

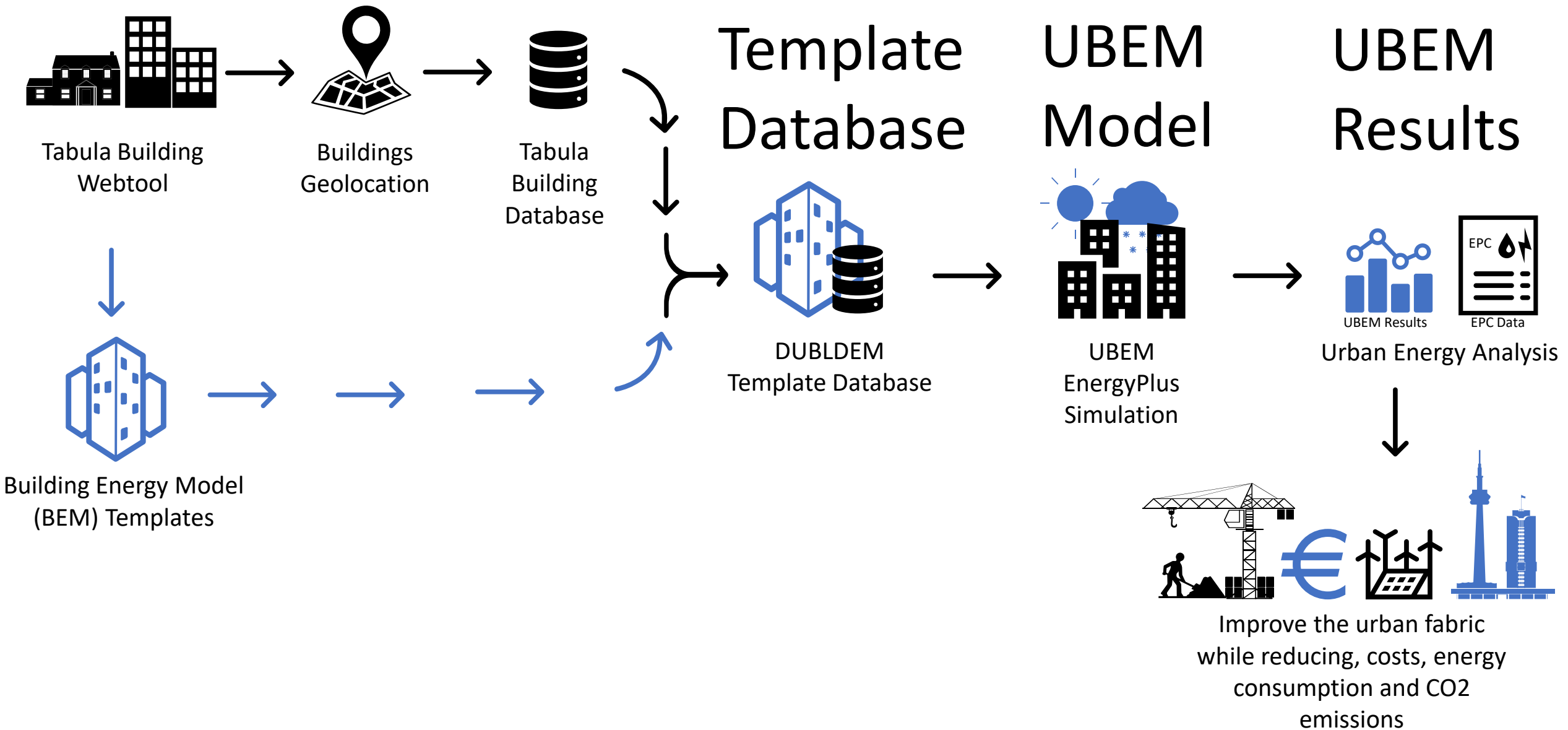
# Using an Urban Building Energy Modelling Towards a Carbon-Neutral Neighbourhood: A case study of Dublin Ireland

