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Solar City Indicator: A methodology and ranking of the potential for PV in UK cities

Energy Research Institute

Doctoral Training Centre in Low Carbon Technologies

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Introduction

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- Aims & Rationale
- The Solar City Indicator
- Physical Capabilities
- Socio-economic Considerations
- Solar City Indicator Results
- Scenario Results
- Conclusion

Aims and Rationale

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- To create a Solar City Indicator, which will demonstrate the potential for solar PV installation within a city, taking into account:
  - Physical capability
  - Socio-economic influences
- To compare the outcome across a selection of geographically distributed cities
- To assess the impacts of changes to
  - FiT
  - Cost of Panels
  - Cost of Electricity
  - Payback
  - Changes to socio-economic factors

Solar City Indicator

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Analysis undertaken to calculate the Solar City Indicator included the following:

- Physical Analysis
  - Annual solar irradiance at each building in a city
    - Latitude
    - Orientation
    - Slope of roof
  - Topological and surrounding building shading effects
  - Weather effects
- Socio-economic Analysis
  - Ability to install solar PV
    - Tenure
    - Housing stock (and income for new FiT rates)
  - Desire to install solar PV
    - Education
    - Environmental consciousness

Recent Growth in Solar PV

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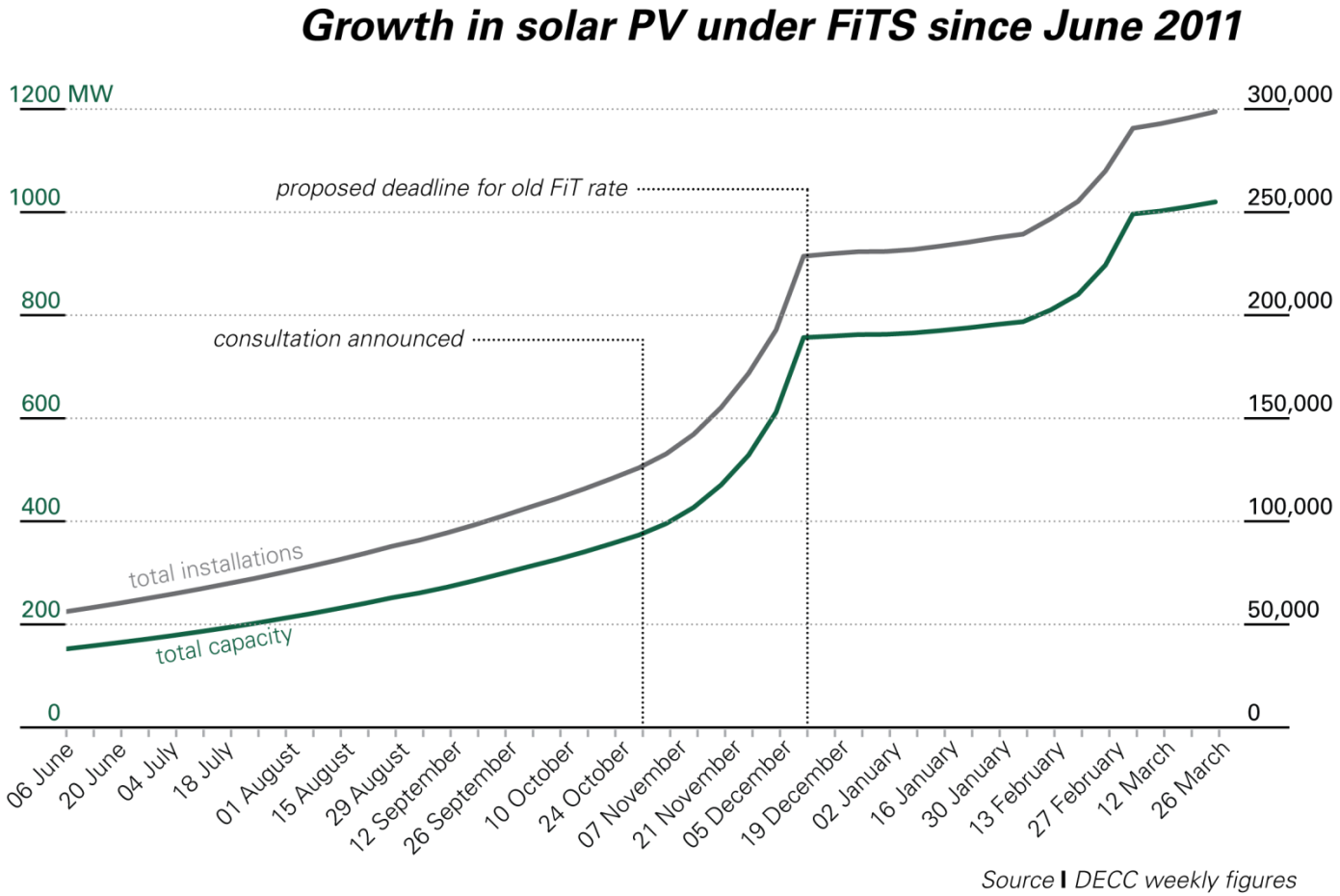

