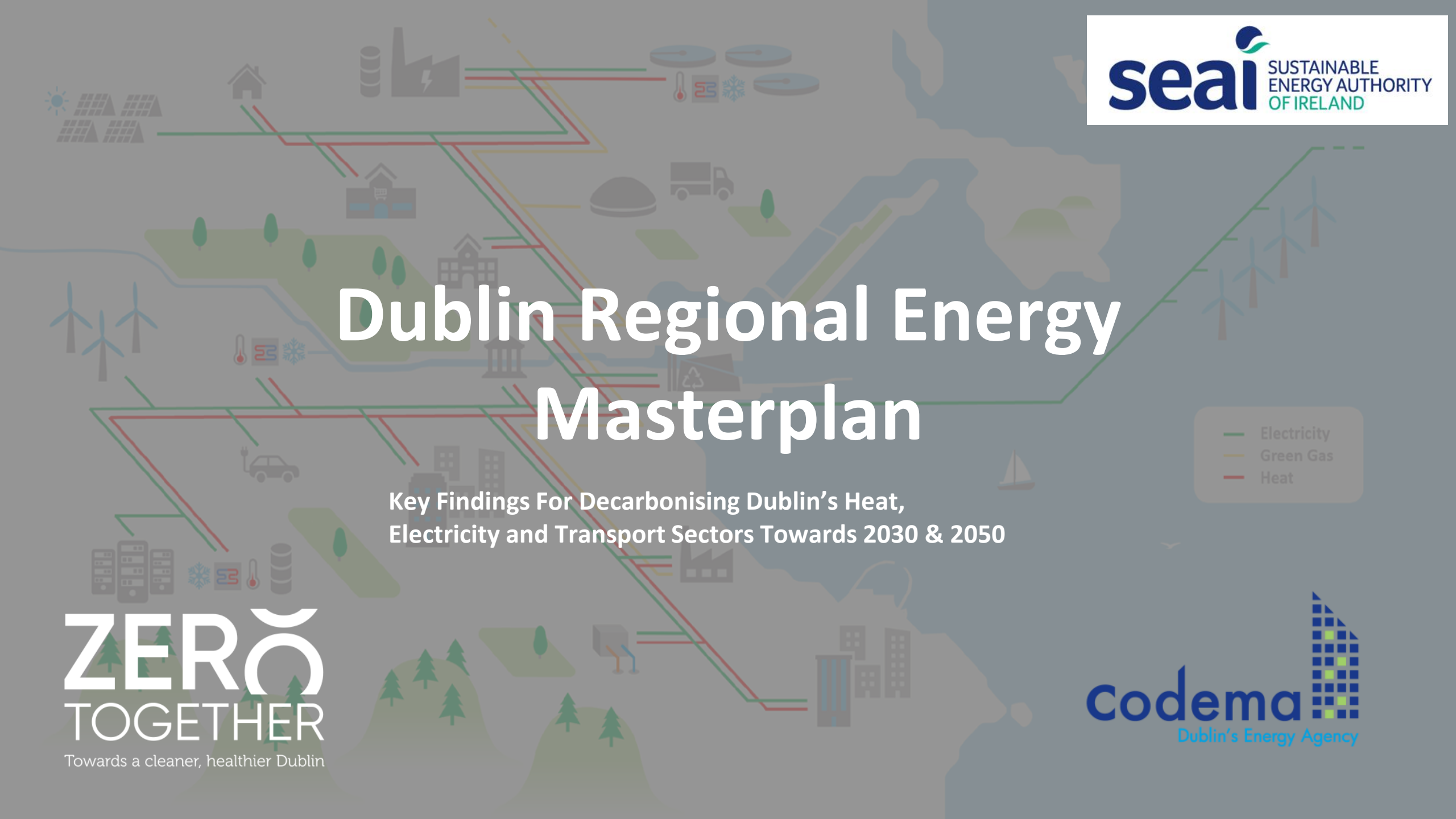
Dublin Regional Energy Masterplan

Key Findings For Decarbonising Dublin's Heat, Electricity and Transport Sectors Towards 2030 & 2050



seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

ZERO TOGETHER
Towards a cleaner, healthier Dublin

Codema
Dublin's Energy Agency

Dublin Regional Energy Masterplan Team

- **Eoin Ahern -** Energy Manager / Transport & Renewable Lead
- **John O'Shea -** Energy Systems Analyst / Heat & Electricity Lead
- **Rebecca Cachia -** Energy Engineer / Emissions & Energy Efficiency Lead

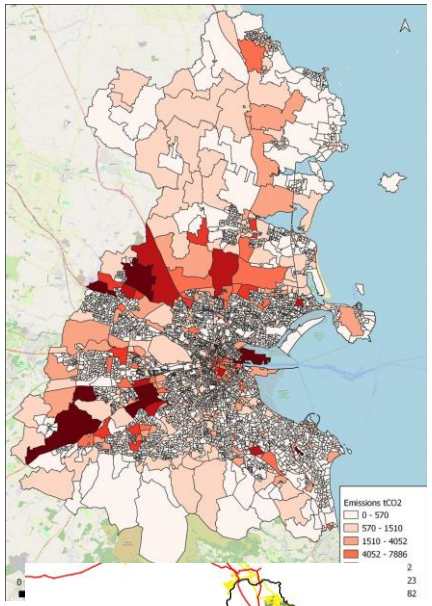
Comhairle Contae Átha Cliath Theas South Dublin County Council

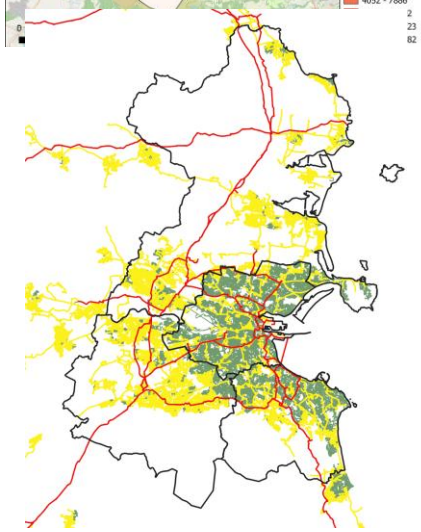
Comhairle Contae Fhine Gall Fingal County Council

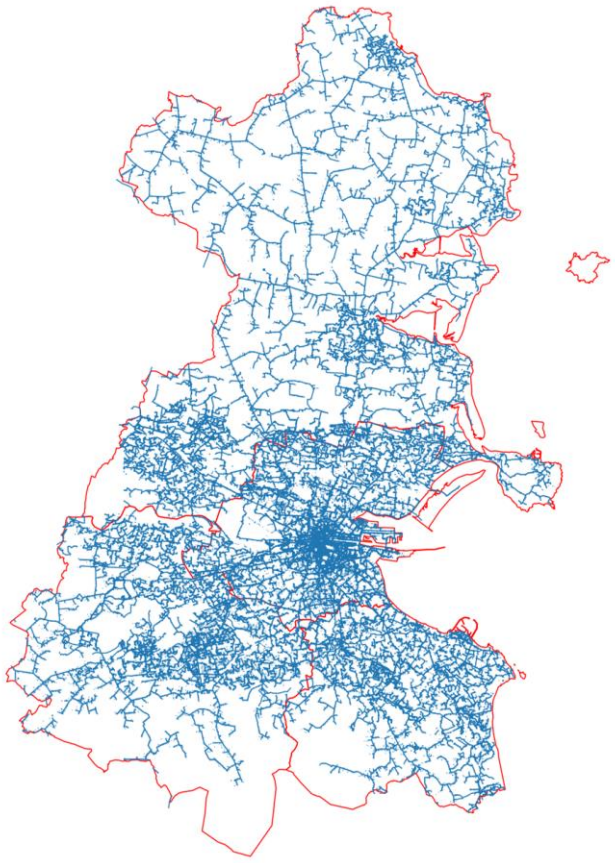
dlr Comhairle Contae County Council

Comhairle Cathrach Bhaile Átha Cliath Dublin City Council

Dublin Regional Energy Masterplan

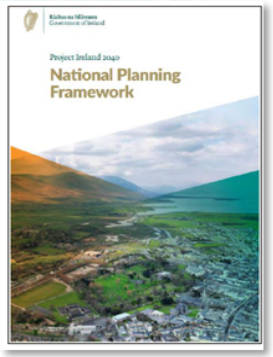




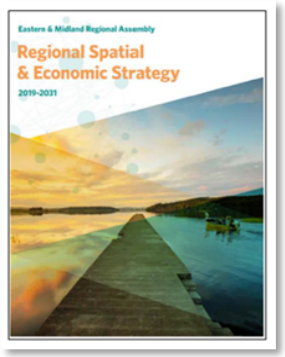


- **First of its kind** in Ireland – building upon best international practice, example for other regions in Ireland to follow
- **Cost-optimal** pathway to 2030 and 2050 targets
- Holistic **integrated energy model** looking **ALL** energy sectors (heat, transport and electricity) and considering **local technical constraints**
- Digital twin of the **local** energy landscape – **evidence base** for informing policy & infrastructure planning
- **Spatially-led** (topographical & spatial constraints included)
- Also considers the wider **social & economic** impacts

Supporting National, Regional & Local Policy & Planning



National – National Planning Framework (assess GHG Impact of CDPs), CAP (Contribution to national targets)

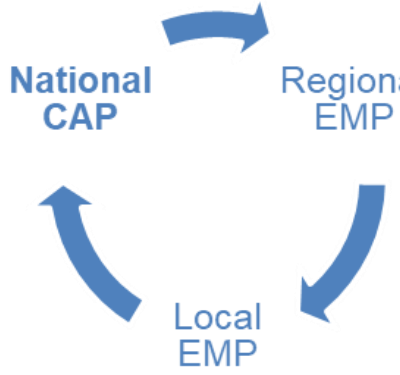


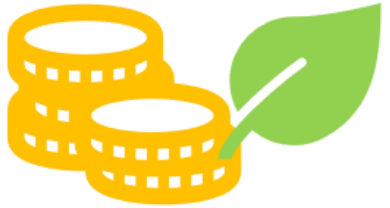
Regional – Eastern & Midlands Regional Assembly RSES (RPO 3.6, 7.35, 7.38, 7.40, 7.42)

Local – Climate Change Action Plans, County Development Plans, Decarbonising Zones, SEC Masterplans

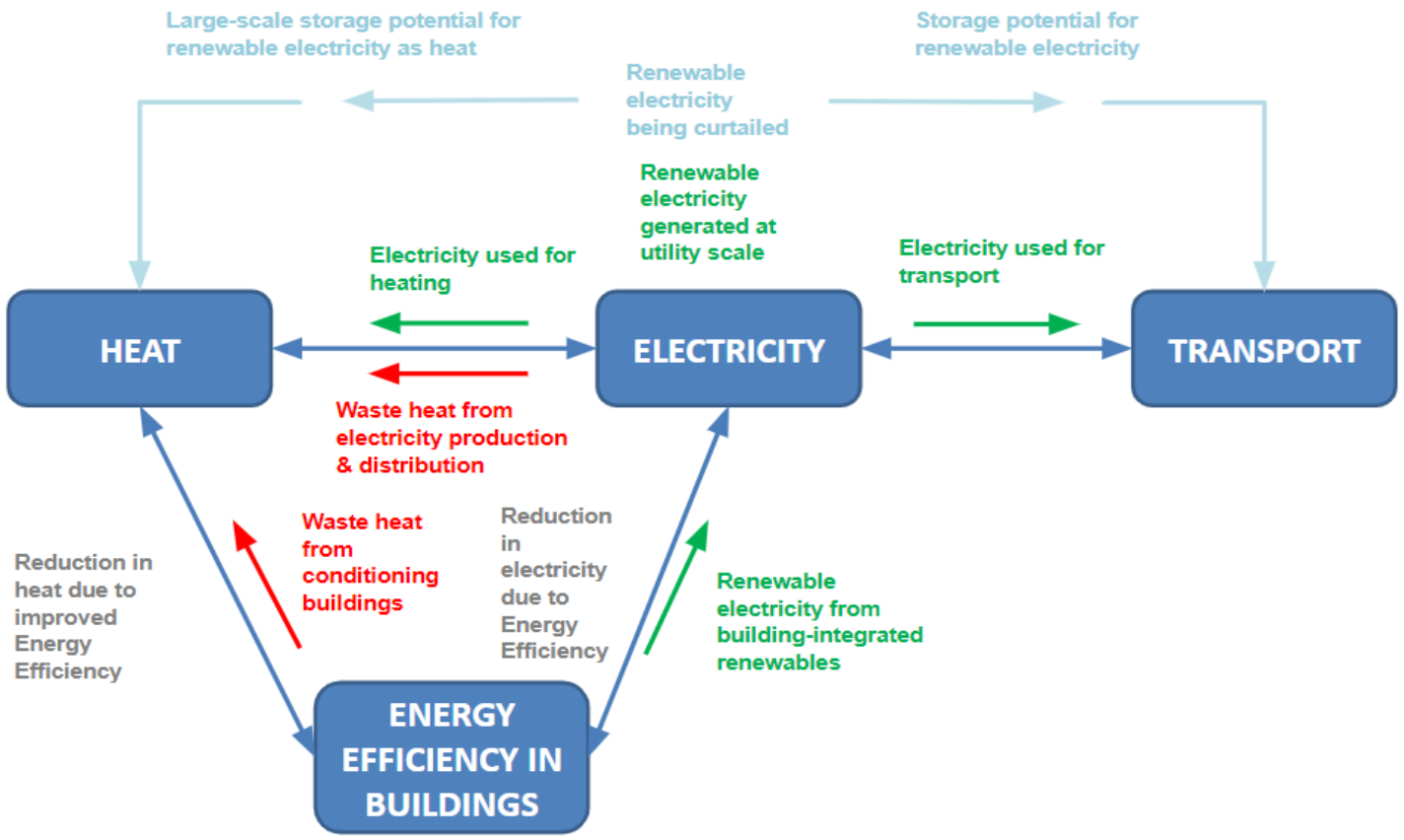
Potential for Supporting Decarbonisation into the Future