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EGU 27/04/2021

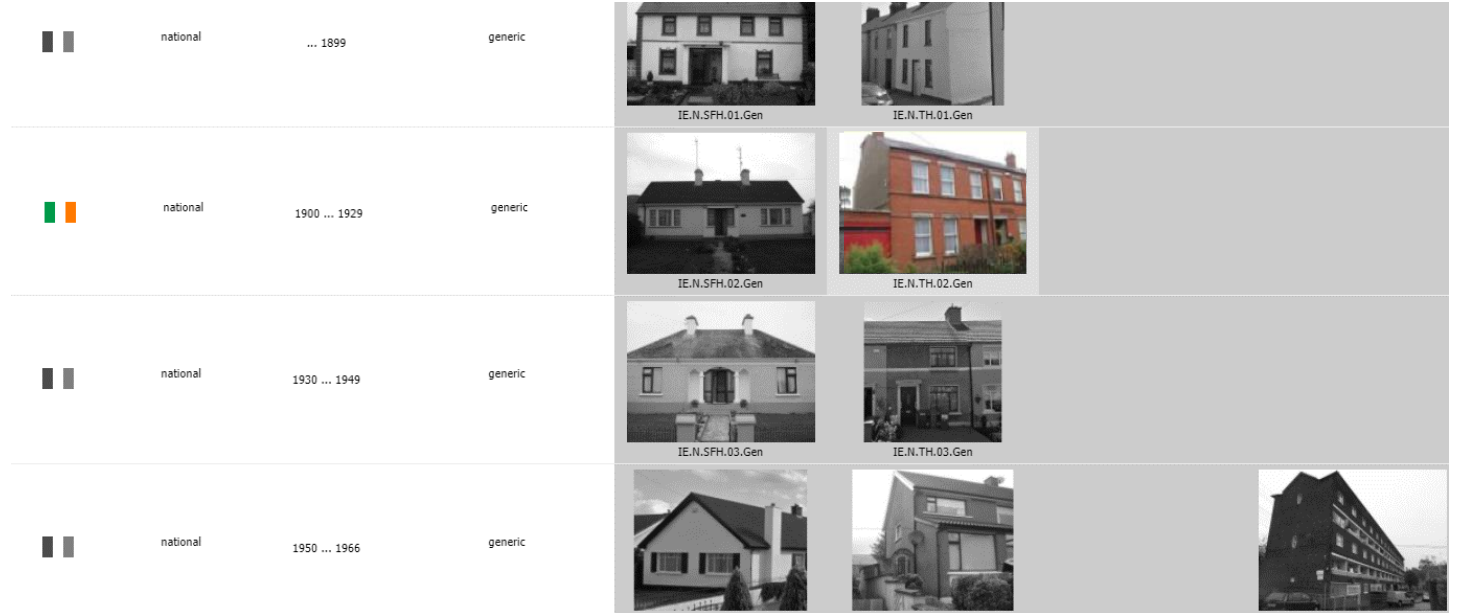


# Dublin Building Database (DUBLD)



# Tabula Webtool

- Building Type
- Building Fabric
- Heating/ Cooling System (HVAC)
- Energy Use Intensity (EUI, kWh/m<sup>2</sup>/year)



TABULA

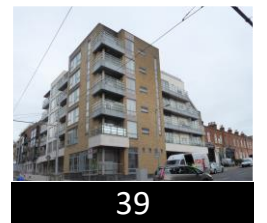
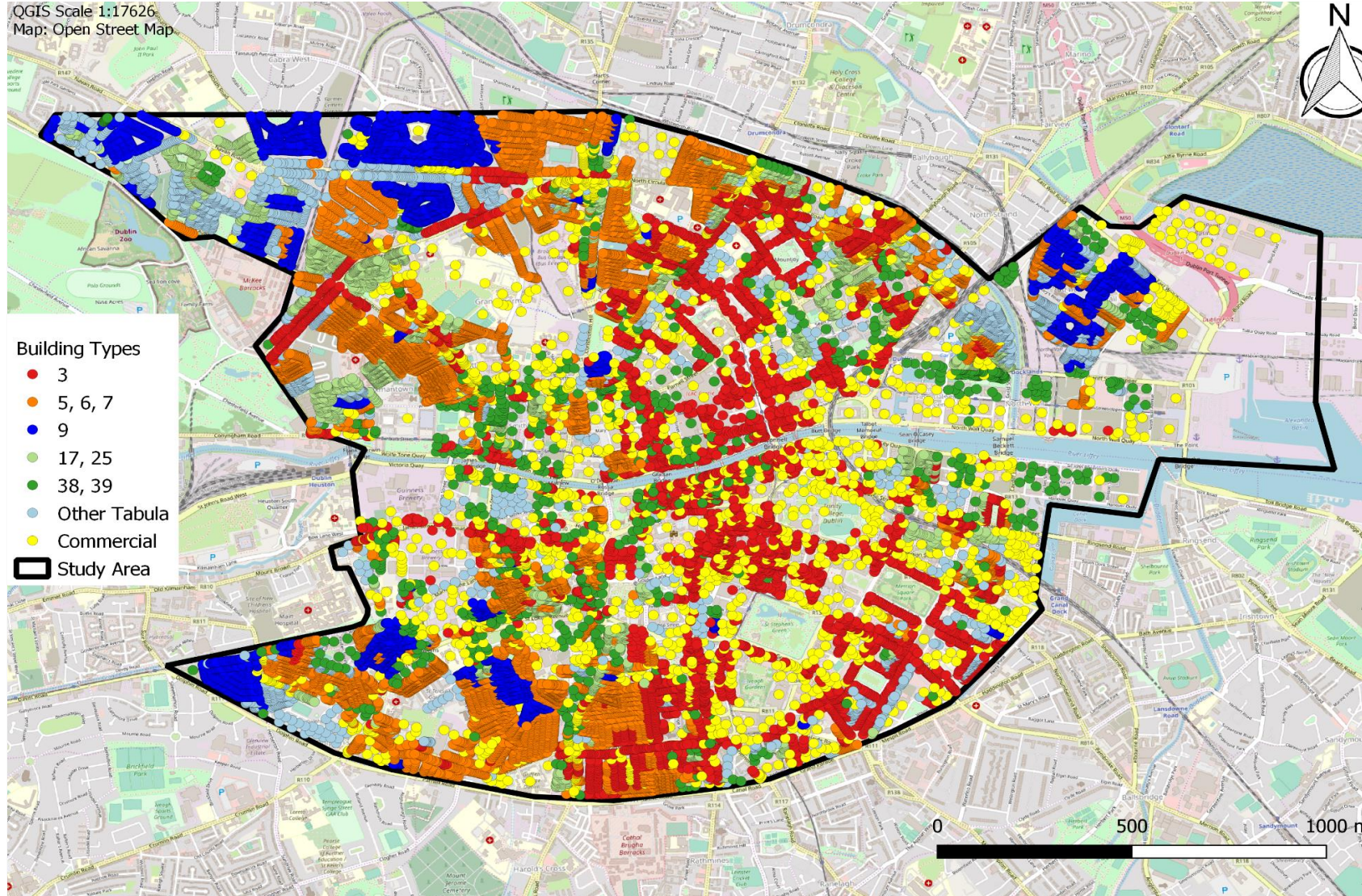
7. Terraced house, solid brick wall, 1900-1929

