



An
Phríomh-Oifig
Staidrimh

Central
Statistics
Office

Geospatial Data Visualisation

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Geospatial Data Visualisation

Formal Statistical Liaison Group
(FSLG) Visualization Seminar

2.00p.m. September 12th 2019
Dublin Castle

Presented by Paul J. Alexander,
Census Geography



Content

- A (very) brief introduction to **Geovisualisation**
- **Example 1 - Proximity Analysis**
- **Example 2 - Area Profiling**

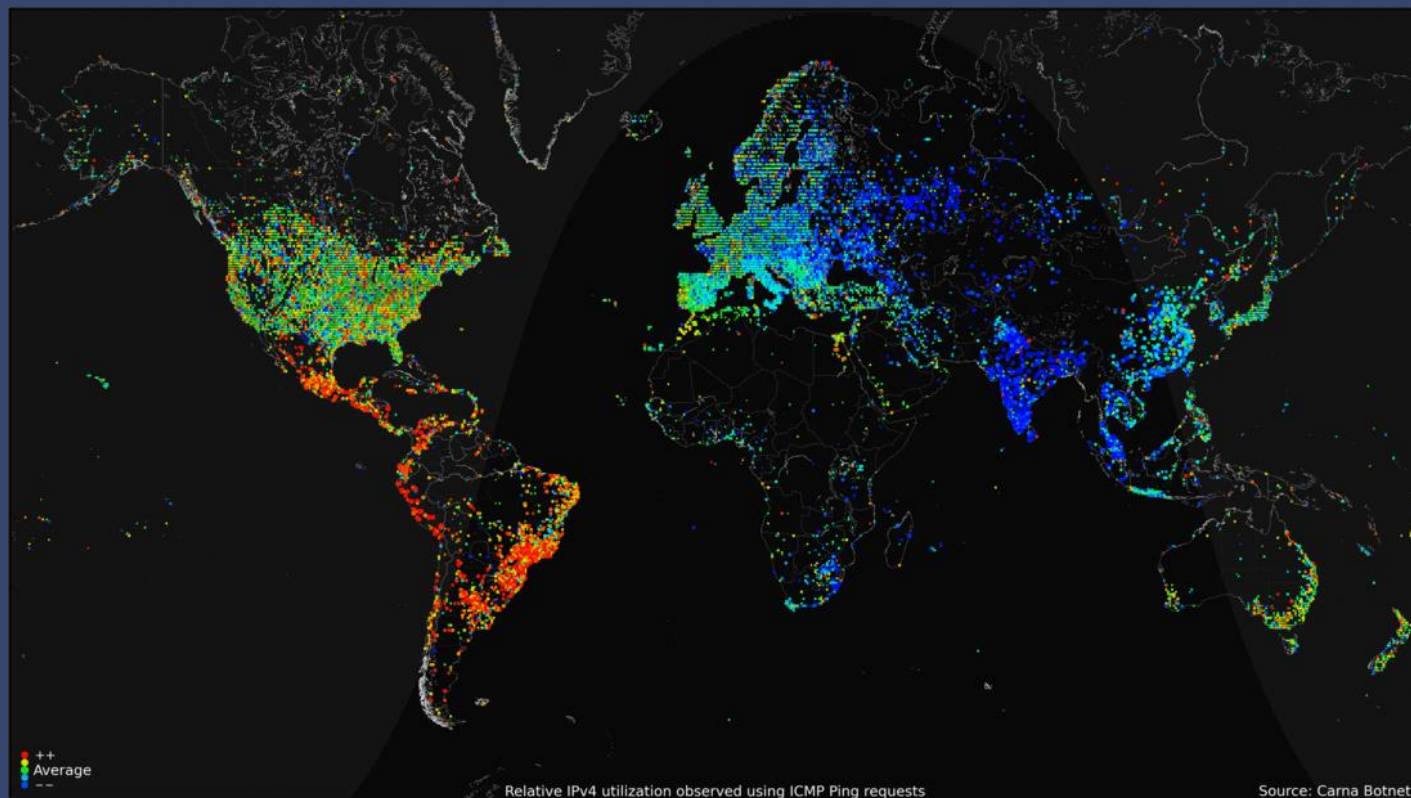




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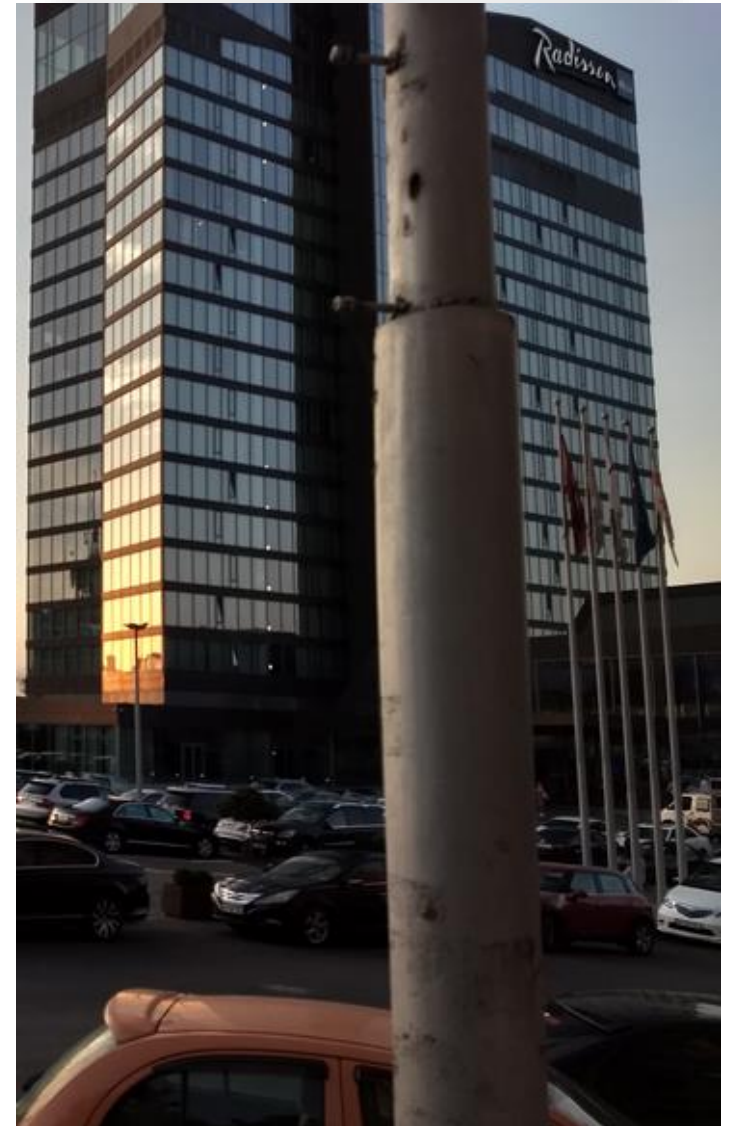
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Geovisualisation



Geovisualisation

- At the turn of this century, MacEachren & Kraak estimated that up to 80% of digital data generated / captured included geospatial referencing:
 - Geographic Coordinates
 - Addresses
 - Post Codes



MacEachren, Alan M., and Menno-Jan Kraak. "Research challenges in geovisualization." *Cartography and geographic information science* 28.1 (2001): 3-12.

www.cso.ie

Geovisualisation

- You may be asking: are my data geographic?
- If your data have...
 - **Locations** (implicit or explicit)
and/or
 - **Times** (implicit or explicit)
- Then they are *probably* geographic... or I could attempt to argue they are! 😊



Geovisualisation

Location A

- Income €1,000
- Expense €250
- Net €750



Location B

- Income €500
- Expense €750
- Net -€250

Comparing two locations



Geovisualisation

Location A @ Time X

- Income €1,000
- Expense €250
- Net €750
- Balance €1,750

Location B @ Time X

- Income €500
- Expense €750
- Net -€250
- Balance €750

Comparing two times / locations



Geovisualisation

Location A @ Time Y

- Income €1,500
- Expense €200
- Net €1,300
- Balance €3,050
- Change +€550

Location B @ Time Y

- Income €1,000
- Expense €200
- Net €800
- Balance €1,550
- Change +€1,050

Comparing two times / locations



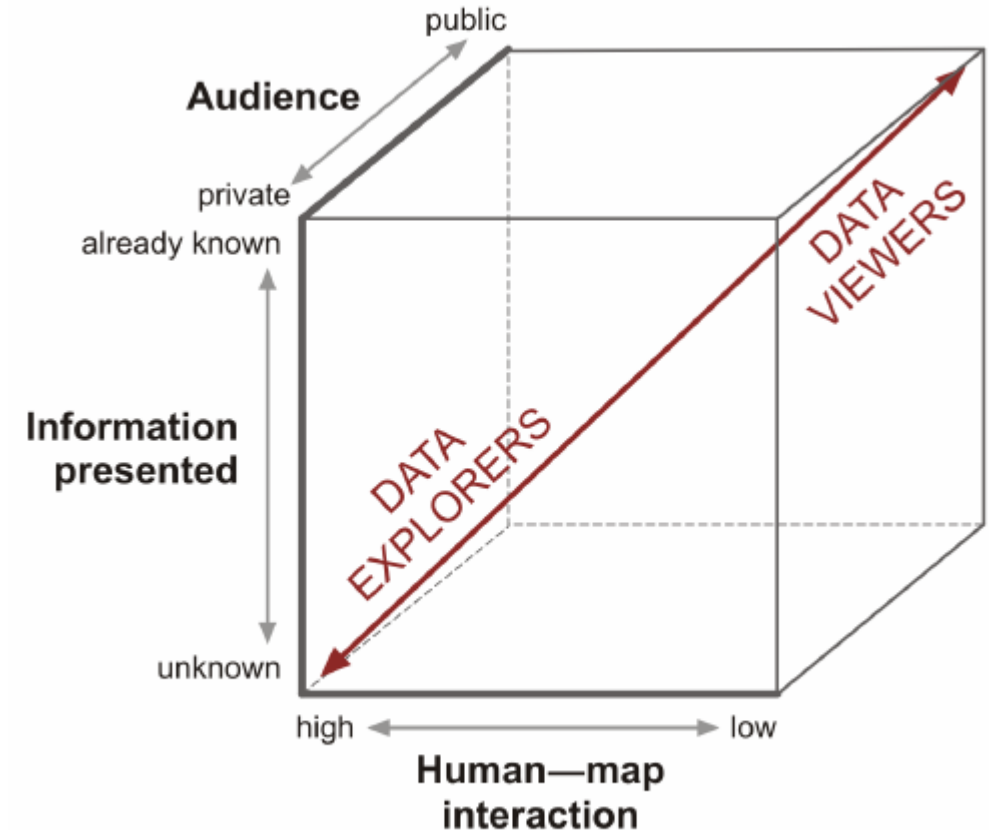
Geovisualisation

- *The purpose of Geovisualization is to provide a graphical ideation to render a **place**, a **phenomenon** or a **process** visible, enabling human's most powerful information-processing abilities – those of spatial cognition associated with our eye–brain vision system – to be directly brought to bear on **complex data***



Geovisualisation

- *If your data have an element of either **space** or **time** (ideally both) it is a candidate for geovisualisation techniques*
- So now you may be asking: What are geovisualisation techniques?
 - Short answer... **MAPS!**
 - Slightly longer answer... a blending of cartography, graphic design, data science and a bit of intuition/creativity



Place of Usual Residence Work,
School or College dataset, Census
2016

Destination City	Households (000's)
Cork	73
Dublin (four local authorities)	564
Galway	44
Limerick (city and county)	65
Waterford	36



0600hrs = People
who leave before
6am...

0700hrs = People
who leave between
06:01 and 07:00

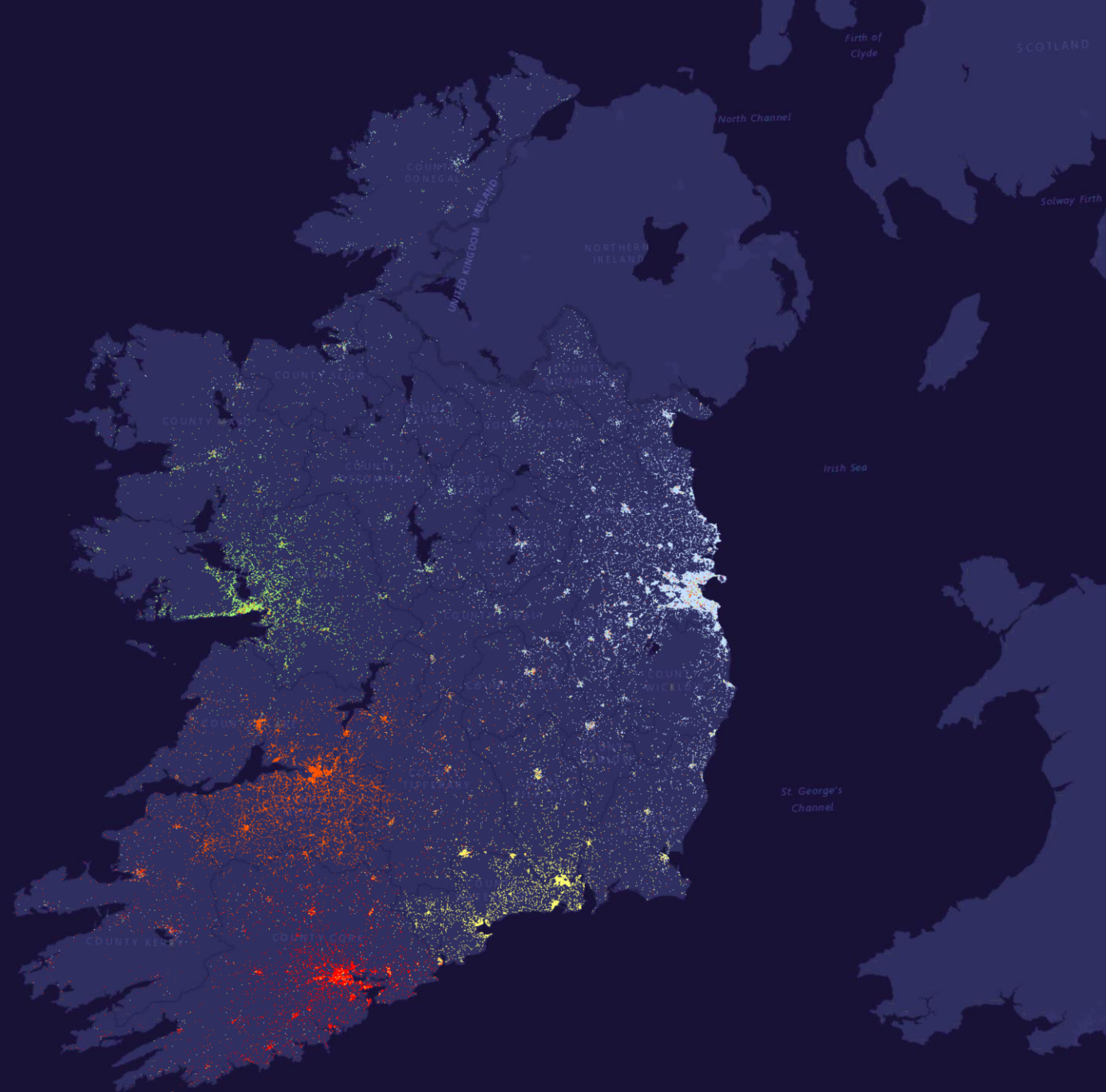
0730hrs = People
who leave between
07:01 and 07:30

[...]