- SEC Masterplans – Continue evidence base sharing for local energy masterplan development
- Feedback into Climate Action Plan – Regional constraints & contributions
- Citizen & stakeholder engagement – Online platform to vote for technologies in their area/register interest for aggregating projects, provide own data to refine data sets
- Provide evidence & insights to mobilise green investment





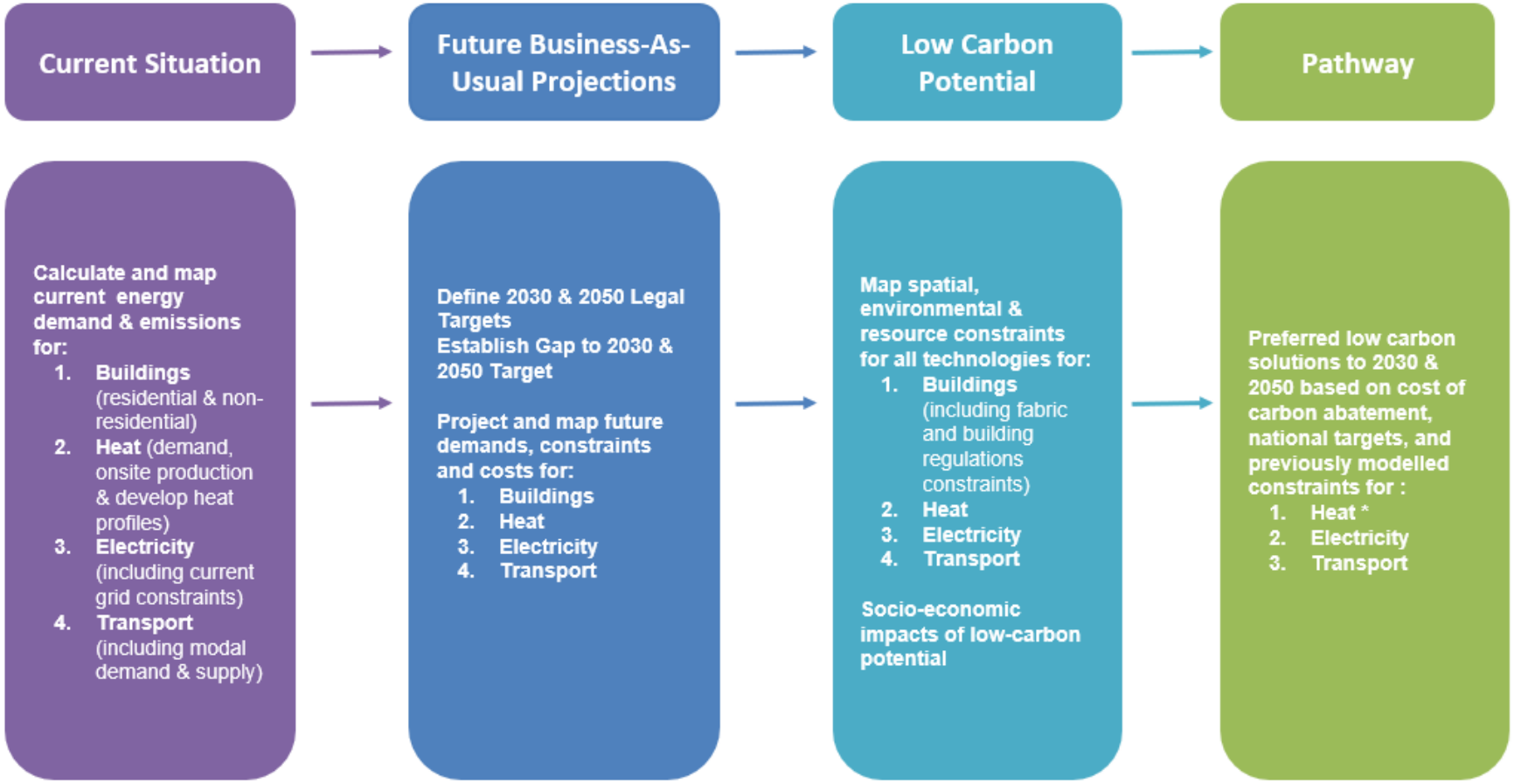
Masterplan Overview



- The main energy sectors identified by this masterplan are the heat, electricity and transport sectors.
- Holistic approach to modelling energy demand is of utmost importance
- The flow and synergies between each energy sector, are captured - energy efficiency in buildings impacts both the heat and electricity sector, whilst transport would impact the electricity sector.

Masterplan Overview

Codema
Dublin's Energy Agency



* Includes building fabric energy efficiency improvements

Big Challenge - Need to work together!

- Prioritised use of **open-source** tools - Python-based with a high degree of replicability
- **Resources and maps available online** which allow for general public to find answers to energy questions in their area and **increase engagement with the area of local energy - available on our Github and Tableau Public**
- Making useful data available (with some pre-processing completed) as a **starting point for further research by wider organisations and Academia** – e.g. working with National Residential Energy Modelling Group agreed a standardised process for cleaning data for wider use
- Output being used to **develop local policy** in the areas of heat, electricity and transport via County Development Plans, Decarbonisation Zone, SEC Masterplans (lasso tool) etc.

