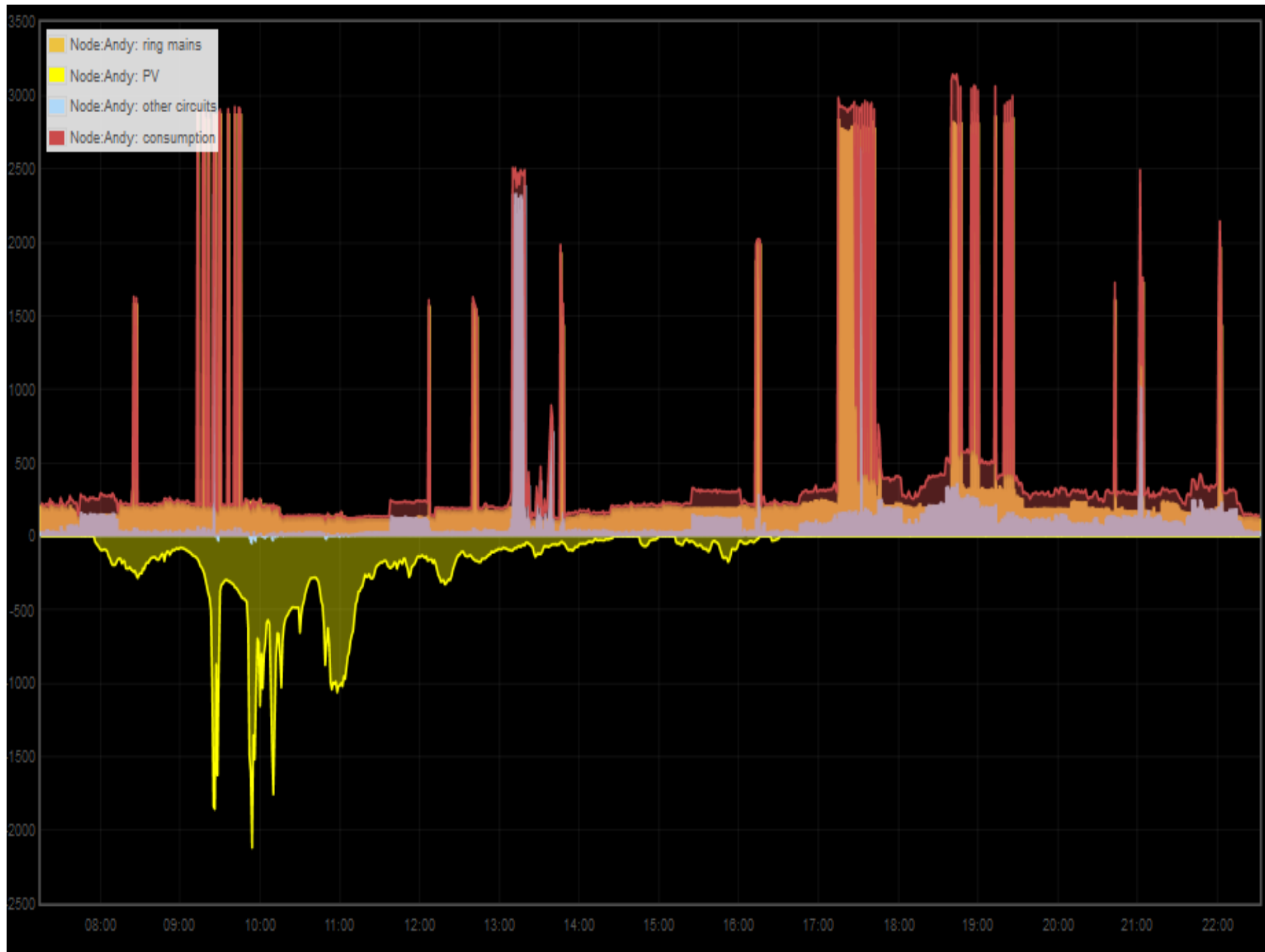
Monthly Budget

PROJECTED MONTHLY INCOME		Income 1	€ 2,500.00
ACTUAL MONTHLY INCOME		Income 1	€ 3,000.00
		Extra income	€ 500.00
		Total monthly income	€ 2,500.00
		Income 1	€ 3,000.00
		Extra income	€ 500.00
		Total monthly income	€ 3,000.00

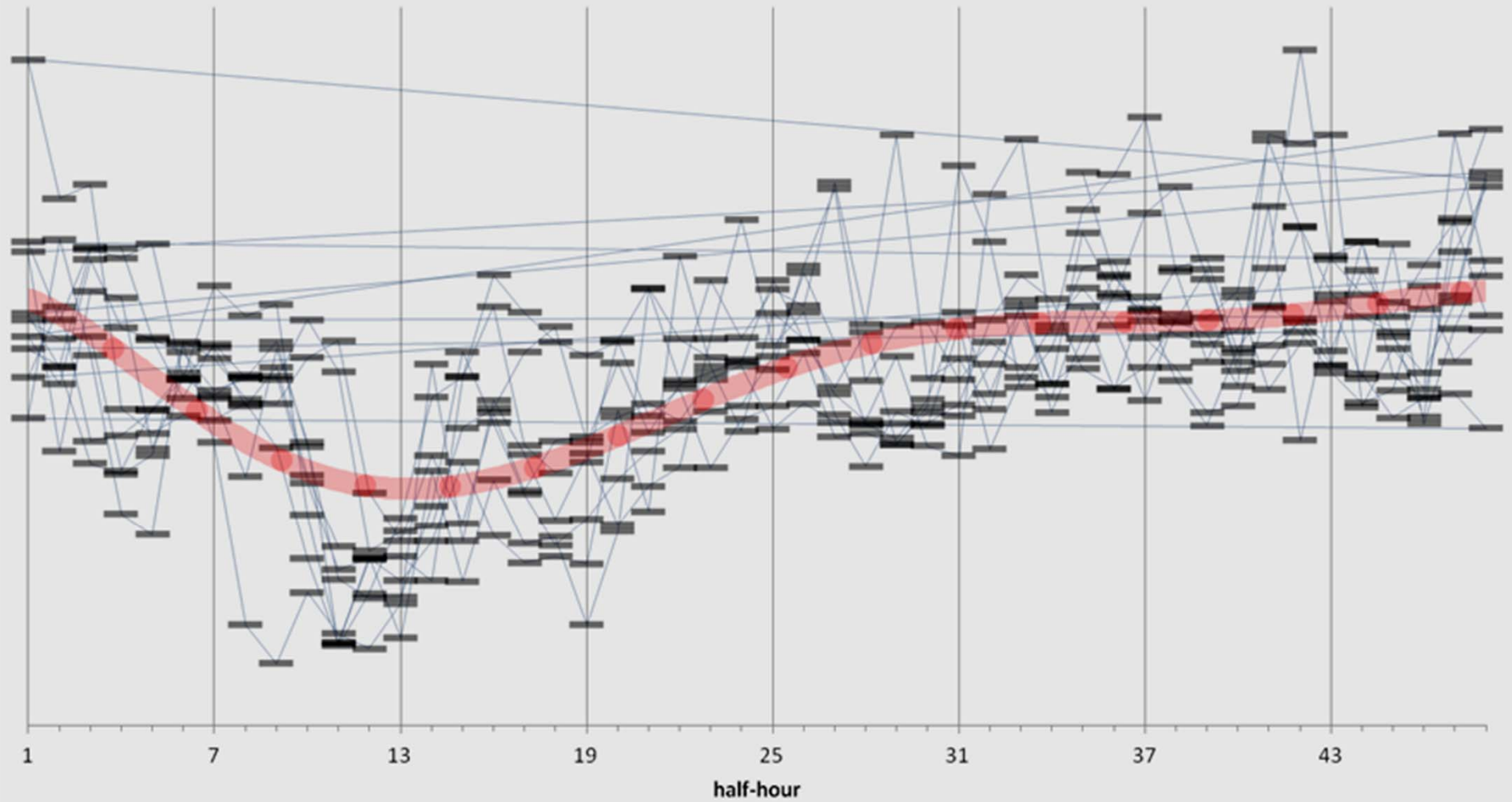
	Projected Cost	Actual Cost	Difference
HOUSING	€ 1,500.00	€ 1,400.00	€ 100.00
Mortgage or rent	€ 60.00	€ 100.00	€ (40.00)
Phone	€ 50.00	€ 60.00	€ (10.00)
Electricity	€ 200.00	€ 180.00	€ 20.00
Gas	€ 50.00	€ 48.00	€ 2.00
Water and sewer			€ -
Cable			€ -
Waste removal			€ -
Maintenance or repairs			€ -
		1,788.00	€ -







Dumbiedykes whole-block consumption daily pattern





Set A kWh
tot 008765.4

CONNECT

SELECT

E1 E2 E3 E4 E5

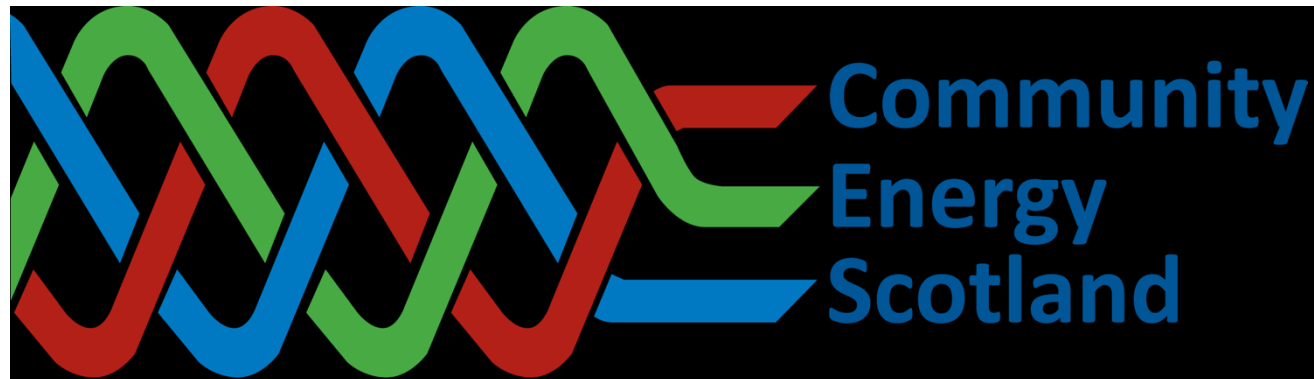
PULSE 1

PULSE 2

EDMI
Mk7C
ATLAS

1000 imp/kWh
7C11-A152-19-F212-4F02-0010
220-240V 50Hz Class B 3K7
0,5-10(100)A CE M11 0120
E211636849 UKJ0120/SGS0001
SN: 211636849
2011
MADE IN SINGAPORE





Empowering Communities

Energy in Buildings—Tower Power

Inclusive approaches to energy solutions

Andy Maybury MA






Ian Dunsmore
Project Manager, Scottish Water Horizons

Low Carbon Energy Solutions

Heat from Waste Water



A scenic landscape of a Scottish loch. In the foreground, there are several tall, purple foxglove flowers growing from a rocky shore. The water is calm, reflecting the sky and the surrounding mountains. The background features dark, rugged mountains under a cloudy sky. The overall mood is serene and natural.

Scottish Water Horizons AN INTRODUCTION



Scottish Water
Trusted to serve Scotland

**Over 1.35 billion litres
of water every day**

2.5 million households

245 water treatment works

**More than 1,800 waste
water treatment works**

**Over 60,000 miles of water
pipes and sewers**

over 5 million customers

156,000 business premises

£1.2 billion turnover

Around 4,000 people





Generating PV power



Enabling digital communications



Recycling food waste


Wholly owned subsidiary of SW

Non-regulated commercial activities

Conglomerate of diverse businesses

Key drivers include

- Climate Change (Scot) Act 2009
- Water Resources (Scot) Act 2013



SHARC Energy Systems AN INTRODUCTION



- SHARC International Group headquartered in Vancouver, BC, Canada
- Founded in 2010 by a team of HVAC & Geo-Exchange engineering professionals
- Developed first product: The "SHARC"
- Recently released second product: The "PIRANHA" for smaller-scale applications
- SHARC Energy Systems - UK division of SHARC International & a wholly owned subsidiary
- SHARC International - currently listed on the Canadian Securities Exchange - (CSE:SHRC)





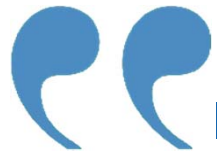
Scottish Government DRIVERS



Scottish Government Heat Targets

- 11% heat from renewable sources by 2020 (currently 5%)
- 80% of domestic heat supplied from low-carbon technologies by 2032
- 94% of non-domestic buildings' heat supplied from low-carbon technologies by 2032






In services (non-domestic buildings), we will need to achieve near zero carbon emissions by 2032. We will focus our efforts up to 2025 largely on energy efficiency improvements.

After 2025 we will prioritise low carbon heat with virtually all natural gas boilers being replaced by low carbon heat technologies by 2032.



Quote from Climate Change Draft Plan 2017





Scottish Borders Campus CASE STUDY



The campus will benefit from:

- ✓ **1.8 GWh** of annual heat
- ✓ GHG emissions saving of in excess of **150 tonnes** per year
- ✓ **20 year** stable heat supply price
- ✓ Ongoing system O&M
- ✓ System SPF **4.2**



The energy centre at Borders College



OFF SITE

Production of equipment:

SHARC skid and PHX

Heat pumps

Controls – software development

Distribution pump sets

ON SITE

Construction of:

Energy Centre

Sewer interface & pumping station
install

500m of flow return heat network,
connecting 5 plant rooms

Plant room adaptation of college heat
distribution – connection to LLH

Customer Feedback



“During our evaluation period we wrestled with the ongoing question, ‘Where’s the catch?’ Surely this could not be as presented, new heating system, price certainty, no capital outlay, significant carbon savings and no ongoing space or delivery issues to worry about.

Yes, there were teething problems as you would expect with a new system but these were overcome, Our suspicions were unfounded and we have now been operating successfully for 18 months.”

