QUANTIFYING THE POTENTIAL FOR ROOFTOP SOLAR PHOTOVOLTAIC IN IRELAND

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MaREI
Energy · Climate · Marine

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Irish Solar Energy Association

FOREWORD BY ISEA

This report is being published at an inflection point for both energy producers and consumers.

Energy bill increases have been compounded by the war in Ukraine and its impact on fossil markets. Irish citizens will be entitled to payment for exporting power they generate themselves and rooftop solar planning restrictions are due to be eased. The EU Solar Energy Strategy sets out a growth trajectory for solar PV with provision for all new residences to have rooftop solar PV from 2029.

As this analysis shows, there are significant potential financial savings for people from their rooftops. Beyond the positive impact on bills, solar PV provides an option for people to directly participate in the battle against climate change. Solar panels could be the entry point for many people on their sustainability journey.

About 24,000 homes have already begun this transition. As this report shows, the rooftops of Ireland have substantial potential.

Many jobs will be needed to deliver this solar opportunity. These roles traverse a range of activities across the trades and business. These are purposeful jobs with real meaning.

Enabling participation in the energy transition will only not create employment, but ensure that people are included in Ireland's decarbonisation journey.

ISEA
Irish Solar Energy Association

WHY SOLAR IN IRELAND

Ireland is known more for wind and waves rather than sunshine, but advances in solar technology and reductions in cost now make it an attractive technology for residential electricity generation in Ireland.

Solar panels that produce electricity are known as solar photovoltaic (PV) modules. These panels generate electricity when exposed to light and since 2010 solar PV has been the fastest growing power generation technology worldwide. Solar PV systems produce electricity that can be used to power your home and heat water. Solar PV systems will still function on overcast days in Ireland although not at their maximum rated capacity. Solar PV systems are rated in kilowatts (kW). A 1kW solar PV system would require 2-3 solar panels on a roof and will generate most of its electricity between April to September.

The deployment of residential solar PV in Ireland addresses key energy and climate issues such as Electricity Affordability, Climate Action and Energy Security.

It does this by:

SAVING MONEY FOR HOUSEHOLDS: A typical household in Dublin with 2.4 kW of solar panels could generate over one third of their annual electricity and save 380€/year in electricity bills with the system paying back for itself in 7 years. Today most modern panels will last for more than 25 years, and cumulative savings are significant. These savings can be increased if the household has an electric vehicle allowing cheap charging of the car throughout the day.

INCREASING SECURITY OF SUPPLY: At the same time fossil fuel use with the power sector is reduced and this reduces emissions and increases the security of supply.

REDUCING GREENHOUSE GAS EMISSIONS: Ireland has committed to delivering one of the world's most ambitious emission reduction targets of a 51% reduction by 2030. Ireland has one of the highest reliance on natural gas within the power system in Europe and delivering on Solar PV will help meet these targets.

INTRODUCTION

WHAT DID THIS STUDY SET OUT TO DO?

This study quantifies the available residential solar photo-voltaic rooftop capacity and associated annual electricity potential in Ireland for the first time using satellite imag-ery and weather data.