GitHub

tableau


UCD
DUBLIN


OLLSCOIL TEICNEOLAÍOCHTA
BHAILE ÁTHA CLIATH
DUBLIN
TECHNOLOGICAL
UNIVERSITY DUBLIN


MTU
Ollscoil Teicneolaíochta na Mumhan
Munster Technological University


ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland


NUI Galway


epa
Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil


MullanGrid
CONSULTING


MaREI
Energy · Climate · Marine


IWEA
Irish Wind Energy Association


IRDEA
Irish
District
Energy
Association


ESRI
ECONOMIC & SOCIAL
RESEARCH INSTITUTE


WESTERN POWER
DISTRIBUTION
Serving the Midlands, South West and Wales


Comhairle Contae
Fhine Gall
Fingal County
Council


seai
SUSTAINABLE
ENERGY AUTHORITY
OF IRELAND


An
Phríomh-Oifig
Staidrimh
Central
Statistics
Office


EIRGRID
GROUP


Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann


Gas
Networks
Ireland


CRU
An Coimisiún
um Rialáil Fóntais
Commission for
Regulation of Utilities


REDAP
energy demand. understood


NTA
Údarás Náisiúnta Iompair
National Transport Authority

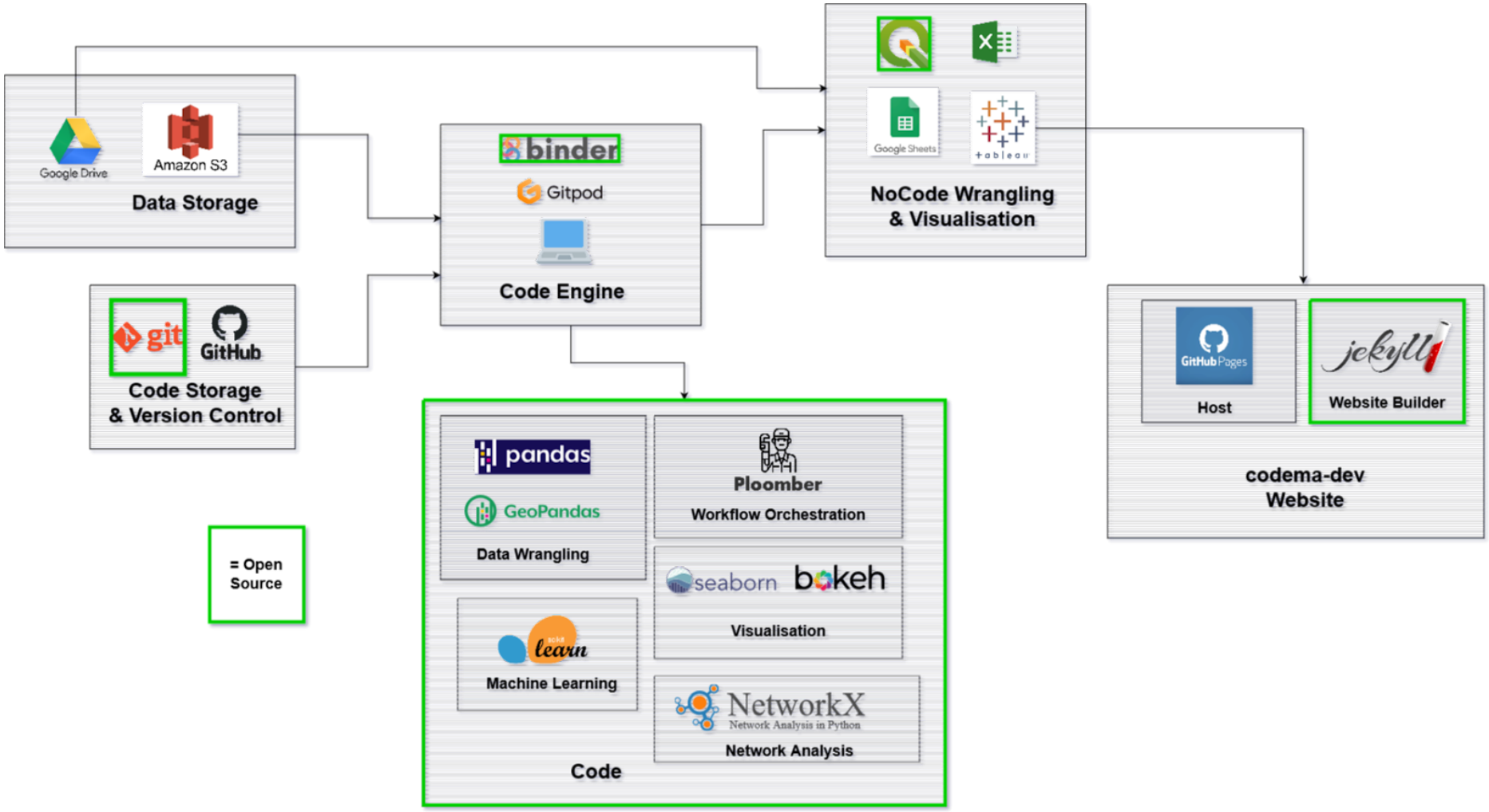

Comhairle Cathrach
Bhaile Átha Cliath
Dublin City Council


Comhairle Contae
Átha Cliath Theas
South Dublin County Council


dlr
Comhairle Contae County Council

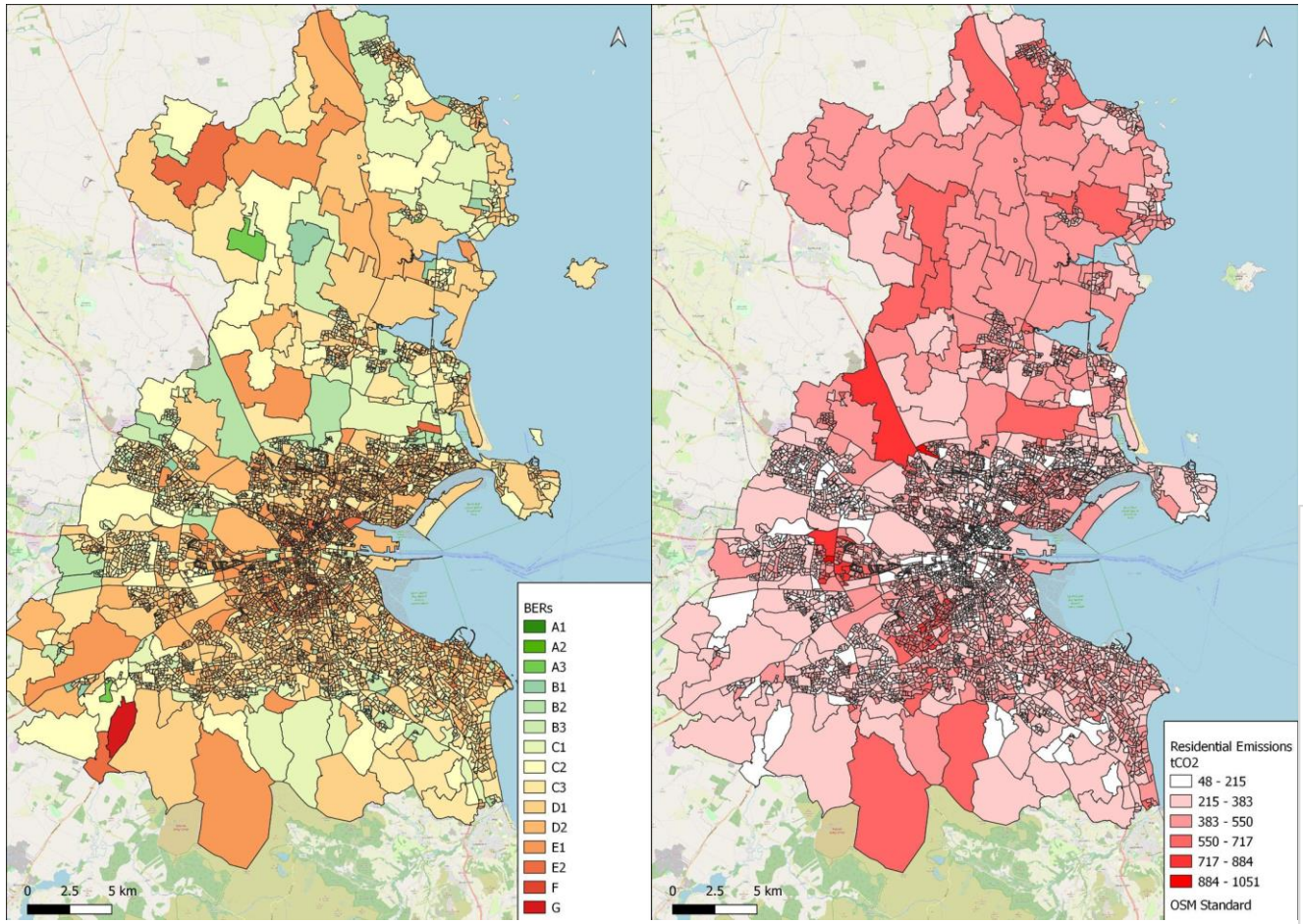

ESB
NETWORKS

Novel Approach

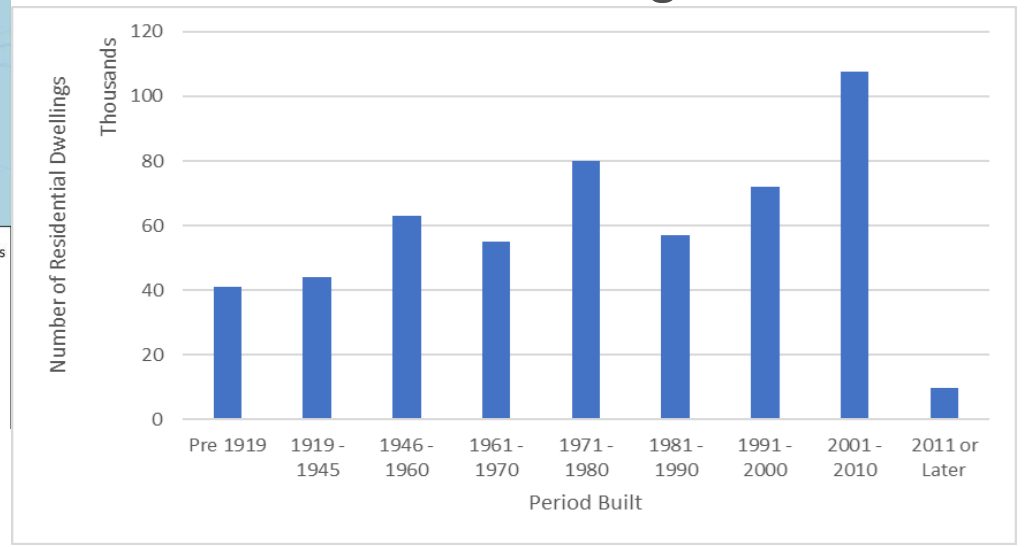


Current Situation

Buildings - Residential

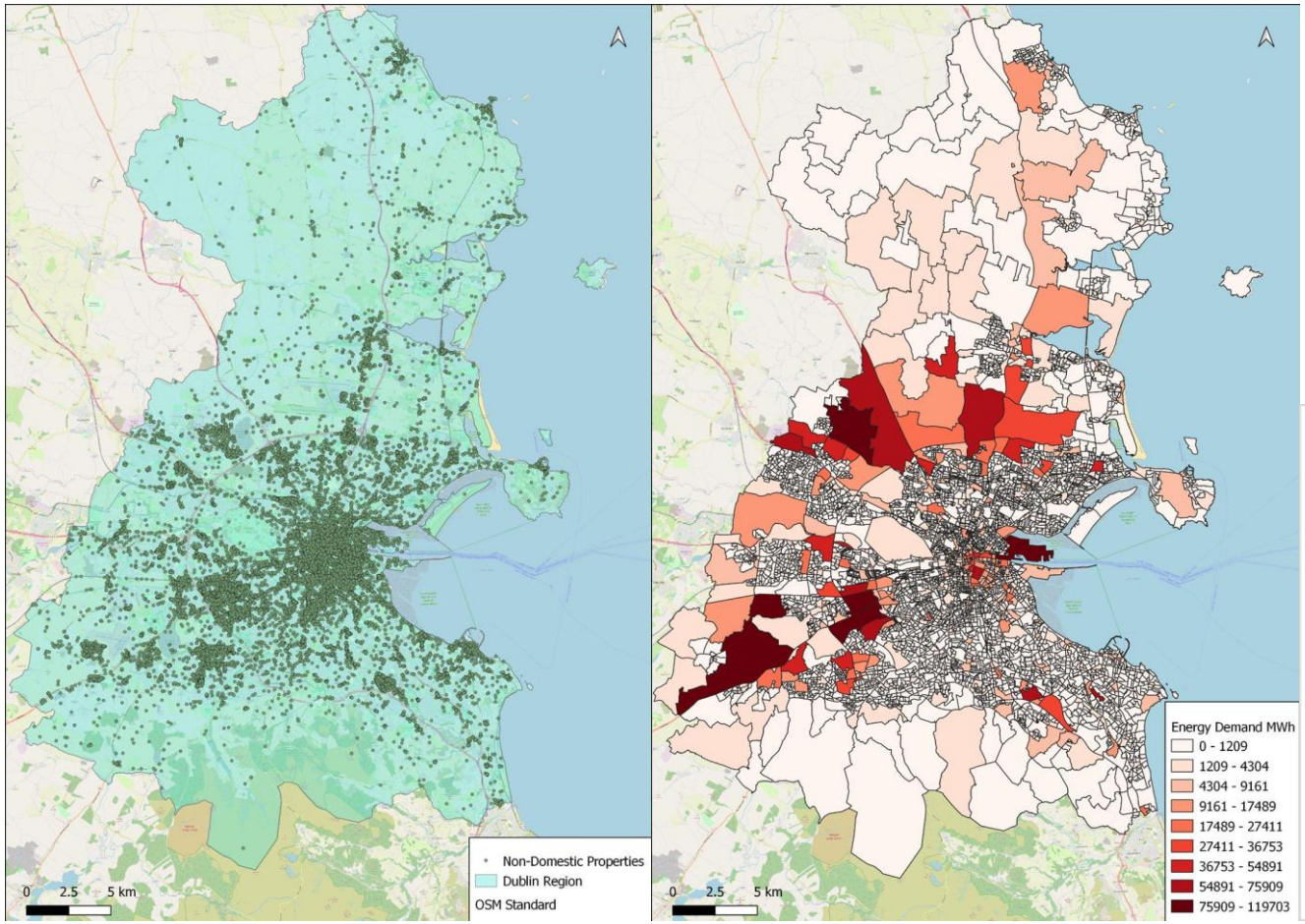


- The housing stock is ageing & poorly rated.
- 78% of residential buildings built before year 2000
- Most common BER is D2 rating (17%)
- Buildings rated D1 or worse make up 58% of the housing stock

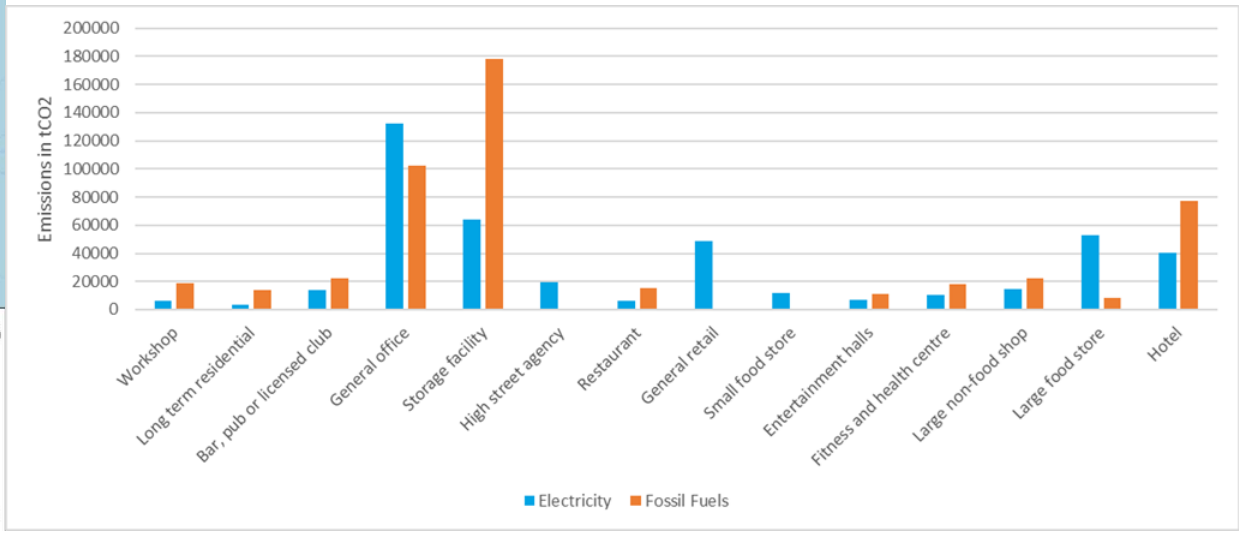


Current Situation

Buildings - Non-Domestic



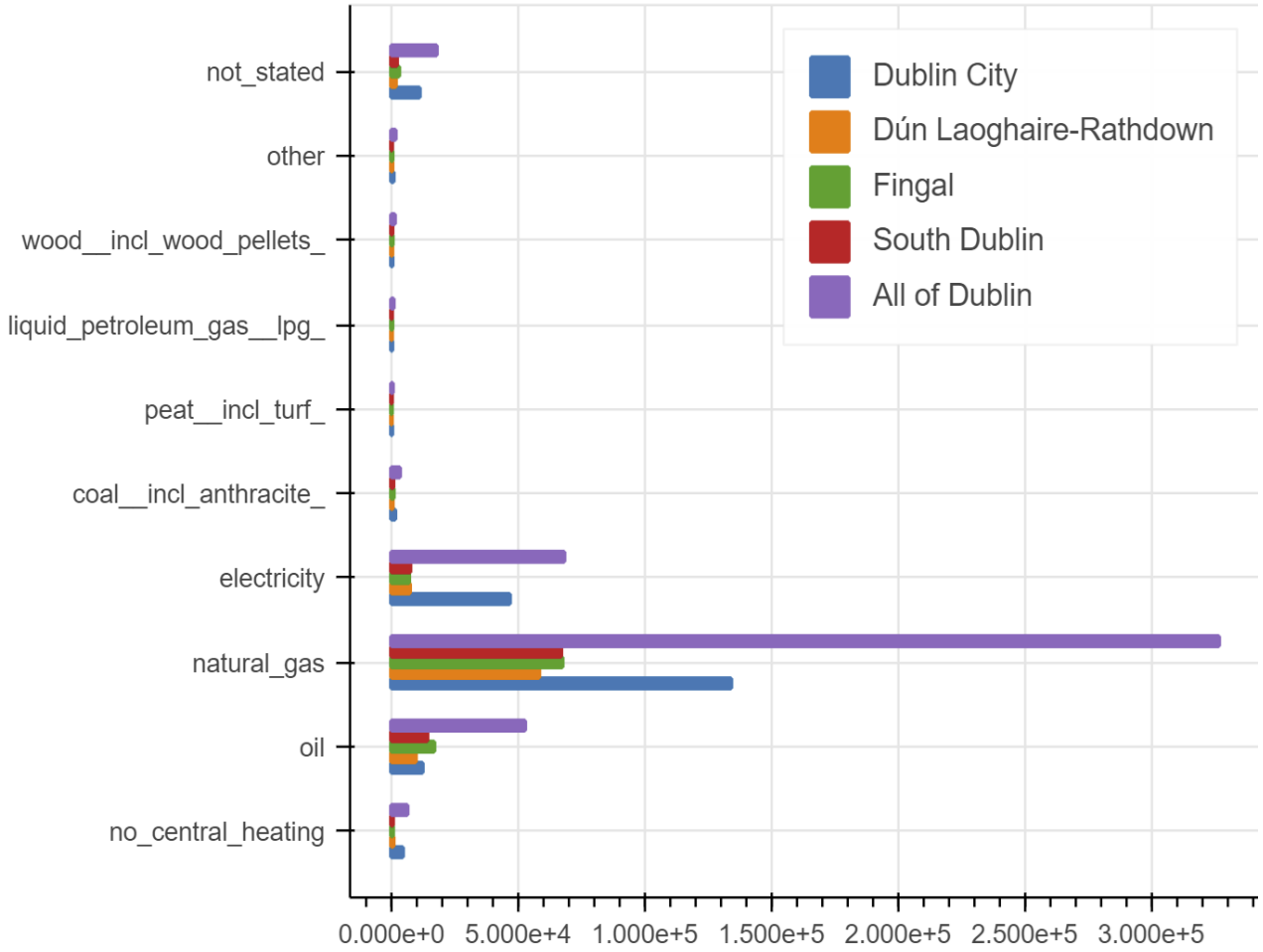
- The total energy demand from non-domestic buildings is 6,300 GWh
- Commercial buildings and services (65%), the public sector (20%) and industrial uses (15%)