- 242,000 new installations since start of June 2011
- 870 MW of additional capacity (now past 1GW total)

Assessing Physical Capability

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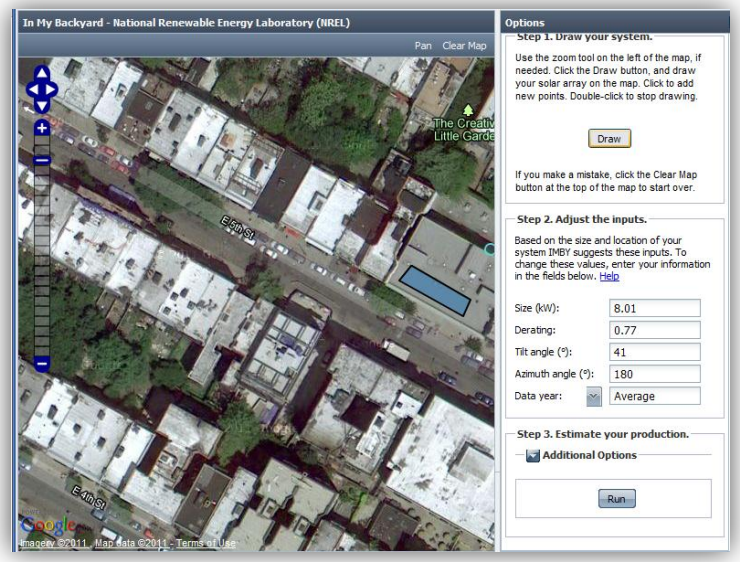
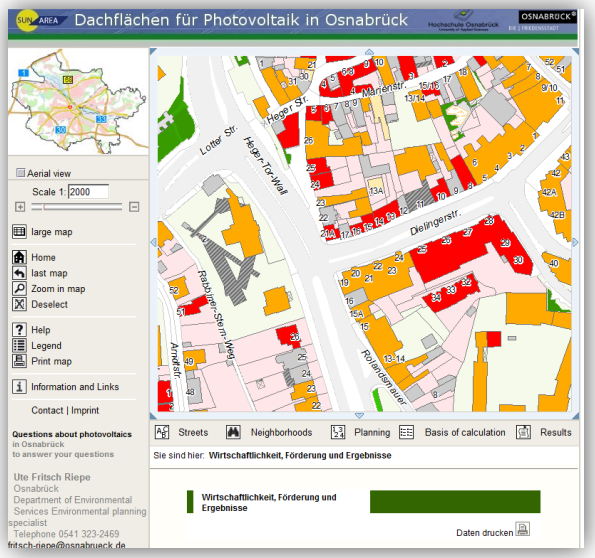
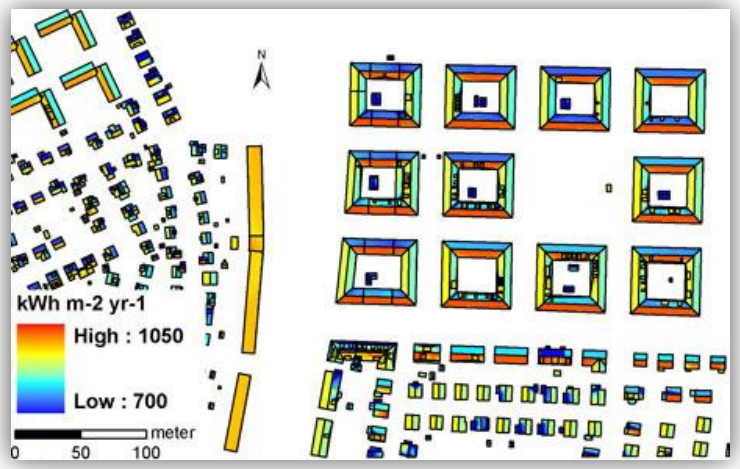


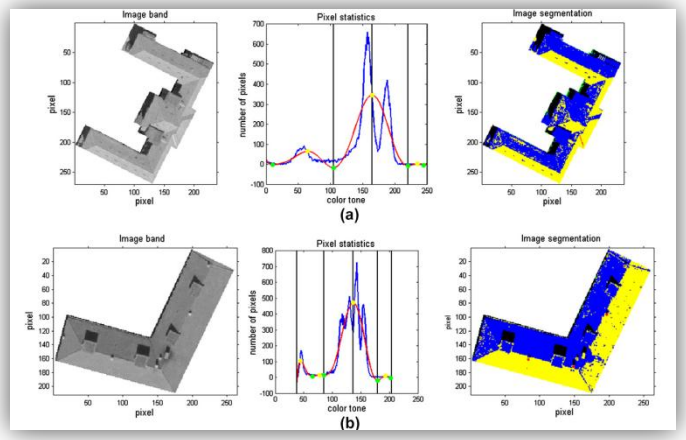
IMBY http://www.nrel.gov/eis/imby/



SUN-AREA http://www.sun-area.net/



SEES http://www.gvc.gu.se/Forskning/klimat/stadsklimat/gucg/software/sees/



P. Asinari and L. Bergamasco (Turin 2011)

Methodology

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Source data from Landmap

Assign building class values to building polygons

Split buildings layer into two layers for larger properties and smaller properties (<200m^2)