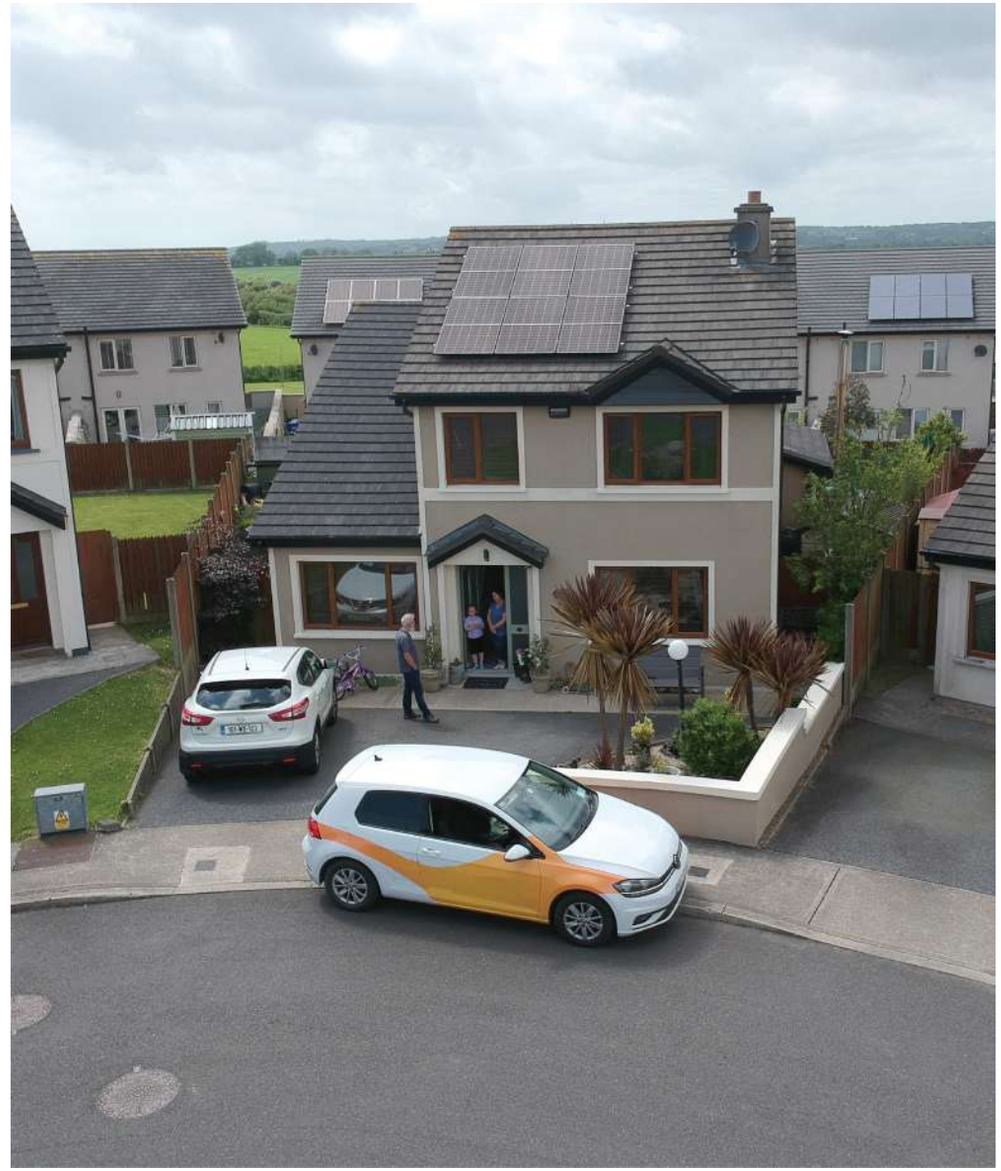
...WHY IS THIS IMPORTANT?

This allows us to understand how we can use rooftops in Ireland to produce electricity and reduce both emissions and energy bills for families.

...AND WHAT SCENARIOS DID YOU INVESTIGATE?

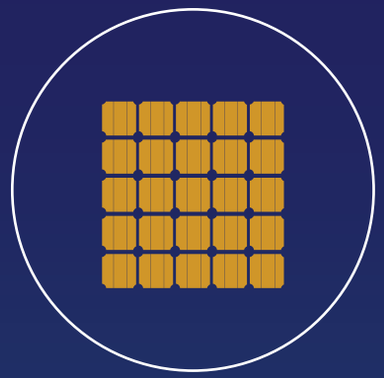
The next 3 slides explain the insights and results we found for 3 scenarios where we assume:

- 6 Solar Panels on each suitable roof
- 10 Solar Panels on each suitable roof
- Maximum Theoretical potential on each roof as an exploratory scenario