Current Situation

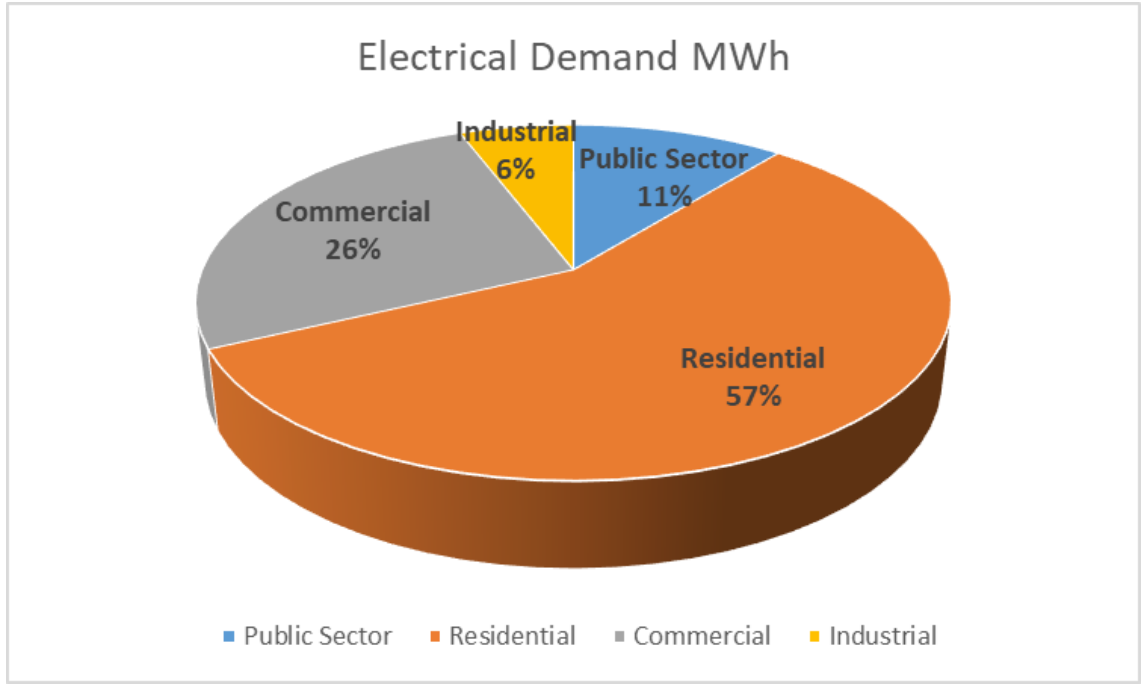
Heat

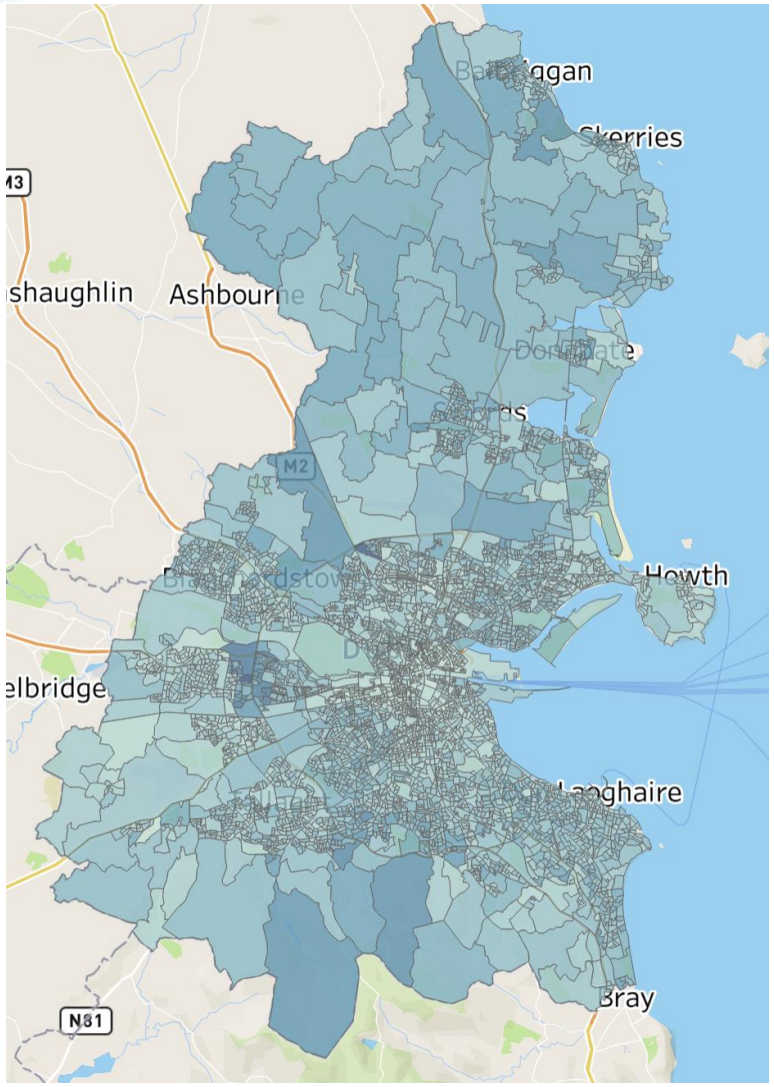
- Total current heat demand in Dublin is 10,328 GWh
- Gas is the predominant heat source - gas boilers currently cover 90% of heat demand in Dublin
- Predominantly individual heating systems in each building