0900hrs = People
who leave between
08:31 and 09:00



0900hrs



Summary

- Geovisualisation is a suite of techniques applied to help drill down into complex spatio-temporal data
- Most commonly done using a geographic information system (but by no means exclusively!)
- As a general rule, if data can be **located** (implicitly or explicitly) and/or **time referenced** then these data can be visualised using a GIS
- GV tends to not rely on static images (hence is separated from traditional Cartography)





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Measuring proximity to services and infrastructure

Visualisation Seminar– 12 September 2019

Developed by Dermot Corcoran & Paul Alexander

Sustainable Development Goals & Indicator Reports,
Central Statistics Office, Ireland

Introduction

- Motivation for research
- Proximity work
 - Challenges
 - Data sources
 - Methodology
 - Initial results
- Future work



Motivation for research

 SUSTAINABLE DEVELOPMENT GOALS

9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE

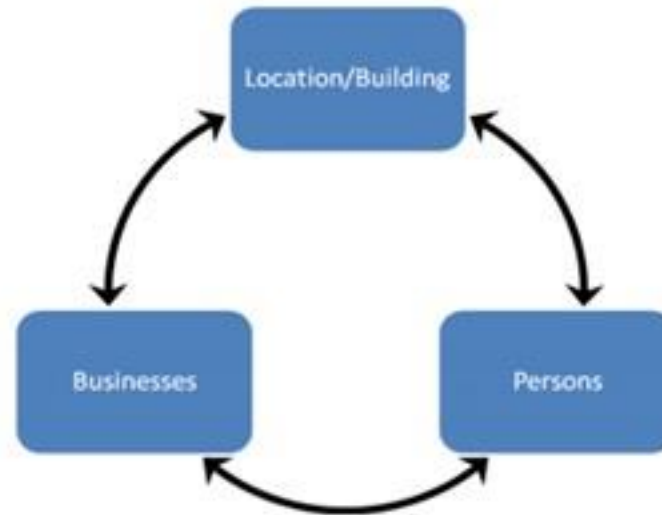


11 SUSTAINABLE CITIES
AND COMMUNITIES



UN-GGIM: Europe

United Nations Committee of Experts on
Global Geospatial Information Management



Challenges

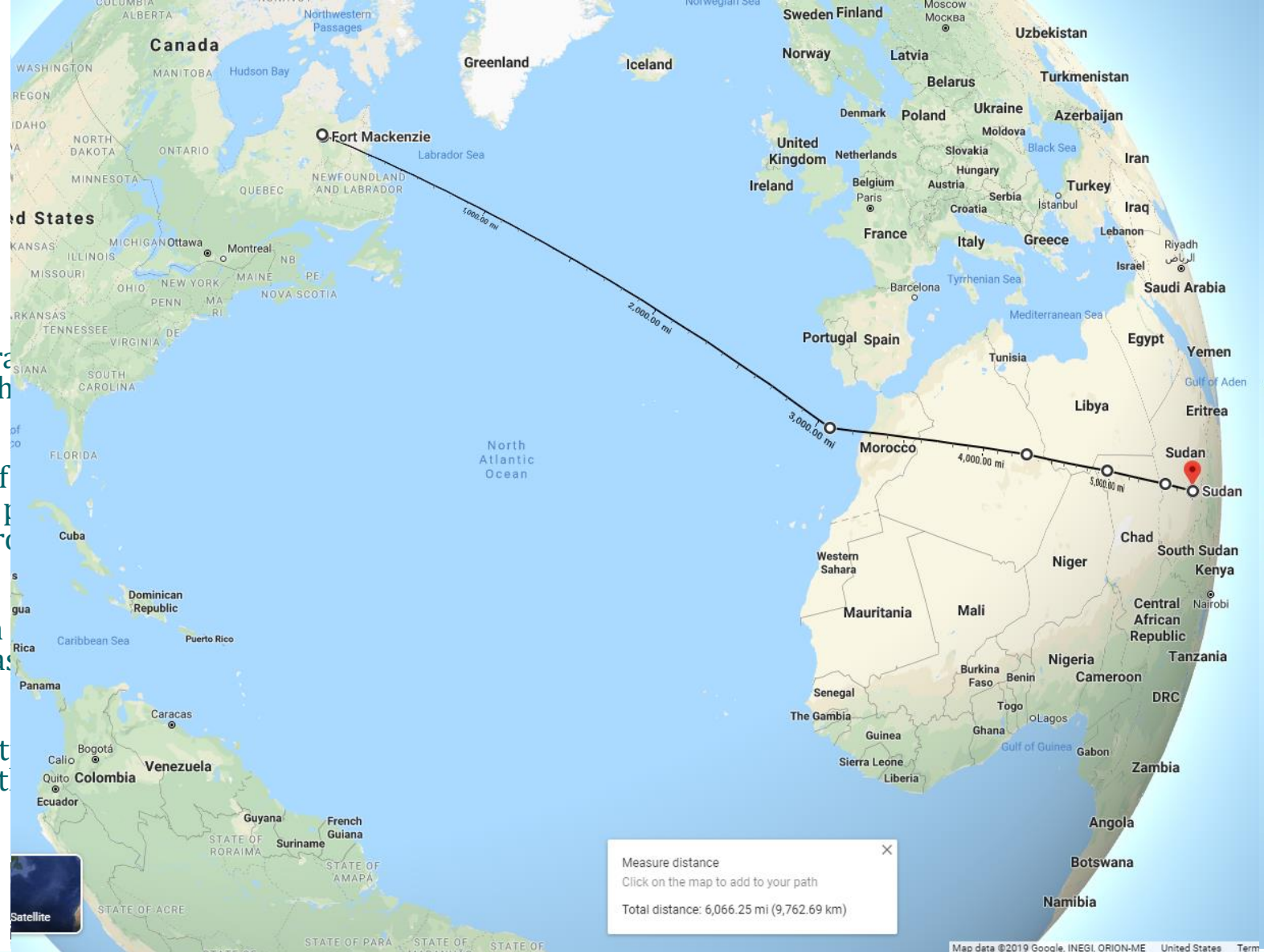
- Physical distance can mean many things...

- Distance Travelled:** The length of a specific path travelled between two points, such as the distance walked when navigating a maze

- Euclidean Distance (displacement):** The length of the shortest possible path through space, between two points, which could be taken if there were no obstacles ("as the crow flies" but not really)

- Geodesic Distance:** The length of the shortest path between two points while remaining on some surface, such as the surface of the Earth ("as the crow flies"... really!)

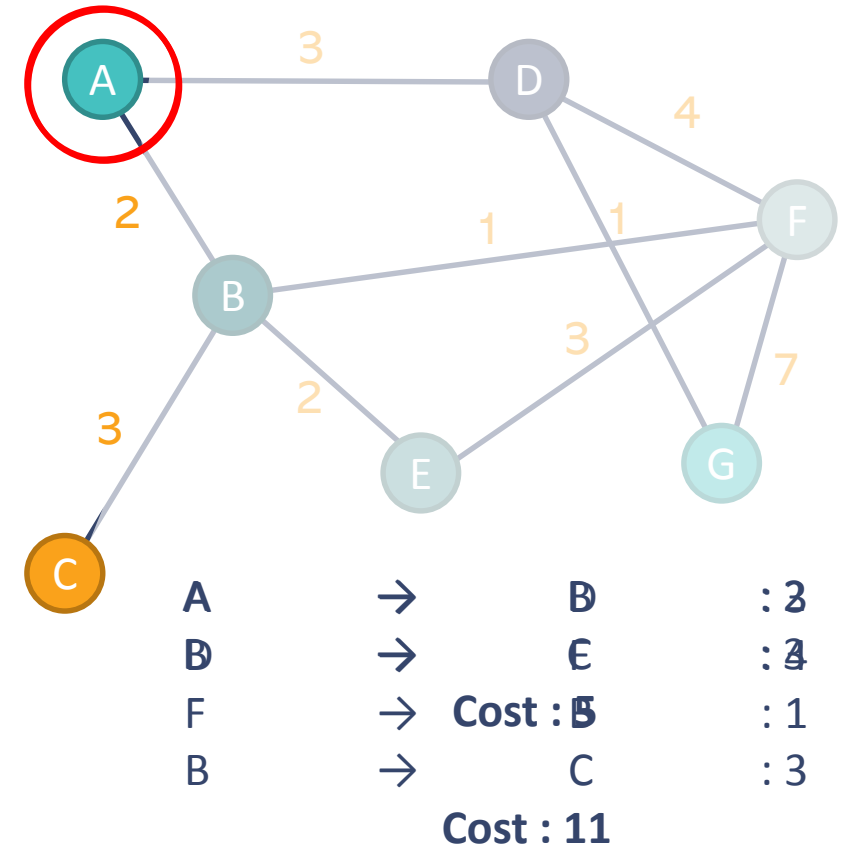
- Path Distance:** The length of a specific path that returns to the starting point, such as a ball thrown straight up, or the distance travelled when it completes one orbit.



Challenges

- Physical distance can mean many things...
- Distance Travelled:** The length of a specific path travelled between two points, such as the distance walked while navigating a maze
- Euclidean Distance (displacement):** The length of the shortest possible path through space, between two points, that could be taken if there were no obstacles (“as the crow flies”... but not really)
- Geodesic Distance:** The length of the shortest path between two points while remaining on some surface, such as the curve of the Earth (“as the crow flies... really!”)
- Path Distance:** The length of a specific path that returns to the starting point, such as a ball thrown straight up, or the Earth when it completes one orbit.

Routing distance...



Challenges for this project

- Identify quality, authoritative, up-to-date data sources for **services** and **infrastructure**
- Best means to get coordinates – Eircode coverage needs improvement
- Build script to perform routing
- Optimise computing time

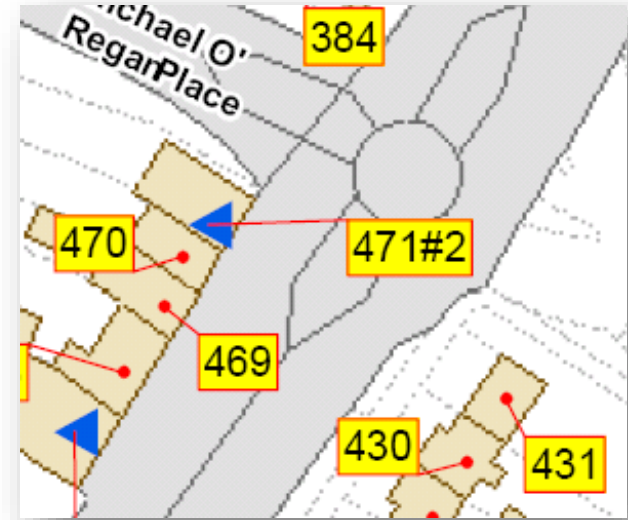
Reminder of ingredients:

1. Origins
2. Destination
3. Routes / Paths



Data sources – Census 2016 (Origin)

- 98% of dwellings linked to address database prior to census
- 2% digitised by census staff
- 2,070,256 dwellings on final census dataset



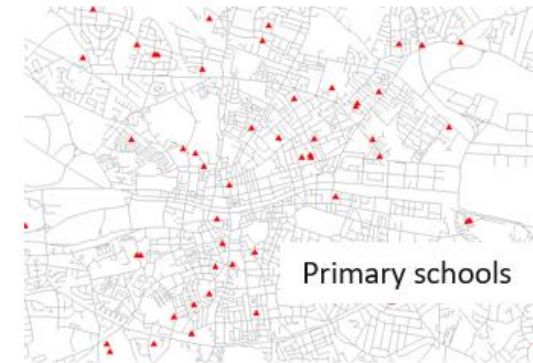
Data sources – PRIME 2 (Road network)

- GDF level 2 (GDF2) from PRIME 2 database
- Over 300,000 segments
- Each segment is seamless and continuous, no broken lines or edges
- Generate network dataset using ArcGIS
- No drive time information - 'Shortest-path' not 'optimum-path' analysis

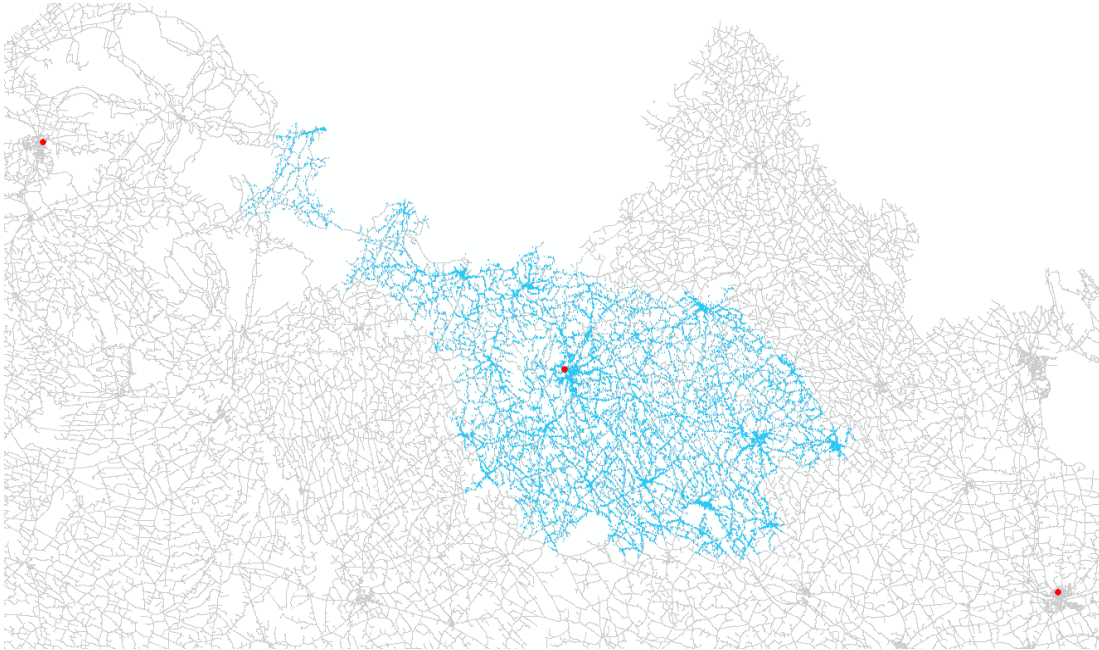


Data sources – Destination points

- Coordinates for number of service and infrastructure sourced from following:
 - Geocoding of authoritative lists
 - Data.gov.ie
 - PRIME 2 database