PUTTING SIX SOLAR [2.4 KW] PANELS ON EVERY SUITABLE HOME

1 million homes have potential for six panels



Equating to 2.5 GW of Capacity or 21% of current power system size

Producing 22% of all residential demand | 1.8 TWh

Meeting 6% of Renewable Electricity Target

Reducing 95,000 tonnes of CO_2 emissions

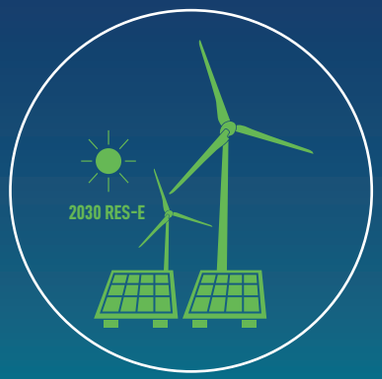
Saving 380€ on annual electricity bills

PUTTING TEN SOLAR PANELS [3.4KW] ON EVERY SUITABLE HOME

1 million homes have potential for ten panels

Equating to 3.6 GW of Capacity or 30% of current power system size

Producing 25% of all residential demand | 2.2 TWh



Meeting 8% of Renewable Electricity Target

Reducing 135,000 tonnes of Carbon Dioxide Emissions

Saving 450€ on a Family's annual electricity bill

MAXIMUM POTENTIAL ON EVERY SUITABLE HOME

*In this scenario all rooftops are assumed to be structurally suitable for PV, whereas in the 2 previous scenarios we assumed 15% of rooftops were not suitable. This is why the number of homes has increased.

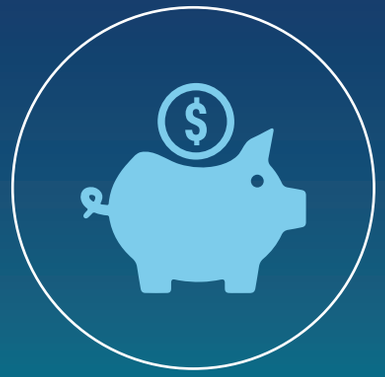
Over 1.3 million homes have roof space for solar panels*