Rob Hewitt – Facilities Manager at Borders College



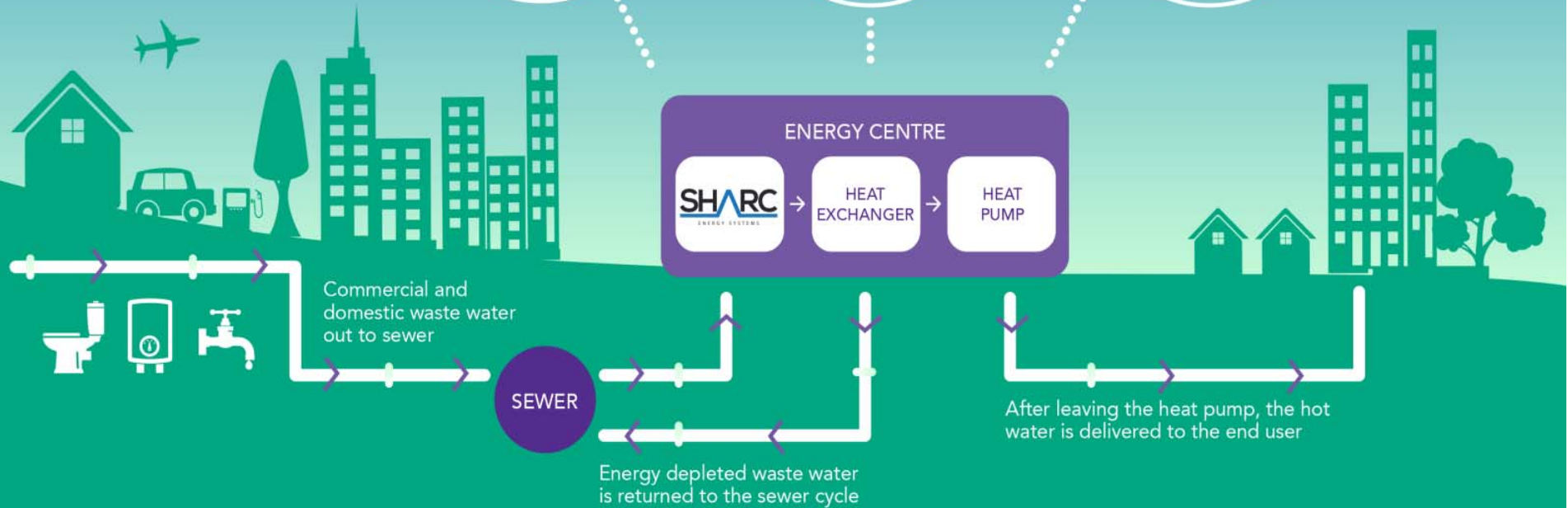
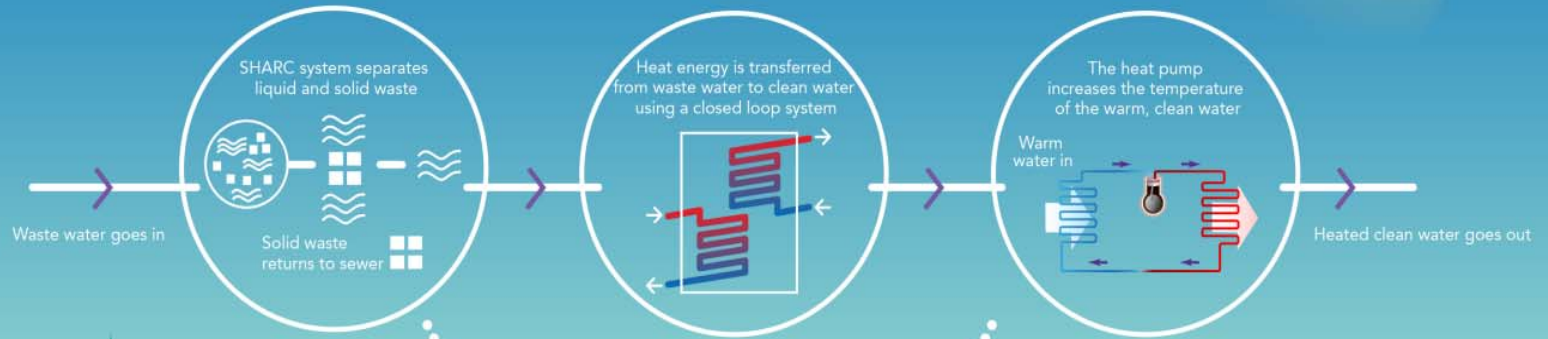
THE TECHNOLOGY

SHARC
Small High Accuracy
Robotics Center

1000 University Ave
Berkeley, CA 94720
415.875.5000

Carroll

Capturing heat from waste water



Waste Water = Energy Source

Over **50%** of Scotland's total energy use comes from heat

Over **50%** of Scotland's greenhouse gases result from heat

£2.6 billion spent each year in Scotland on heating and cooling

Over **921 million litres** of waste water are produced in Scotland each day

Over **31,000 miles** of sewers (distributed heat) across Scotland

An aerial photograph of a tall, stone tower with a complex, spired top, situated on a hillside. The tower is the central focus, with a dense forest of trees in autumn colors in the foreground and a town with many houses in the middle ground. In the background, there are rolling hills and a clear sky. A semi-transparent blue grid overlay is positioned over the left side of the image, containing the text.

Low carbon heat in existing buildings



Retrofit Challenge

- Built in the 19th Century
- Partially listed status
- Single glazed windows
- Connected to district heating network from central energy centre
- No changes to emitter system

High Mill, Borders College



Retrofit Challenge

- Built in 2006
- Library and Leisure Centre
- Diverse heat demands within the building
- Remote location
- Replacing failed Biomass
- Minor emitter upgrades needed

Aqualibrium, Campbeltown





Retrofit Challenge

- Grade A listed building
- Iconic location
- Planning process including many special interest groups
- Sewer 8m deep
- Underground energy centre
- No change to emitter system

Kelvingrove Museum, Glasgow

Questions





Eddie Boyd
Energy & Sustainability Manager,
The Highland Council



Energy in Buildings: Green Heat & Power

Planning for Change



Eddie Boyd | Energy & Sustainability Manager | The Highland Council

Existing Built Environment

What are the barriers to intervention?

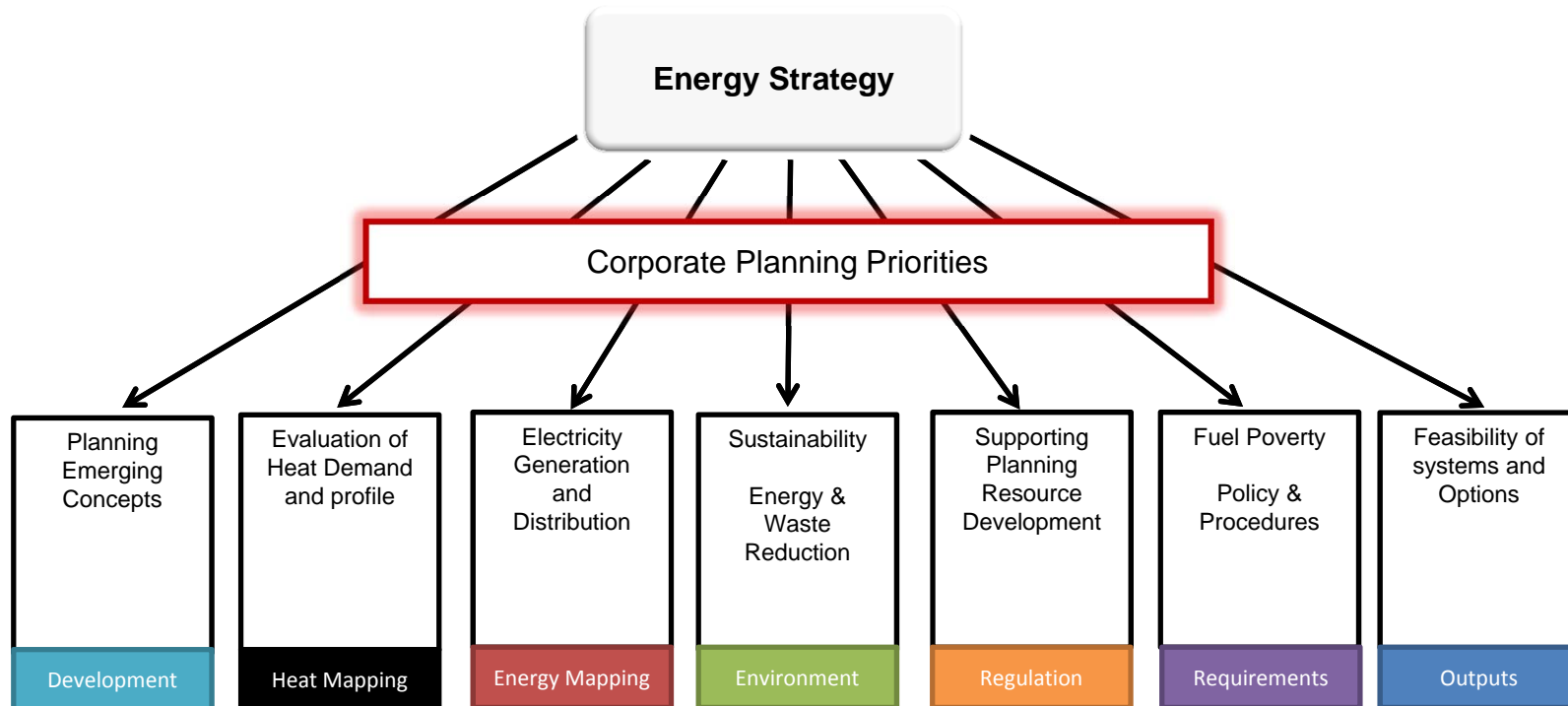
- Restricted buildings
- Unmanaged change
- Varying priorities
- Changing demands
- Lack of available data
- Lengthy consent periods



Highland Council

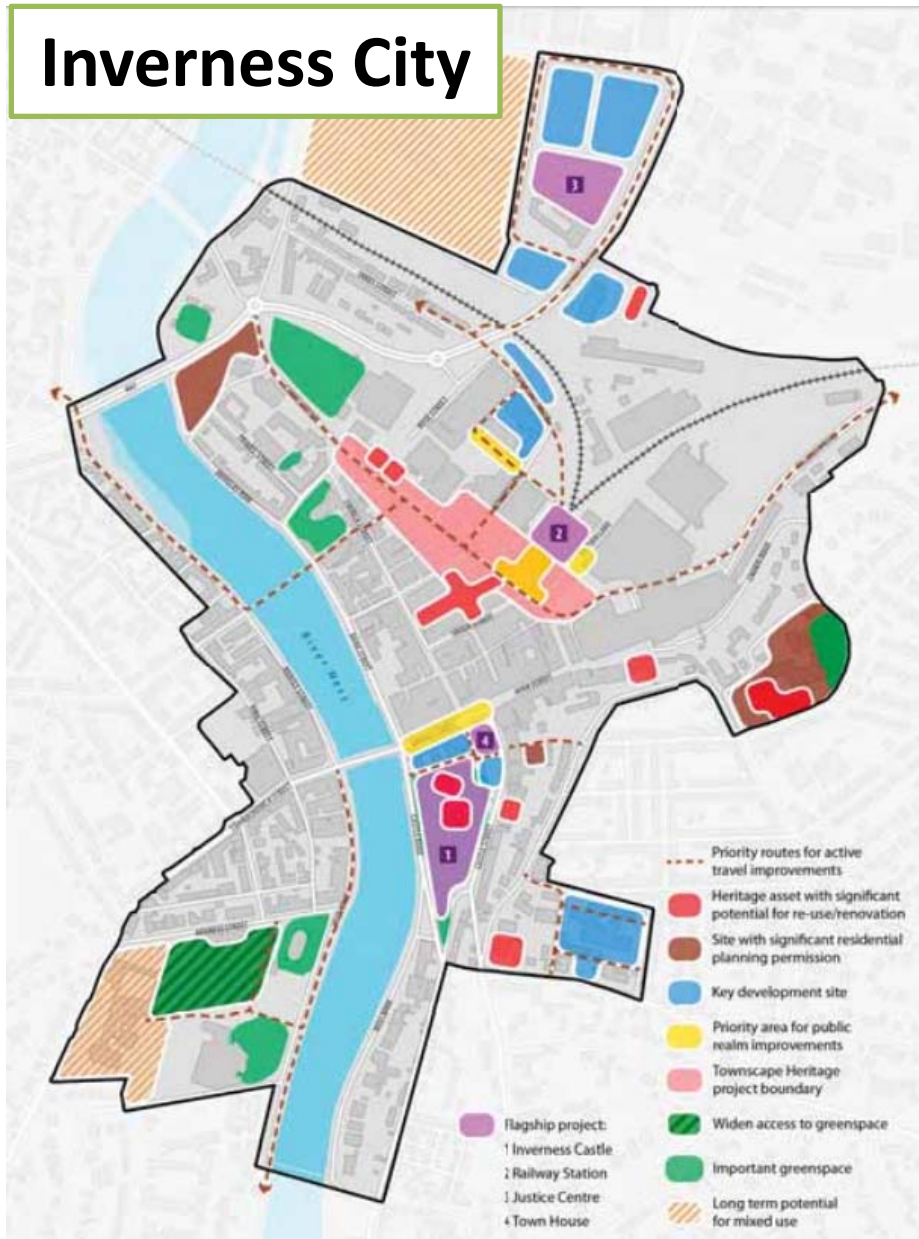
Energy & Low Carbon Planning

Bringing carbon and energy change into the environment of the local plan



Energy & Low Carbon Planning

Inverness City



Opportunities?