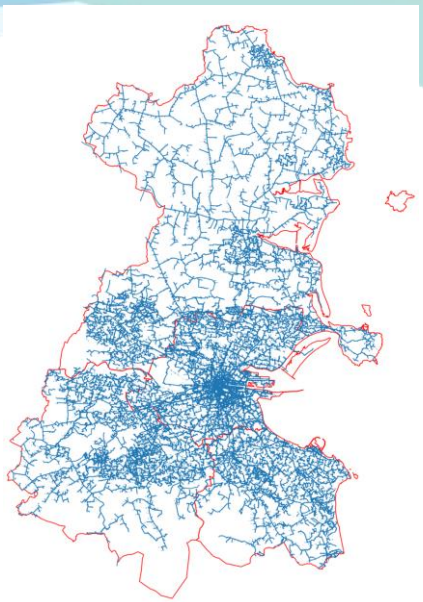


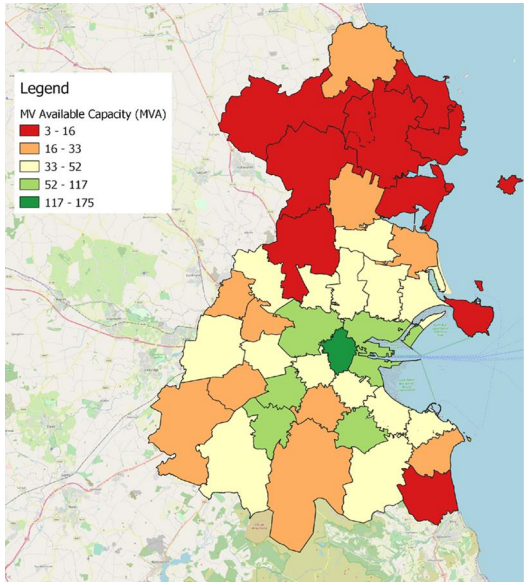
Current Situation

Electricity



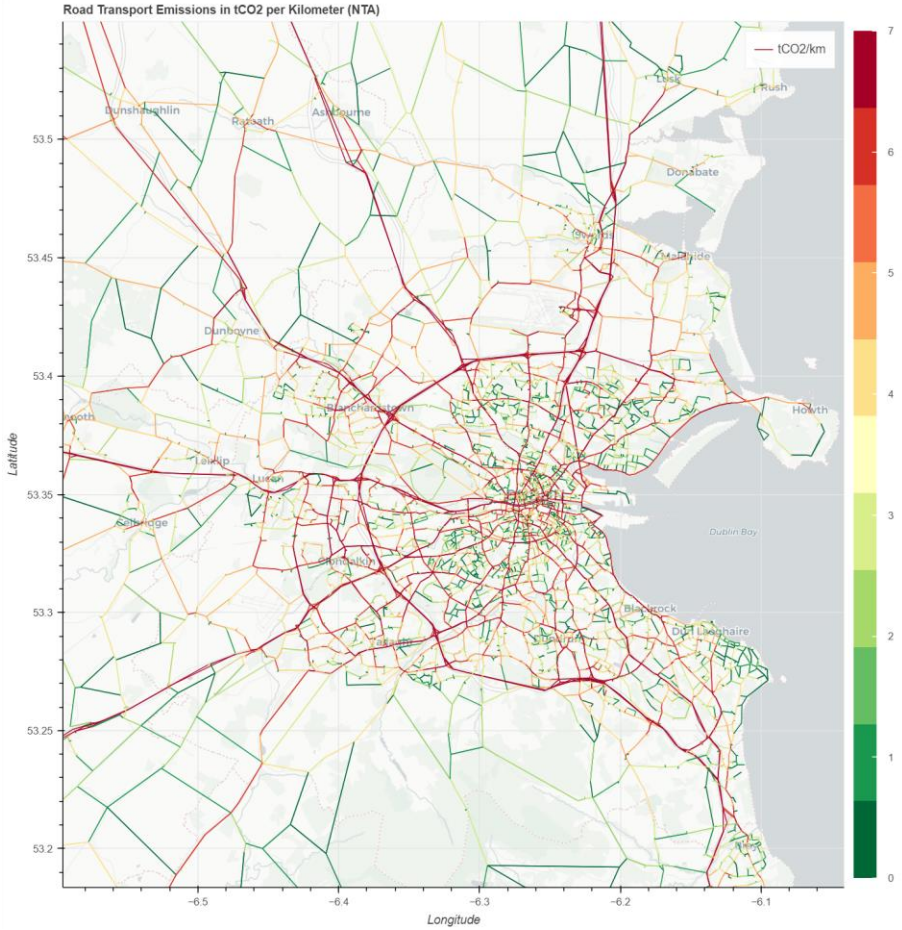


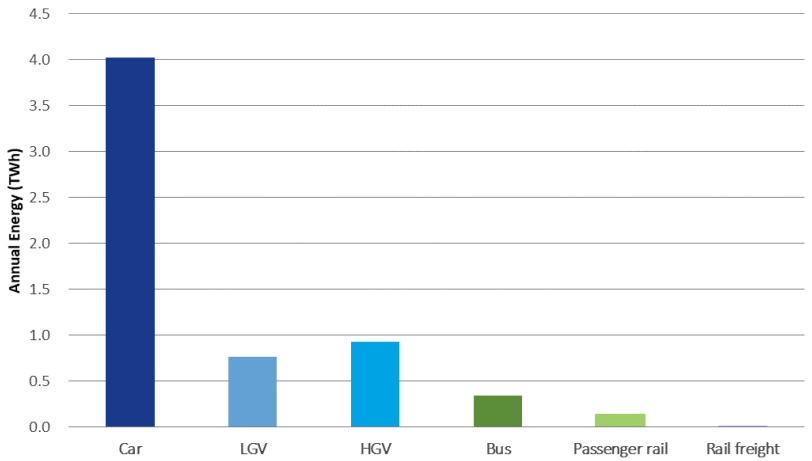


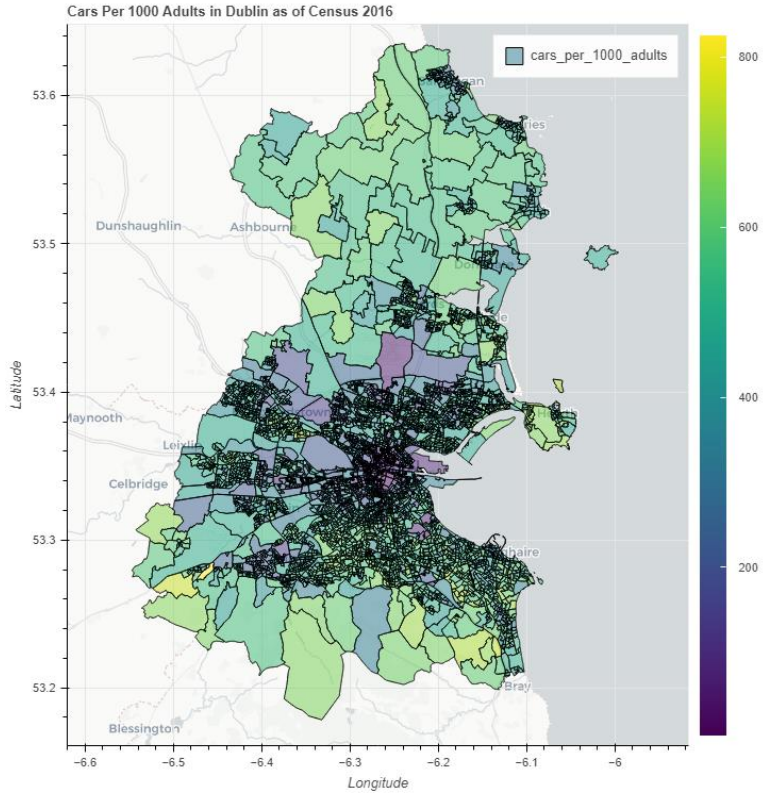


Current Situation

Transport

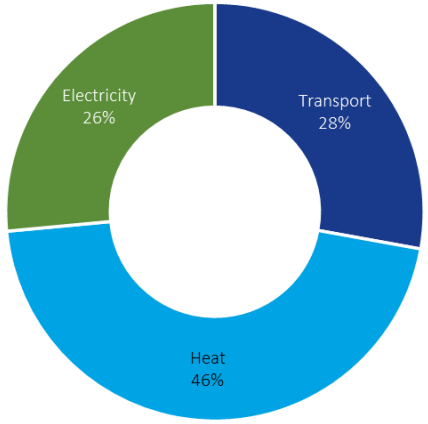


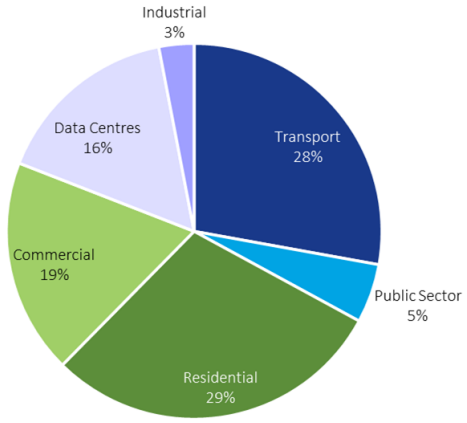


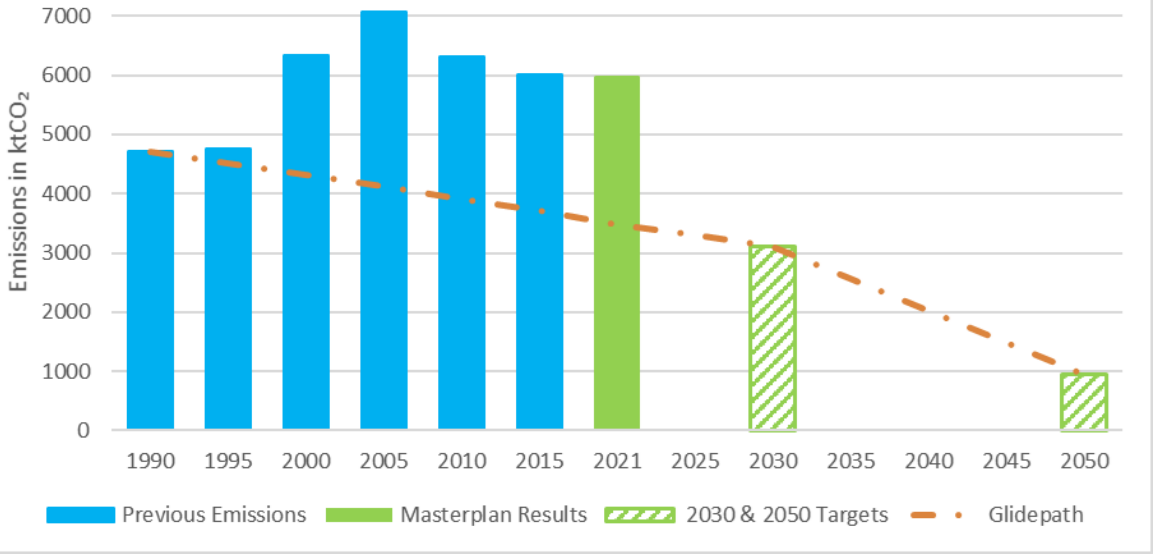


Current Situation

Total Emissions & Gap to Target

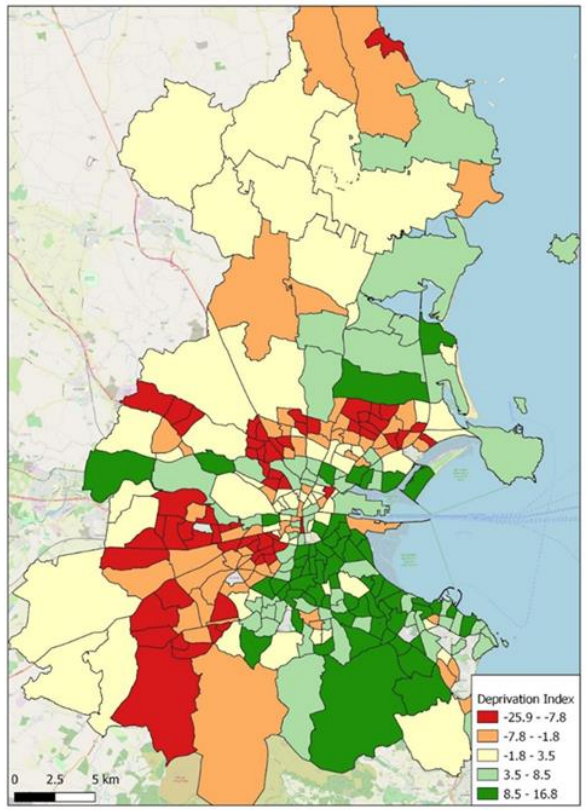


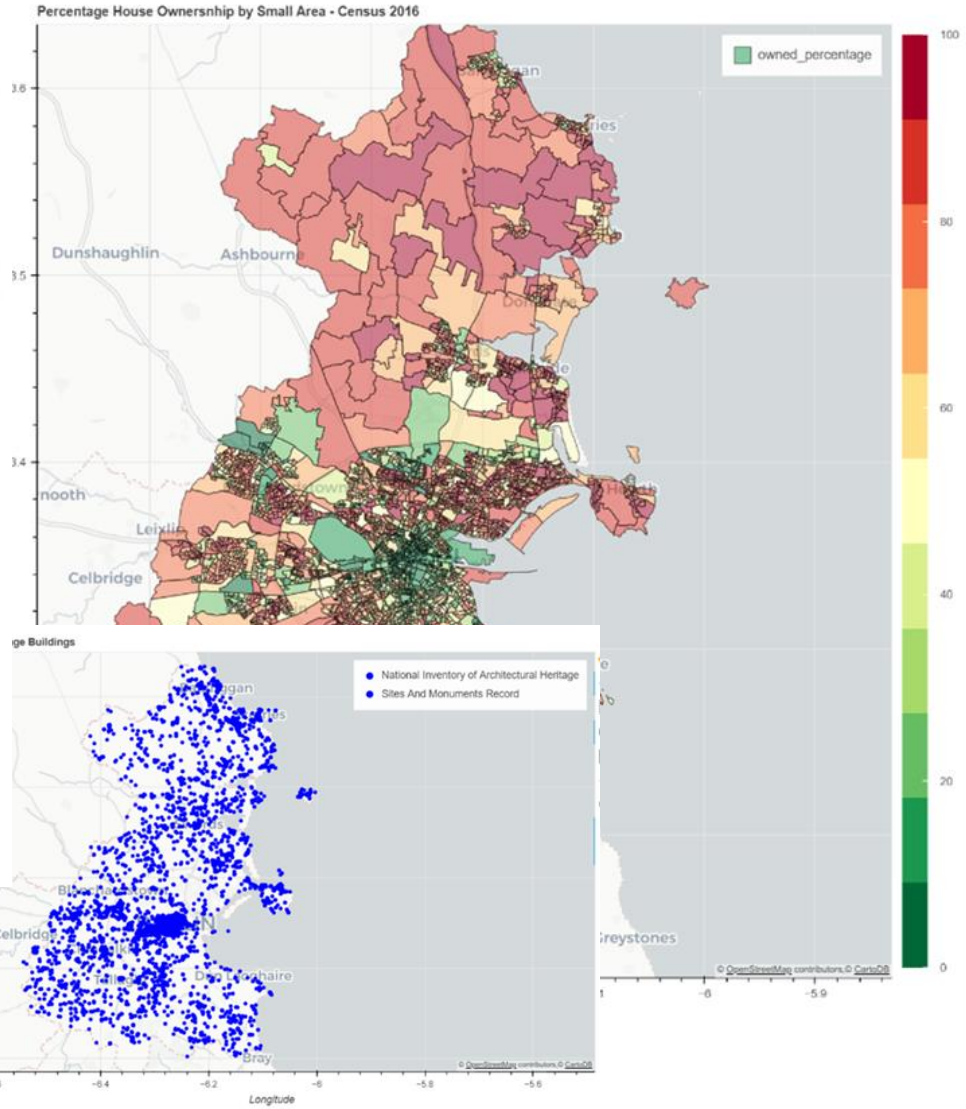




- Dublin's emissions account for **5,699 ktCO$_2$**, 4.22 tonnes of CO$_2$ per person (for the sectors identified in the DREM)
- **Heat 46%**, **transport 28%** and **electricity at 26%** of total emissions
- The sectors that have the highest impact on emissions are the **residential and transport** sector, which combined, contribute **57%** to total emissions.
- The current gap to the **2030 target** amounts to 2,856 ktCO$_2$ (**48% reduction in emissions** needed to meet the 2030 target from 2021).
- A reduction of 5,025 ktCO$_2$ (**84% reduction in emissions** to meet the **2050 target from 2021**) will be needed to meet the 2050 net zero target.

Challenges & Barriers
Buildings





Barriers to building fabric upgrades:

- Accessibility – making it possible and easy for decision makers to retrofit their buildings
- Affordability – retrofit costs can be quite expensive especially to meet specific building regulation standards
- Appetite – there is a need to make businesses and homeowners aware of the benefits of energy efficiency upgrades

Where to Start – Map of Homes with Poor EE in Areas with DPI Below Average

- Building energy efficiency rating (BER) from SEAI database and extrapolated by building age for remaining buildings
- Deprivation Index used to outline residents most at risk to energy poverty
- Both are combined to identify areas where retrofitting should be concentrated first

Energy Poverty:
- BER D1 or Lower
- Unemployment > 20%
- DPI < -10 (Disadvantaged)