Building elements:		Insulation	U - value
<b>Walls</b>	Solid brick, 325 mm	none	1.64
<b>Roofs</b>	Pitched, insulation between joists	50 mm	0.68
<b>Floors</b>	Suspended timber floor	none	0.69
	Solid floor (kitchen)	none	0.79
<b>Windows</b>	Single glazed, wooden frame	N/A	4.8
	Single glazed, metal frame	N/A	5.7
<b>Doors</b>	Solid timber	none	3.0
Heating systems characteristics:		Fuel	Efficiency
<b>Primary</b>	Central heating boiler, pipe work un-insulated	Mains gas	65%
<b>Secondary</b>	Open fire in grate	Smokeless	30%
<b>Hot water</b>	From primary heating system. Electric immersion used in Summer.		
<b>Cylinder</b>	Insulated with 25mm lagging jacket, no cylinder thermostat.		
<b>Controls</b>	Programmer only		

**Description:**  
 Typical redbrick house found in Dublin, Cork, Limerick etc from late 1800s up to 1930s. Often includes a flat roof extension to rear. Suited to a mix of internal and external wall insulation. Suspended timber floors are common that can be retrofitted with insulation.

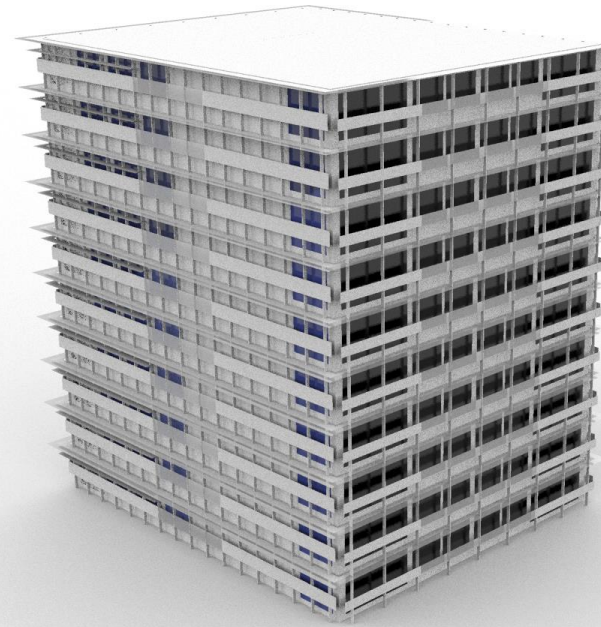
# GIS Dublin Building Database (DUBLD)

## Tabula Building Archetypes

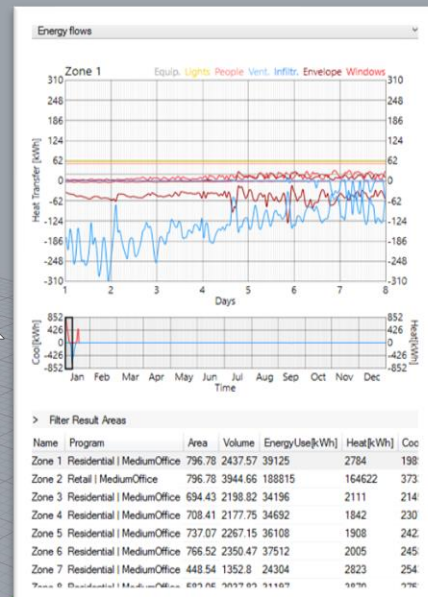
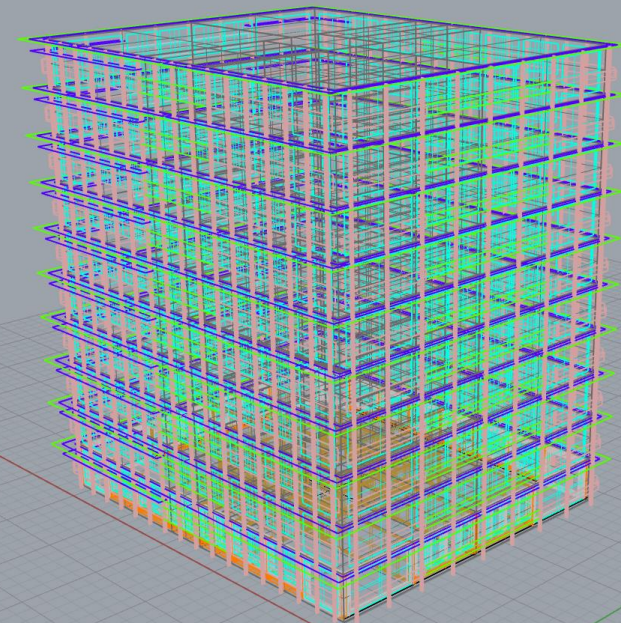


# Building Energy Model (BEM)

- BEMs simulate EUI for existing and conceptual buildings
- Produce high temporal resolution energy data
- Need thermophysical and geophysical properties to work
- Generally applied to standalone buildings due to computational limitations
- Now UBEMs can simulate multiple building stock with advanced algorithms and computational power