Energy efficiency and low carbon heat encouraged in existing buildings, along with;

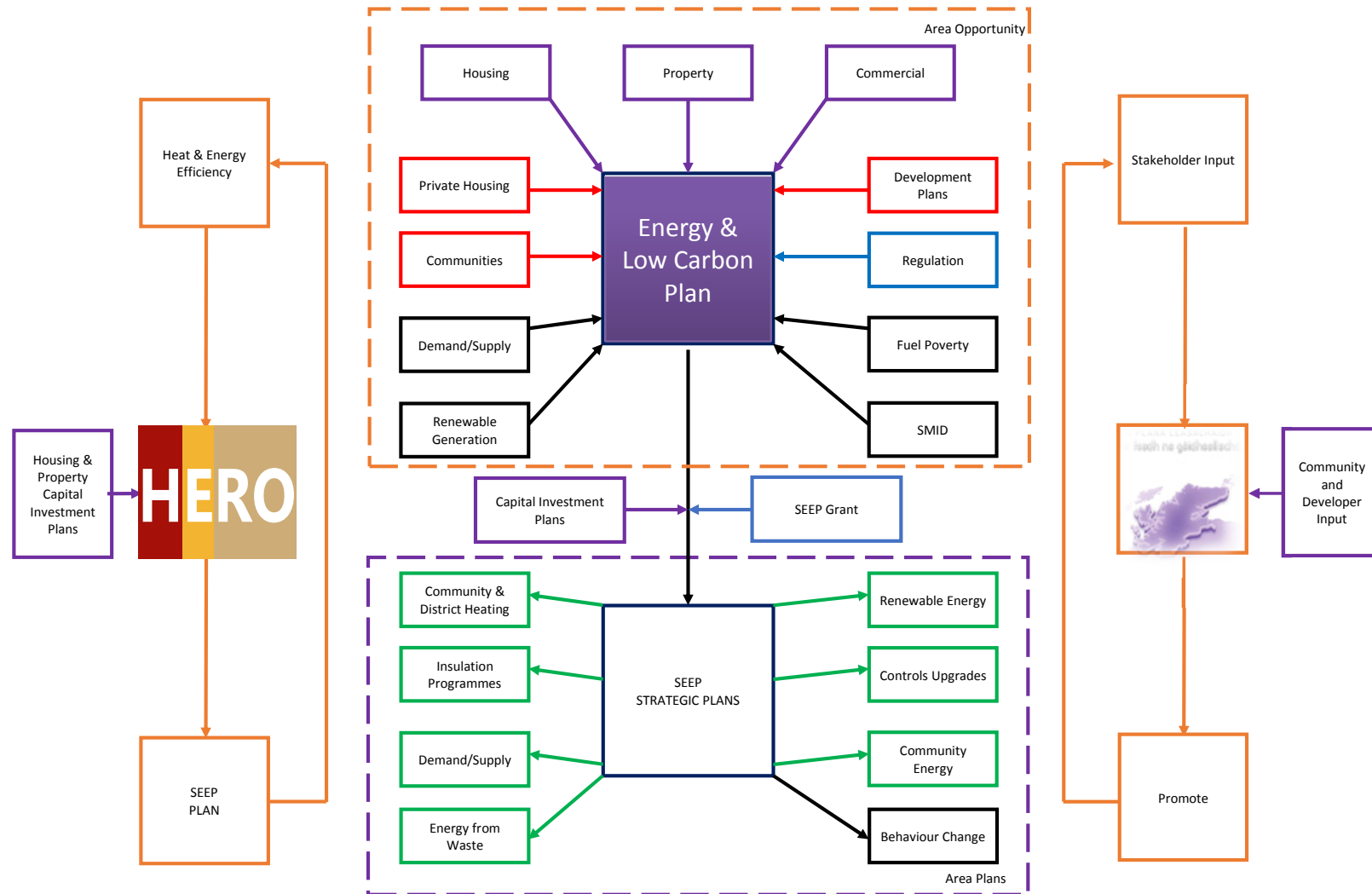
- Heat networks
- Micro-generation
- Mini-grids & Storage
- Renewables
- Heat recovery

Barriers?

- Planning consent
- Co-operation
- Visibility of options
- Maximising development
- Certainty of opportunity

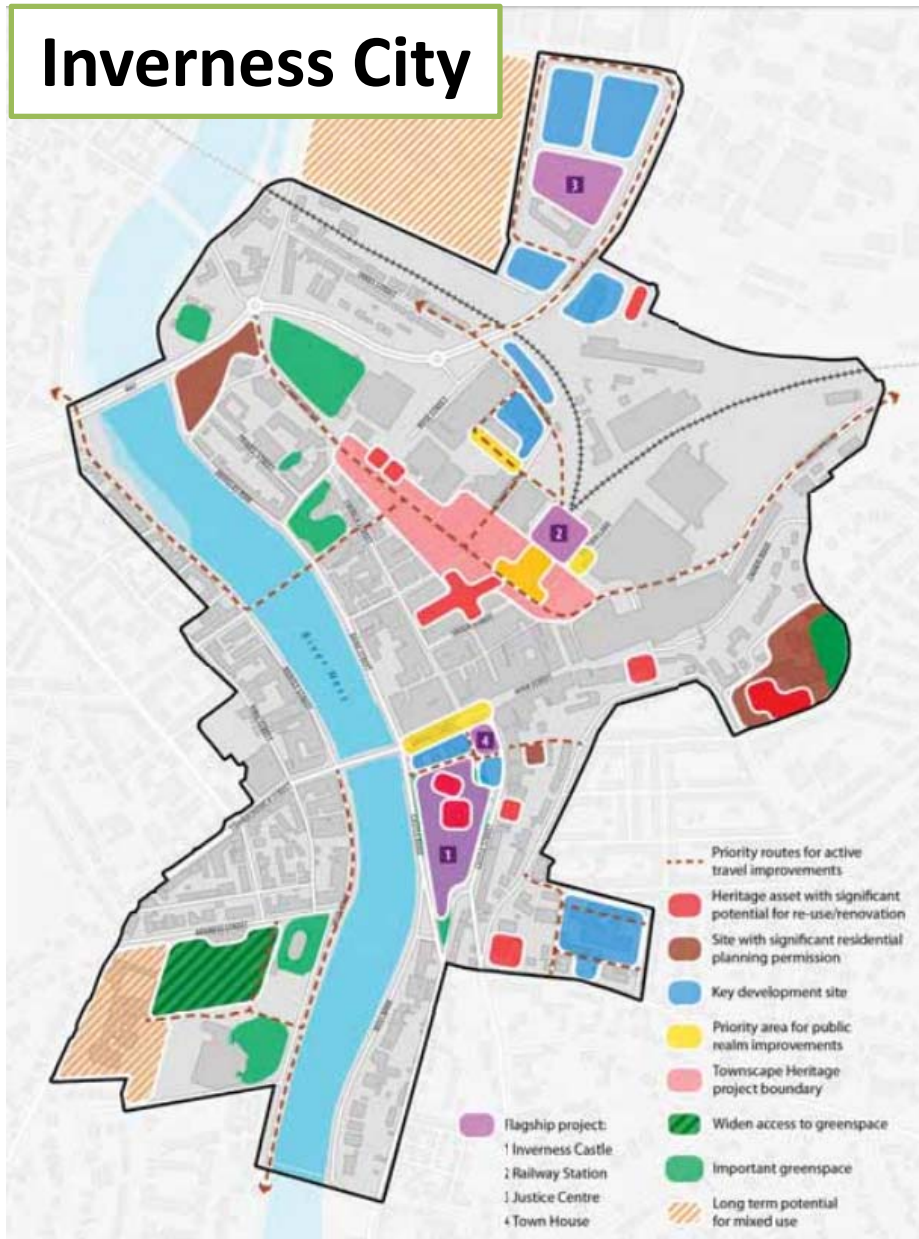
Energy & Low Carbon Planning

Internal Direction



Energy & Low Carbon Planning

Inverness City

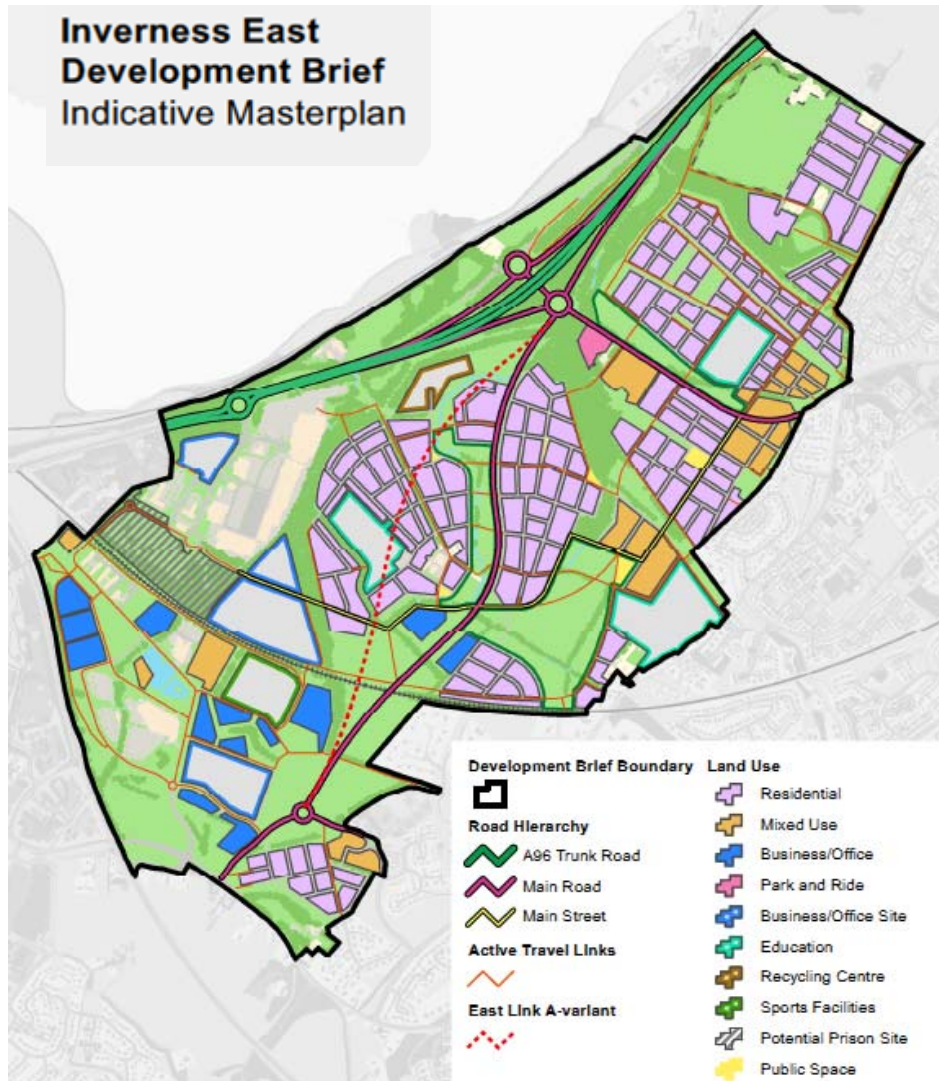


Energy Landscape Solutions

- District Heating zones
- Low Carbon Heat zones
- Water course heat collection zone
- Gas Network zone
- PV locations
- Plans for decarbonised gas development
- Electricity storage and smart grids
- Waste heat collaboration
- Energy exchange nodes
- Ecar infrastructure

Energy & Low Carbon Planning

Internal Collaboration



Energy Planning

- ✓ Text of brief includes a more specific and inclusive approach to energy
- ✓ Applicants expected to demonstrate how proposals comply with sustainable policies, use Heat Map
- ✓ Brief states high potential of area to incorporate numerous energy solutions due to mixed use e.g.
 - Local generation (capture) of energy and heat
 - Local distribution of energy and heat
 - Electricity and heat storage
 - Electric vehicle charging
 - Air cleansing structures
 - Water re-use and cooling networks

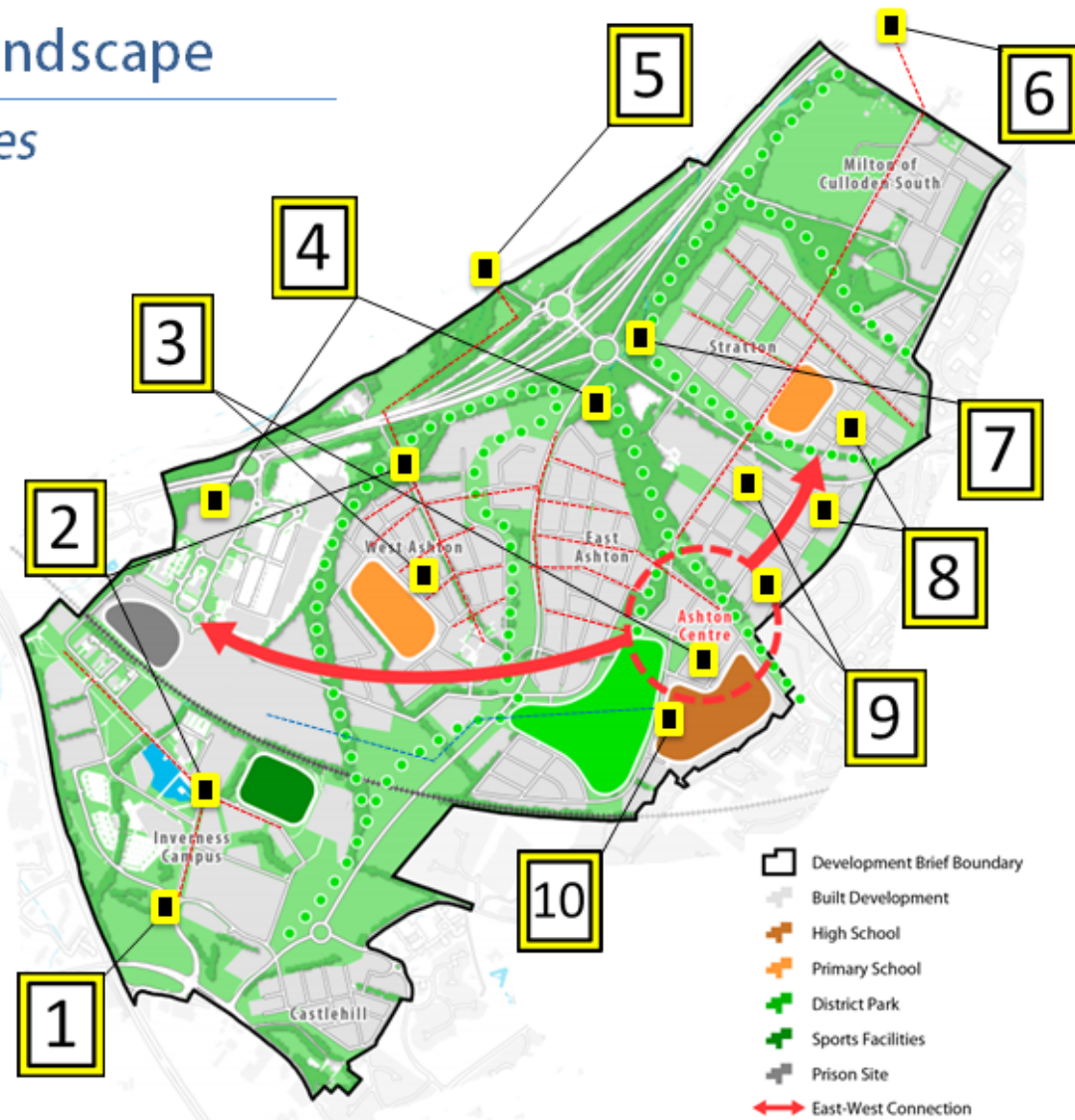
Energy & Low Carbon Planning

Internal Collaboration

Inverness East Energy Landscape

Recognising the Possibilities

1	Community Air Source Heat Pump
2	Electricity/Heat Storage Stations
3	Air Cleansing Structures
4	PV Solar Energy Systems
5	Community Water Source Heat Pump
6	Wastewater Heat Recovery Heating
7	Solar Canopy & Charger Car Park
8	Home Storage and Charging
9	PV Roofs
10	Sustainable Drainage Systems (SuDS)

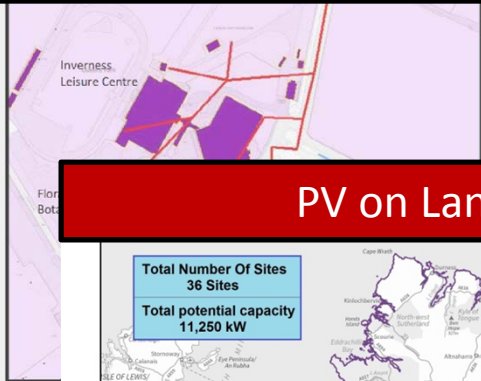


Energy & Low Carbon Planning

Highland Council – Scoping Works

We are exploring a wide range of energy opportunities...