Reduce Digital Surface Model to building footprints

Analyse slopes and aspect of roofs

Compute insolation using Area Solar Radiation Tools

Overlay aspect, slope and insolation layers to produce suitable areas

Evaluate total insolation for each property's suitable area and assign to attribute table

Export attribute table to excel and process using custom macro

Methodology

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Small Properties

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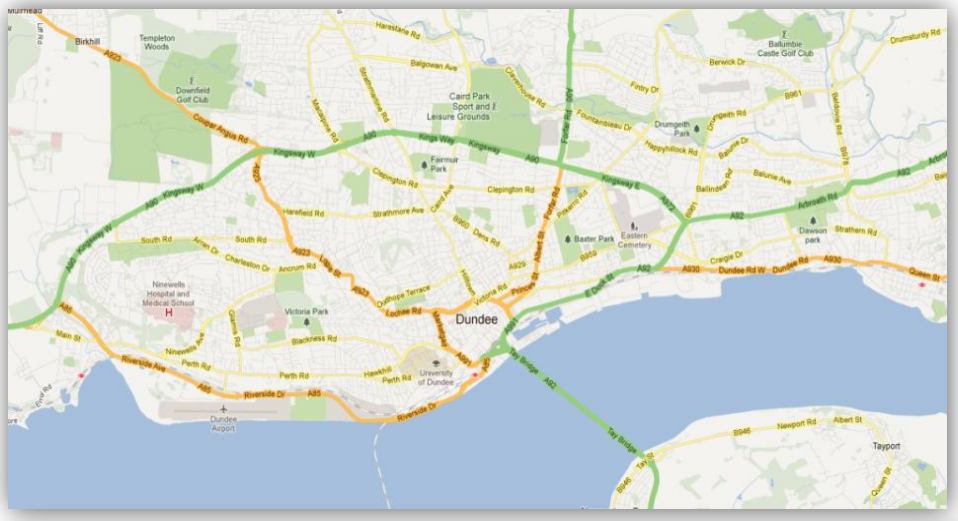