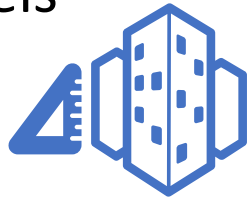
**Create UBEM Template With BEM model**



# Urban Building Energy Model (UBEM)

## Multi-building simulation

1. Massing Models



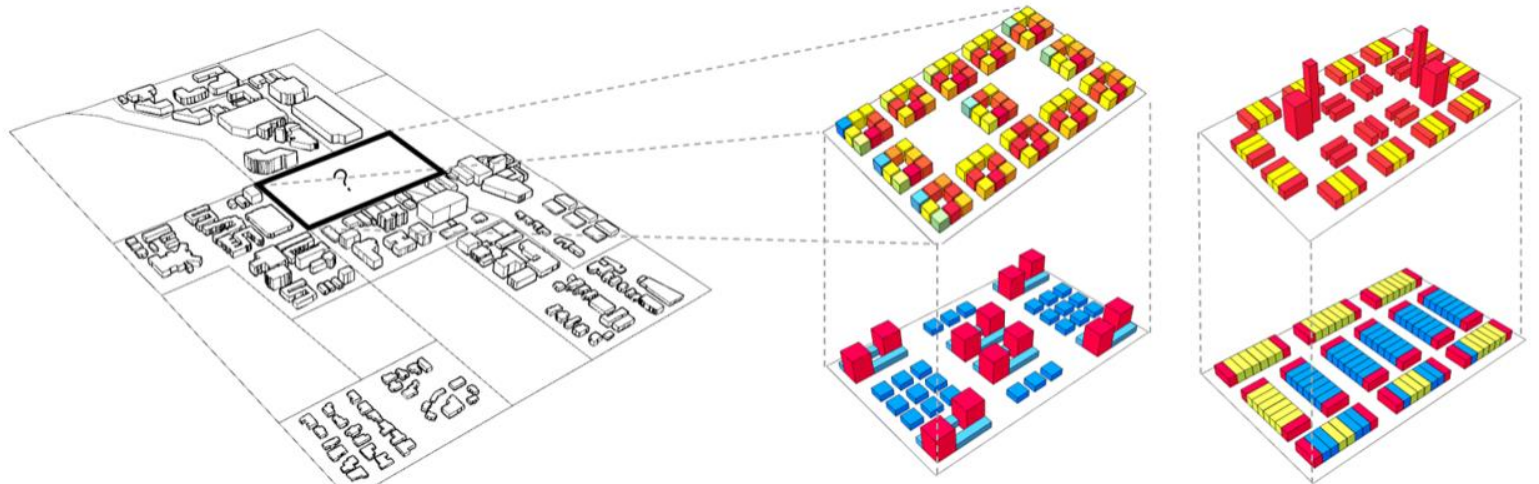
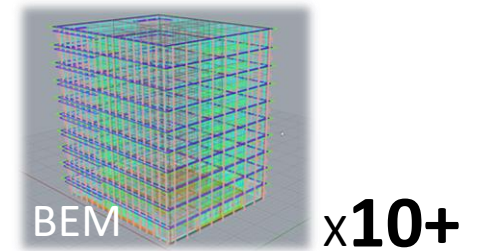
2. Retrofit Models