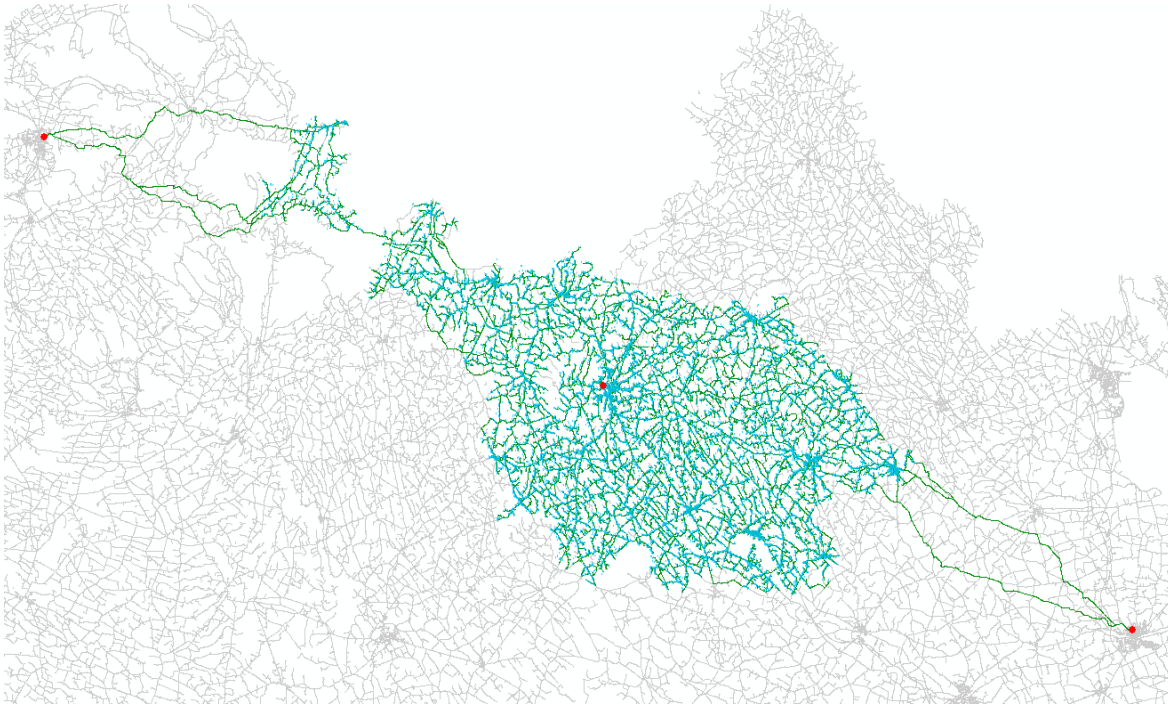
Measuring Shortest-path distance



- Python script using arcpy package
- Load in origin points by county
 - Reduces processing time
- Load in destination points



Measuring Shortest distance

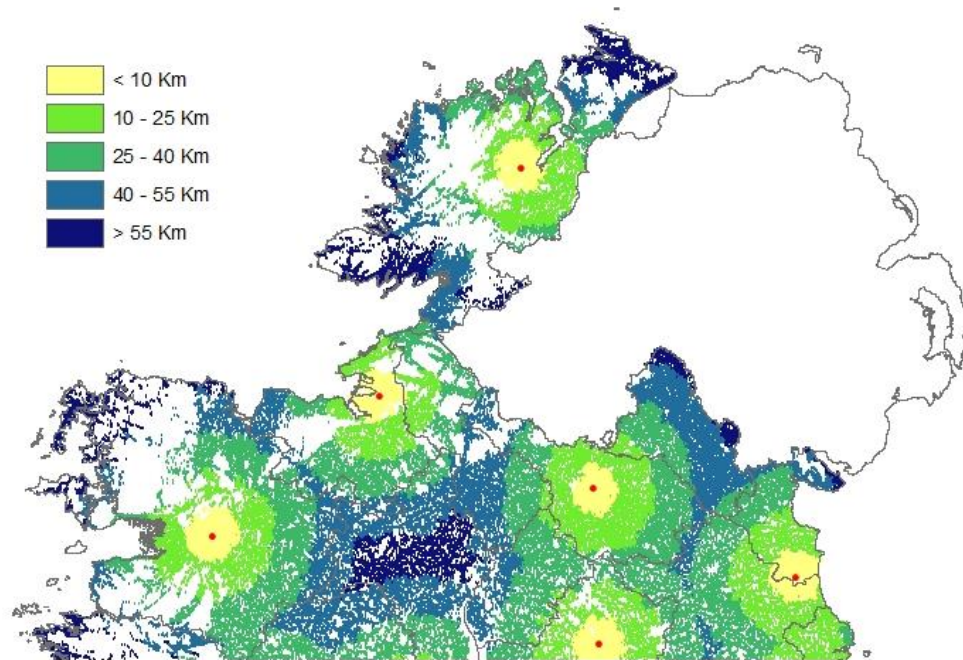


- Generate origin-destination matrix (Dijkstra's algorithm)
- Write out ID and distance of nearest destination for each origin
- Change destinations and repeat before moving to new county

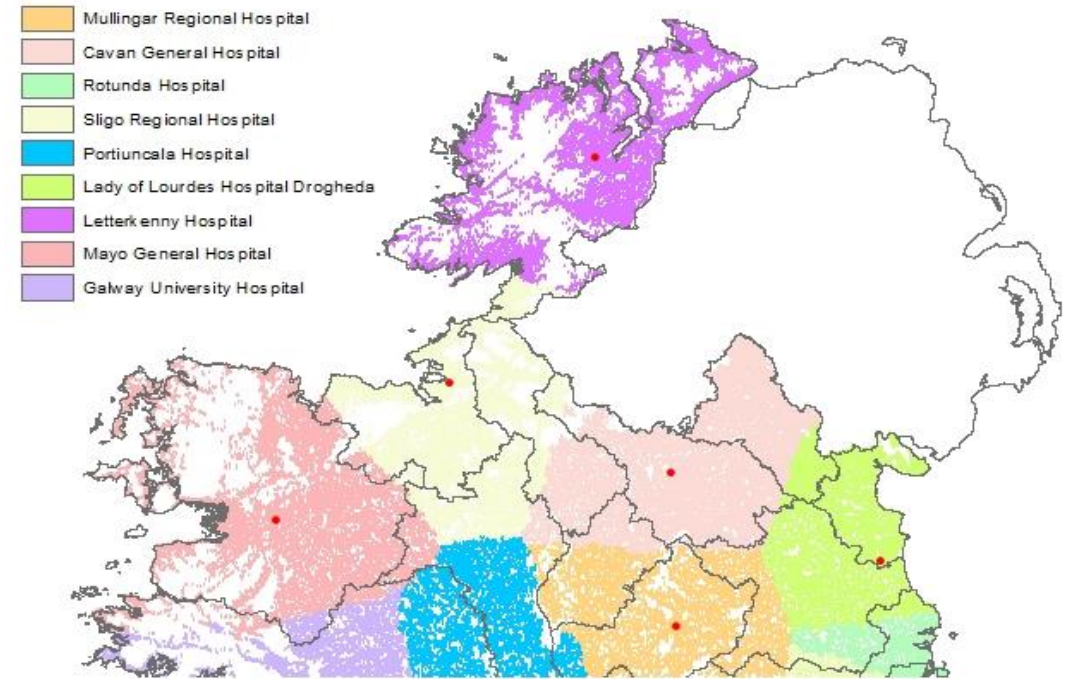


Results – proximity to Maternity Hospitals

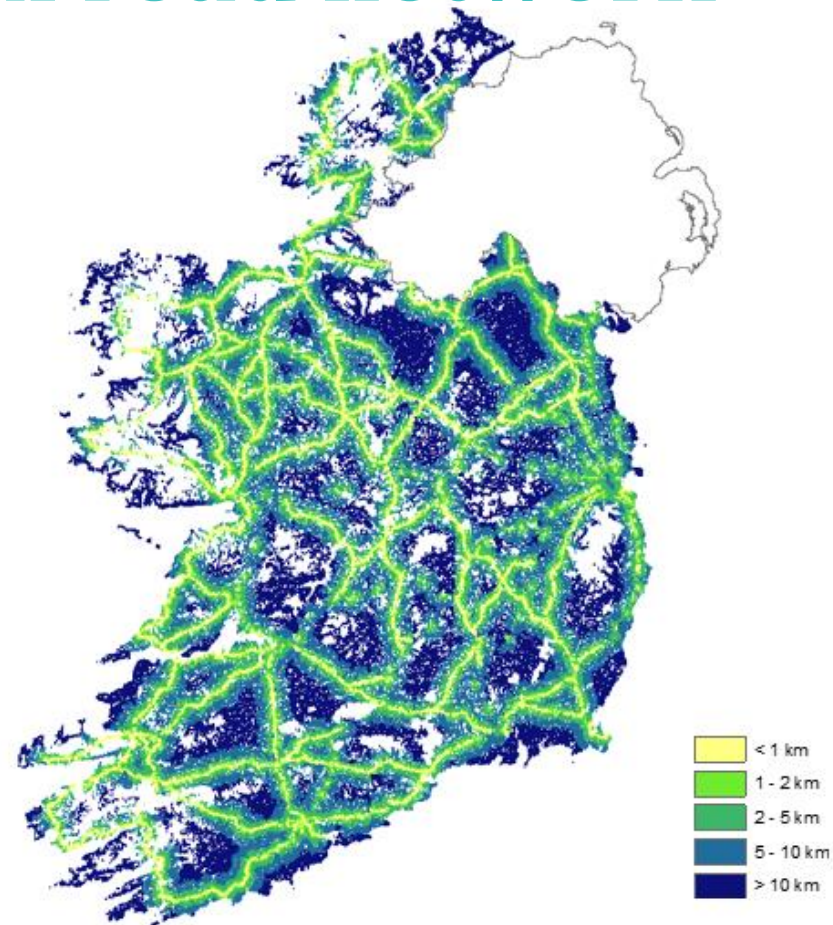
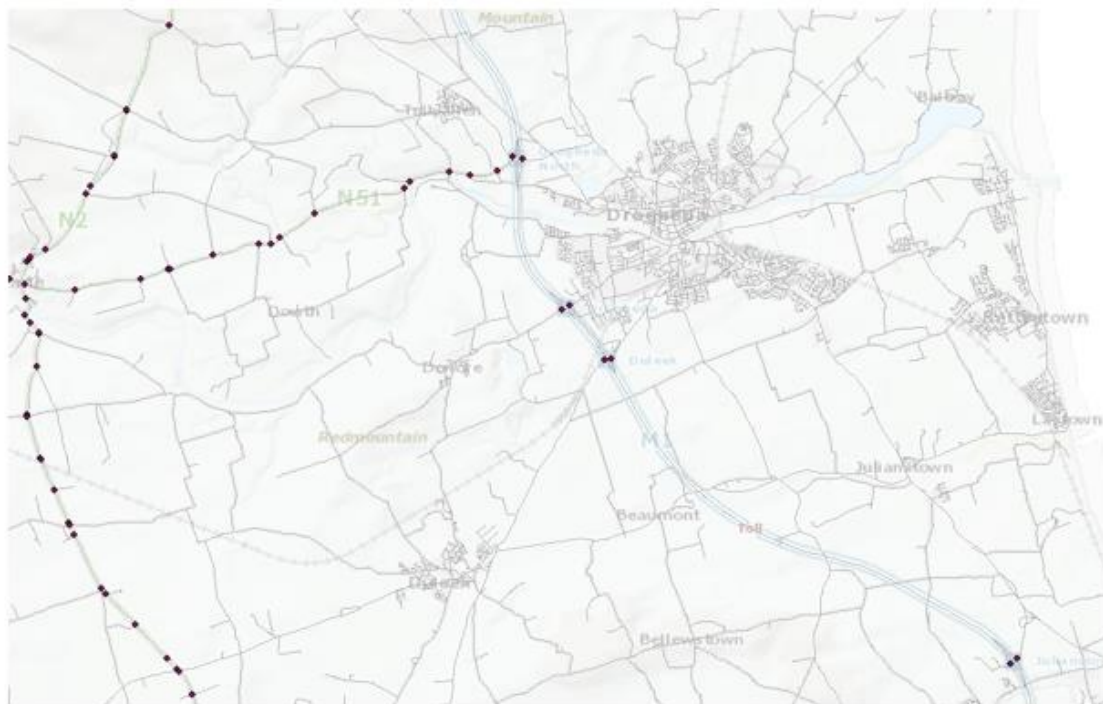
Shortest path distance to nearest Maternity Hospital