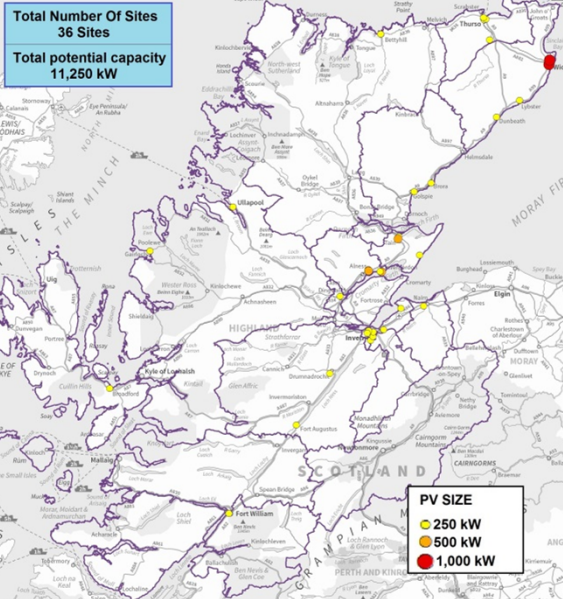
Energy Islands



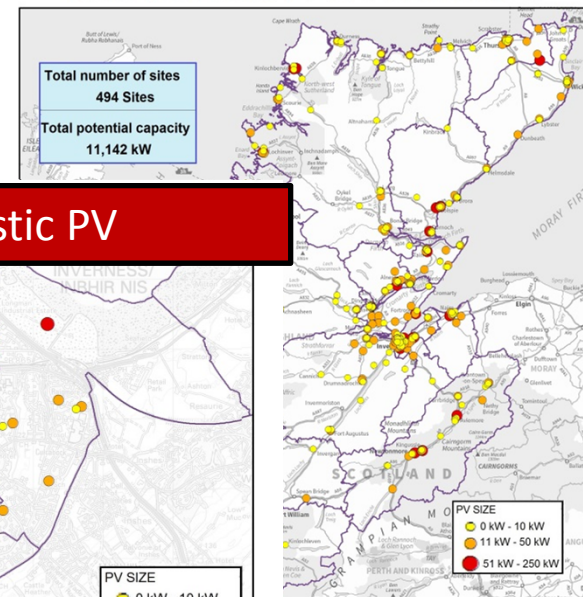
District Heating Planning



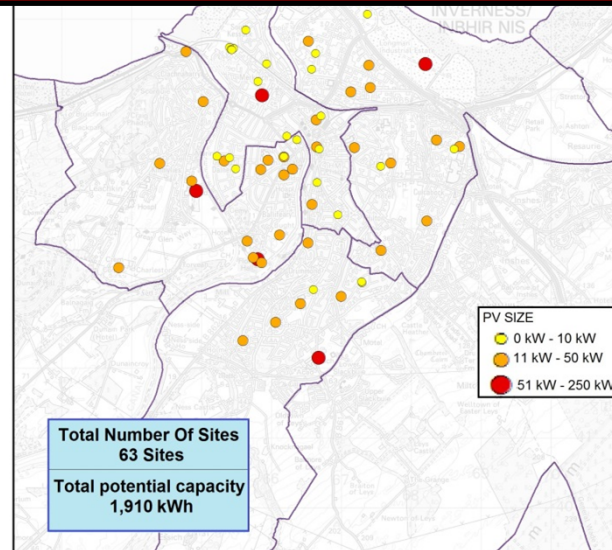
PV on Land



NON DOMESTIC PV OPPORTUNITIES



Non-Domestic PV



- Opportunities
- HC Cluster
- Proximity to
- Estimated
- Demand
- Capacity
- Low Carbon
- System/Source
- Wastewater
- Water Source
- Biomass
- Other

Energy & Low Carbon Planning

How can YOU add value?

Solar PV on
council houses

Solar PV on
council buildings
& land

Electric transport

Supplying energy

Wind Potential

District heating

Efficiency &
behaviour across
the council estate

Energy
consultancy
services

Linking SEEP with
commercial
activities

Large scale
renewables

Helping solving
energy issues
faced by citizens

Placing energy at
the heart of key
council decisions

Get Involved with Highland



energy.engineering@highland.gov.uk



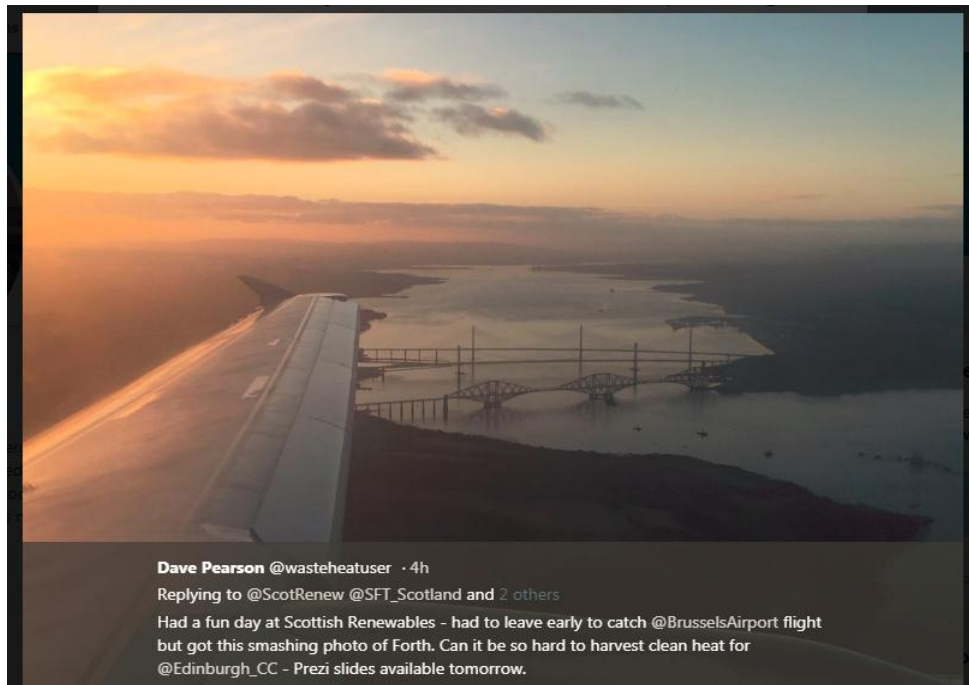
Eddie Boyd | Energy & Sustainability Manager | The Highland Council



Dave Pearson
Director, Star Renewable Energy



https://prezi.com/9mkixlsljejl/?utm_campaign=share&utm_medium=copy&rc=ex0share



Plan(t) now for the future!

A few reasons why heat pumps and cities are the perfect match for renewable energy, energy efficiency and clean air.



 <p>Renewable energy</p>	 <p>Energy efficiency</p>	 <p>Clean air</p>	 <p>Supply security</p>	 <p>Local jobs</p>	 <p>Smart Grids</p>
Heat pumps use renewable energy from air, water and ground.	Heat pumps increase energy efficiency.	Heat pumps reduce CO ₂ emissions and air pollution levels	Heat pumps reduce import dependence and thus increase security of energy supply at an affordable price.	Heat pumps create and maintain local, European jobs in research, design and installation of heating systems.	Heat pumps can serve as "thermal batteries" supporting stable smart electric grids.



Viv Cockburn, Director of Corporate Services and
Low Carbon, Scottish Futures Trust

Andy Maybury, Consultant, Community Energy
Scotland

Ian Dunsmore, Project Manager, Scottish Water
Horizons

Eddie Boyd, Energy & Sustainability Manager, The
Highland Council

Dave Pearson, Director, Star Renewable Energy



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Urban Innovation: Creating the Cities of Tomorrow




Hannah Smith, Senior Policy Manager,
Scottish Renewables

Mark Wheeldon, Innovation Project Manager -
Hydrogen 100, SGN

Ken Ross OBE, CEO, Ross Developments &
Renewables

Mike Collins, Senior Geologist, Arup & Geon
Energy Ltd

Ben Miller, Policy and Communications
Manager Scotland, Smart Energy GB





Mark Wheeldon
Innovation Project Manager - Hydrogen 100,
SGN



Hydrogen 100 feasibility study & Safety case

Mark Wheeldon

February 2018



SGN

Your gas. Our network.



Scope (phase1 feasibility)

To include Front End Engineering Design with the aim of determining the viability from both a technical and economic viewpoint of constructing the first 100% Hydrogen network.

Method

Three feasibility studies that will run concurrently - All three studies will have the same scope but will be conducted in different locations with very different existing and potential network features.

Study one - Levenmouth, Fife

.

Study two –MACC Developments Ltd, Machrihanish Airbase

Study 3 – Aberdeen conference Centre, Aberdeen



Feasibility FEED Study
(Site Specific)

1-2 Years

Demonstration Network
(Construct and Operate)

New PE Network

Feasibility Study

Conversion of Public Network

1 Year

Small Scale Conversion Demonstration
(Expansion of demo site)

(Significant customer interaction)

3-4 Years

Medium Scale Conversion

With Storage CCS & SMR

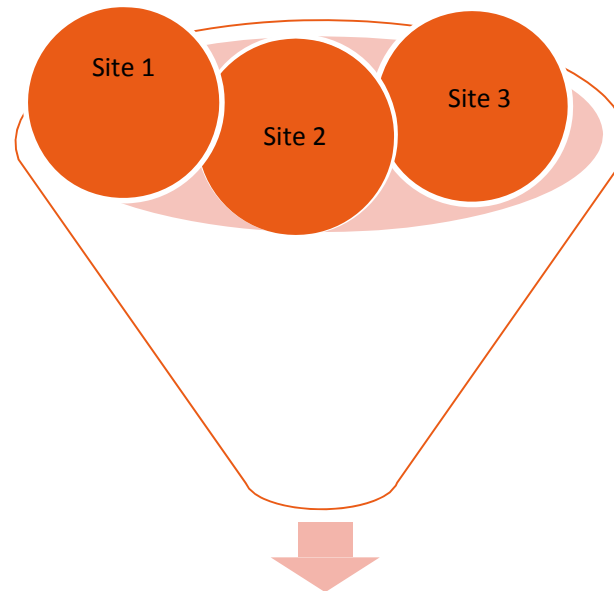
NIA

NIC + ? + BEIS? +
Scottish Government

NIA?