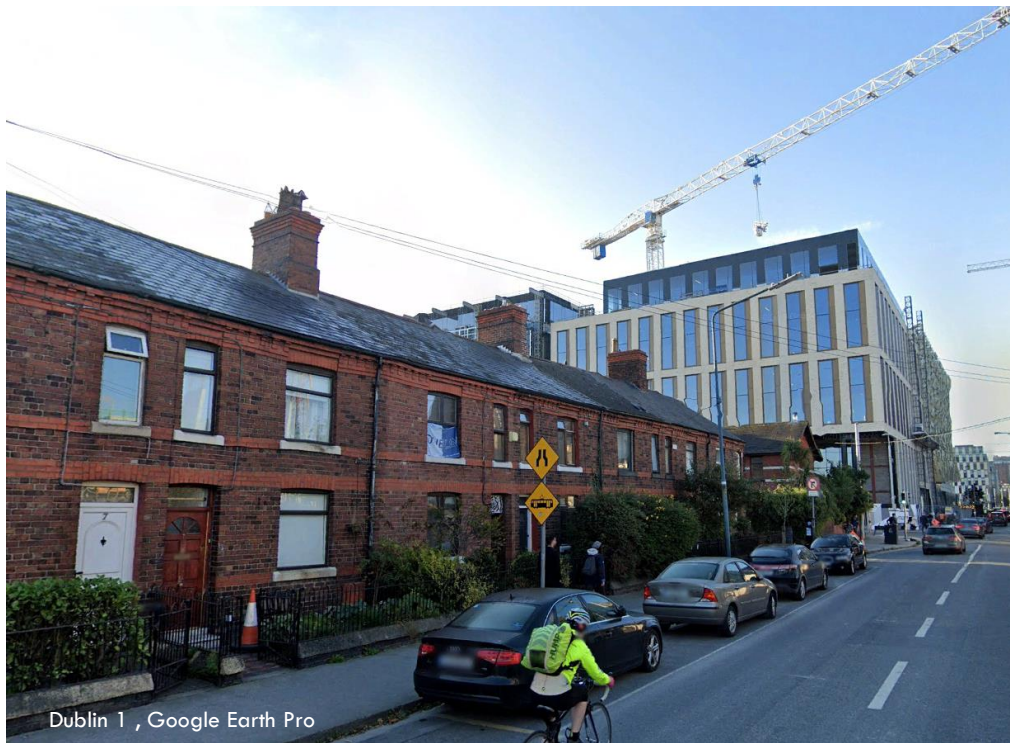
3. Urban Design



4. Grid Management Models

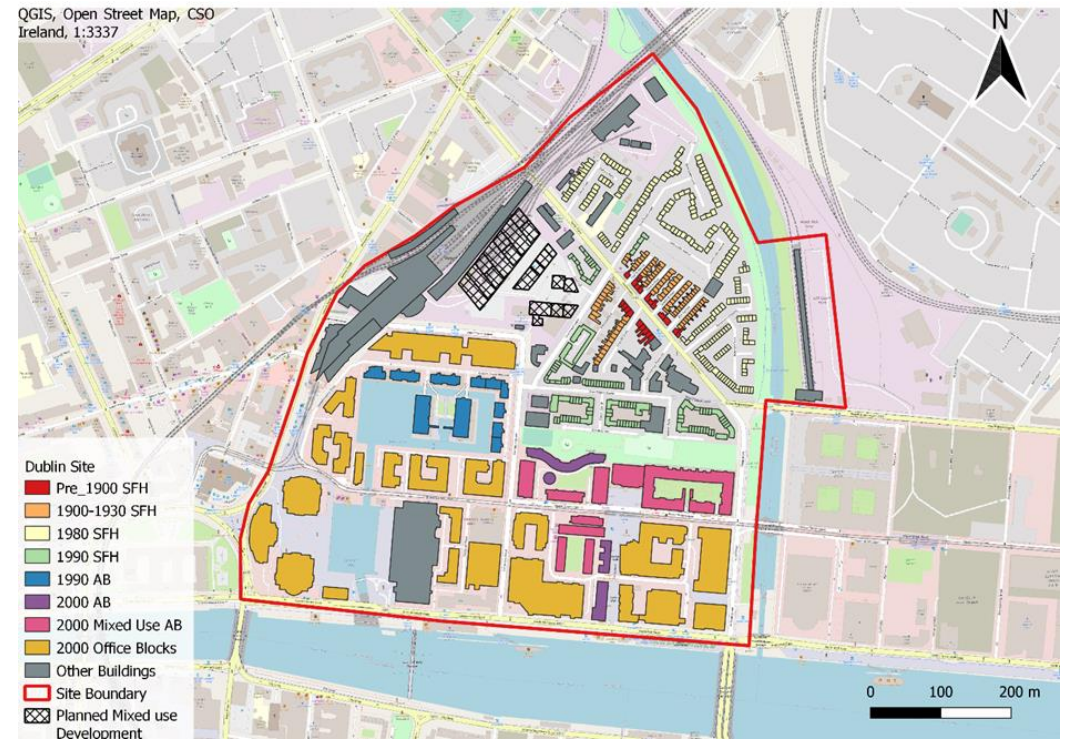


# Case Study Connolly and Seville Place

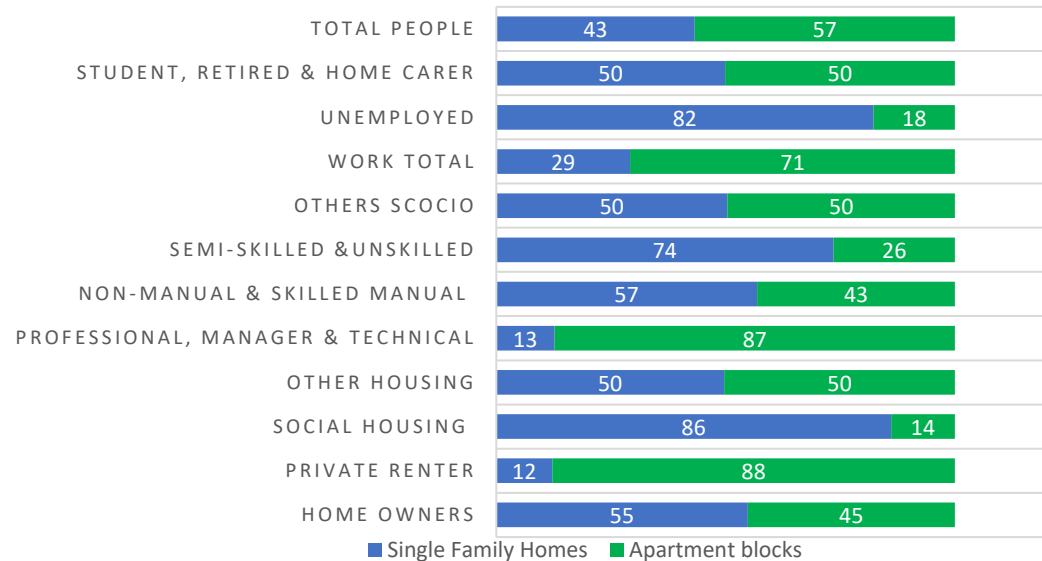


Dublin 1 , Google Earth Pro

Area has a binary contrast of **old** and **new buildings** with a similar **contrast** of Higher and Lower socioeconomic **occupants**.