☑ (All)
☑ False
☑ True

HP CSO Deprivation Index 2016

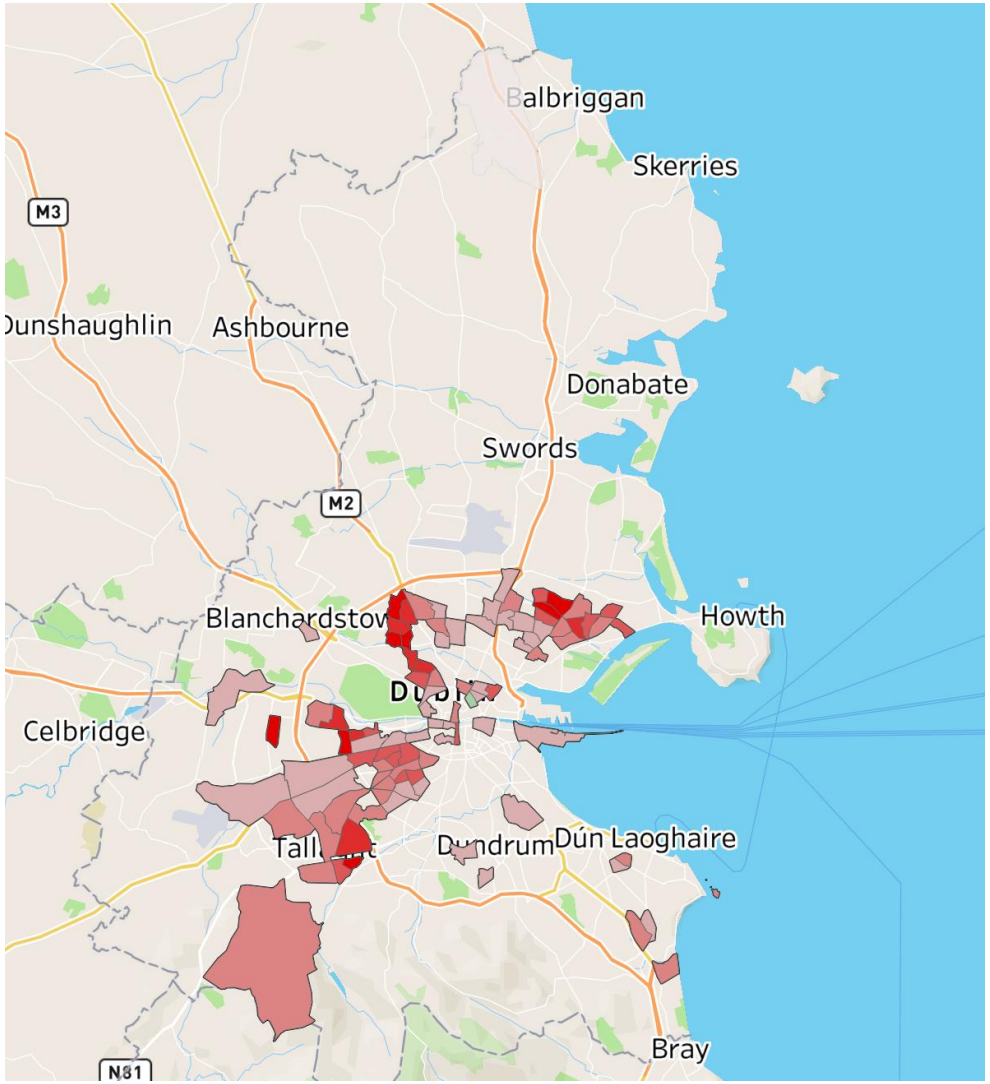
-25.90 16.80

BER Rating

☑ (All)
☑ B1
☑ B3
☑ C1
☑ C2
☑ C3
☑ D1
☑ D2
☑ E1

HP Deprivation Index 2016

-25.00 25.00

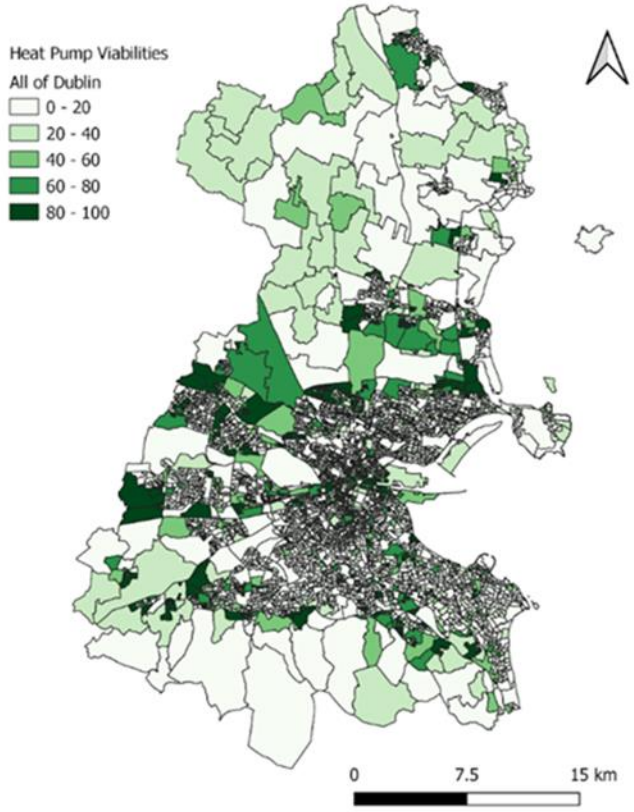


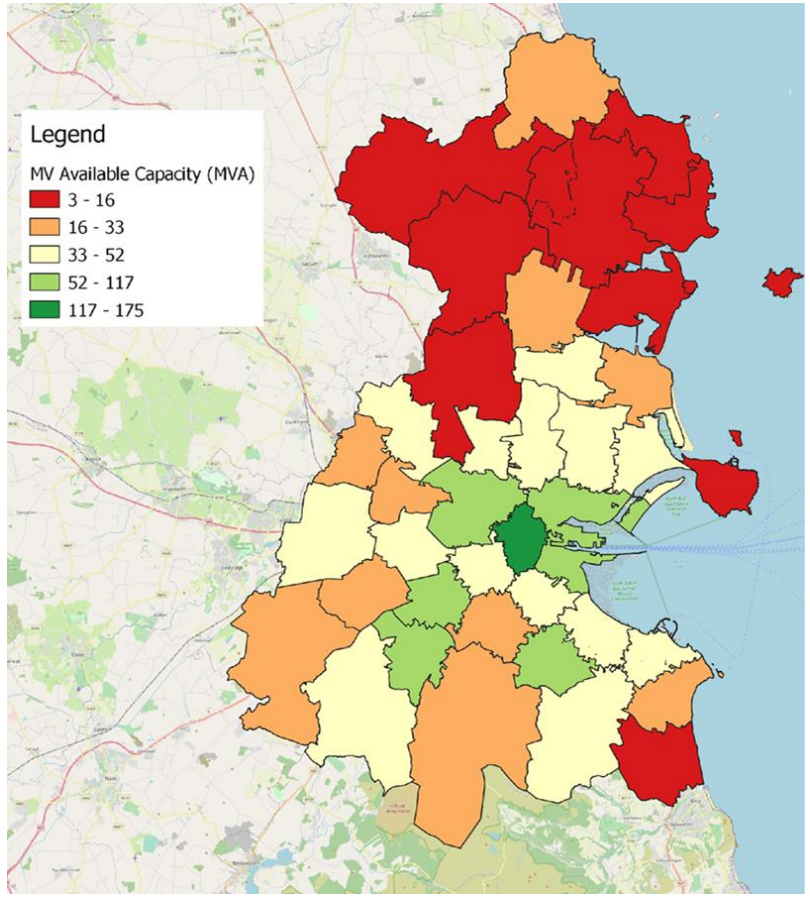
Challenges & Barriers

Heat

Barriers to decarbonising heat:

- High capital cost and cheap gas (relative to electricity)
- Suitability of building to adopting heat pumps (suitable heat loss index - also required to secure grants)
- Cost of elec grid upgrades to electrify heat
- Maintaining efficient operation & high level of service

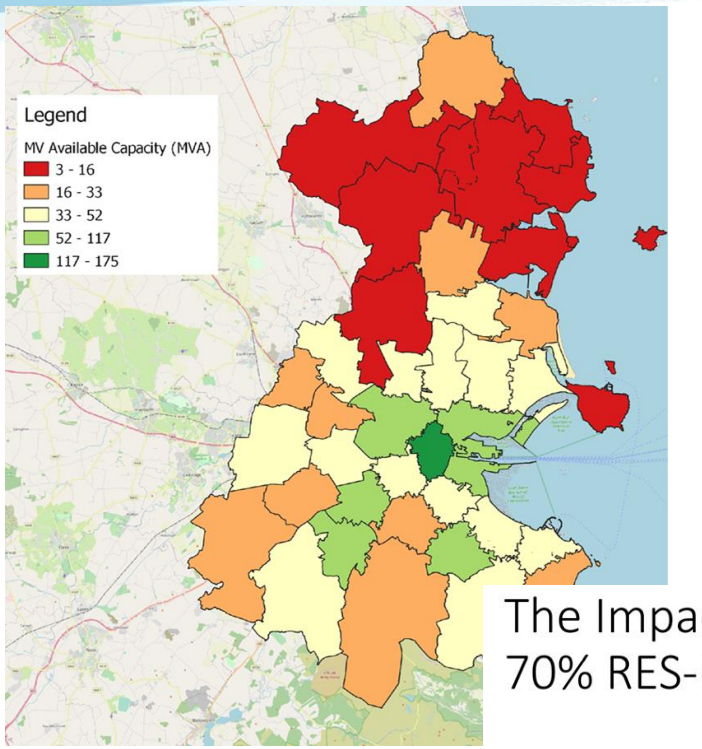




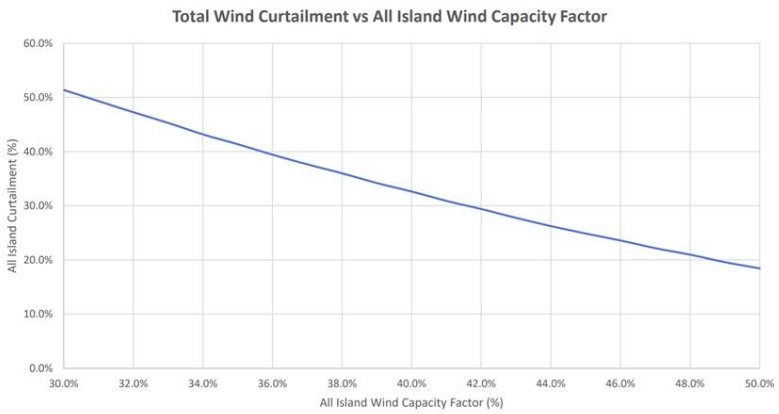
Challenges & Barriers
Electricity

Barriers for electricity sector:

- Achieving the scale of generation required - what & where is the potential
- Need for supporting infrastructure - Transformers, power quality equipment, grid connections
- Excessive dispatch down impacting on cost-effectiveness - role of storage & grid services



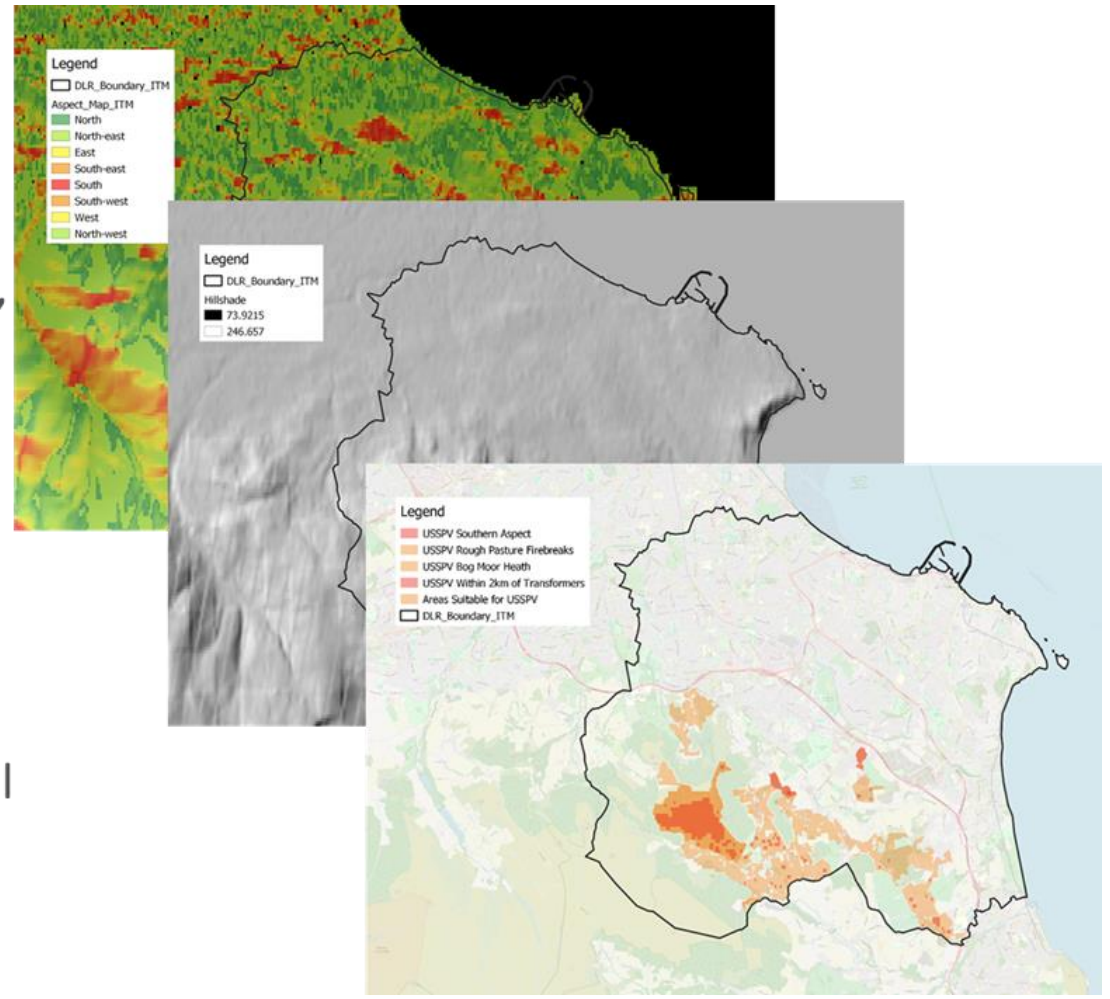
The Impact of Improved Wind capacity factor on 70% RES-E System



Challenges & Barriers

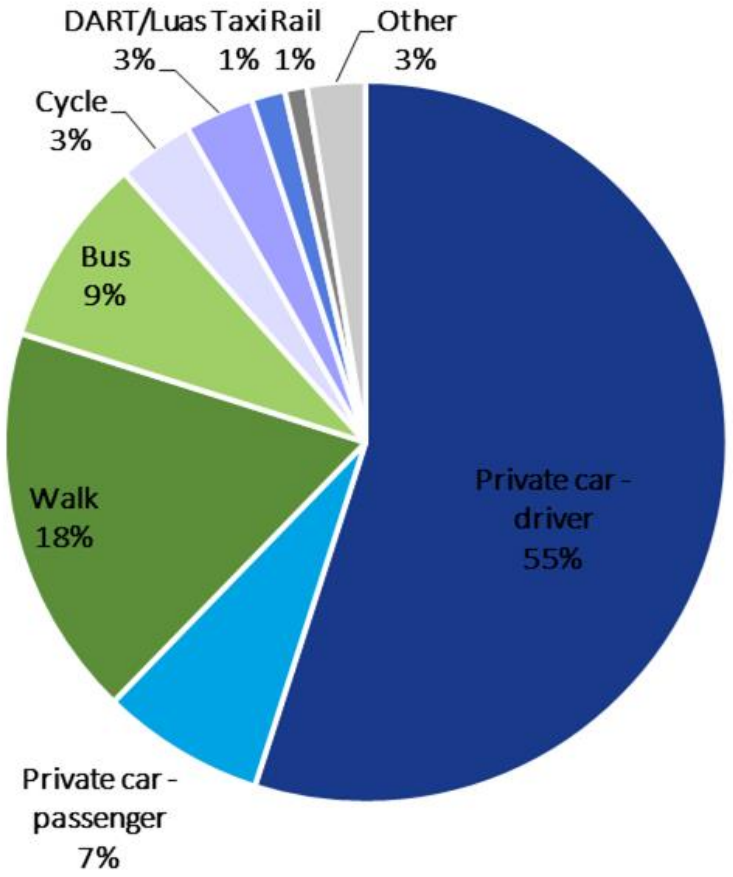
Electricity - Identifying Local Potential USSPV

- **Environmental and feasibility constraints:**
  - Grid proximity
  - Environmentally sensitive areas (SPA, SAC, NHA etc.)
  - Open space with minimal shading
  - Avoid northern slopes >10 degrees and flood zones
  - 30m from woodland, rail, roads
  - Land use/value (e.g. landfill, cutaway bog)
  - Large enough area (10ha)
  - Caveat - Land character assessment (visual impact) not currently included



Challenges & Barriers

Transport



Cork councillors vote to remove section of cycle lane in front of school for car parking