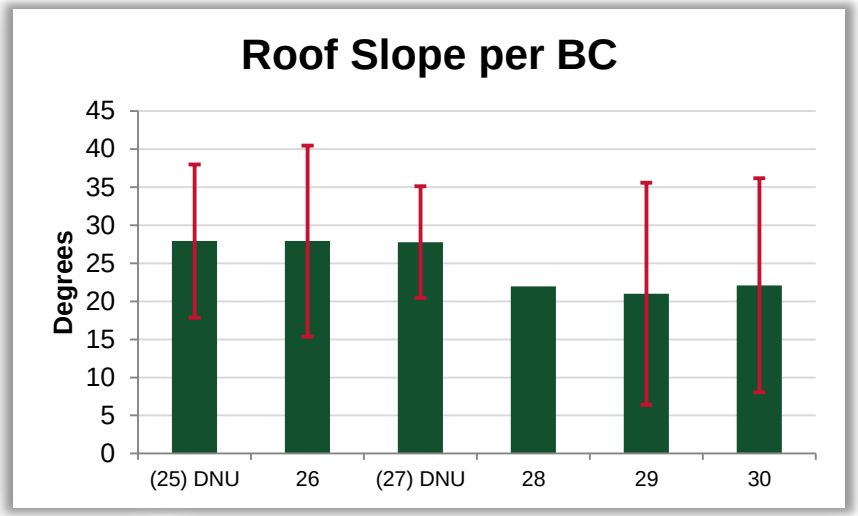

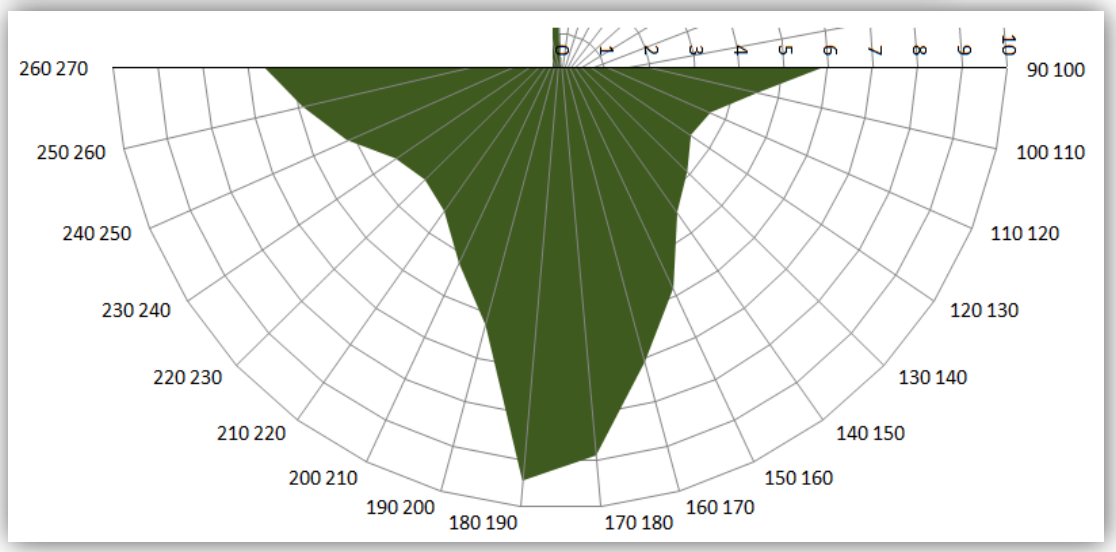

Physical Results

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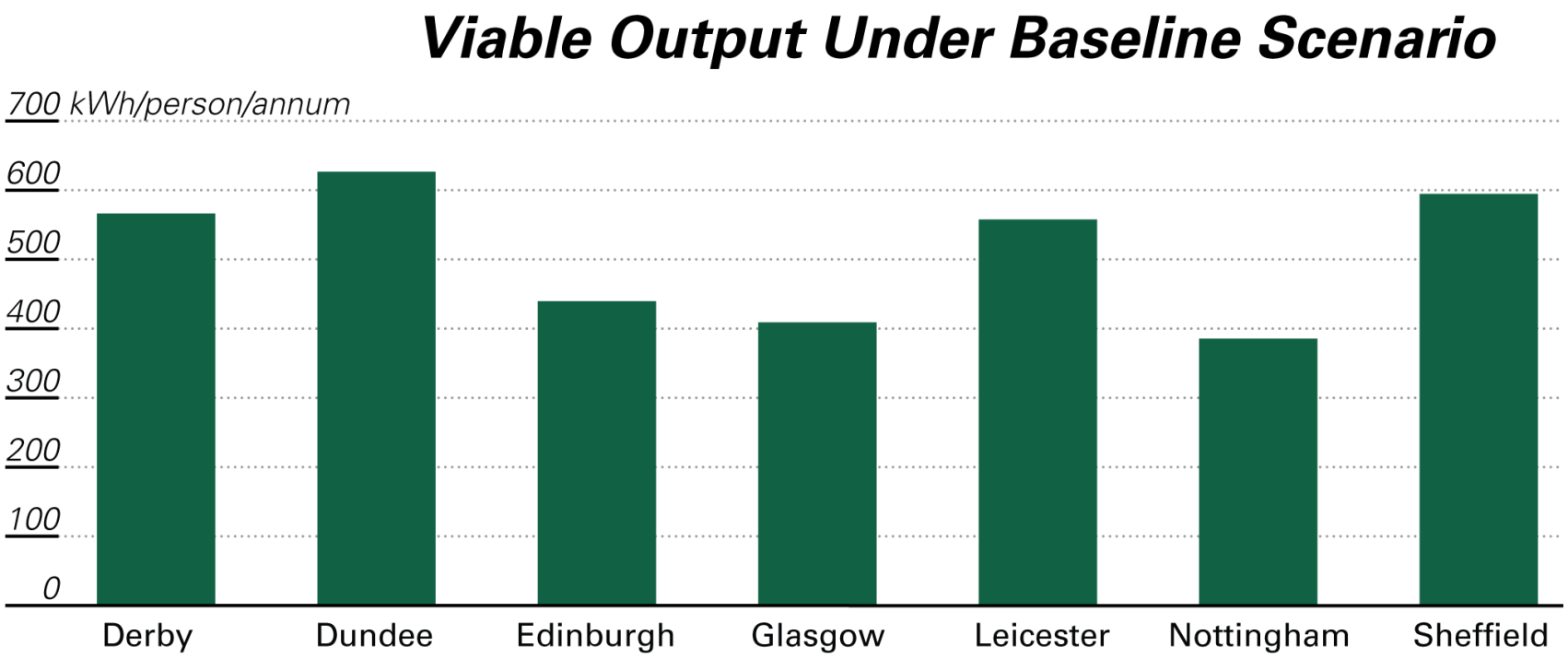

Socio-economic Factors

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1. Desire Factors

Education - % of adult population with a minimum qualification of level 4/5

Environmental Consciousness - % household waste recycled

2. Ability Factors

Tenure - % of households owned

Housing Stock - % houses/bungalows

Income - average income employed/retired population (Depending on FiT Level)