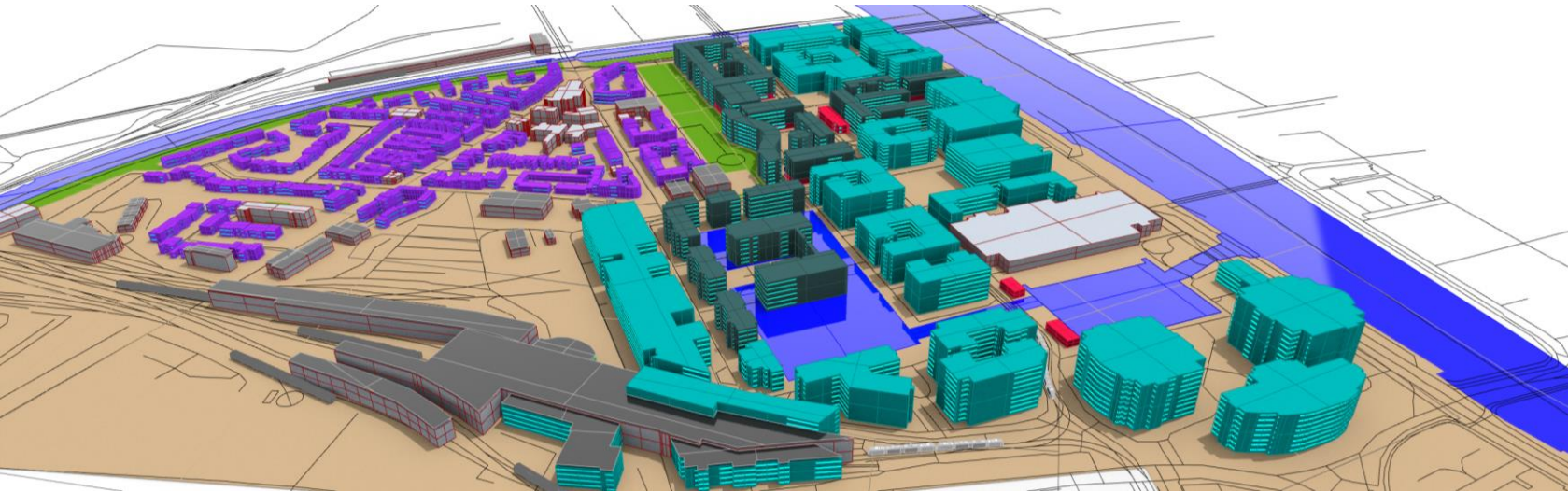


### SITE OCCUPANT PROFILES OF SFH & AB



# Current Site Interventions

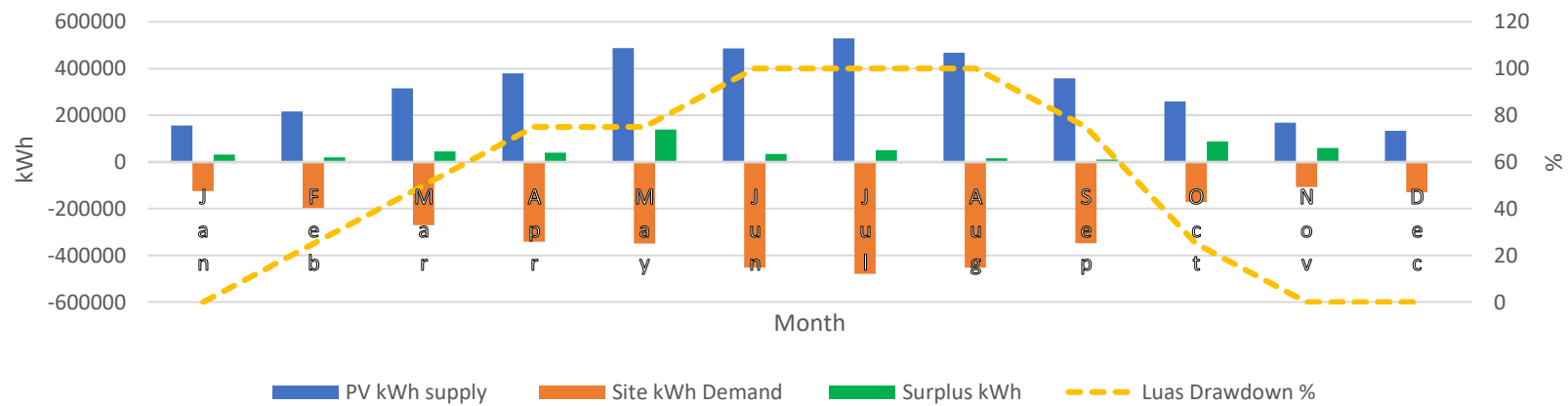
# Energy Equity Intervention



## Legend

- Social Housing
- Offices
- Apartments
- Retail Units
- Various Buildings (Shading)
- PV Panels
- Site Boundary

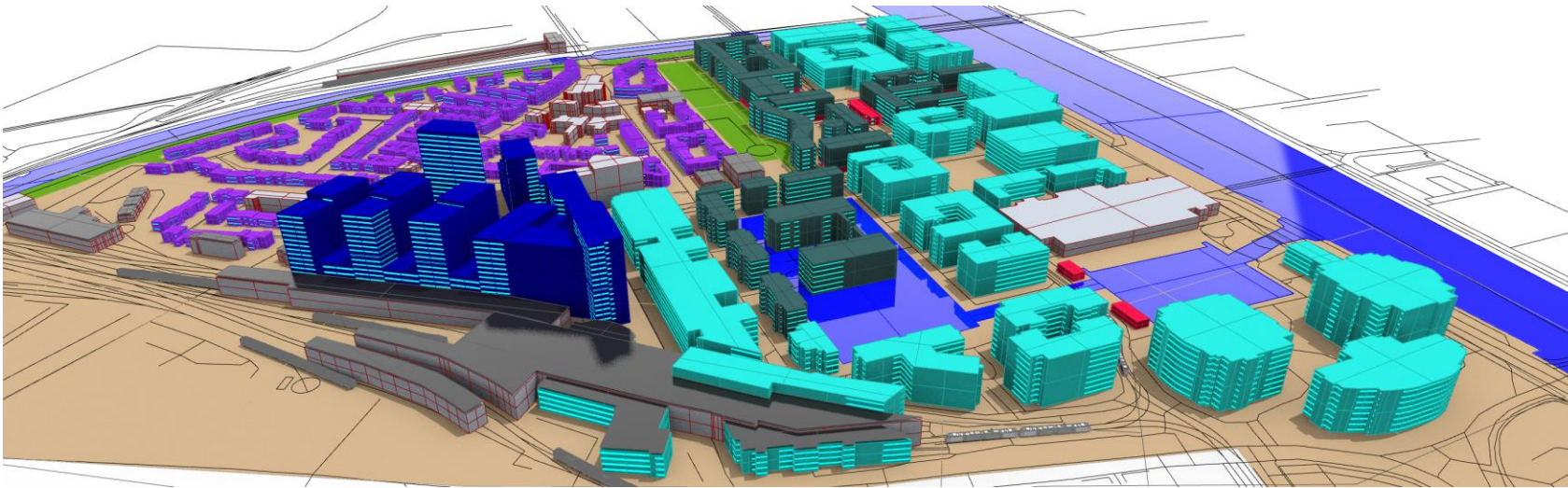
Dublin Site PV Analysis



PAYBACK		Euro
Upfront cost		€15,070,845.63
Annual Carbon Savings		€129,470.91
Annual kWh Savings		€1,399,801.91
Total Annual Savings		€1,529,272.82
Payback years		9.85