Equating to 13 GW of Capacity or 113% of current power system size

Producing 36% of all residential demand | 3.1 TWh

Meeting 19% of Renewable Electricity Target

Reducing 306,000 tonnes of CO_2 emissions



Saving €500+ on annual electricity bills

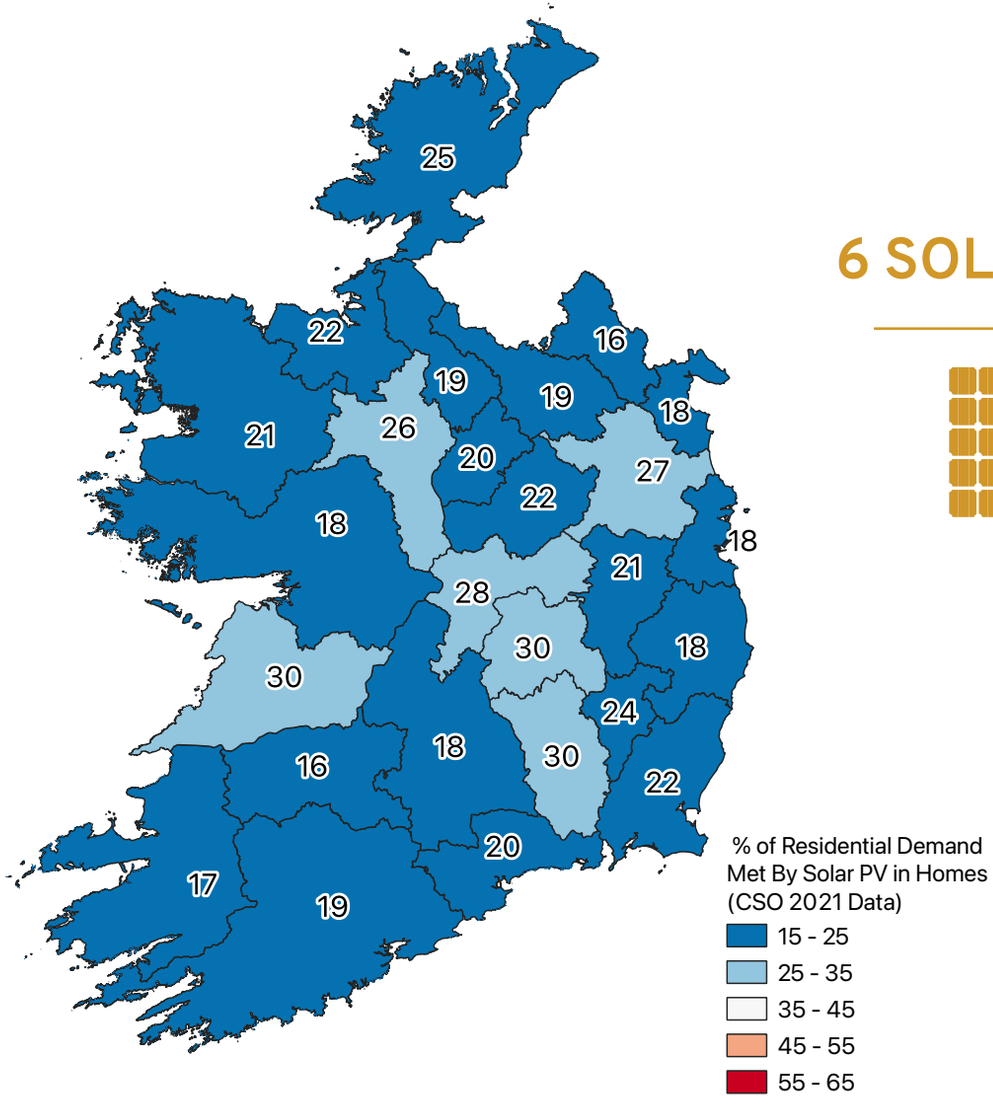
COUNTY LEVEL FINDINGS

Across Ireland, we found a significant variation on the potential for rooftop solar by county. This essentially reflects the variation in residential building and population density across Ireland. For example, while Dublin is one of the smaller counties by geography, it has the highest potential for rooftop solar PV as it has a very large number of available roofs and population. In contrast, a large county like Mayo has a lower potential as it has fewer people and fewer residential buildings.

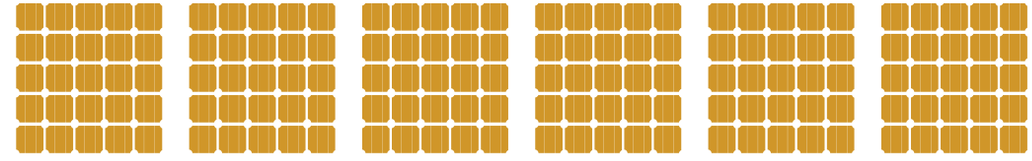