Socio-economic Factors

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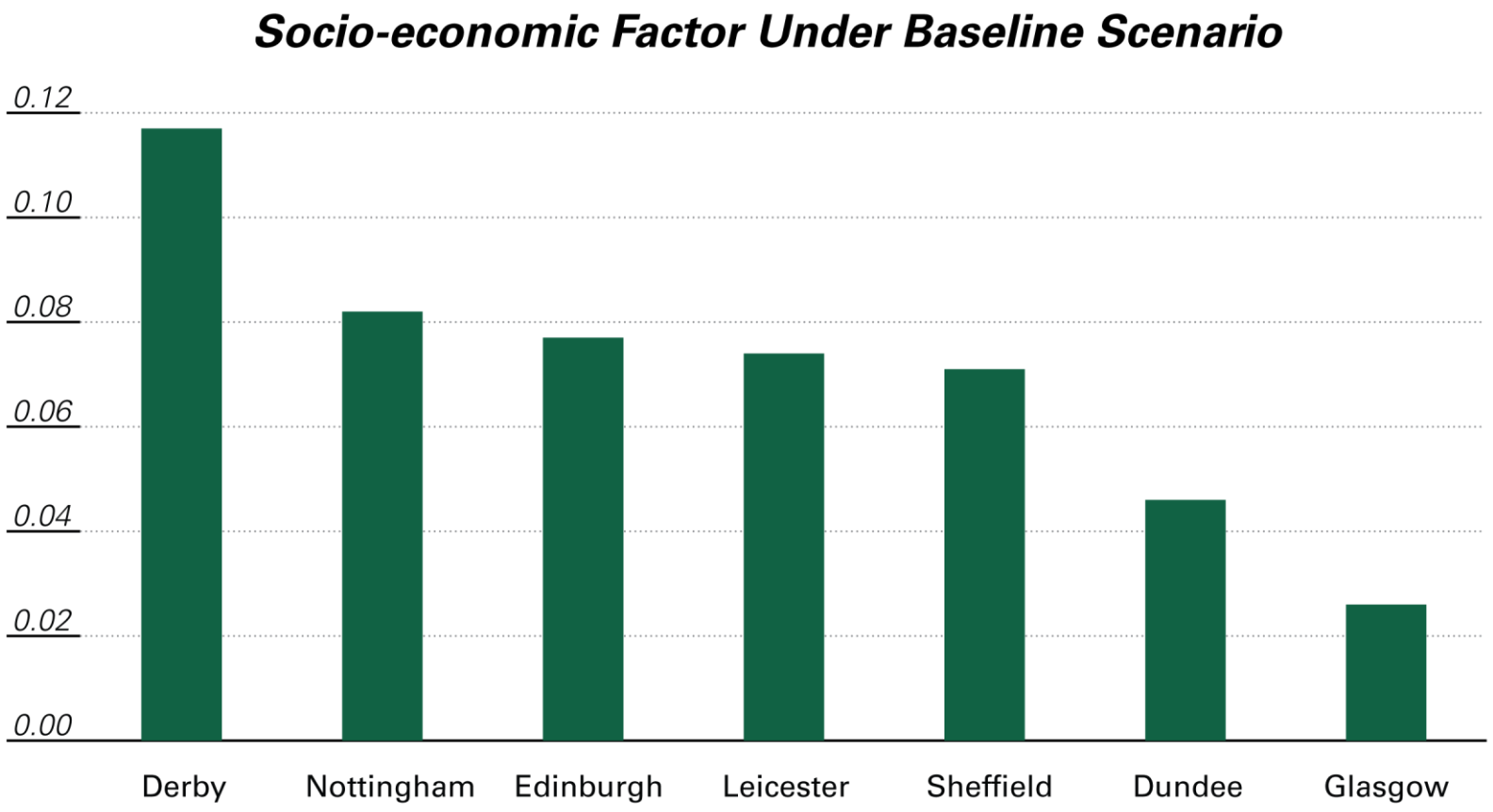

Socio-economic Scenarios

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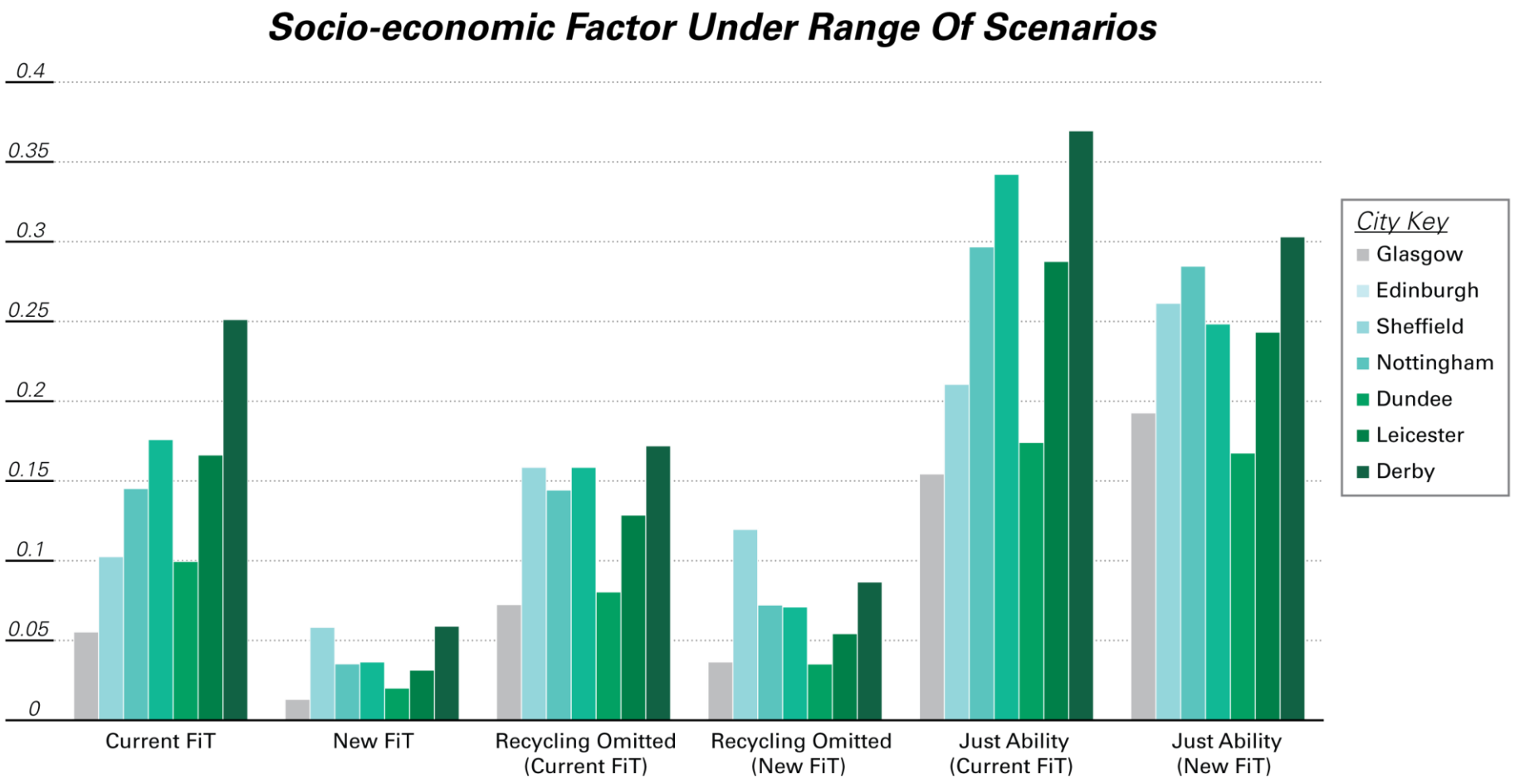