February 14, 2022 by Cian Ginty

IMAGE: A planned section of cycle lar

Galway council revokes plans for temporary 3km cycleway

Updated / Tuesday, 15 Feb 2022 08:02

Emergency services had expressed concerns about re

By Pat McGrath
Western Correspondent

Dublin MetroLink to be delayed until 2035 at the earliest

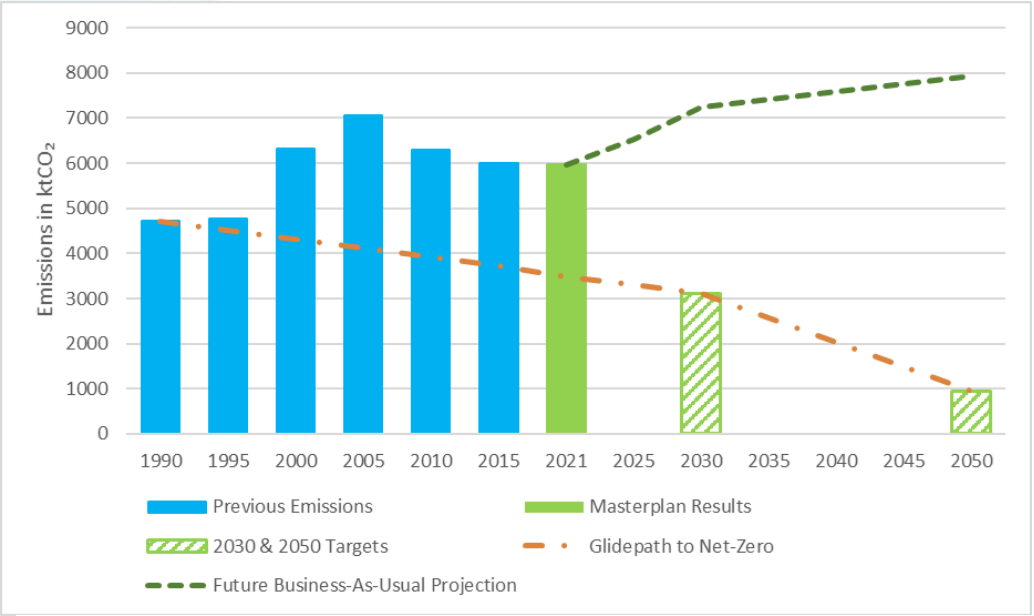
Public 'have lost all faith' in project as delays continue, says member of PAC

Thu, Feb 3, 2022, 13:03 | Updated: Thu, Feb 3, 2022, 13:06

Ronan McGreevy

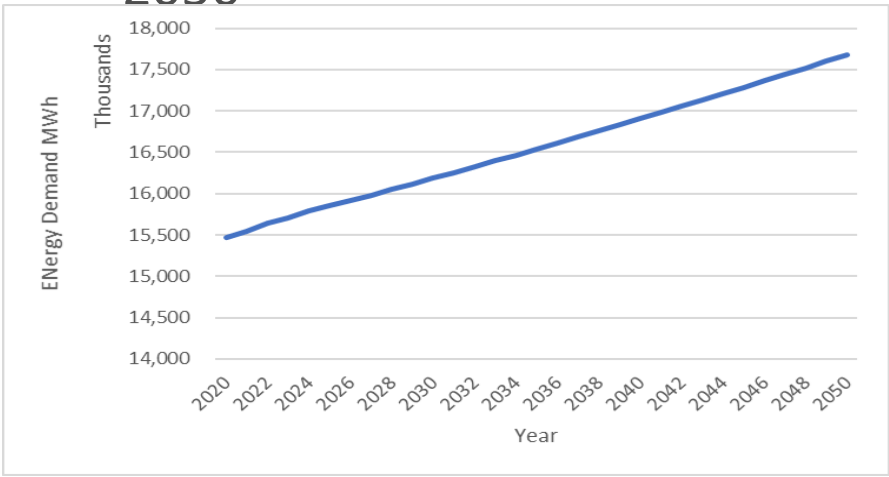
About €83m has been spent so far on MetroLink, the PAC heard.

Business-As-Usual
Buildings & Transport



Business as Usual	Current	2030	2050
	Annual Emissions (tCO2)		
Car	1,085,234	917,950	986,108
LGV	205,014	294,474	316,339
HGV	247,092	374,547	402,357
Bus	88,953	115,201	123,755
E-bike, e-cargobike	0	0	0
Rail freight	239	239	239
Passenger rail	37,174	42,627	55,113
Total	**1,663,707**	**1,745,038**	**1,883,911**
% change		**5%**	**13%**

- **BAU emission** projections to **2030** will increase by **21%**
- **BAU emission** projections to **2050** will increase by **33%**
- **Transport emissions** alone **will increase by 13% by 2050**
- **Building emissions** (including heat & electricity) alone will increase by **41%** by 2050



Pathway to 2030 & 2050
Transport

Increased Ambition	Current	2030	2050
	Annual Emissions (tCO2)		
Car	1,085,234	301,054	0
LGV	205,014	154,575	0
HGV	247,092	262,760	0
Bus	88,953	70,476	0
E-bike, e-cargobike	0	789	0
Rail freight	239	11,324	0
Passenger rail	37,174	13,446	0
Total	**1,663,707**	**814,423**	**0**
% change		**-51%**	**-100%**

	To 2030	To 2050
Low-carbon alternative	€/tCO_2 Abated	
BEV Car	(379)	(649)
BEV LGV	(209)	(288)
BEV HGV	179	(313)
BEV Bus	(22)	(220)
Walking	(7,982)	(7,904)
Cycle	(6,011)	(5,955)
E-bike	(3,760)	(3,625)
E-cargo bike	(926)	(910)

2030:

210k EVs, car-km 40%↓

Public transport: bus-km 25%↑

Freight: logistics management, EVs, e-cargo bikes, rail

2050:

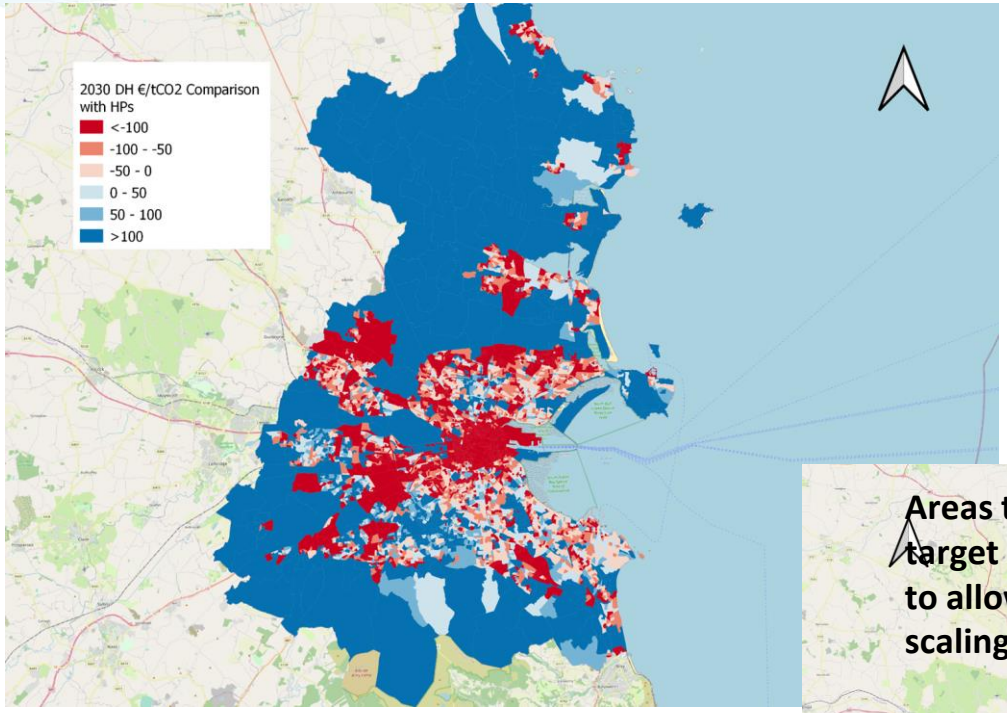
EVERYTHING electric

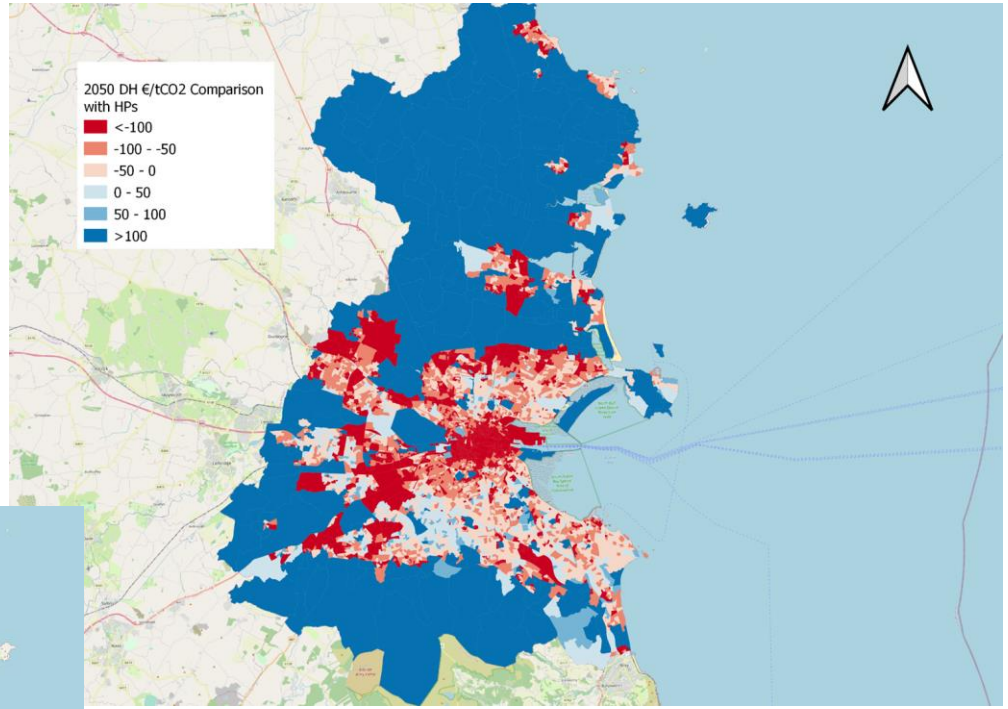
Car-km 50%↓

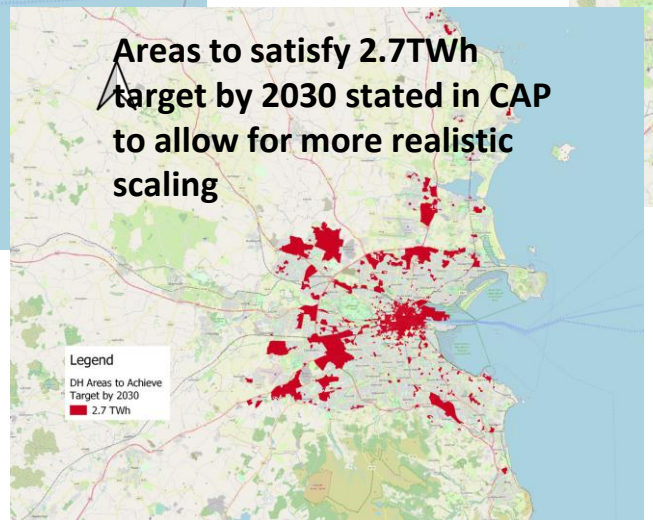
Bus-km 50%↑

Pathway to 2030 & 2050

Heat







Areas identified as more suited for either DH or HP based €/tCO2

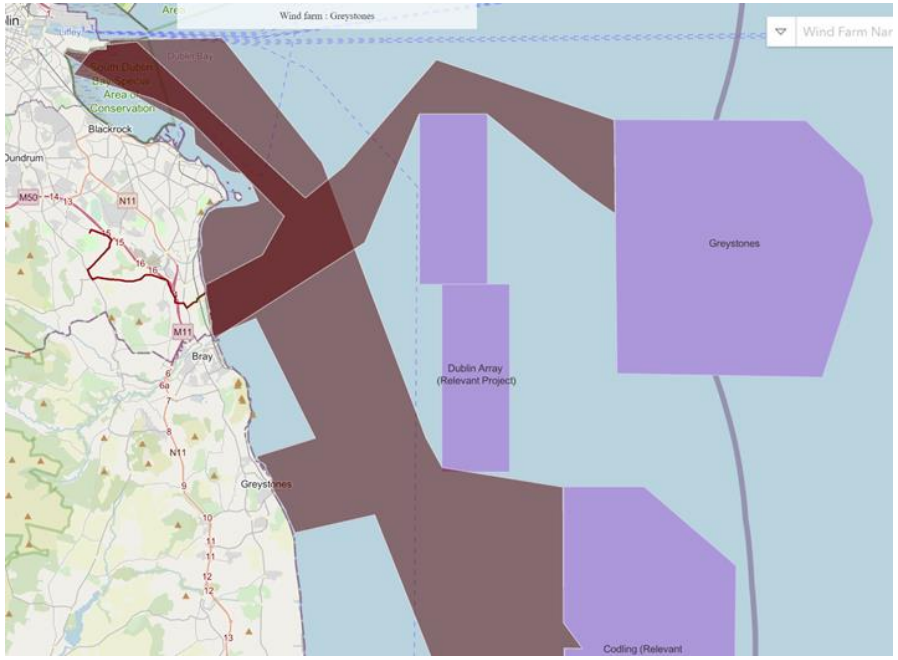
Technology	€/tCO$_2$ Median 2050
District Heating	150.6
Heat Pumps	263.9