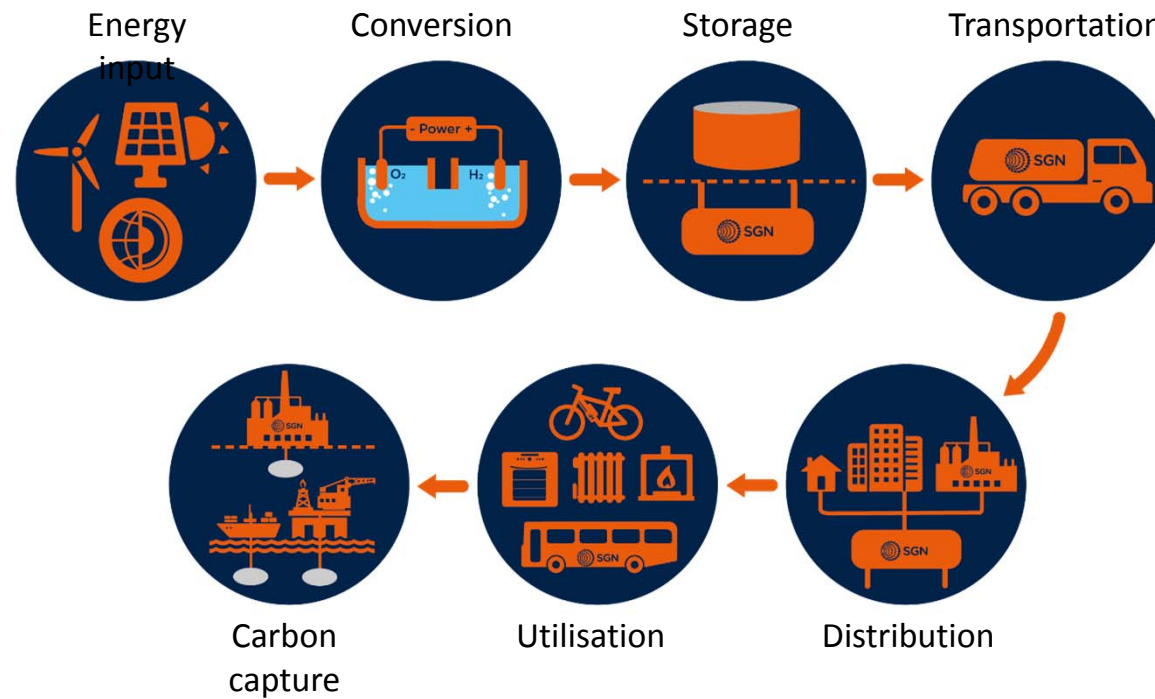


SGN H₂ Project – Safe, secure, reliable Distribution

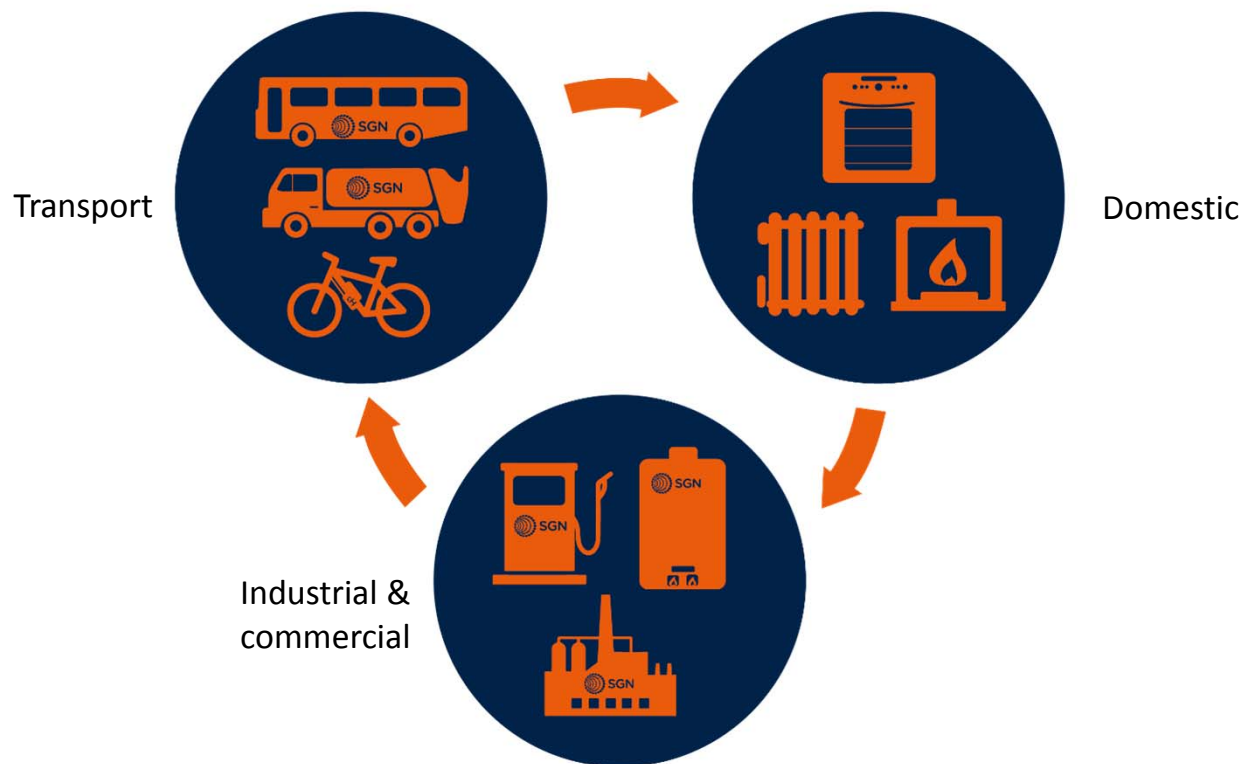


Construction Demonstration
100% H₂

Hydrogen network






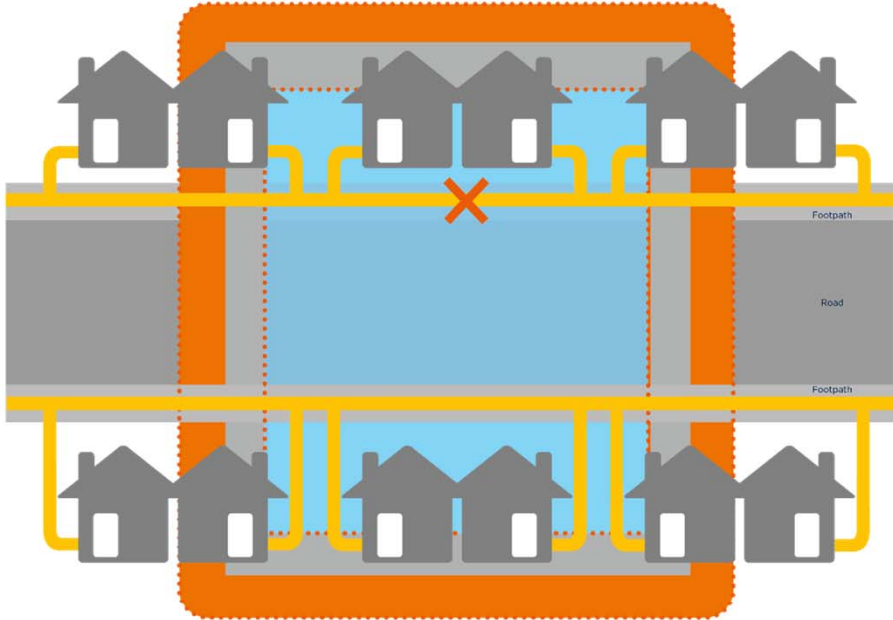
H₂ Applications



Search zone for gas escape



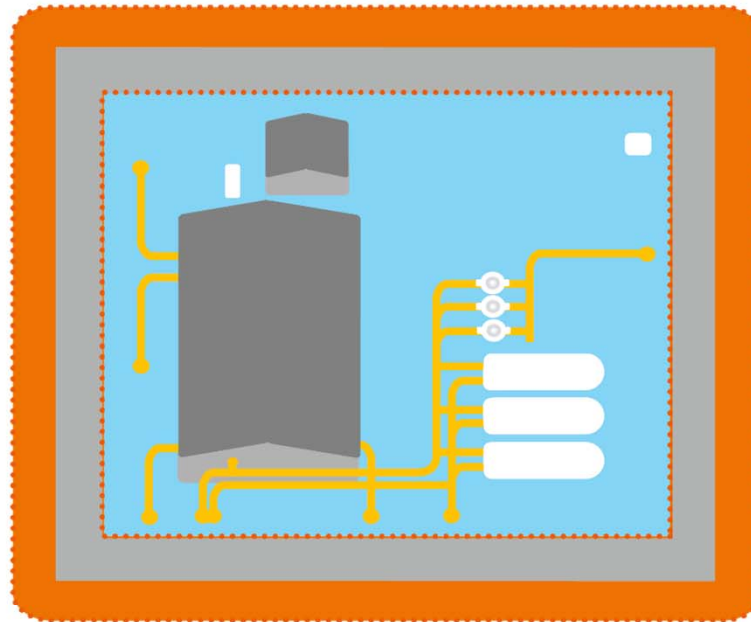
 H₂ search zone?  Natural gas search zone  Gas escape location



PRS station and governor Hazardous Area'



 H₂ hazardous zone?  Natural gas hazardous zone



Detonation
Deflagration

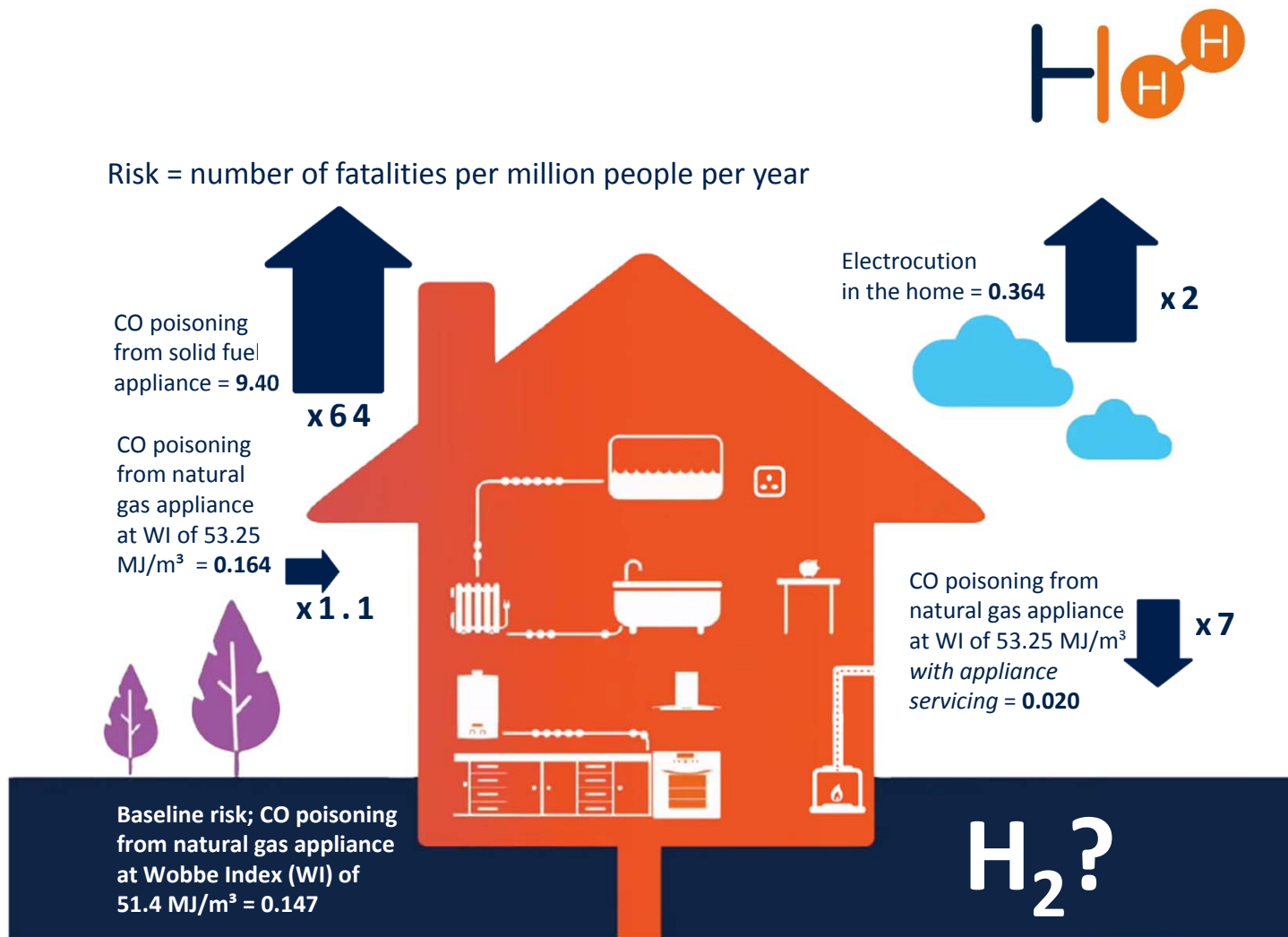


Detonation Vs Deflagration



Relative risks to the home

Risk = number of fatalities per million people per year

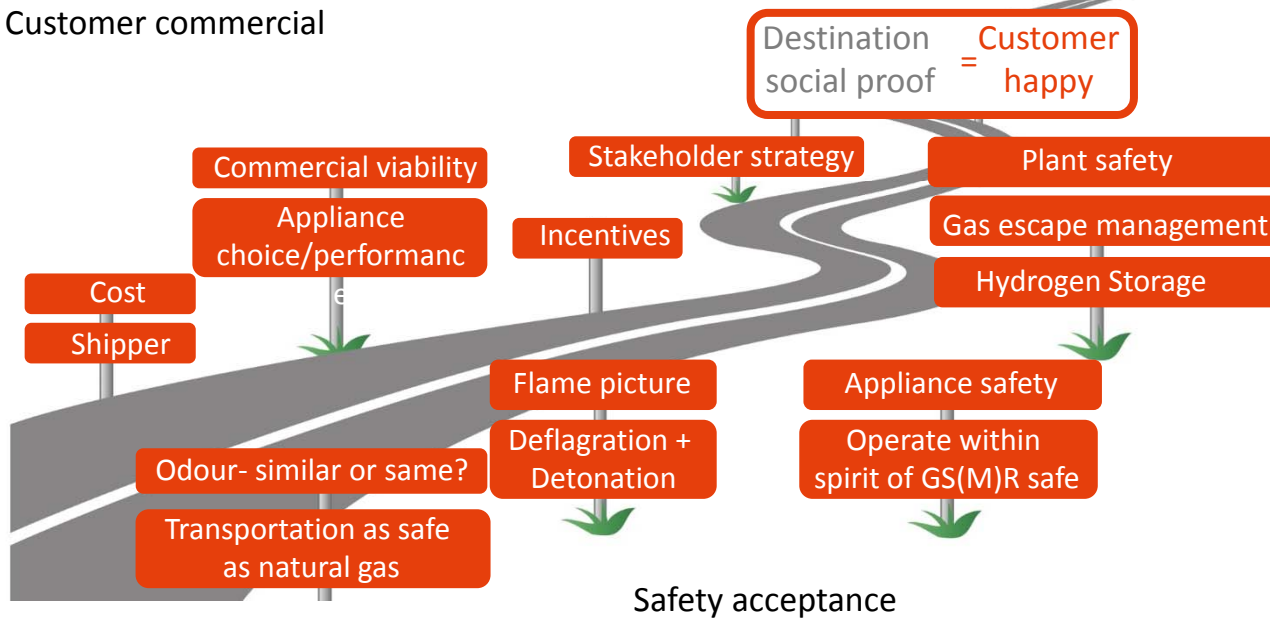


H₂ Road to social proof



H₂ conversion

Customer commercial



H100 Feasibility study (Work program)



Compliance
framework

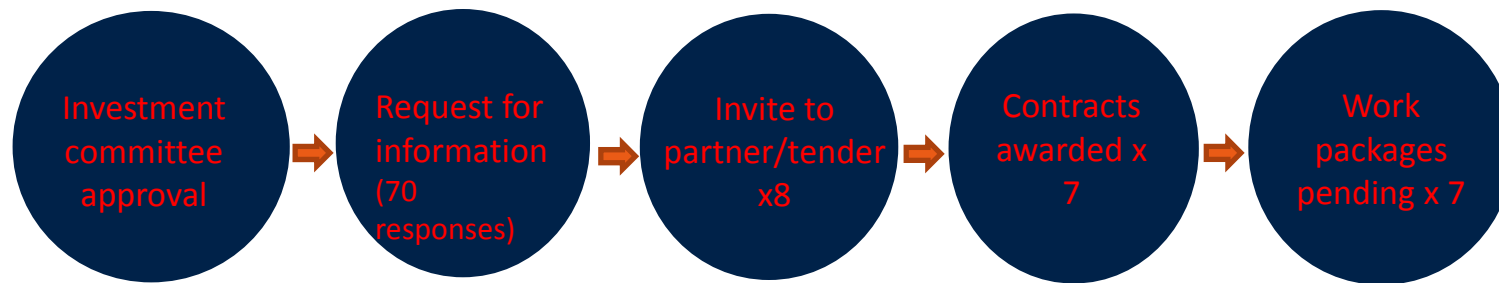
Technical & Commercial
viability

1. Technical assurance and program overview
2. Stakeholder and customer strategy
3. Safety case & Operational procedures
4. PE materials and jointing techniques
5. Characteristics of hydrogen
6. Consequence testing (NDT & DT)
7. Hydrogen logistics (Production & Supply)
8. Hydrogen metering
9. Gas quality
10. Appliance testing

- A. **Site agreements**
Feasibility and FEED @ Levenmouth, Campbeltown & Aberdeen
- B. **Site feasibility study's**
Technical and Commercial Viability, recommendations and options for each site
- C. **FEED**
Technical requirements, Cost of execution, Risk.