The electricity that can be generated from solar photovoltaic naturally varies with the amount of sunshine each location gets but it is not a significant factor in determining the total annual available output. This is because there is not a big variation across the country in what is called the 'capacity factor' of solar PV. The capacity factor is the percentage of the year at which a system produces its full output and for Ireland it varies by about 1% between counties with the highest potential in the southwest and counties in the northwest with lower potential. Our analysis looks at the county levels only and we would expect variation within each county.

Photo Credit: 3 Counties Energy Agency (3cea)

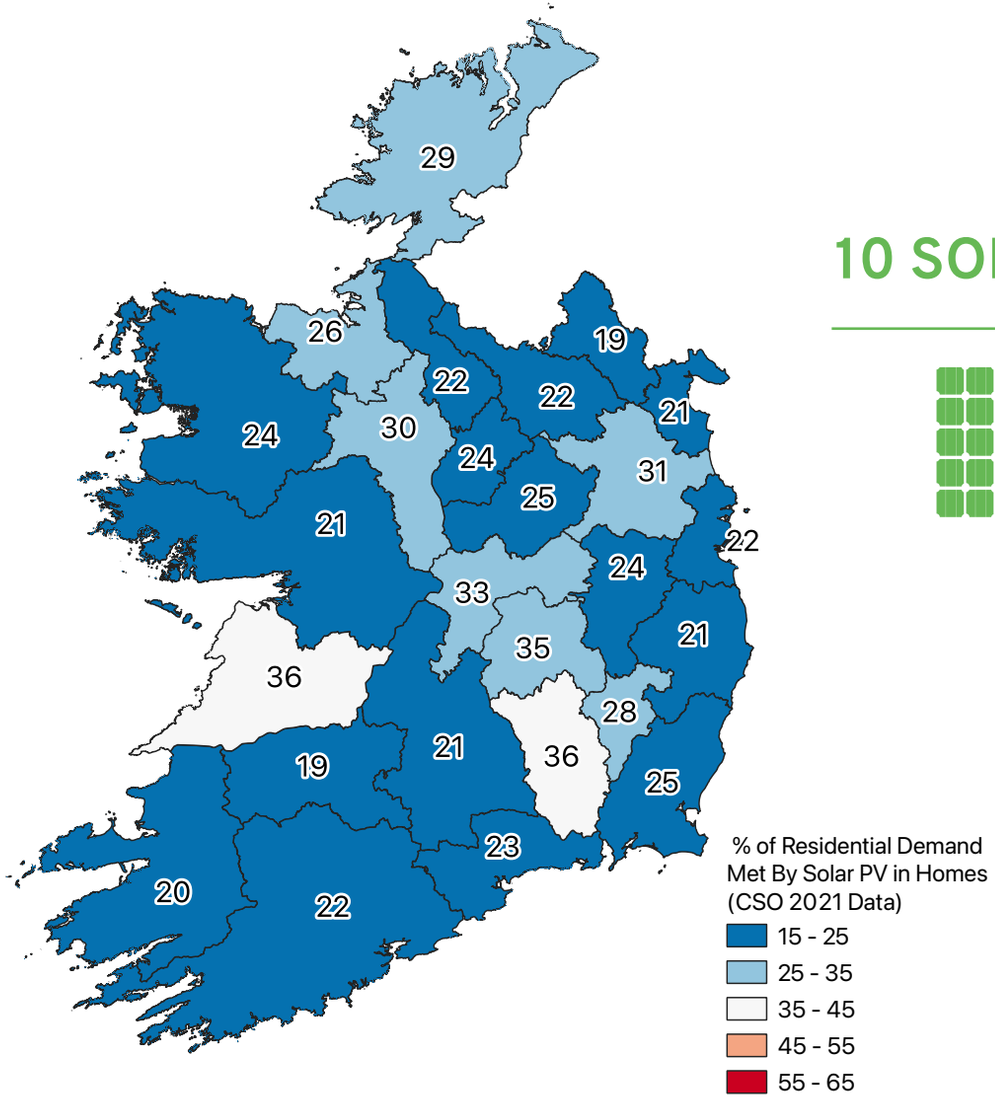
COUNTY LEVEL FINDINGS (% OF ANNUAL RESIDENTIAL DEMAND MET BY SOLAR ROOFTOP PV)