Pathway to 2030 & 2050

Electricity

Technology	GWh		tCO_2 Saved	
	2030	2050	2030	2050
Utility-Scale Solar PV	854	1,057	277,124	343,036
Onshore Wind	130	325	42,163	105,572
Offshore Wind	5,241	13,124	1,700,768	4,258,600
Building-Integrated Solar PV	84	270	27,237	87,763
Curtailment Assumed Avoided by EV+DH	462	2,421	149,892	785,551
Total	**6,309**	**14,776**	**2,047,292**	**4,794,972**

Technology	€/MWh	€/tCO_2 Abated
Offshore Wind	65.6	-55.0
Onshore Wind	52.9	-94.0
Utility-Scale Solar PV	50.6	-101.1
Closed-Cycle Gas Turbine	97.8	N/A
Open-Cycle Gas Turbine @ 500 hours	228.9	N/A
Open-Cycle Gas Turbine @ 2000 hours	157.6	N/A
Building-Integrated Solar PV	131.1	147.0
Current Generation Mix (2019)	83.4	N/A

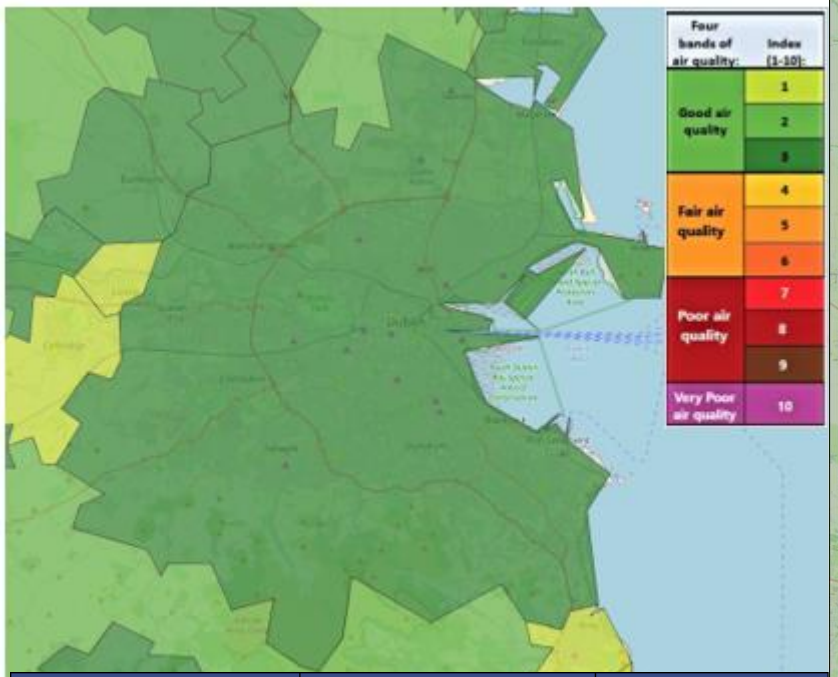


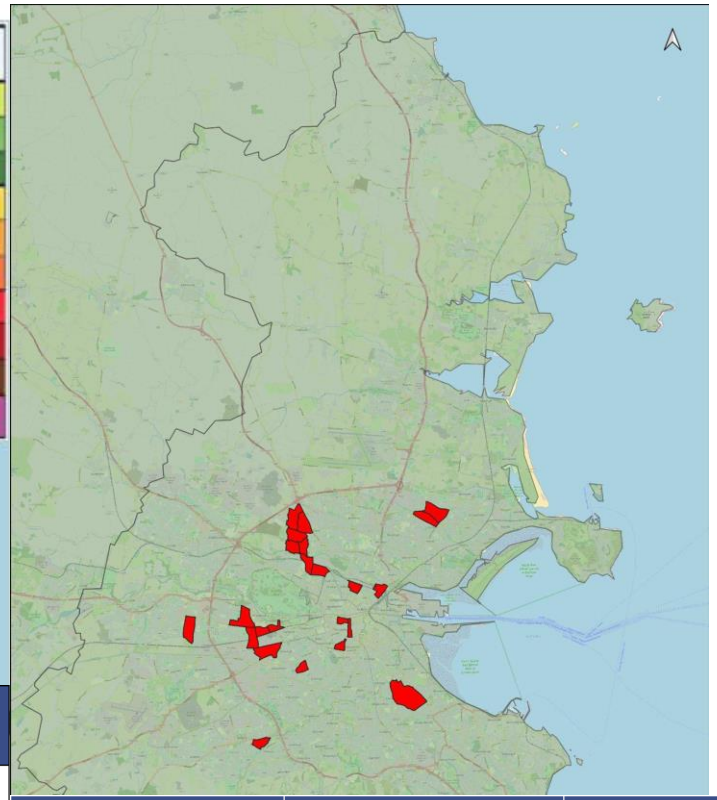
Social & Economic Impacts

Social and economic benefits from the Dublin Region Energy Masterplan:

- Health Benefits - **Improvement in Local Air Pollution and Air Quality**
- **Local employment generated** (direct & indirect)
- **Avoided Carbon Costs** - Cost of Carbon (Shadow price)
- **Reduction in Energy Bills** for Residents & Businesses
- **Warmer Homes**
- **Reduction of Fuel Poverty**
- **Reduced reliance on Fuel Imports**

Social & Economic Impacts



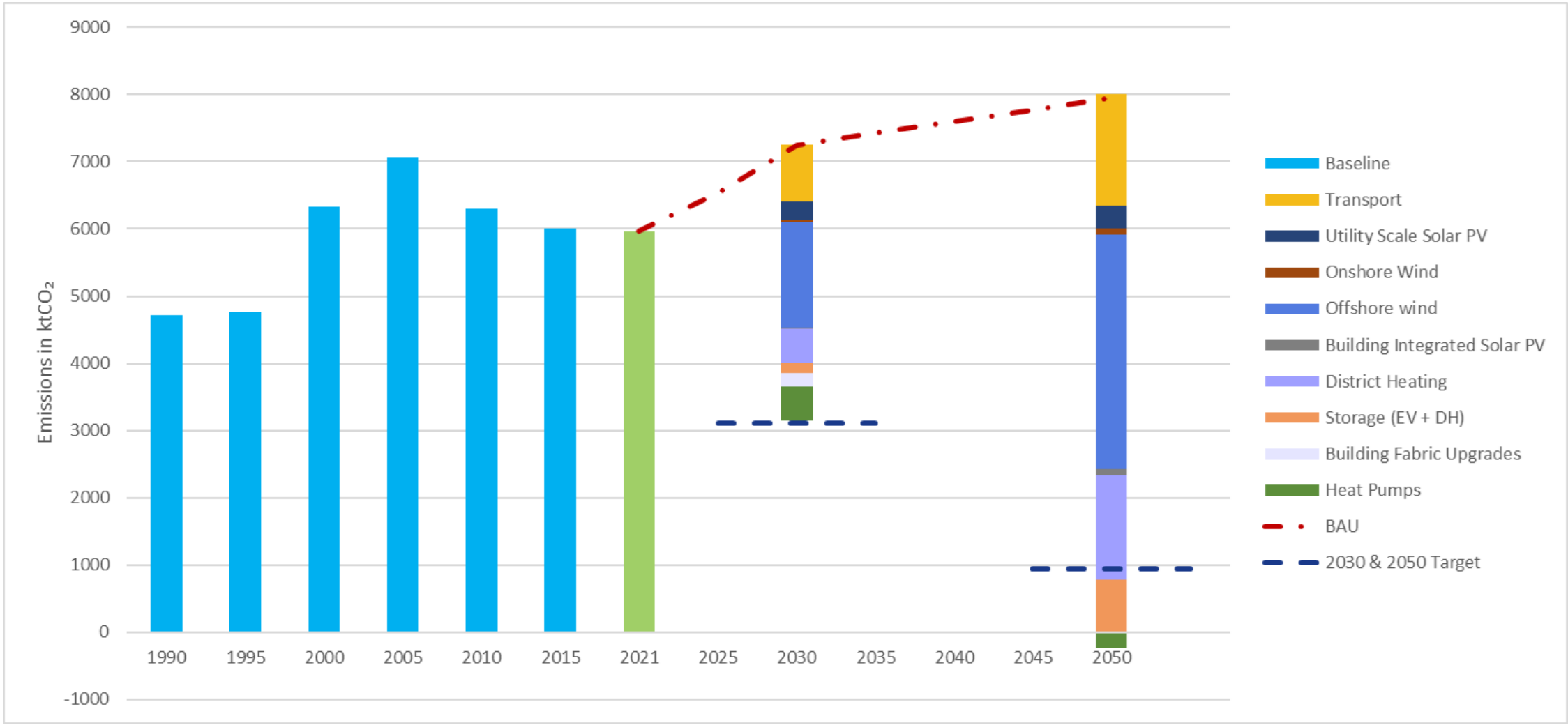


	Reduction in $ktCO_2$ by 2030	Reduction in $ktCO_2$ by 2050
Electricity/ Renewable Energy Generation & Storage	2,047	4,795
Heating/ Low Carbon Technologies/ Building Fabric Upgrades	1,212	1,783
Transport	844	1,662
Total	**4,103**	**8,240**

- **Decrease energy costs by a total of €519 million** per year from **renewable energy technologies** (onshore and offshore wind, utility scale solar PV and building integrated solar PV)
- **Avoid a cost of over €24 billion**, if we were to apply the shadow price of carbon to the total avoided emissions over the lifetime of the masterplan
- Increase **direct jobs by over 182,500 by 2050**

Technology	Increase in RE Potential by 2050 GWh	tCO_2 Saved by 2050	Reduction in Energy Costs in €
Onshore Wind	267	86,569	8,357,100
Offshore Wind	10,761	3,492,052	336,819,300
Utility Scale Solar PV	1,057	343,036	138,784,100
Building Integrated Solar PV	270	87,763	35,451,000
Total	**12,355**	**4,009,420**	**519,411,500**

Pathway to 2030 & 2050



Pathway to 2030 & 2050

If the Dublin Region were to carry out all the suggested recommendations, it could potentially:

- reduce emissions by **4,103 $ktCO_2$ by the year 2030**
- reduce emissions by **8,240 $ktCO_2$ by 2050**
- increase **renewable electricity** generation in the Dublin Region to **14,780 GWh** by 2050.
- **meet the 2030 targets** and **exceed the 2050 target**, going beyond an 80% reduction and becoming **carbon-negative** (-295 $ktCO_2$) by 2050
- **decrease energy costs by a total of €519 million** per year from **renewable energy technologies** (onshore and offshore wind, utility scale solar PV and building integrated solar PV)
- **avoid a cost of over €24 billion**, if we were to apply the shadow price of carbon to the total avoided emissions over the lifetime of the masterplan
- increase **direct jobs by over 182,500 by 2050**

Pathway to 2030 & 2050

If the Dublin Region were to carry out all the suggested recommendations, it could potentially:

- Create a healthier city with cleaner air, quieter streets with more space for nature and people

Key Recommendations

Energy Planning

- **Guidelines for local level energy planning are made available** to municipalities
- **Energy planning becomes a requirement** for implementing local level energy plans with clear pathways and long-term commitments to a low-carbon future

Building Energy Efficiency

- To alleviate energy poverty, the county should consider **prioritising energy efficiency upgrades in areas that have been identified in this masterplan as being energy poor**.

- **Regulatory solutions to tackle the issue of split incentives** should be considered, minimum energy efficiency standards for rented properties are applied; funding mechanisms for energy efficiency upgrades, particularly addressing long payback periods and high upfront costs in both the residential and non-residential sector, need to be addressed.

Key Recommendations

Heat

- Evidence-based **zoning for DH** and having requirements in place for buildings in these areas re connection, futureproofing, characterising heat sources (waste heat reports)
- **Ensure low-carbon heat sources are treated fairly in Part L building regulations** (in line with REDII)
- Make **financial support more easily available** for these low-carbon solutions

Electricity

- **Support the development of generation assets** where suitable
- Development of **enabling infrastructure** needs to be supported to realise renewable potential
- Promote the adoption of **building integrated PV particularly in buildings where demand and production profiles match**

Transport

- Electrifying 550k cars will not solve Dublin's transport problems - **need to reduce no. of cars substantially**
- **Focus needs to be on active travel and buses to 2030** - additional powers required for LAs to reallocate road space to more sustainable modes

Think Global, Act Local

Codema
Dublin's Energy Agency

Dublin Energy Masterplan

Spatially-led cost-optimal pathways to 2030 and 2050 targets

Zero Together

Outlines actions that must be invested & implemented every year to 2050 and engage all stakeholders required to make that transition.

Implementation of projects at scale

Low-carbon Projects to bundle and deliver large-scale investments required

Key Takeaways

- Dublin can achieve its 2030 and 2050 targets
- This will result in avoided costs of €24 billion, this cost would be better invested in renewable sources of energy, public transport and active travel, energy efficient homes and heating options to reduce emissions and citizens' utility and mobility bills
- Active travel is the most cost effective way to decarbonise transport and can bring transformative societal benefits for Dublin

Novel Approach - Need to work together!

Codema
Dublin's Energy Agency

Websites:

- Our maps - https://codema-dev.github.io/
- Our network - https://energy-modelling-ireland.github.io/

Scripts:

- Building stock model based on DEAP - https://github.com/codema-dev/rc-building-model
- Reproducible Python scripts used in creating the maps on codema-dev.github.io - https://github.com/codema-dev/projects

Apps:

- Dublin Energy App - https://github.com/codema-dev/dublin-energy-app
- Irish Building Stock Generator - https://github.com/energy-modelling-ireland/ibsg

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