H100 final report
(Options and
recommendations)

Hydrogen 100 project – progress to date



Thanks

Mark.wheeldon@sgn.co.uk



SGN


Your gas. Our network.



**Ken Ross OBE, CEO, Ross Developments
& Renewables**

&

**Mike Collins, Senior Geologist, Arup &
Geon Energy Ltd**



Scottish Renewables Low Carbon Cities Conference 20 February 2018

Ken Ross, CEO

Ross Developments & Renewables Ltd

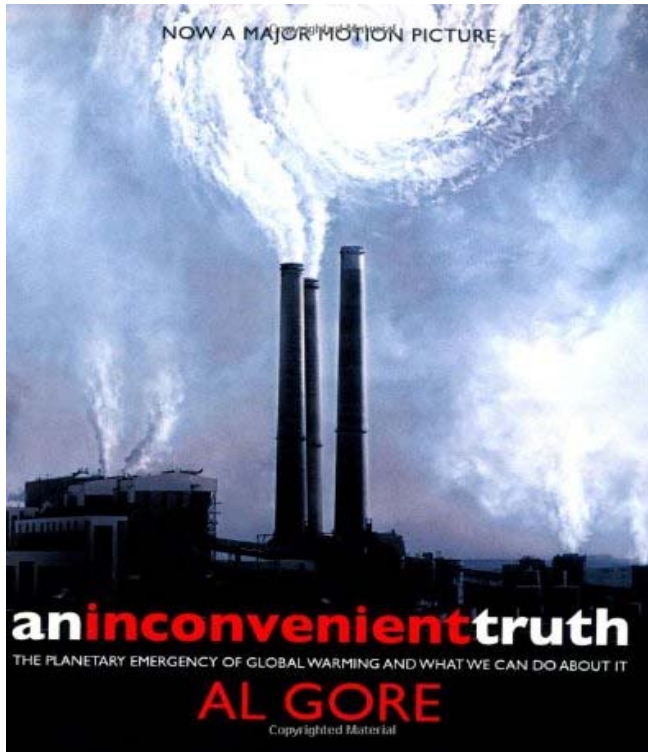
ROSS

DEVELOPMENTS &
RENEWABLES LTD



ARUP

**Scottish Renewables Low Carbon Cities Conference
20 February 2018**



An Inconvenient
Truth:
The Planetary
Emergency of
Global Warming
and What We Can
Do About it by
Al Gore







DEVELOPMENTS &
RENEWABLES LTD

VALUES

COMMERCIAL

Integrity

Professionalism

Innovation

CULTURAL

Fun

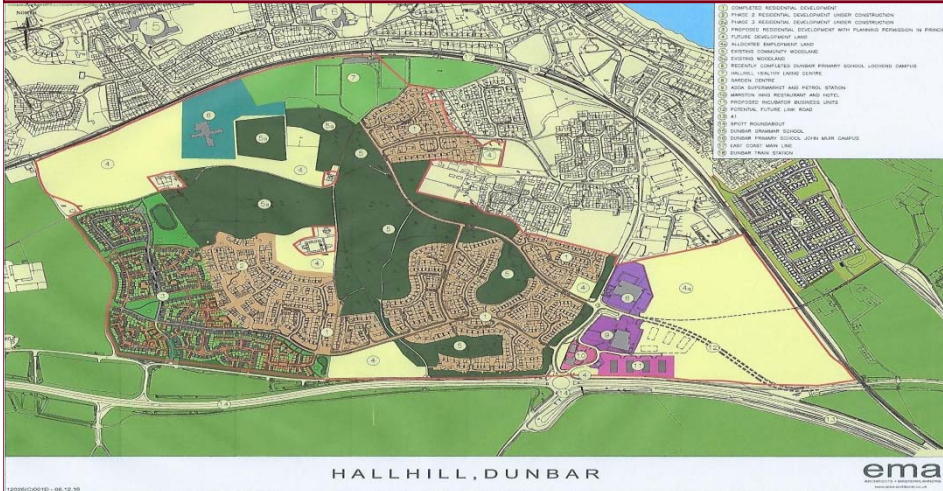
Family

Trust

Resilience

From your values flow your behaviours and activities

MASTERPLAN FOR HALLHILL AREA OF DUNBAR



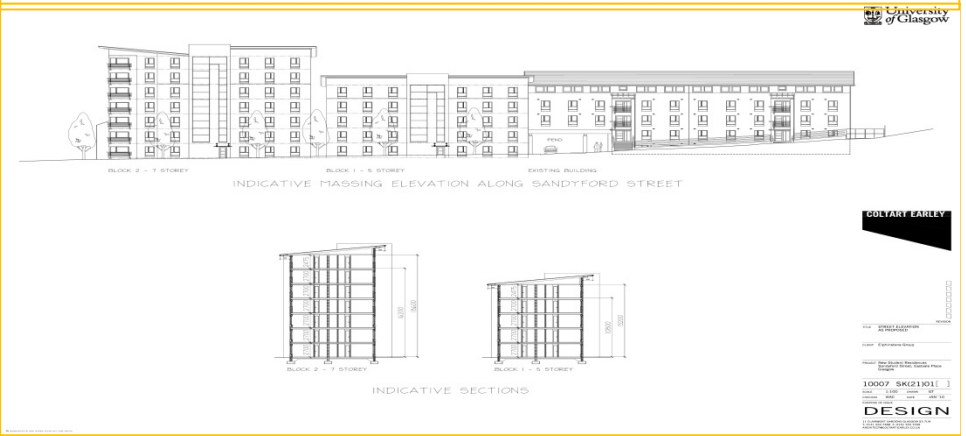
STEWARTFIELD



GREENLAW MASTERPLAN



SANDYFORD STREET, STUDENT ACCOMMODATION





HALO ENTERPRISE & INNOVATION HUB
1



HALO #ROCKCRIBS LIVE / WORK STUDIOS
2



HALO #ROCKWAVE URBAN WAVE SURF
3



HALO CHILDRENS INNOVATION & NURSERY HUB
4



HALO URBAN PARK / PUBLIC REALM
5



HALO RESIDENTIAL
6



HALO DIGITAL MANUFACTURING
7



HALO RENEWABLE ENERGY CENTRE
8



AERIAL DIAGRAM

HALO™



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RENEWABLES LTD



**Department for
Business, Energy
& Industrial Strategy**





Innovating a Low Carbon Geothermal Future in the UK

Mike Collins – Geothermal Project Manager

*BSc(Hons), MSc, CGeol, EurGeol, FGS, CSci, CEnv, MIEEnvSc, PIEMA
UK Registered Ground Engineering Professional*

Scottish Renewables Low Carbon Cities Conference 20th February 2018

www.geonenergy.com

ARUP

GEL Heat and power from the Earth
GEOHERMAL ENGINEERING LTD.

Geon
energy

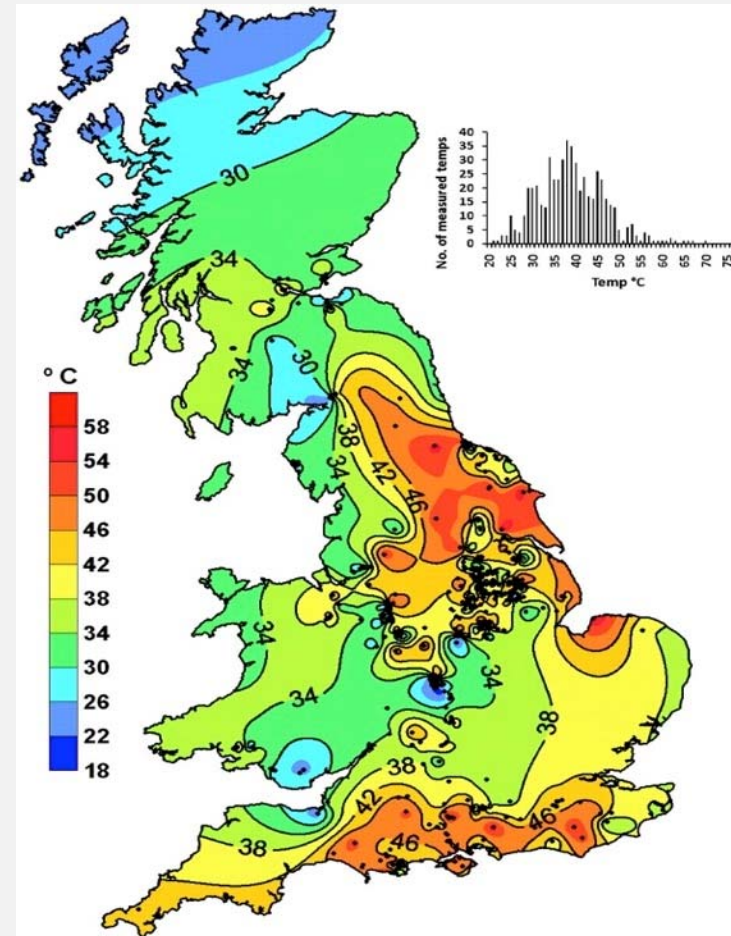
UK Deep Temperature Profile

Ground Temperatures are well understood.

UK thermal gradient average is 2.8°C per 100m increase in depth (BGS).

Large areas of Scotland have a suitable thermal gradient ($50 - 70^{\circ}\text{C}$) at 2km.

Permits deep geothermal heat delivery at location of heat demand.





Joint Venture between Arup and Geothermal Engineering Ltd. Geon Energy plans, designs, installs and operates deep geothermal single well (DGSW) systems to supply renewable and sustainable heating

ARUP

- Firm of more than 12,000 engineers, planners and designers across 40 countries.
- Provides experts in energy, geotechnics, geomechanics and built environment

GEL *Heat and power from the Earth*
GEOHERMAL ENGINEERING LTD.

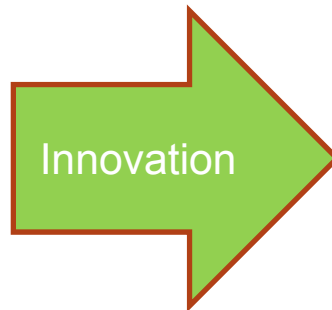
- Award winning start up firm, emerging UK leader and developer of new geothermal heat supply concept.

Need for Geothermal Innovation to Deliver UK resource potential

Reasons

- Suitable Deep Aquifers / Rock Permeability - **RISK**
- High Capital Costs - **RISK**
- Geographical Reach
- Heat Demand
- **Need to start simple to move forward!**

geon
energy

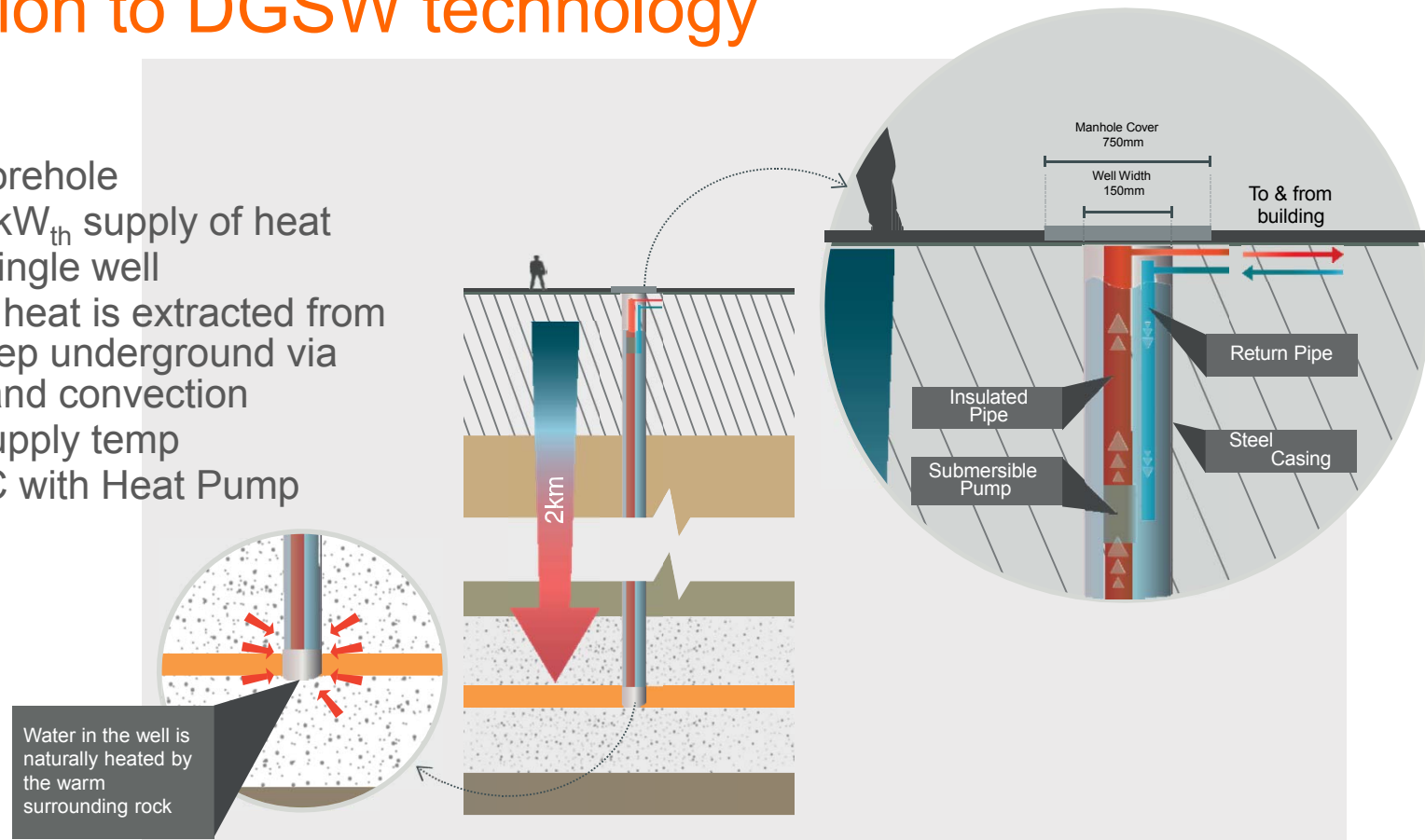


How the DGSW removes these challenges

- Does not rely on high permeability rock / abstraction of large volumes of water
- Can work in almost any geological environment.
- **No** fracking or stimulation,
- **No** injection of fluids or chemicals,
- **No** seismic risks.
- Low cost, replicable and transformational technology that can be taken to heat demand.
- All aspects of the well underground. **No** visual Impact.
- Small Footprint

Introduction to DGSW technology

- 2km deep borehole
- Approx. 400kW_{th} supply of heat
- Innovative Single well
- Low Carbon heat is extracted from hot rocks deep underground via conduction and convection
- Circa 60C supply temp
- Boost to 80C with Heat Pump



Rosemanowes Test Well 2014

DGSW testing in existing 2.3km deep well.