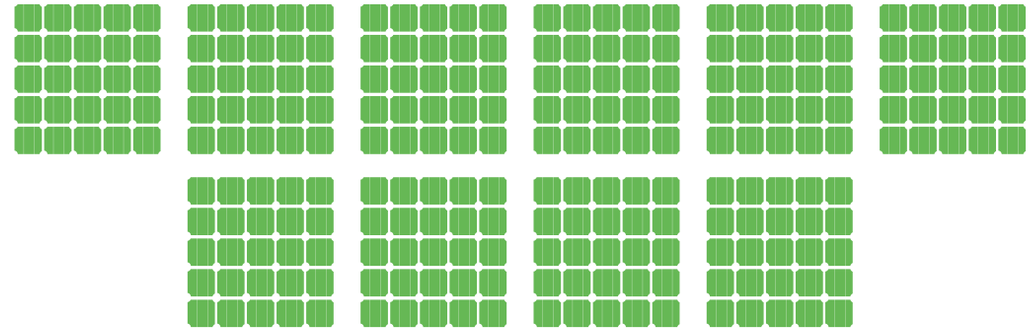
6 SOLAR PANELS ON EACH SUITABLE ROOF



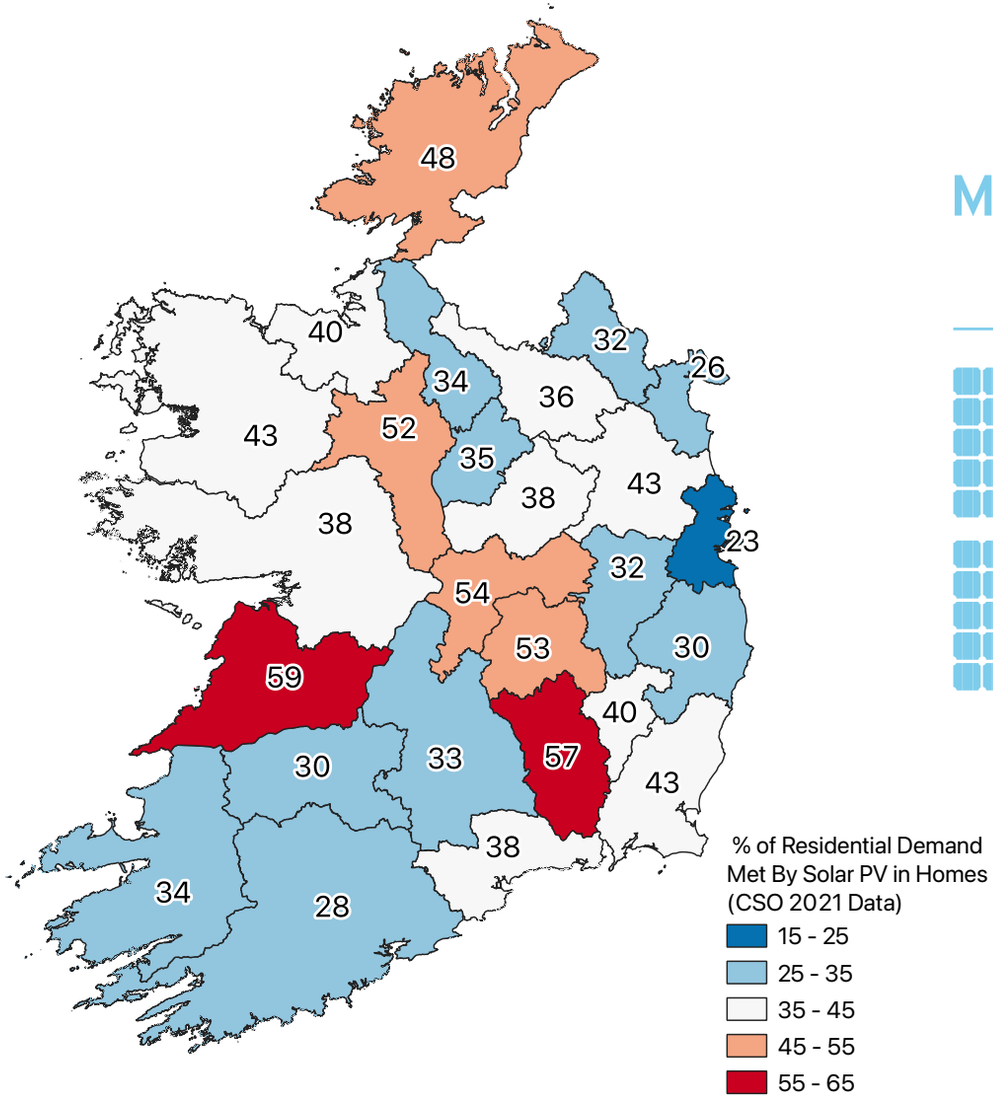
COUNTY LEVEL FINDINGS (% OF ANNUAL RESIDENTIAL DEMAND MET BY SOLAR ROOFTOP PV)



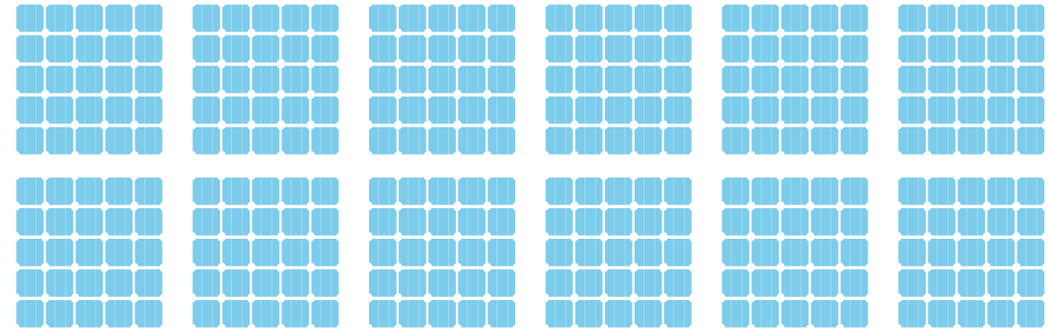
10 SOLAR PANELS ON EACH SUITABLE ROOF



COUNTY LEVEL FINDINGS (% OF ANNUAL RESIDENTIAL DEMAND MET BY SOLAR ROOFTOP PV)