Overall Results

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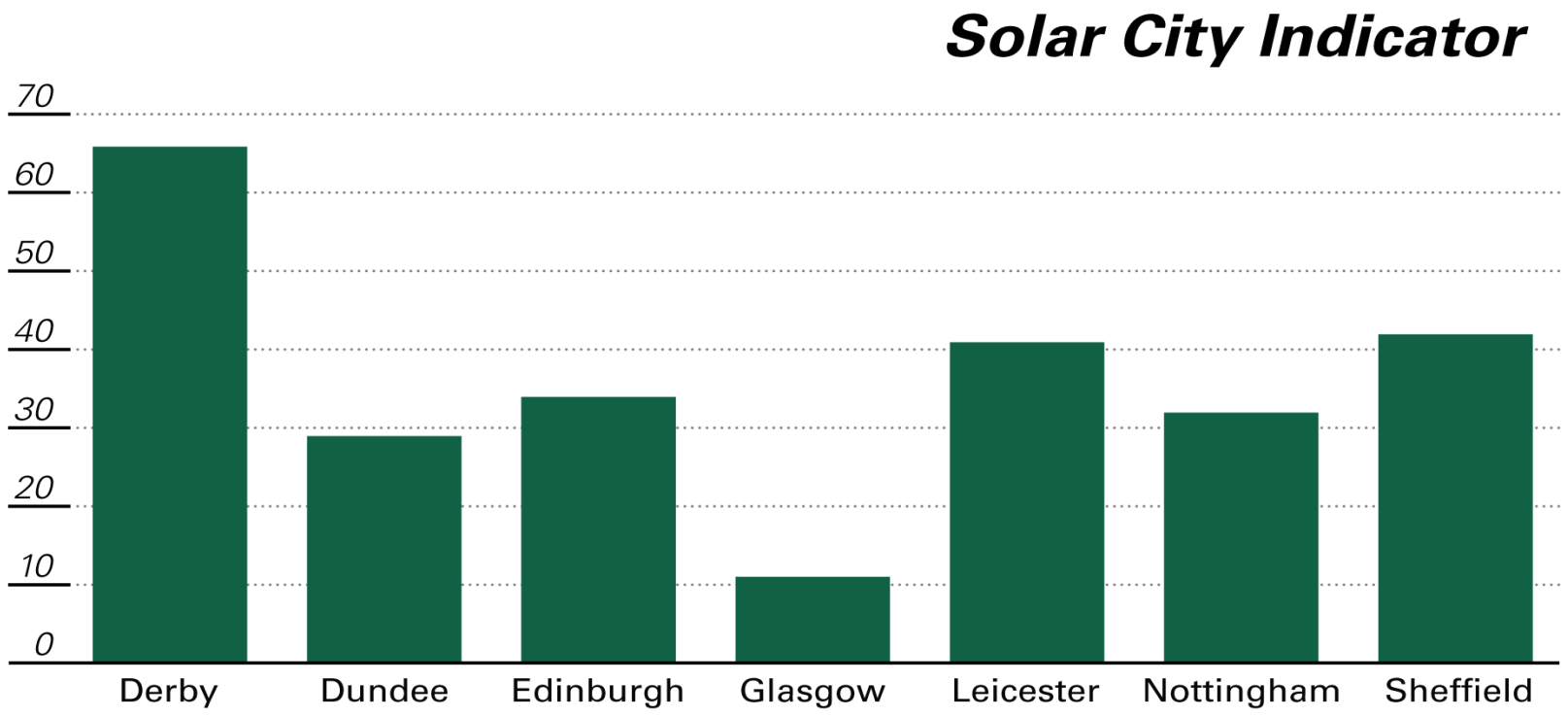