Drew Geothermal Water at **69 °C**

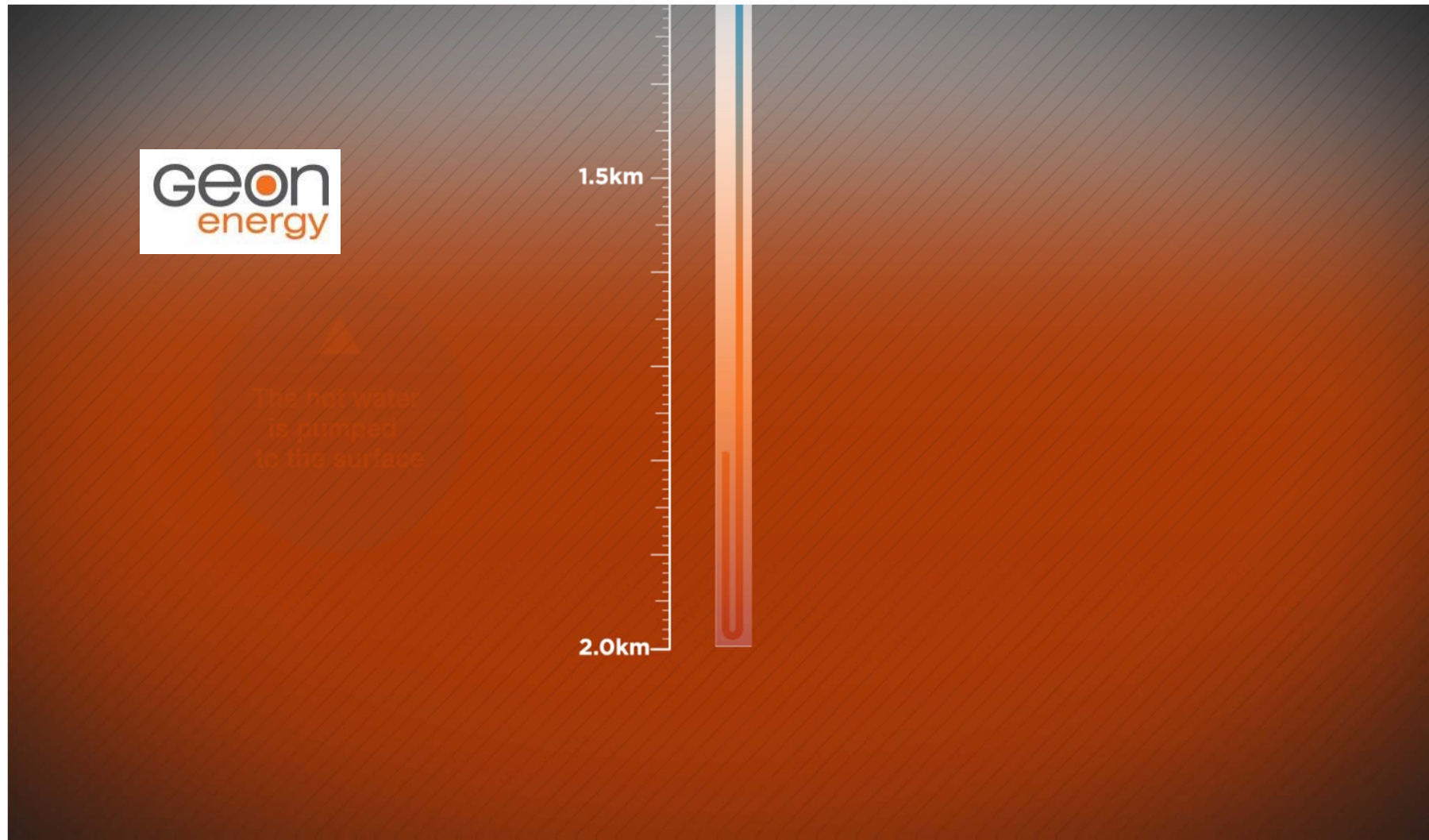
7kW input required to deliver a peak load of 363kW

COP of **52** (compared to 4 for GSHP!)

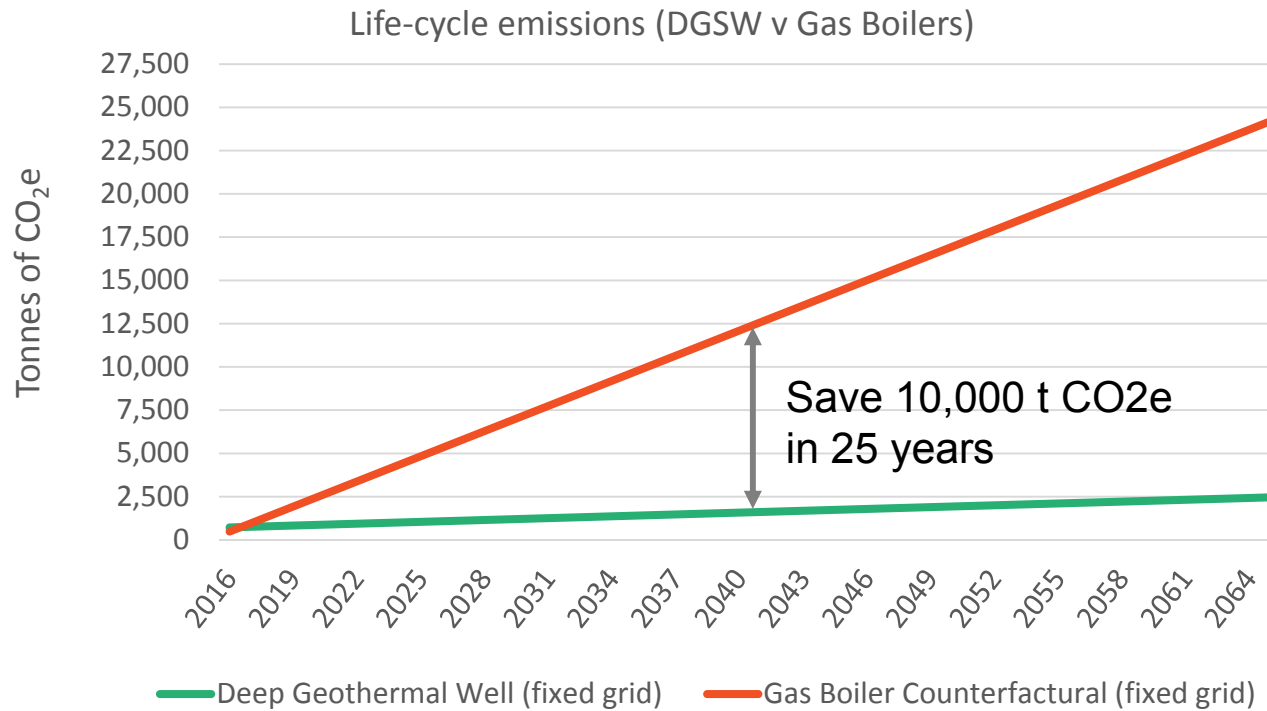
UK Renewable and Engineering Innovation Award Recognition 2015 & 2017



Deep Geothermal Single Well



Why Geothermal? A CO₂ Comparison



- **12 times more carbon efficient** than gas boilers.
- **COP 20-50**
- Construction **carbon emissions offset in less than one year.**
- **Save tonnes of carbon emissions in design life.**

'Active' Geothermal Energy Projects in the UK



Glasgow ESIOS
Geothermal
Minewater Research
Site



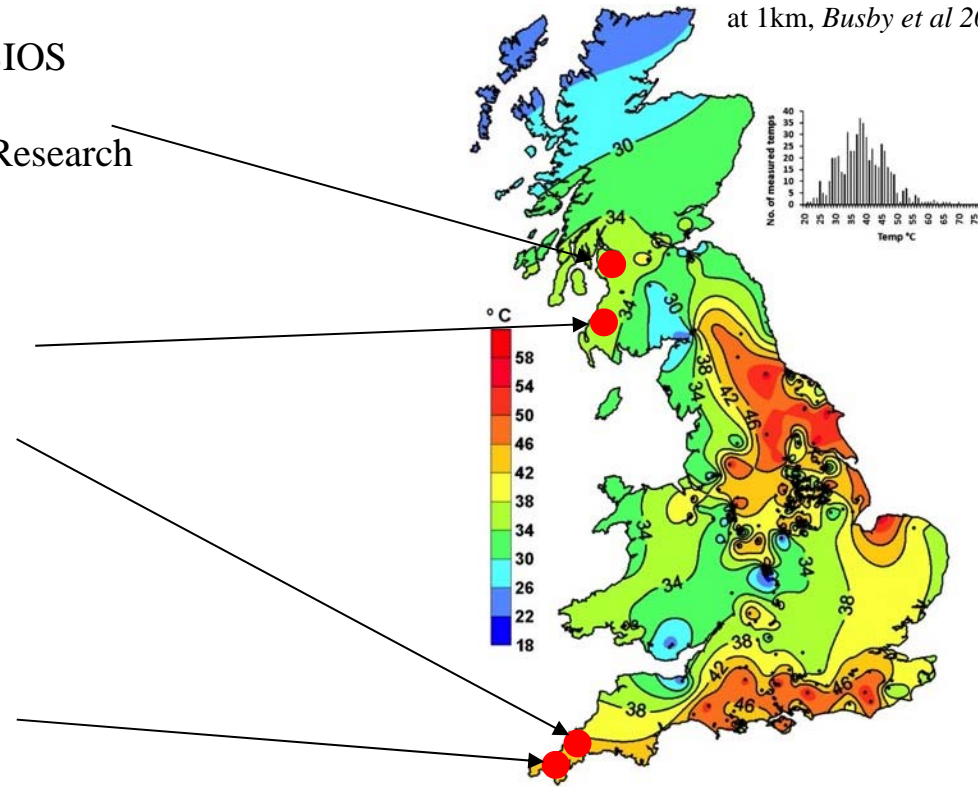
Kilmarnock Halo,
DHN

Jubilee Pool,
Cornwall



Cornwall Deep
Geothermal
Electricity
Demonstrator

Measured Temperatures
at 1km, *Busby et al 2011*



Jubilee Pool, Penzance, Cornwall – Geothermal Heat Supply



- REA Project Award 2016
- 1.4km DGSW
- Deliver 35C to Outdoor Lido.
- DGSW drilling commenced January 2018



THE IHALO
KILMARNOCK LTD



Geon Energy

Scotland's **First** Deep Geothermal DHN (The Halo, Kilmarnock)

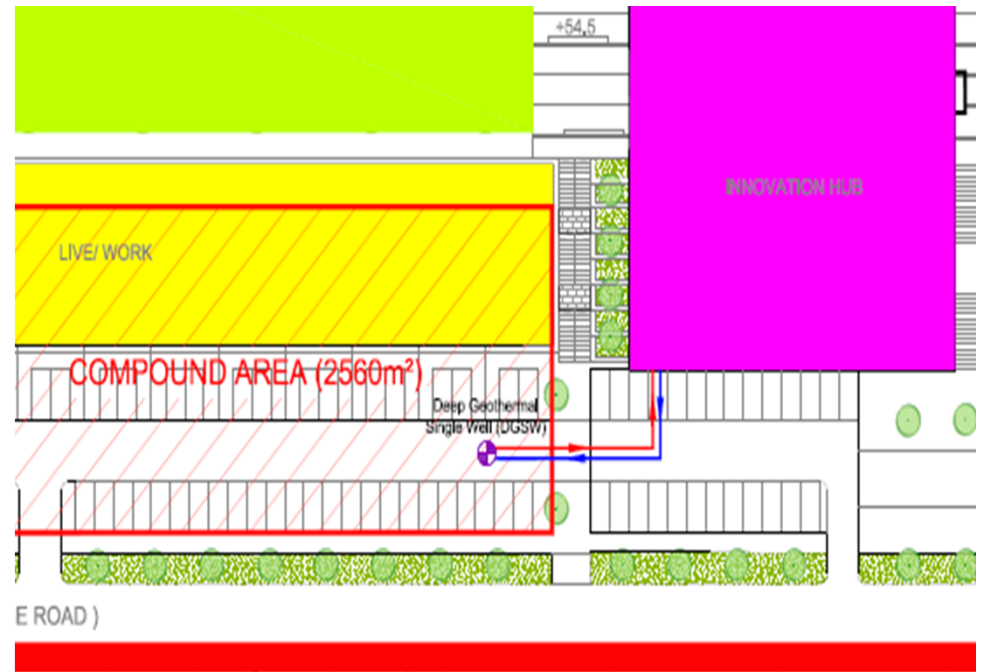
DGSW to be drilled to 2km to deliver decarbonised heat to the developments Innovation Centre.

Low Carbon heat transferred across heat exchanger to be distributed via district heat network (DHN) to Phase 1 of the development.

Project funded £1.8m by



and being developed by:



Timescales for Halo Deep Geothermal project

Planning and Consenting September 2017 – February 2018

Commencement of Drilling in April / May 2018

Well Testing and Commissioning June to August 2018.

Well Operational Dec 2018 (Condition of LCITP Funding)



United Downs Deep Geothermal Electricity Demonstrator

Highly Innovative Well Design

1-2 MW Electricity Demonstrator

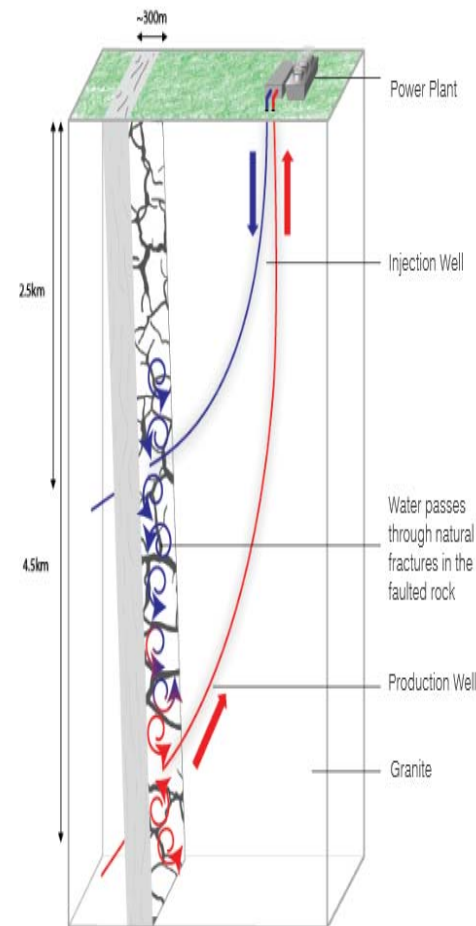
Drilling of 2.5km and 4.5km to commence in May 2018.