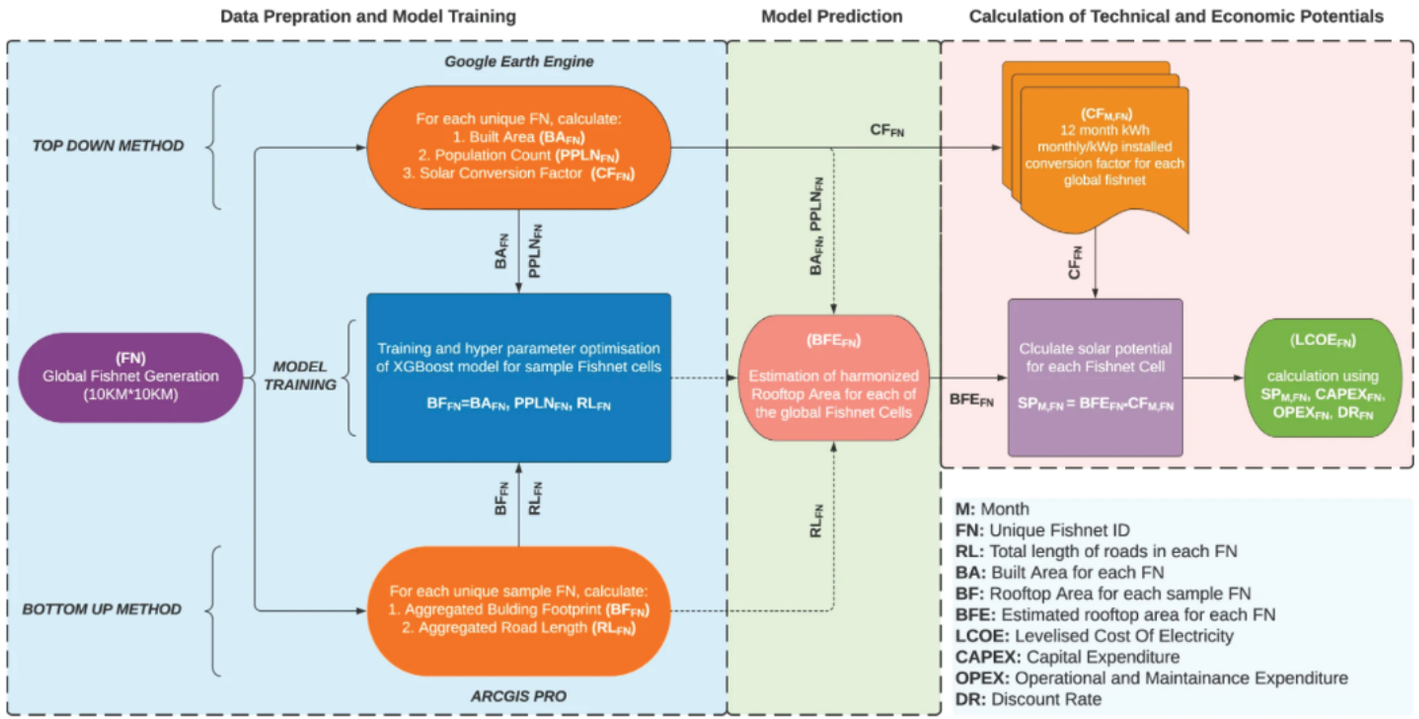
MAXIMUM THEORETICAL POTENTIAL ON EACH ROOF



APPENDIX

The framework developed in this study starts with data preparation and mapping of various geospatial metrics to both Top-down and Bottom-up pathways. The machine learning model is trained and used to estimate BFEFN values from BAFN, PPLNFN, and RLFN values (See image for explanation of terms and link to research paper below). Next, the BFEFN values are used to calculate the technical potential (SP) with the aid of the conversion factors (CF). Finally, the calculated potential dataset is used to map the potential by county with costs determined using SEAI's solar calculator which is available online https://www.seai.ie/tools/solar-electricity-calculator/

Model parameters and regional mappings are provided in [High resolution global spatiotemporal assessment of rooftop solar photovoltaics potential for renewable electricity generation | Nature Communications]



CALCULATION SUMMARY

Available Rooftops from GIS and Data Mapping

X

Adjusted for Vacancy Rates per County (CSO) and structurally unsuitable roofs (own estimates)

X

County Specific Capacity factors (SEAI)

X

Installation Losses due to Deviations from South + Tilt (SEAI)

X

Occupancy Assumptions for own uses (Own Estimates)