Scenarios

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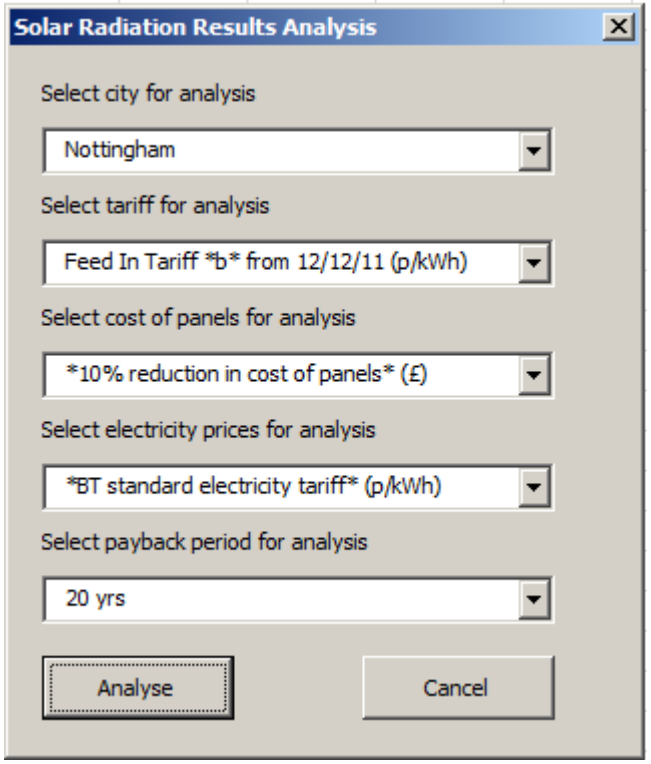
Series of scenarios considered changes in:

- FiT Rates
- Electricity Prices
- Acceptable Payback Period
- Price of Panels



Cost of Panels Reduces

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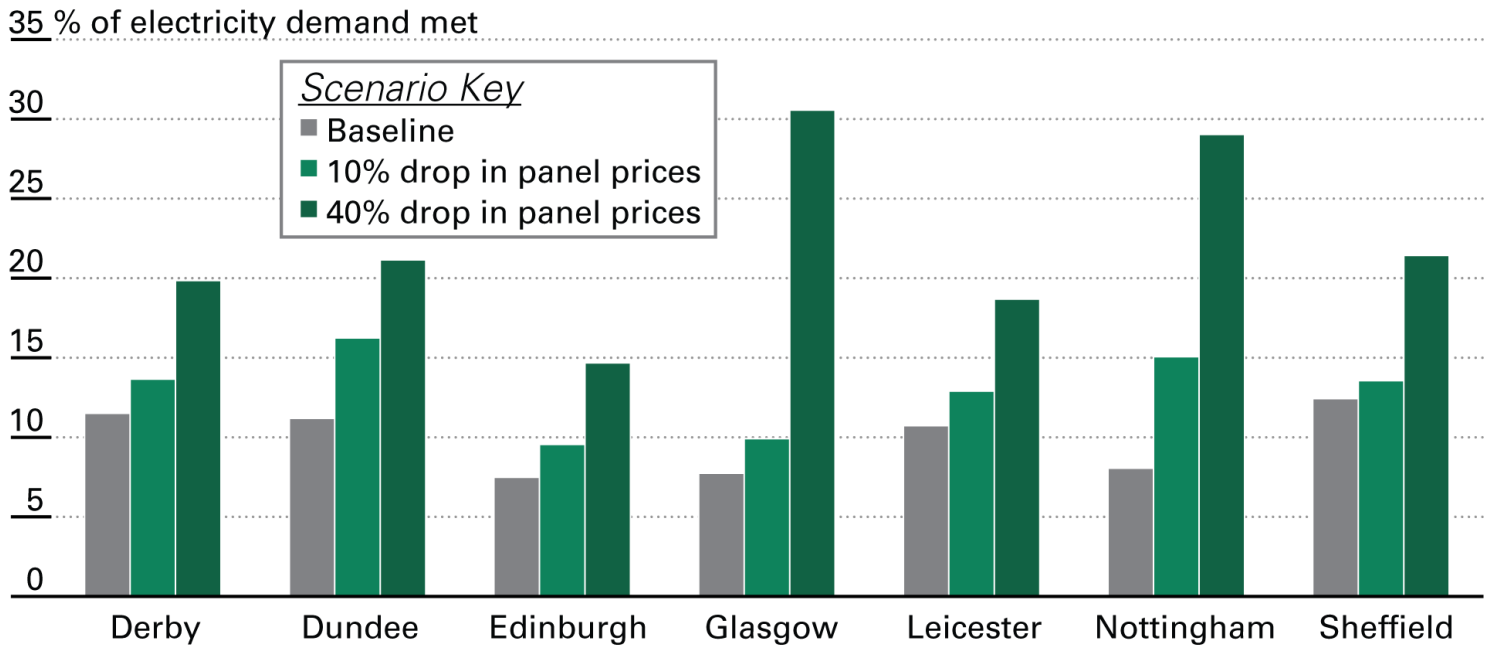
% of Electricity Demand Met When Panel Costs Fall