# Bad Neighbour Development (New undermines Intervention)

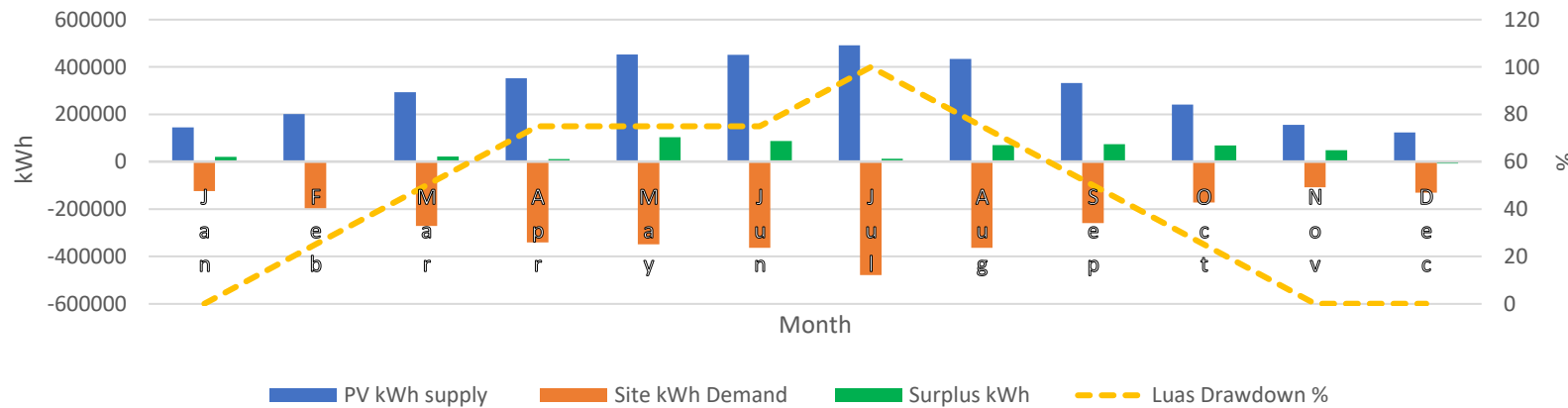
# Energy Equity Intervention



## Legend

- Social Housing Estates
- Offices
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- Retail Units
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- PV Panels
- Site Boundary
- New Buildings

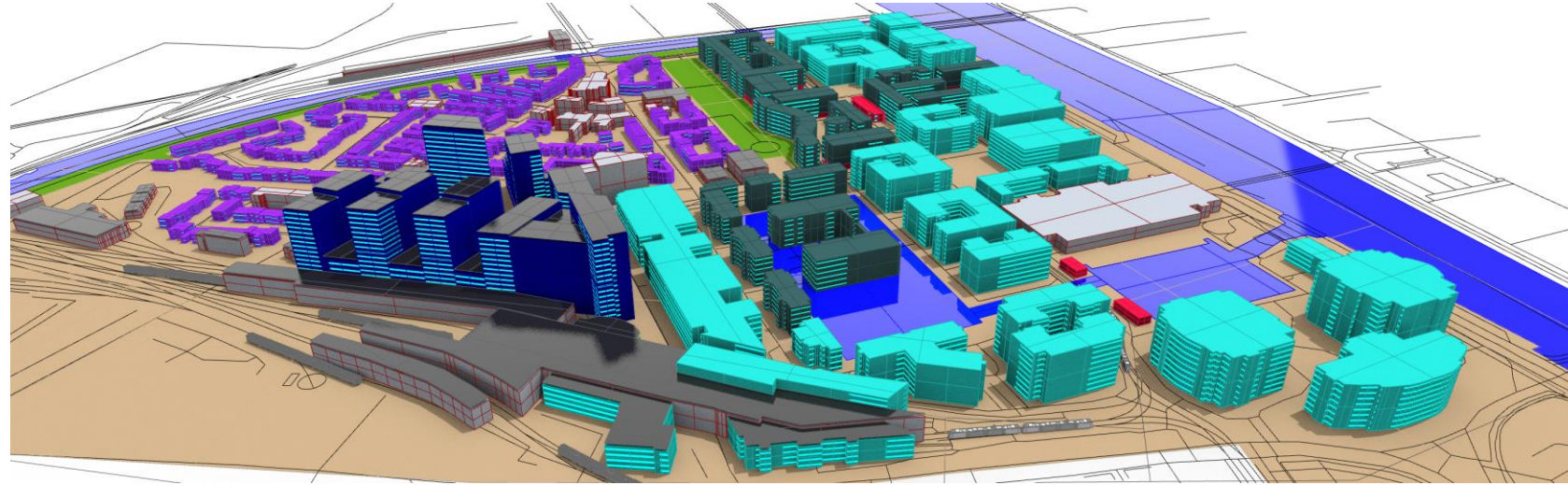
Dublin Site PV Analysis



PAYBACK	Euro
Upfront cost	€14,676,251.42
Annual Carbon Savings	€129,470.91
Annual kWh Savings	€1,399,801.91
Total Annual Savings	€1,529,272.82
Payback years	9.60