Catchment Areas of Maternity Hospitals

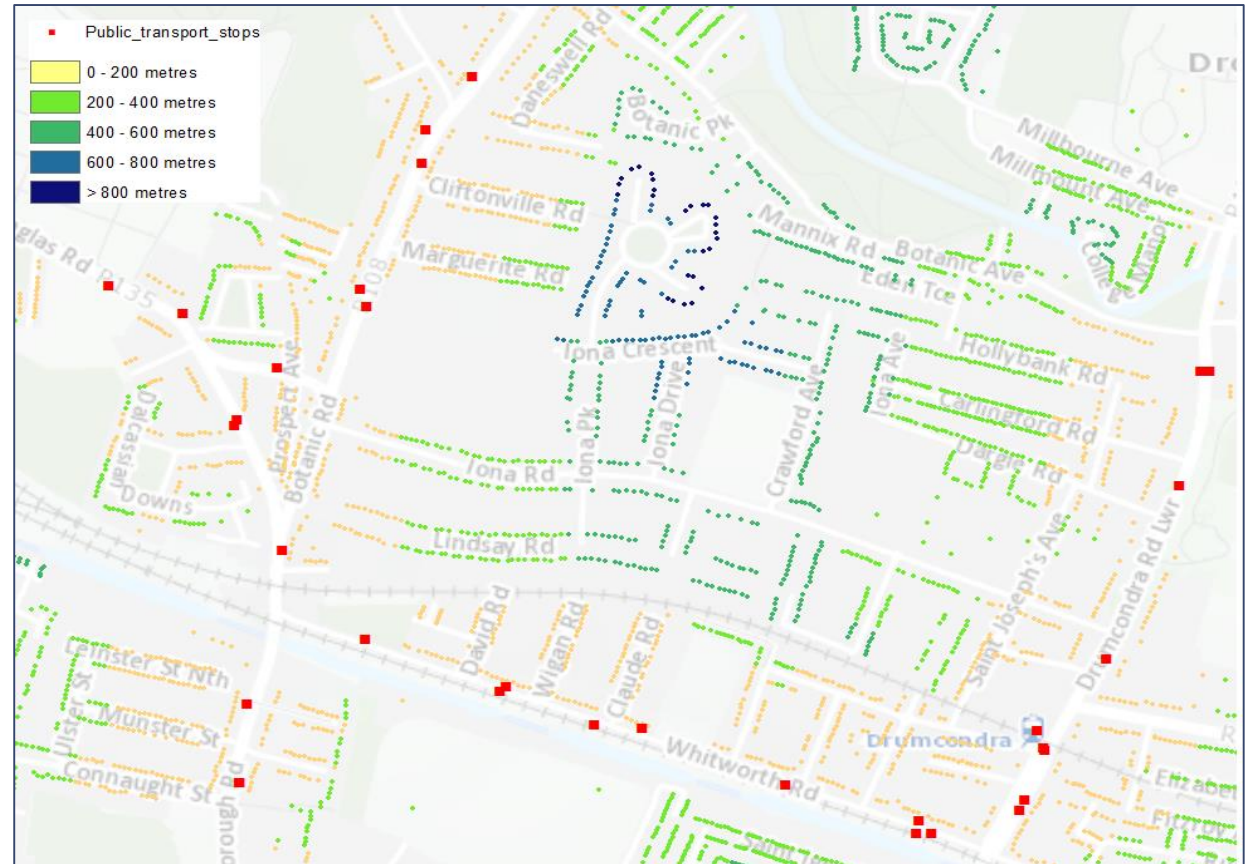


Results – proximity to national road network



Results – SDG Indicator 11.2.1

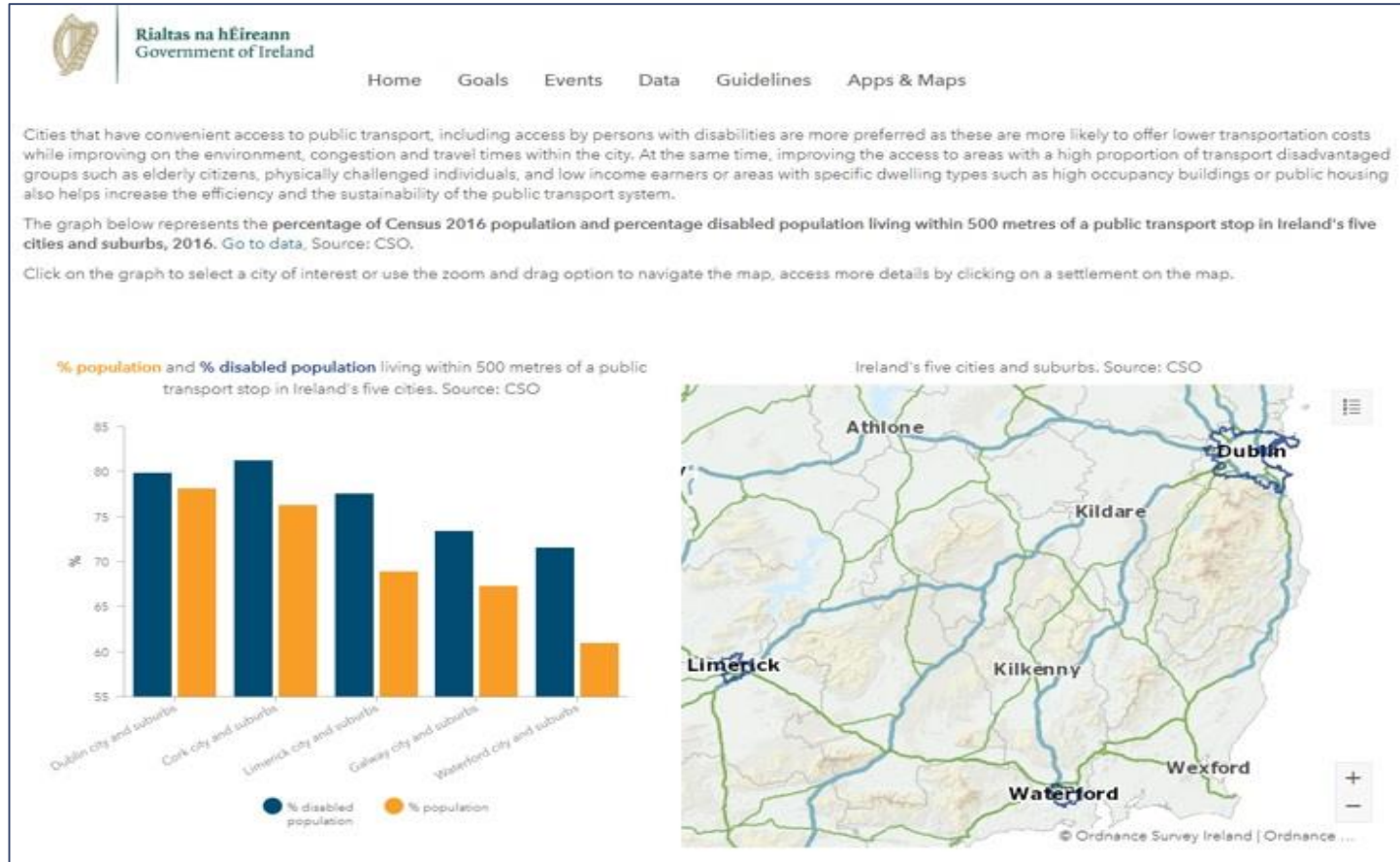
- Indicator 11.2.1
 - Proportion of population that has convenient access to public transport by sex, age and persons with disabilities
- Identify Census 2016 dwellings within 500 metres shortest distance path of frequently serviced public transport stop



Results – SDG Indicator 11.2.1



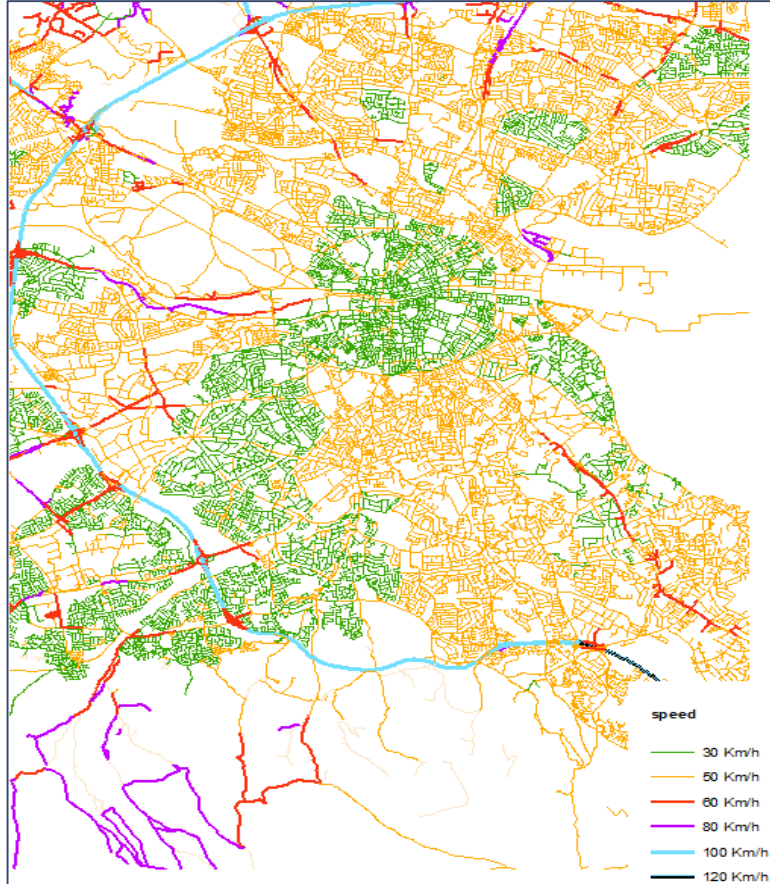
Results – SDG Indicator 11.2.1



<http://irelandsdg.geohive.ie/>



Possible future work



- Better labelling of enumerator maps
- Improved methodology for calculating travel allowance to enumerators and survey interviewers
- Calculation of travel-time (Satnav data?)
- POWSCAR work (Addition of travel distance, respondent travel time versus Satnav travel time)
- Exploration of commuting patterns from geocoded administrative sources
- Add value to pathfinder projects (Health, Education etc)
- National complementary SDG indicators
- Creation of Proximity RMFs
- Small Area Accessibility index?



Conclusion and Discussion

- Routing is now a feasible option in context of statistical processing
 - Can help measure disparities in accessibility
 - A practical reason for the Eircoding of datasets and for introducing an 'early Eircode'
- Project shows the statistical value of combining primary and secondary sources
- Challenge is to build upon existing work by integrating new data sources and by sharing knowledge





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*Thank
you*

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Pilot Area Characterisation Project

Kiera Jane O'Sullivan

Nova Sharkey

27th June 2019

Outline

- Introduction
 - Area Characterisation
 - ~~• Dashboards~~
- Demonstration
- ~~• Reflections~~





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Introduction

Area Characterisation Pilot Project

- The initial driver was to develop a product to profile the environmental characteristics of an area – both the quality of the environment and the impact of the area on its environment
- Requires a lot of environment-related data that are not yet available
- We worked with the SDG Division on a pilot project to develop the concept of an area-focussed product and explore its potential
- The aim was for a product that could work thematically – e.g. environment, education, SDGs, equality under the nine grounds (Gender, Marital status, Family status, Sexual orientation, Religion, Age, Disability, Race, Membership of the Traveller community), etc.



Area Characterisation Pilot Project

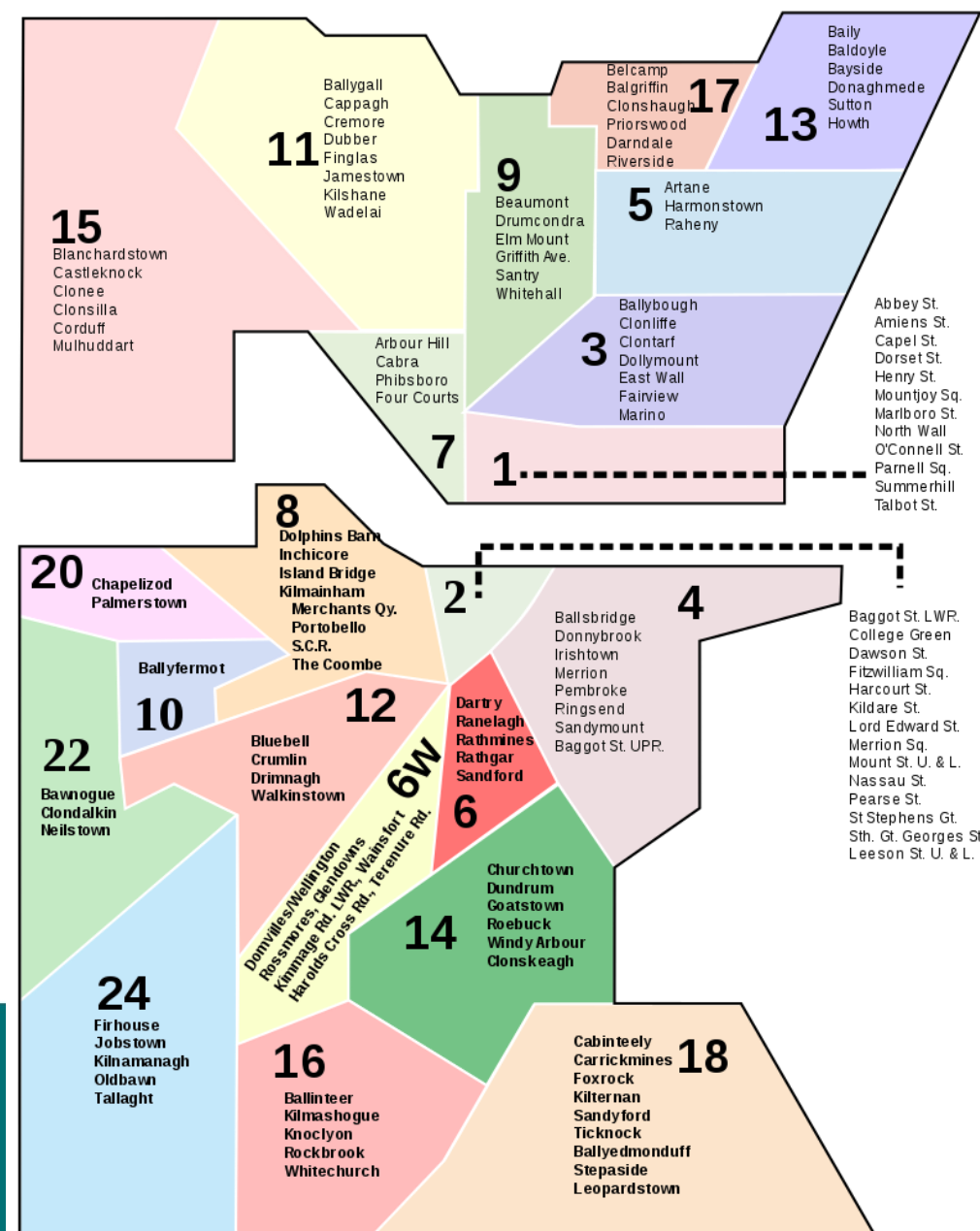
- Project started on **29th May**, with an initial meeting to agree our approach
- We wanted:
 - A small number of indicators to portray a single geographical area
 - To use a geographic area that was known and could be coded from postal addresses
 - To include a map of the area
 - A variety of charts and graphs to be visually appealing
- The inclusion of time series or comparison with national level data was considered – we would do this if time allowed



Area Characterisation

- As a first step, we looked at developing some pilot indicators for Dublin Postal Districts
- Dublin Postal Districts are well-known and very meaningful to Dubliners
- Different profiles – interesting to characterise

Dublin Postal Districts



Dublin 6



Area Characterisation

- The dashboard is designed as a one-shot image – there is no scroll down or next page option. The indicators must be chosen very carefully to enable an integrated and systematic characterisation of the area
- Different spatial scales can be used – small areas to NUTS regions
- Granularity of data (Census, survey sample, etc.) will impact the scale of the area that can be profiled/characterised
- Different indicators may be appropriate for different spatial scales
- Characterisation of rural areas would need appropriate indicators – urban/rural split



Data Sources

- Wide variety of survey and administrative data available to CSO but shortage of geocoded and small area coded data
- Preferred option is to use a well-known geography that can be extracted from detailed address strings
- With a small amount of work both county and Dublin postal district can be extracted from address registers
- This was done with the water and gas meter data and with the Building Energy Ratings data
- Could be done for the Business Register and Revenue and Social Protection registers etc.
- Eircodes will make more flexible geography possible but most registers are still only around 60% coded



Indicators

- Under the Statistics Act, 1993, the CSO can access confidential data containing addresses. This means the CSO can add dashboard geography to data sources that are not available as open data, and can use the most appropriate data to produce meaningful indicators
- Short-listed 8 indicators for the purposes of the pilot project – these are **not** meant to be definitive in any way
- Emphasis on producing output from the pilot to obtain feedback on worthwhileness of the approach
- As work progressed, the dashboard became the preferred medium to display all the indicators on one screen



How to select indicators

- Choose a few areas that you are familiar with and identify indicators that distinguish them e.g. residential or commercial
- Indicators can portray an area at a point in time or over time
- There is a lack of historical data coded at the Dublin Postal District level
- Indicators should be complementary rather than over-lapping
- Dwelling type and age are a good indication of the energy efficiency of a building
- % of persons aged 25-64 living and working/studying in the same area
- Commuting modes/distances