↓

Electricity Sent to Grid outside of own use and immersion Heating

=

Annual Production

FAQ'S

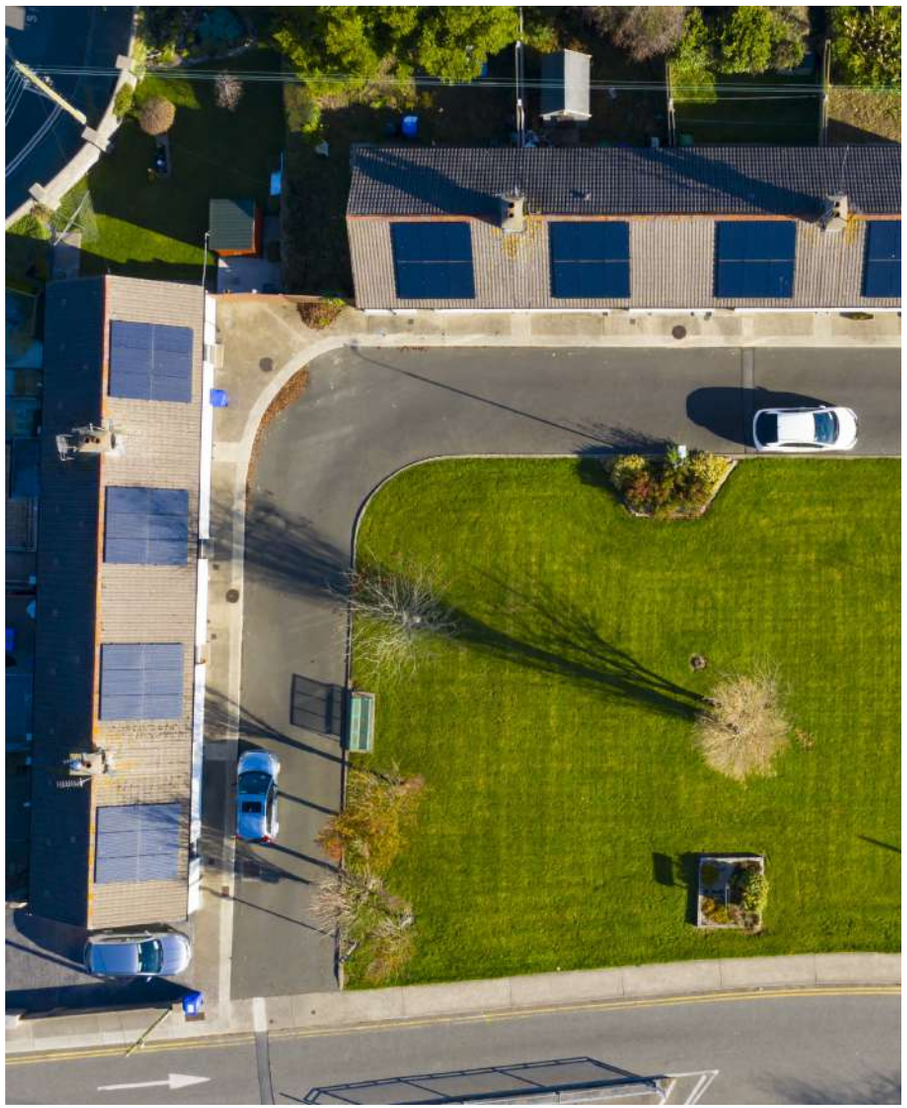


Photo Credit: 3 Counties Energy Agency (3cea)

WHO WROTE THIS REPORT? This report was written by Siddharth Joshi and Paul Deane from the MaREI centre which is the Science Foundation Ireland Research Centre for Energy, Climate and Marine, coordinated by the Environmental Research Institute (ERI) at University College Cork. Graphic design and layout was done by Karen O'Callaghan also with the MaREI centre.

WHO FUNDED THIS REPORT AND WHY? This report was funded by the Irish Solar Energy Association (ISEA). ISEA was established in 2013 to advance a policy and regulatory landscape promoting solar as a leading renewable energy technology that will decarbonise Ireland's electricity system, and contribute to a successful and strong clean economy.

WHAT ARE THE MAIN STRENGTHS OF THE ANALYSIS? The analysis undertakes a high-resolution assessment of rooftop solar photovoltaics potential in Ireland using big data, machine learning and geospatial analysis. This allows us to get a detailed understanding of the actual potential for rooftop solar PV in Ireland.

WHAT ARE THE MAIN WEAKNESSES OF THE ANALYSIS? The analysis does not consider any local constraints such as access to rooftops, shade from trees or nearby buildings or local electricity grid constraints for exports. We do assume that 15% of all available homes are unsuitable for rooftop solar PV due to structural issues.

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