# Good Neighbour Development (new development Improves Intervention)

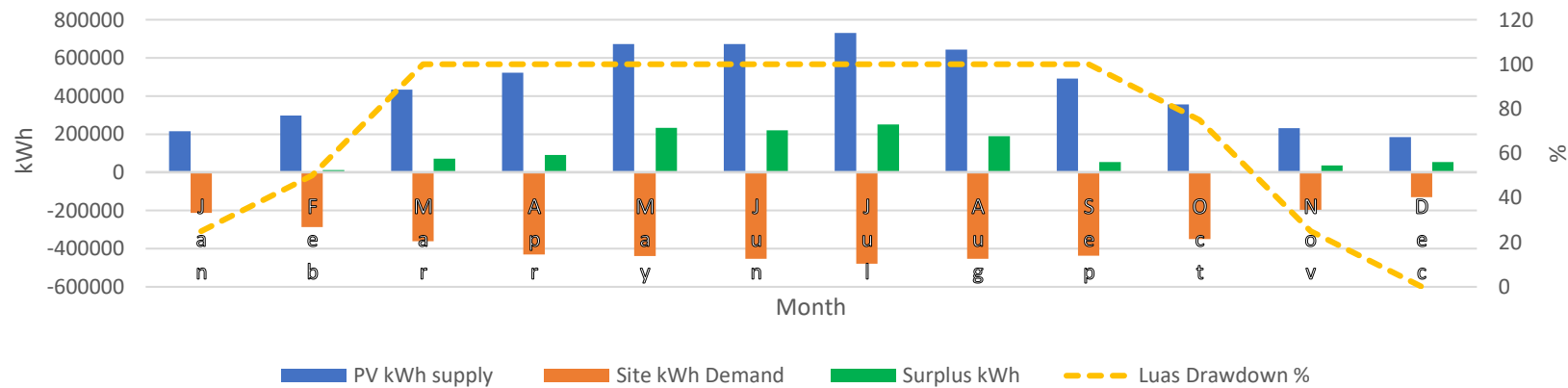
# Energy Equity Intervention



## Legend

- Social Housing Estates
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- Apartments
- Retail Units
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- PV Panels
- Site Boundary
- New Buildings

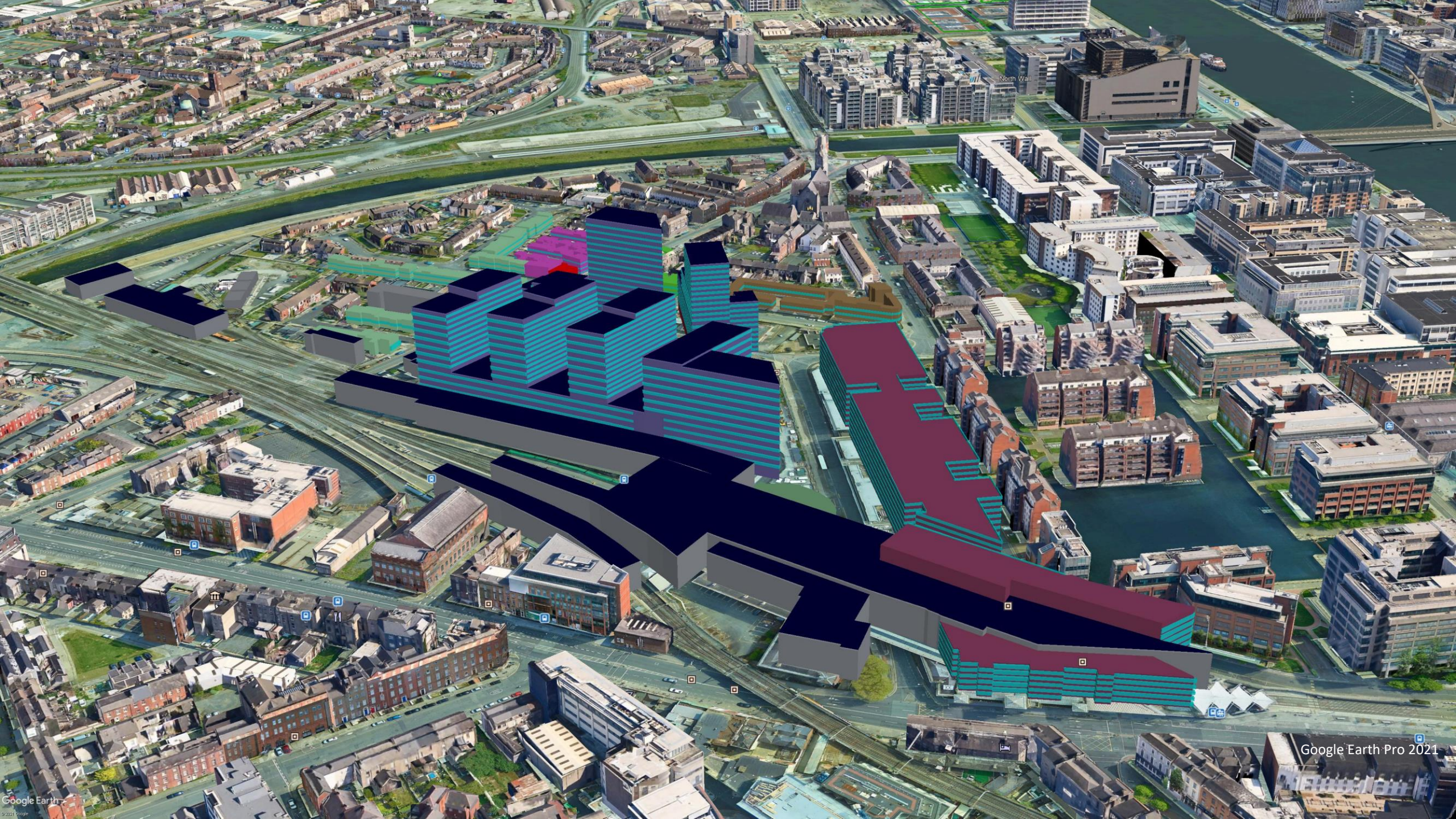
Dublin Site PV Analysis



PAYBACK	Euro
Upfront cost	€17,648,109.77
Annual Carbon Savings	€129,470.91
Annual kWh Savings	€1,399,801.91
Total Annual Savings	€1,529,272.82
Payback years	11.54

# Bespoke Technology & Policy

- Implement PV and grid sharing technology coupled with building retrofits for poorest performing building stock
- Introduce good neighbour policy making new developments mitigate or pay for the loss of daylight and energy



North Wall

Thank You



MIT SUSTAINABLE DESIGN LAB

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