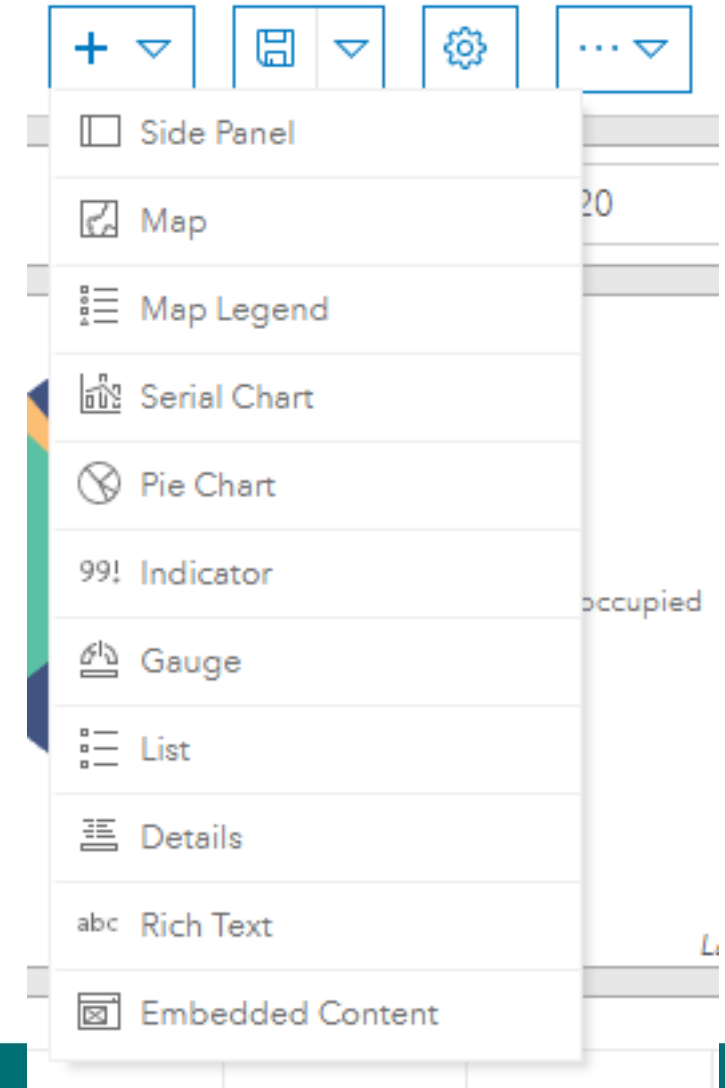
Dashboard

- A way to see, at a glance, the characteristics of importance of an area – a broad picture in one view
- Multiple visualisations that work together on a single screen
- Using charts or graphs helps humans to visualise large amounts of complex data
- Interactive – users can select an area of interest – e.g. Carlow, Dublin 12
- Intuitive – can easily flag data indicating ‘bad’ or ‘good’ status – e.g. red or green



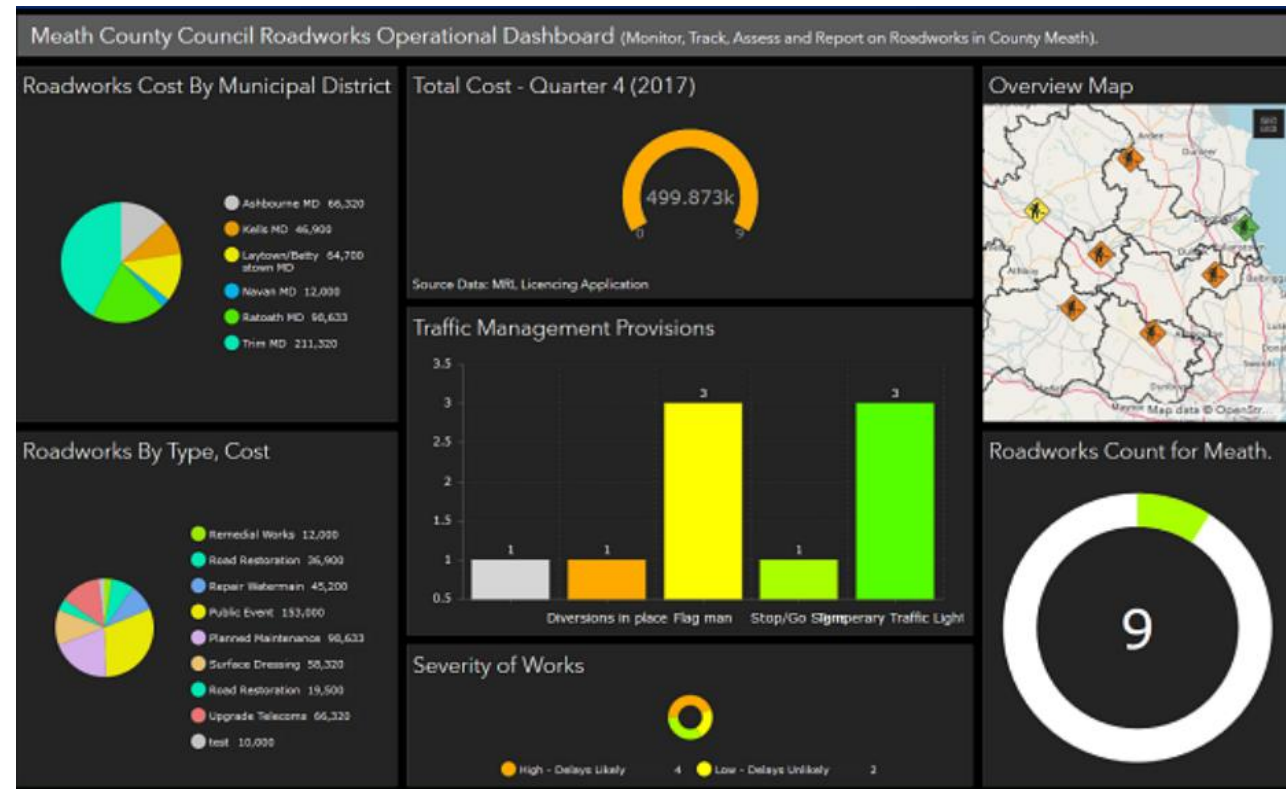
ArcGIS Operations Dashboard

- Dashboards in the ArcGIS Platform
 - Data display typically includes a map or spatial context
 - Different options available to create dashboard
 - Requires training in GIS to realise full potential of the dashboard and mapping tool



Other organisations

- Meath County Council – Roadworks Operations Dashboard





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Demonstration

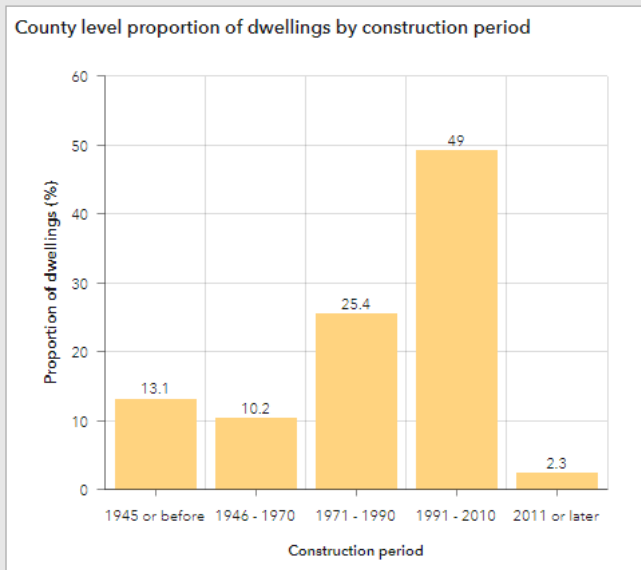
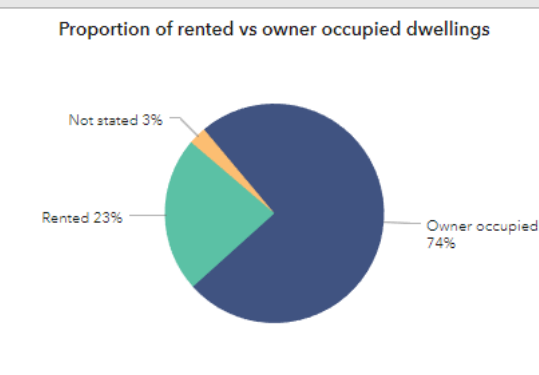
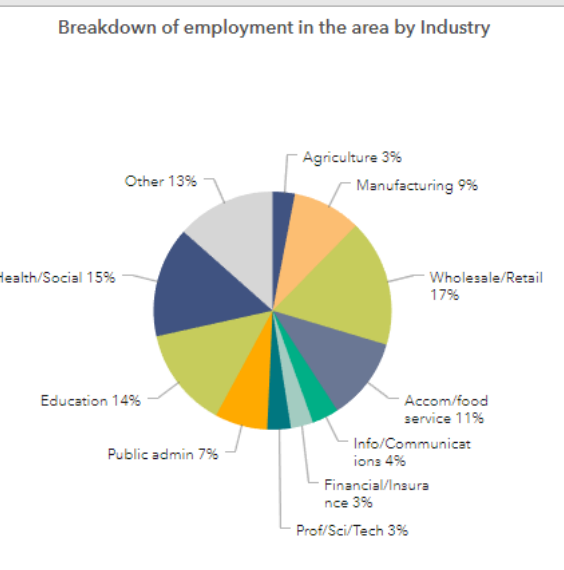
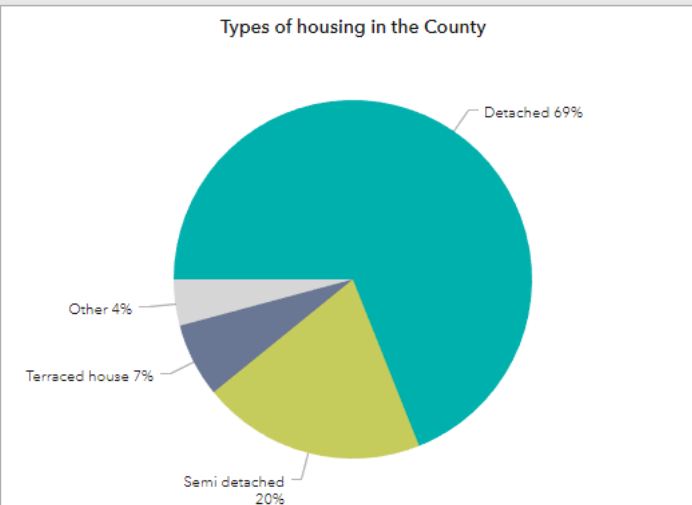
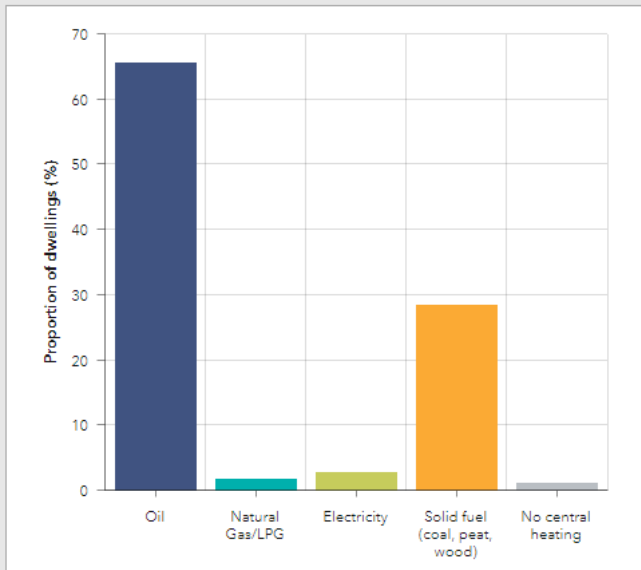
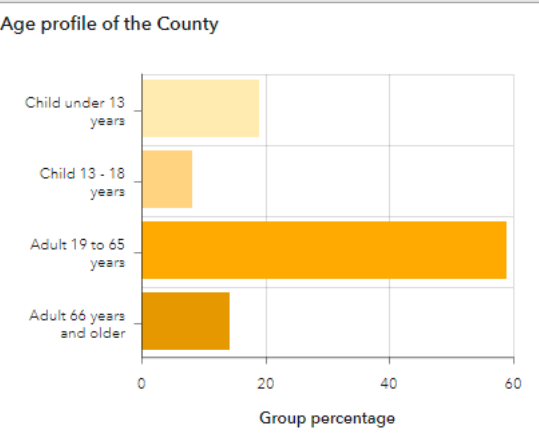