- A 40% decrease in the cost of panels would result in a 136% increase in total viable output and would make 73% of large properties viable (baseline = 14.3%)

Feed-in Tariff Changes

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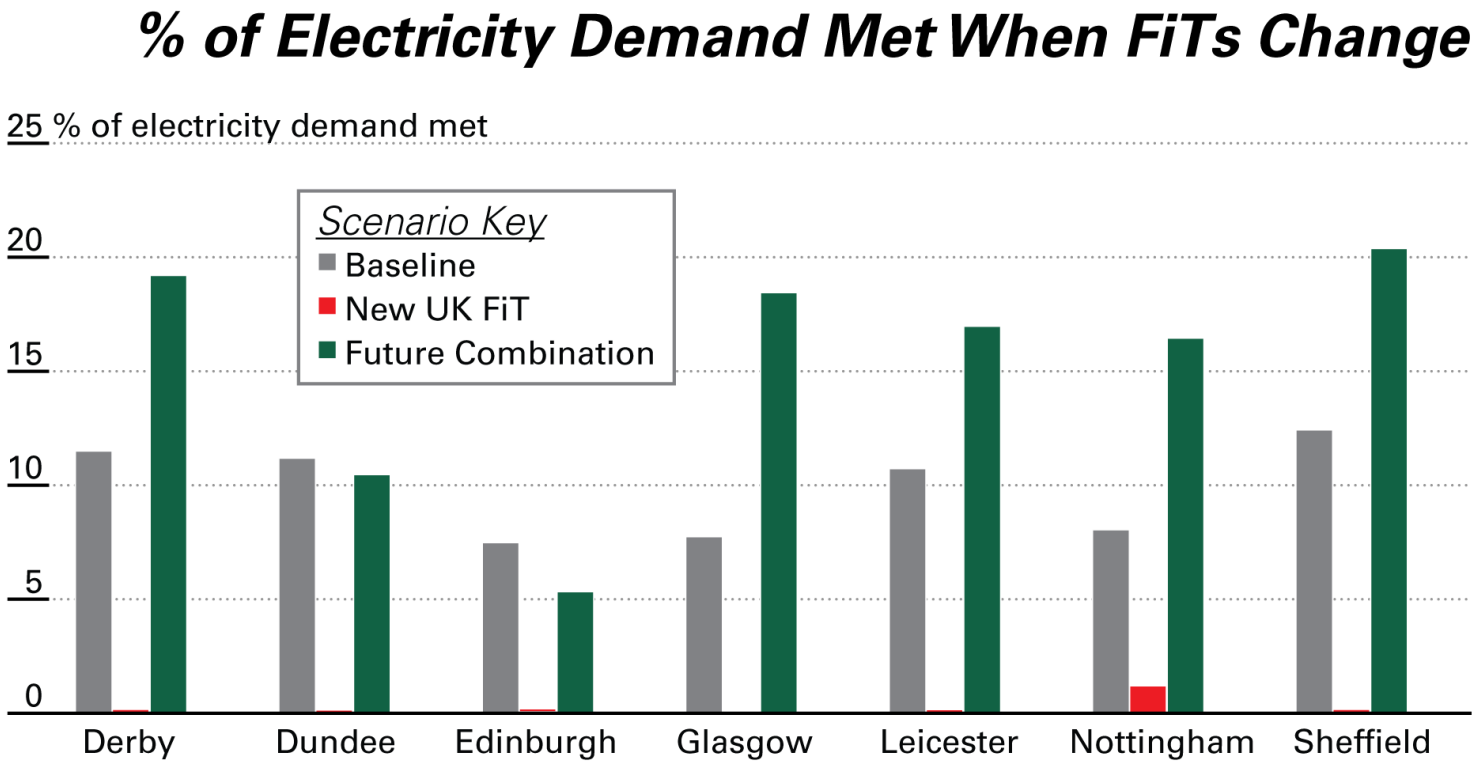

- New UK tariffs result in a 98% reduction in total viable output and leave less than 1% of large properties viable

Further Work

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- Physical Capability
  - Improvements for small property estimations
  - More accurate representation of unusual roofs
  - Automated ‘cleaning’ process for building polygons
  - Ultimately limited by data availability and low resolution of LiDAR data

- Socio-economic Influences
  - Underpin factor choice with more qualitative research into what determines uptake levels.
  - Design a methodology that more effectively incorporates uptake among businesses into account.

Conclusions

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- A method for assessing a city's potential to install solar PV has been demonstrated
- A North/South divide is not as clear as might be preconceived
- Socio-economic factors have a strong influence on likely uptake
- Viability is highly dependent on price of panels, which are expected to keep falling
- New FiT will have a significant impact on a growing PV industry

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Thank you

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