Low Carbon geothermal electricity

Project Overview

Unlike the previous Hot Dry Rock research project carried out in Cornwall in the 1980s, UDDGP plans to target a permeable geological structure called the Porthowan Fault Zone, which lies about 800m to the west of the United Downs site. Two deep holes (wells) will be drilled into it, one for injection at about 2,500m depth and one for production at 4,500m. The temperature at the bottom of the production well is expected to be about 190 °C.

Water will be pumped from the production well, fed through a heat exchanger and then re-injected into the ground to pick up more heat from the rocks in a continuous cycle. The extracted heat will be used to supply a demonstration power plant.





Ben Miller

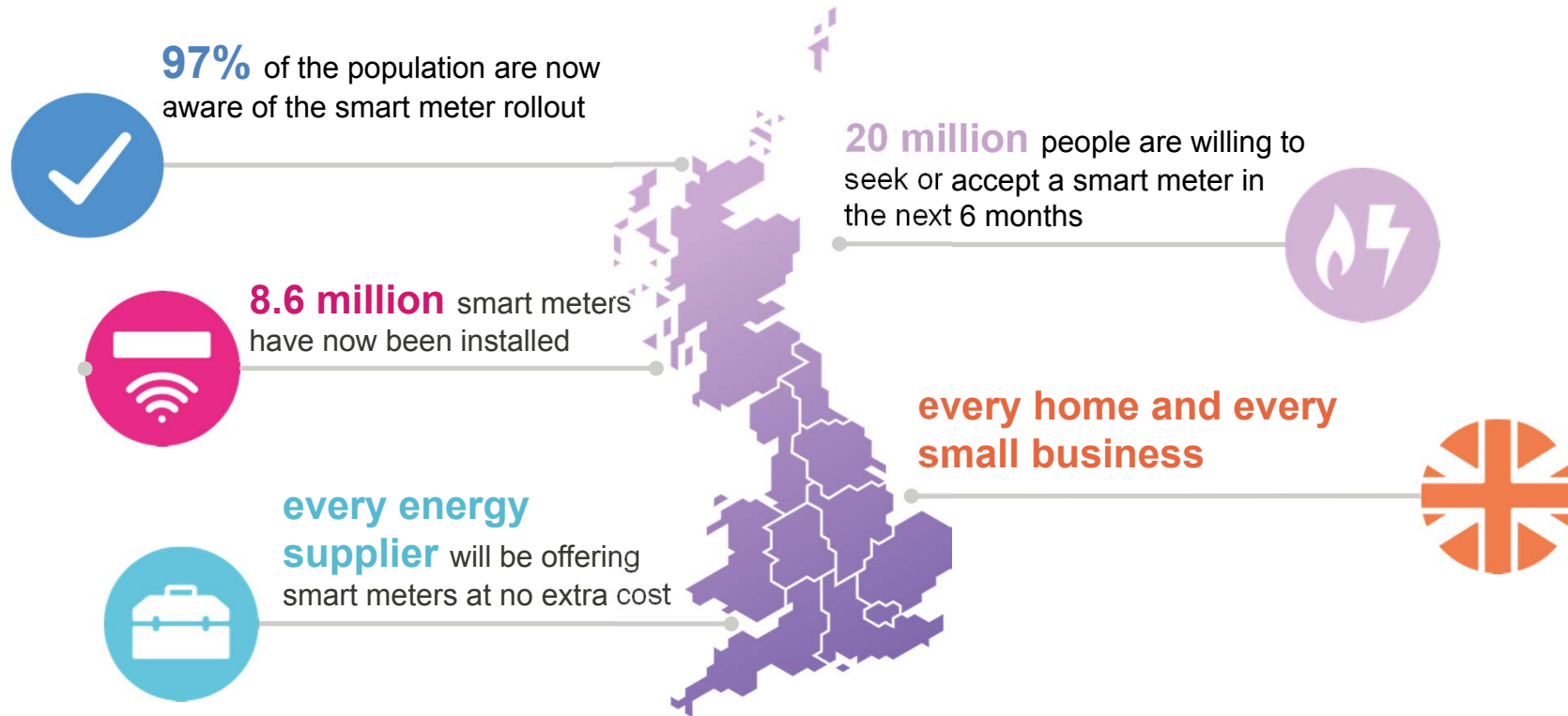
Policy and Communications Manager
Scotland, Smart Energy GB



Urban cities: creating the cities of tomorrow

20 February 2018

Britain's digital energy revolution is underway



Dyson plans 2020 launch for electric car

British tech group to enter motor industry at time of intense change



Renault enters UK energy storage market with Powervault and M&S trials

Vattenfall enters UK home energy market with iSupplyEnergy acquisition

Shell to supply energy to UK households after takeover of First Utility

Move by Anglo-Dutch oil firm expected to shake up market whose competitiveness has been under intense political scrutiny

France's Engie aims to restore trust in energy firms with tracker tariff



全城過雷 Love
Power your Love



IN 2016,

300,000

CUSTOMER REGISTERED
CLP DONATED

HK\$ 6,000,000

HELPED

20,000

HOUSEHOLDS IN NEED EVERY YEAR

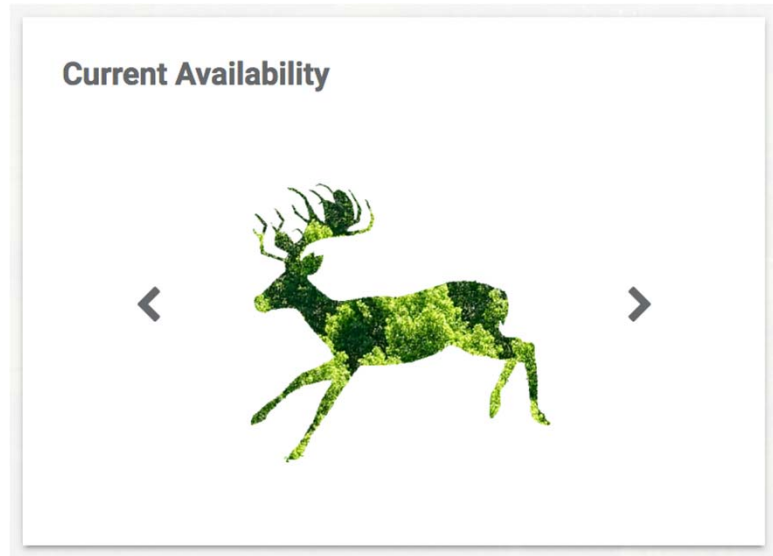


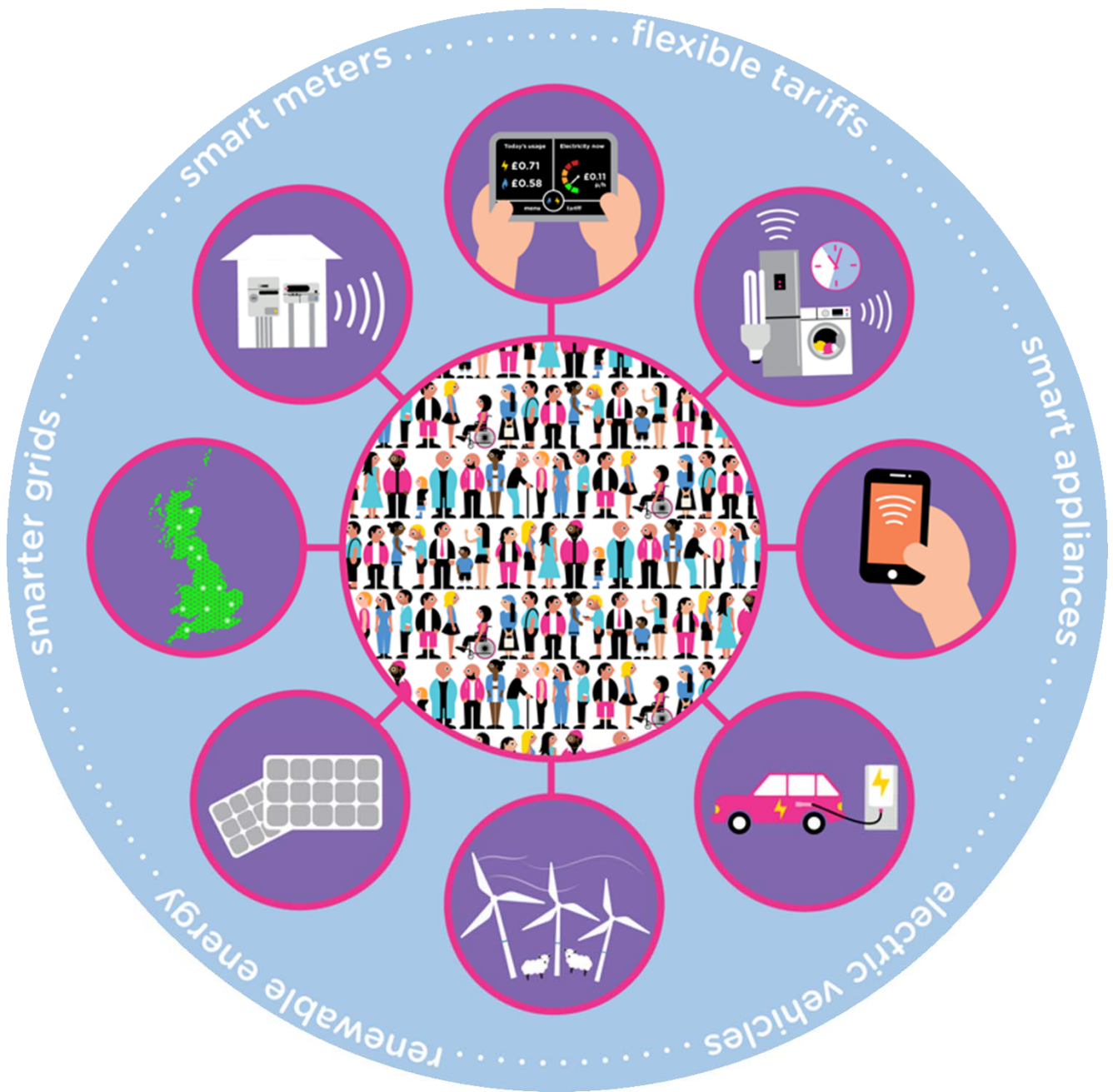
bankymoon





GET SWITCHED ON





Could energy data transform healthcare?

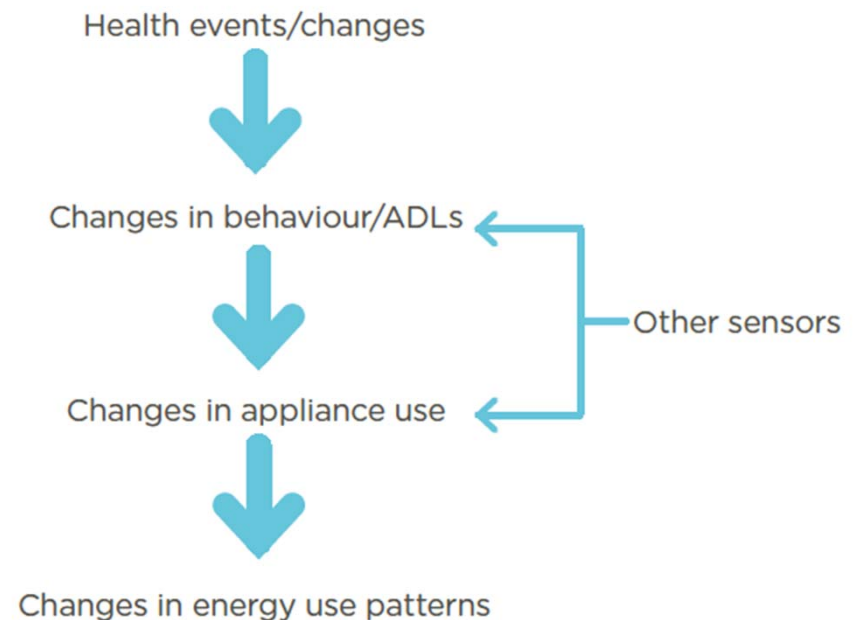
A smart future for everybody

The smart meter rollout will create a broad platform for innovation thanks to the detailed data generated by households.

More care is taking place in the home rather than in institutions.

Smart meter functions such as real-time information and a modern payment system will already help vulnerable households.

Using the data stream to analyse behaviour could lead to much wider benefits.



Micro and macro

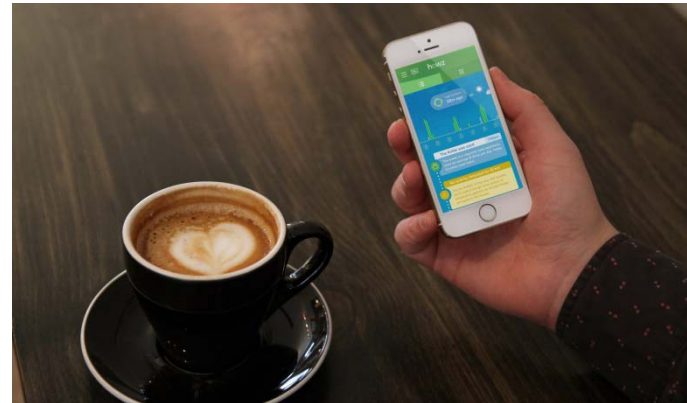
Potential uses of smart energy data

Ongoing monitoring of conditions

Alerting relatives or care professionals

Aiding diagnosis

Aggregate data analytics



What can smart meters offer?

Smart meter advantages as a platform include:



Near ubiquity



Historical data



Low cost



Versatile





The voice of the
smart meter rollout

Thank you






Hannah Smith, Senior Policy Manager,
Scottish Renewables

Mark Wheeldon, Innovation Project Manager -
Hydrogen 100, SGN

Ken Ross OBE, CEO, Ross Developments &
Renewables

Mike Collins, Senior Geologist, Arup & Geon
Energy Ltd

Ben Miller, Policy and Communications
Manager Scotland, Smart Energy GB



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