Population 2016

Population of Donegal

159,192

33 persons/km2

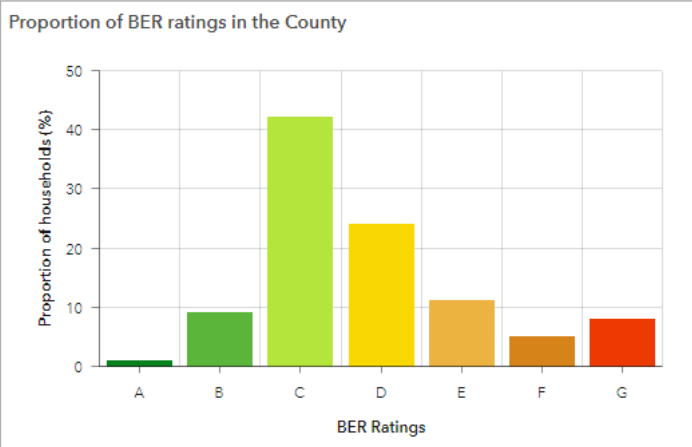


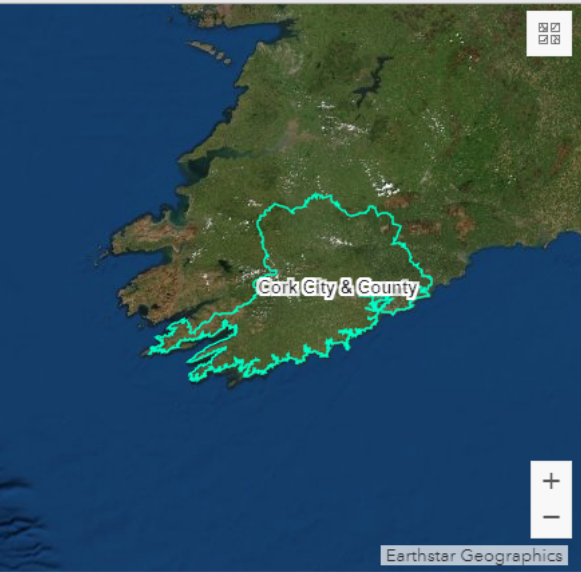
Number of BER certified dwellings

24,877

Average age of certified dwellings: 29 years

Last update: a few seconds ago





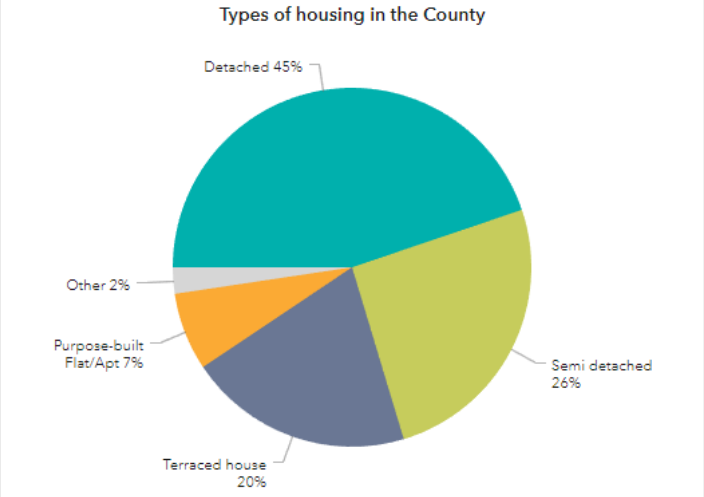
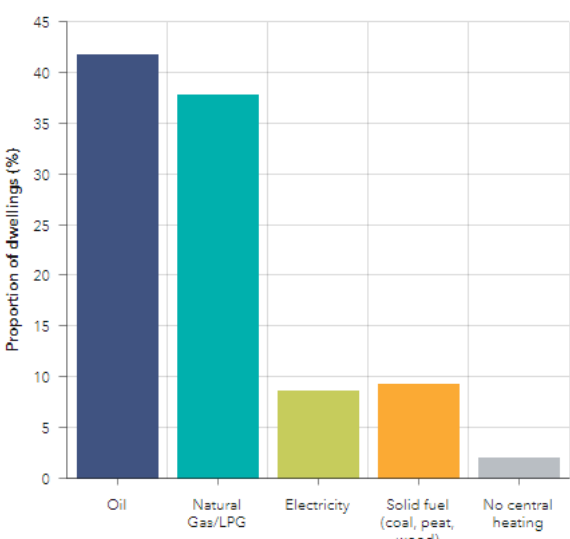
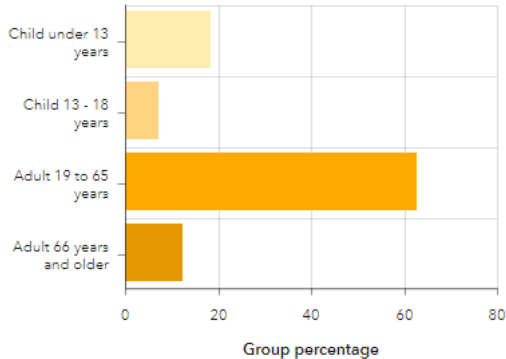
Population 2016

Population of Cork City & County

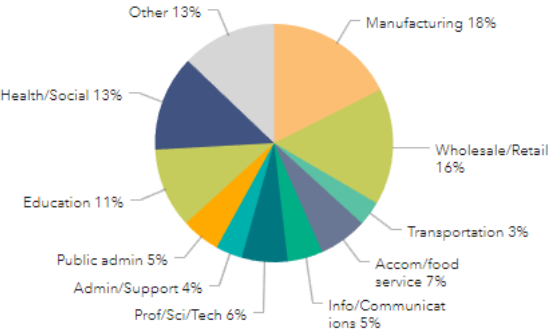
542,880

72 persons/km2

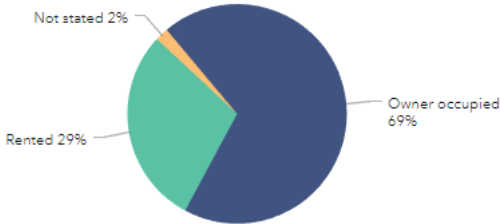
Age profile of the County



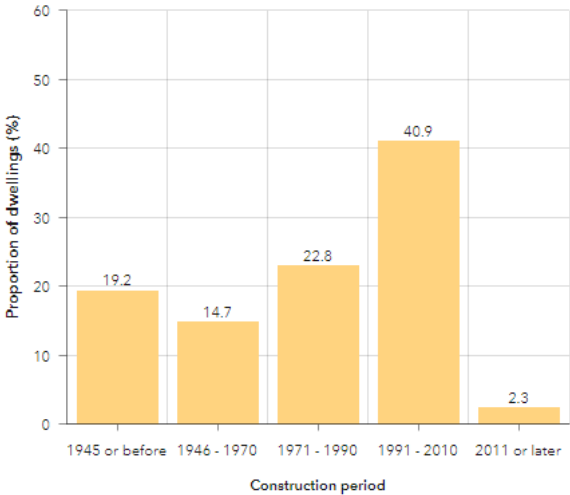
Breakdown of employment in the area by Industry



Proportion of rented vs owner occupied dwellings



County level proportion of dwellings by construction period



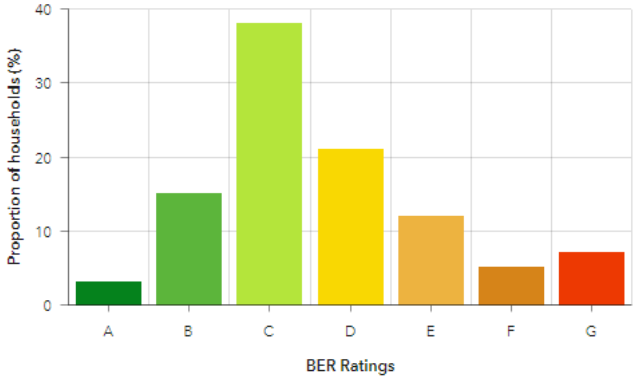
Number of BER certified dwellings

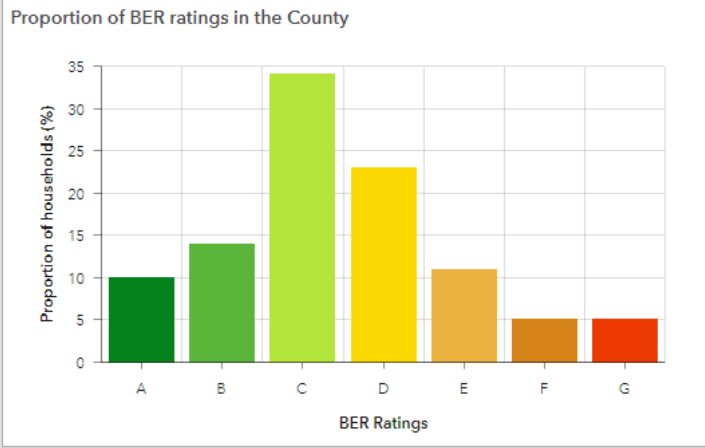
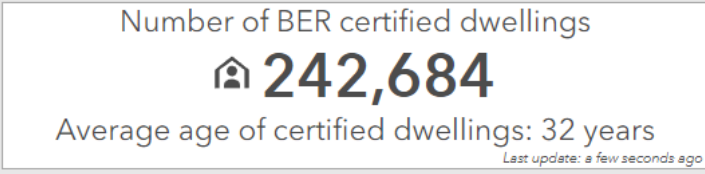
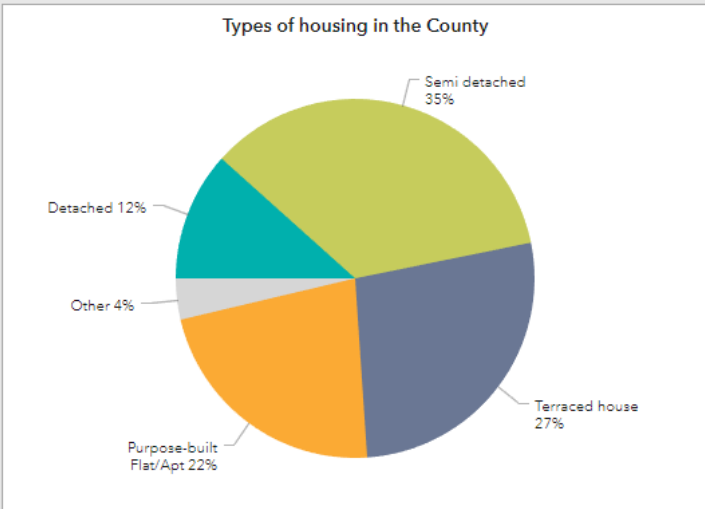
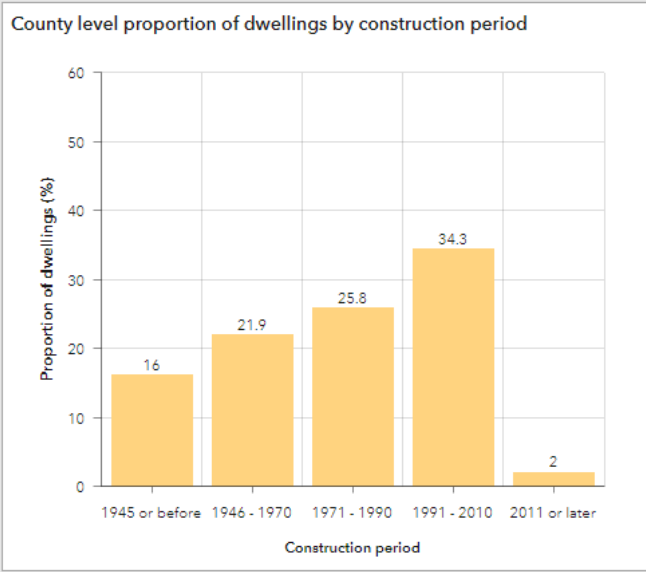
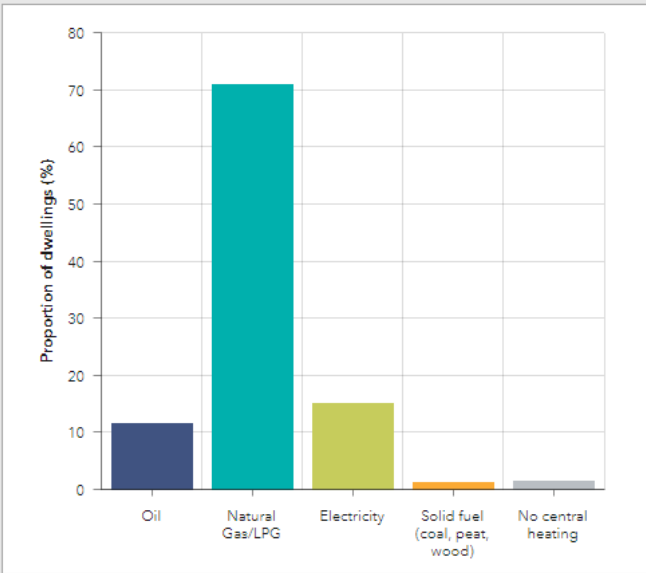
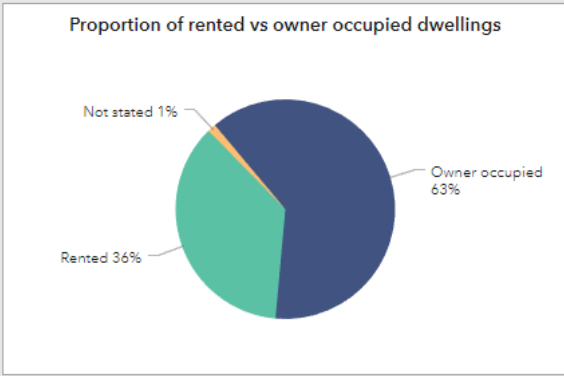
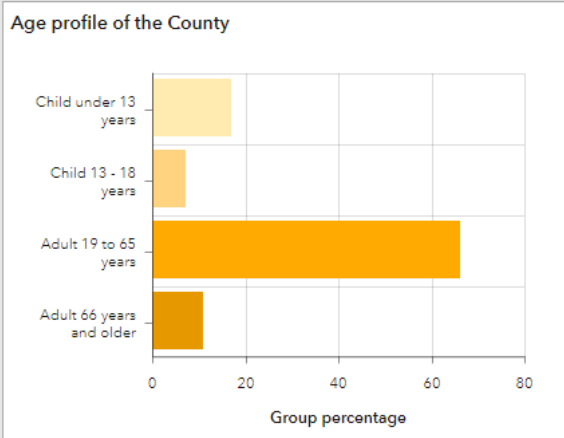
93,931

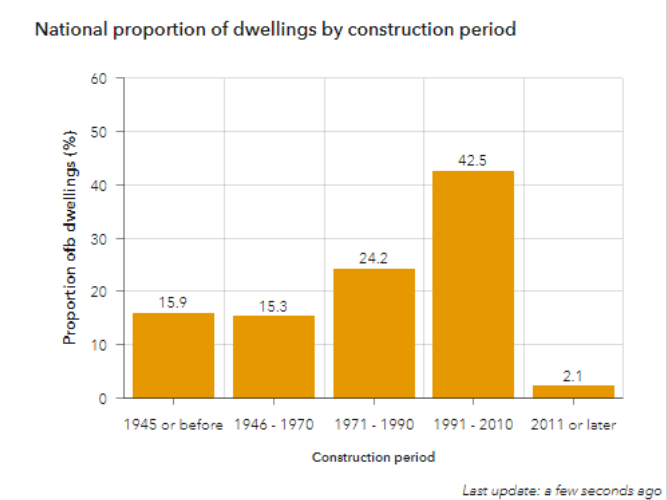
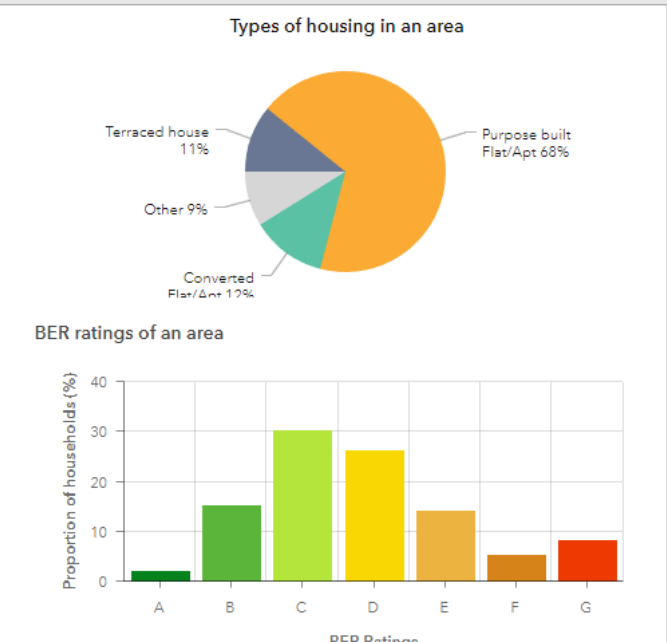
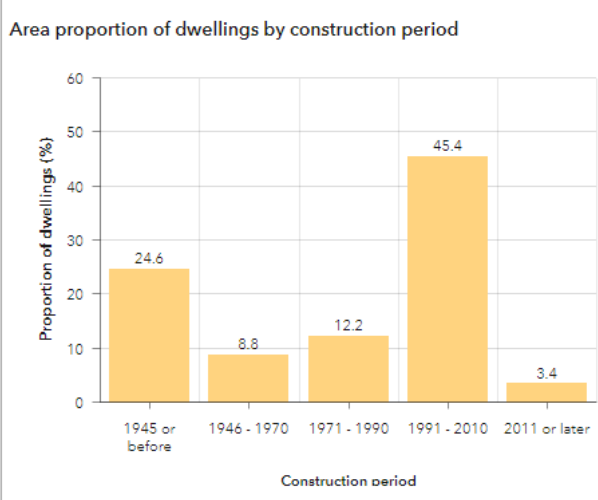
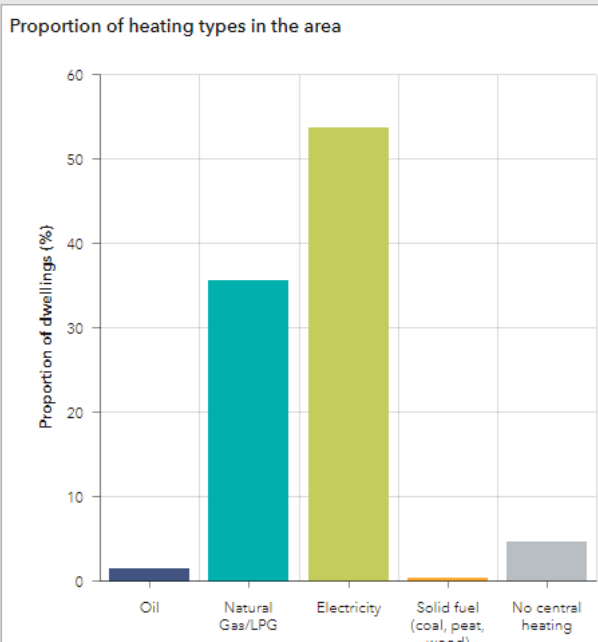
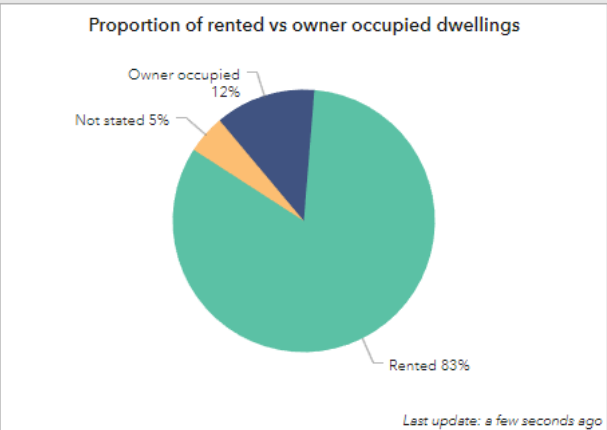
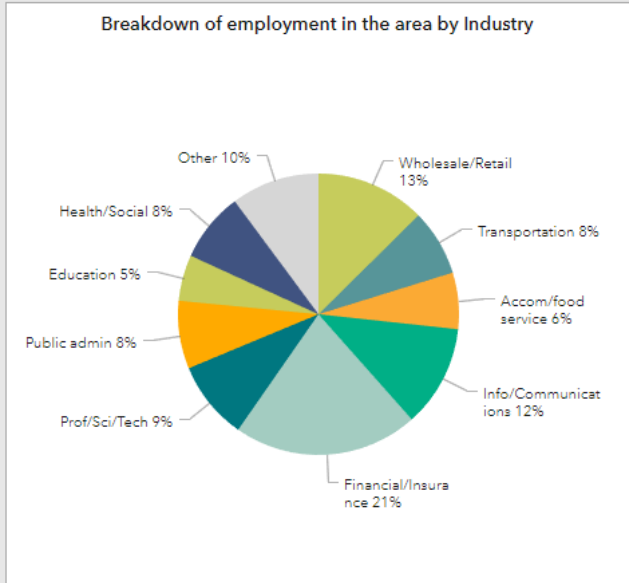
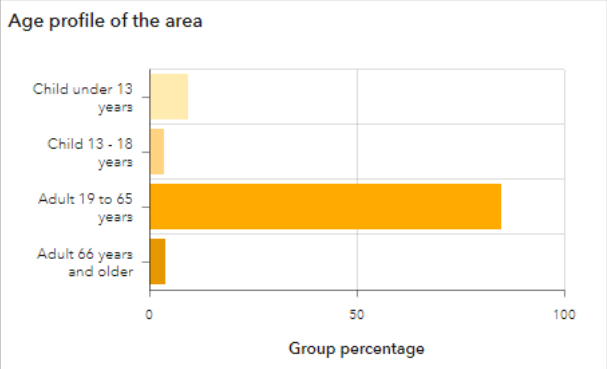
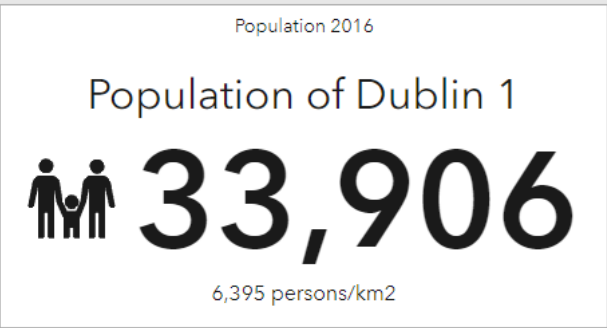
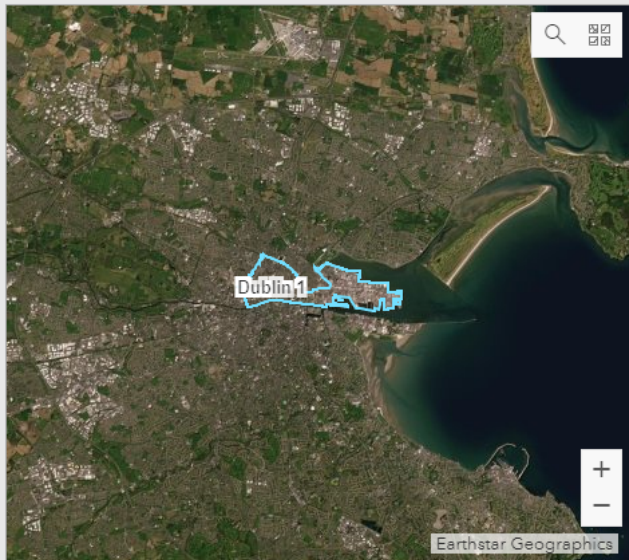
Average age of certified dwellings: 39 years

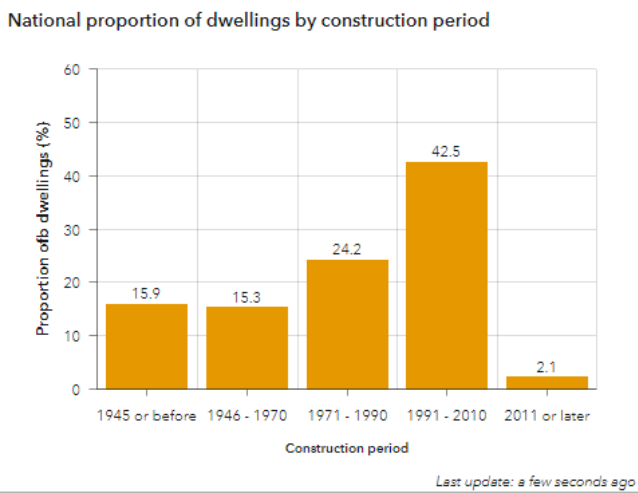
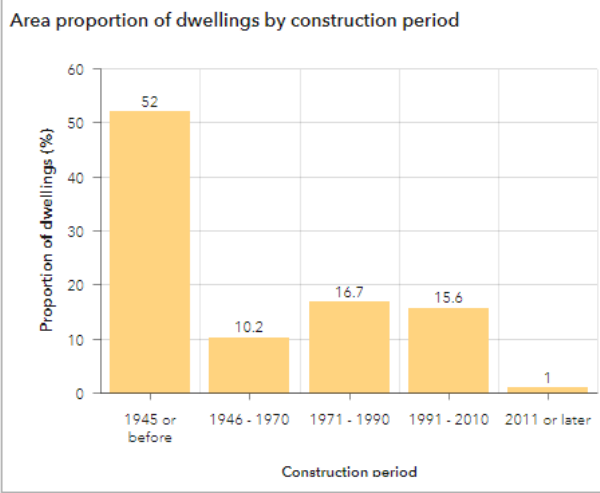
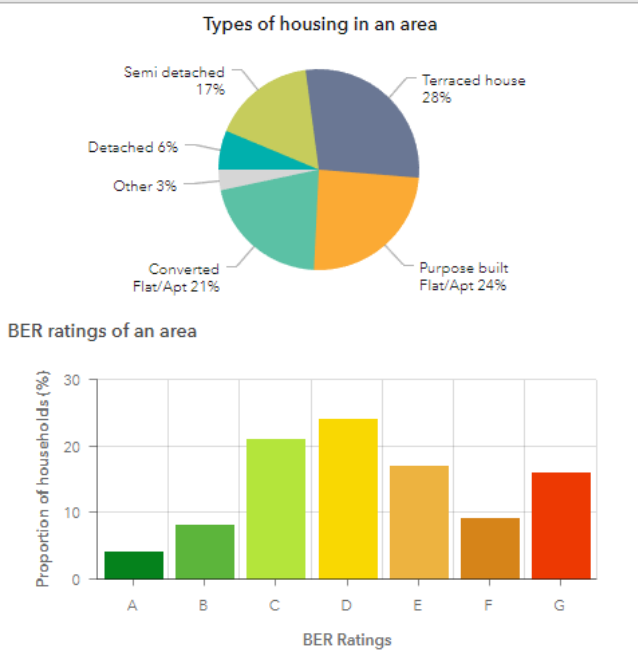
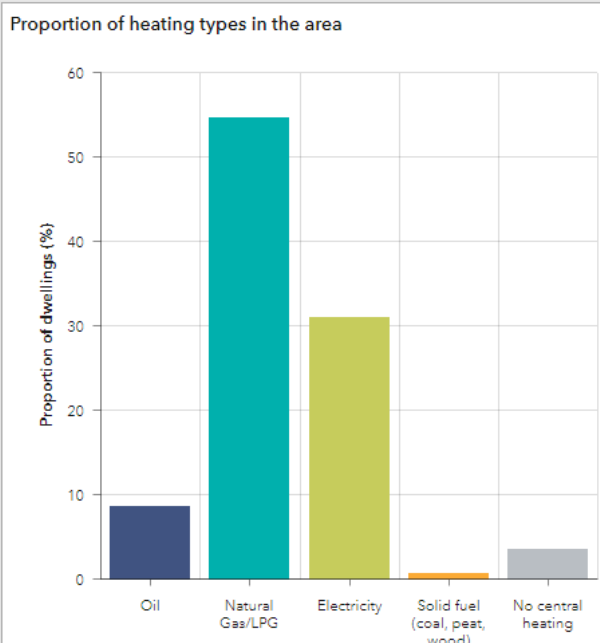
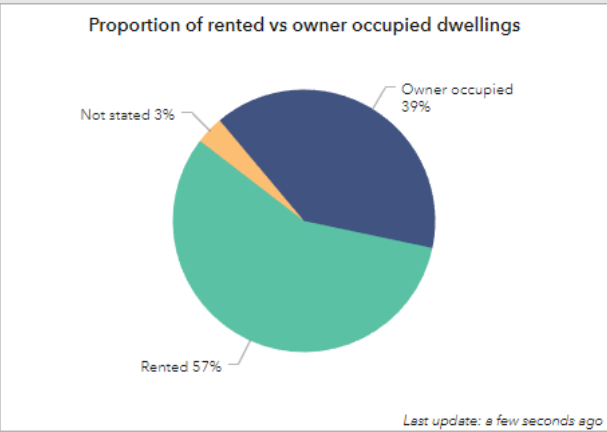
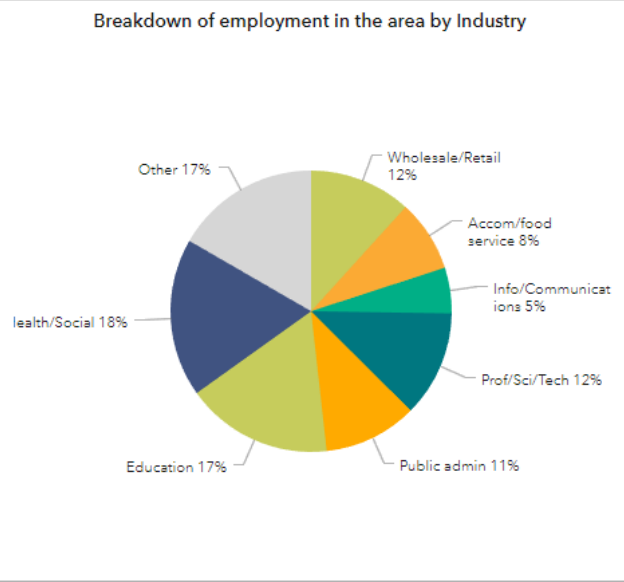
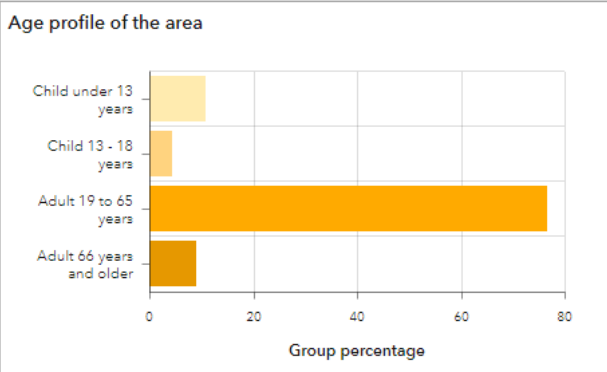
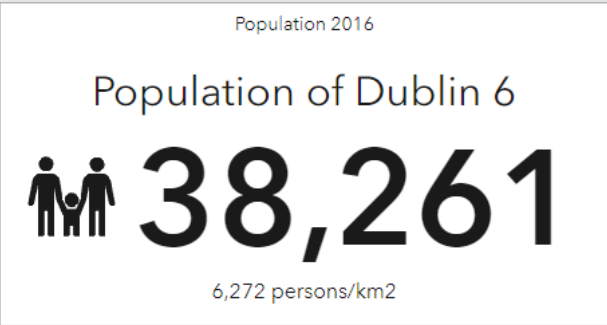
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Proportion of BER ratings in the County



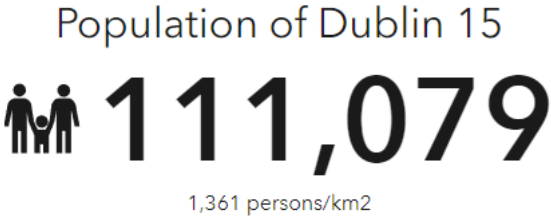




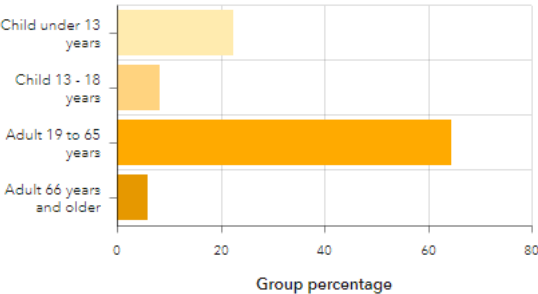




Population 2016

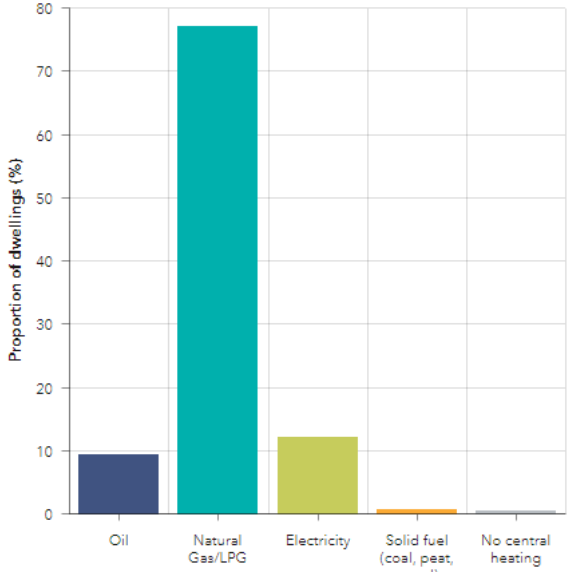


Age profile of the area

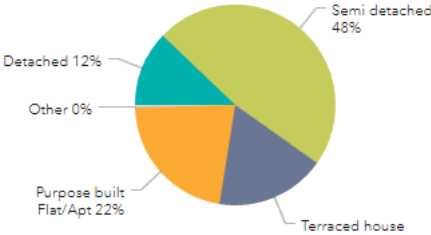


Last update: a few seconds ago

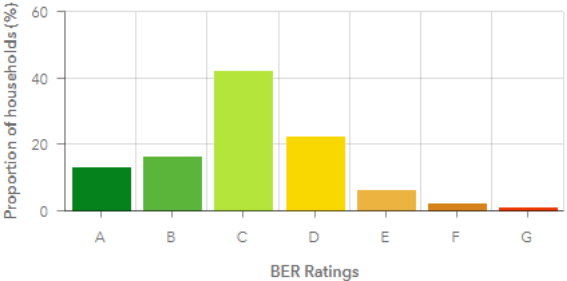
Proportion of heating types in the area



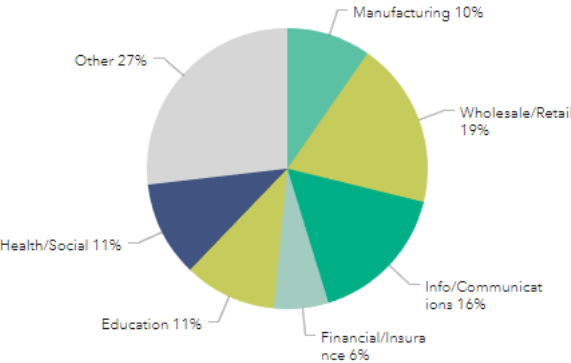
Types of housing in an area



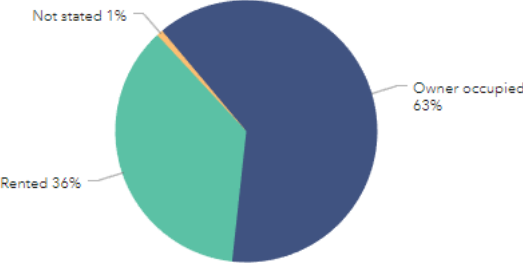
BER ratings of an area



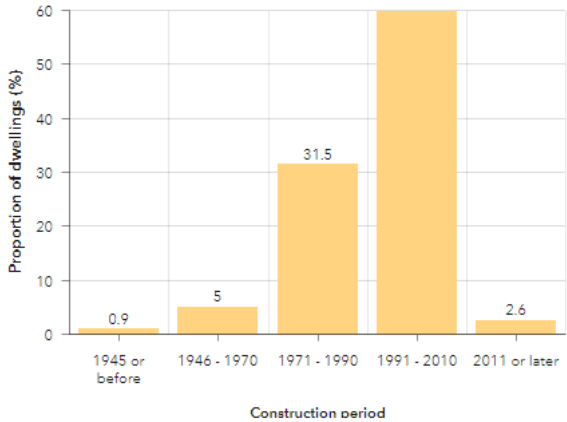
Breakdown of employment in the area by Industry



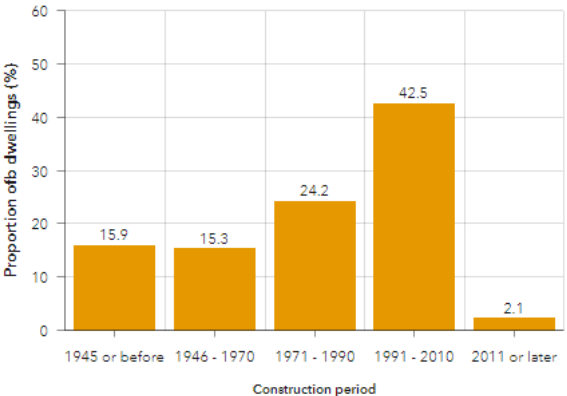
Proportion of rented vs owner occupied dwellings



Area proportion of dwellings by construction period

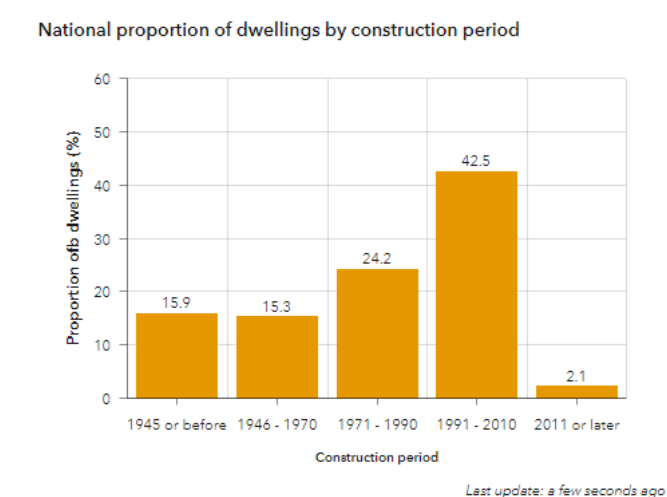
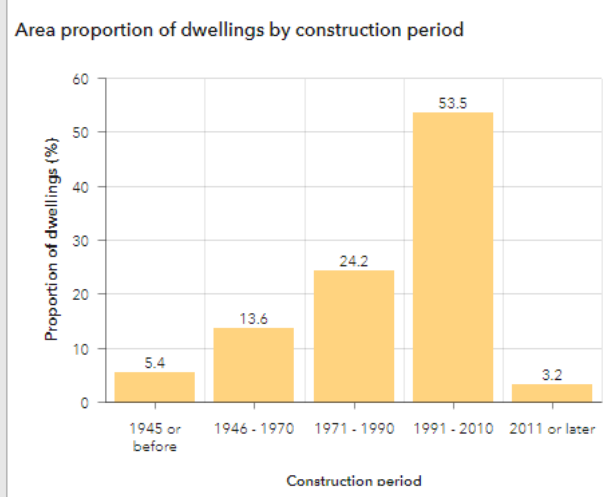
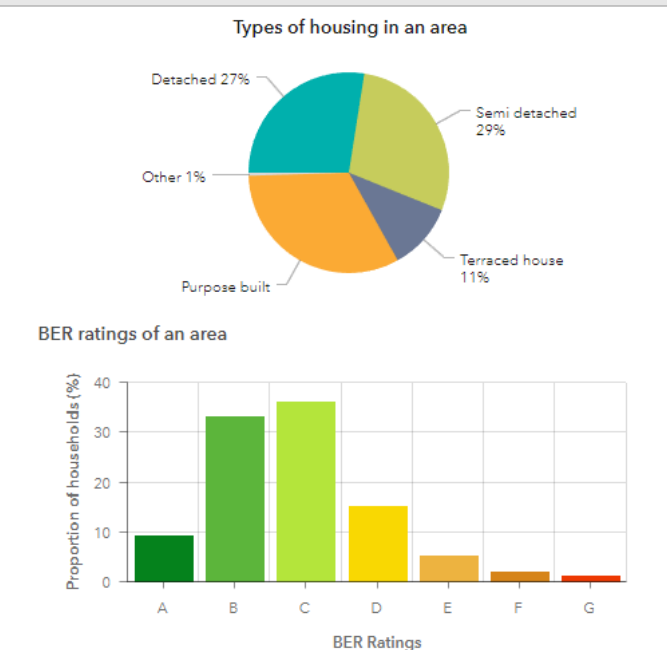
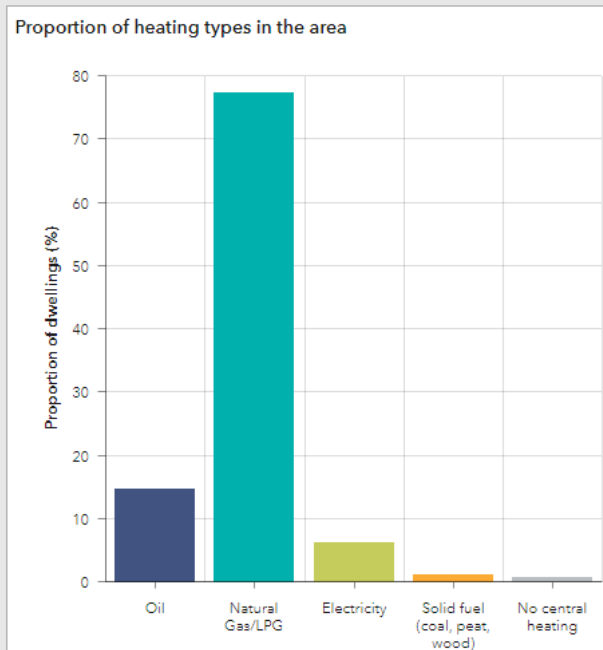
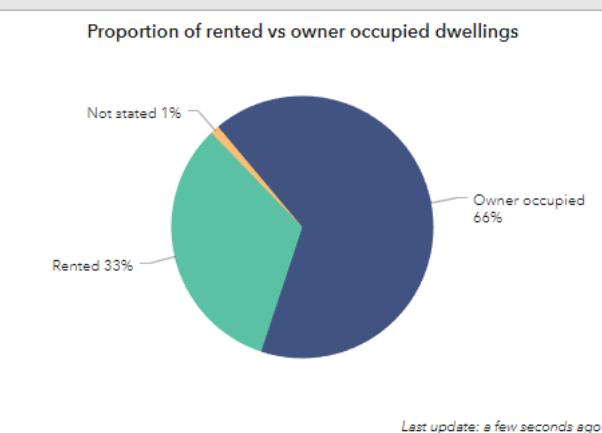
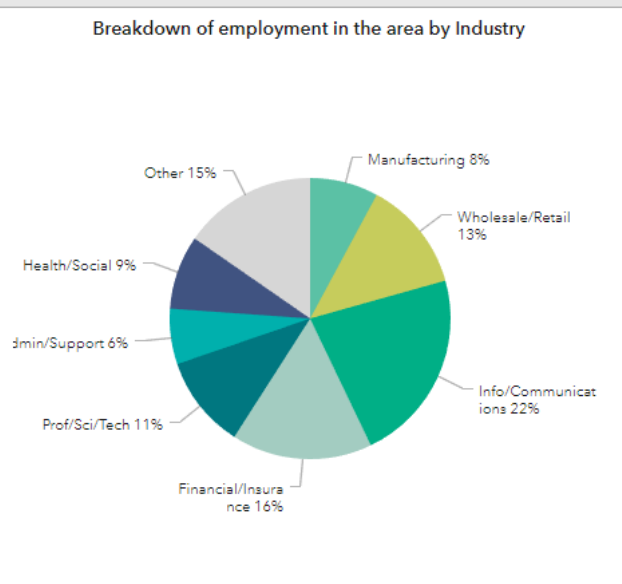
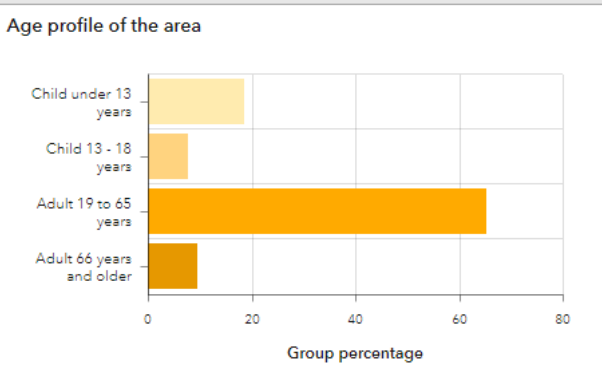
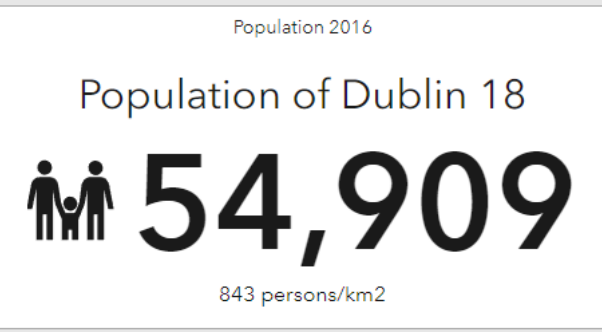


National proportion of dwellings by construction period



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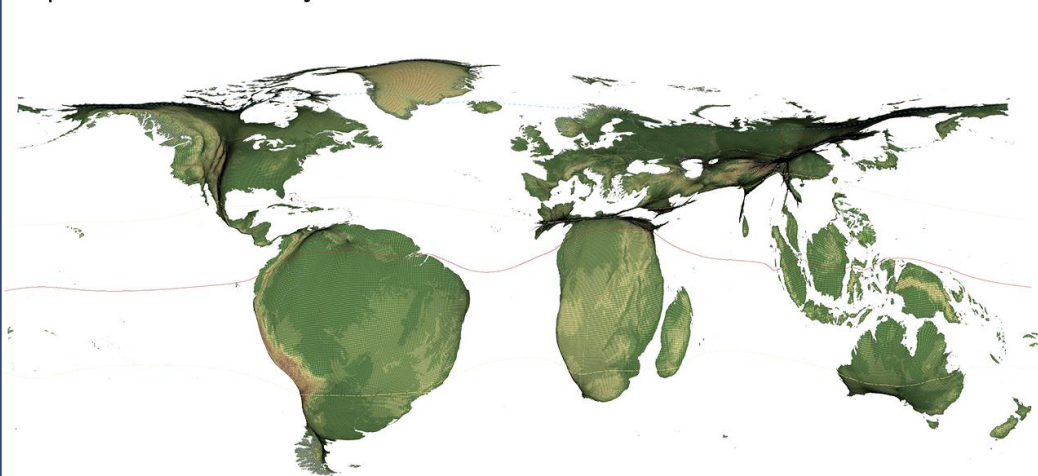


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Thanks for your attention

Precipitation Distribution January



Niederschlagsverteilung Januar

Benjamin Hering
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