THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

BUSINESS SCHOOL
ENERGY CENTRE

Advances in solar research

Energy Spotlight
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Topics

Developments in solar energy research on:

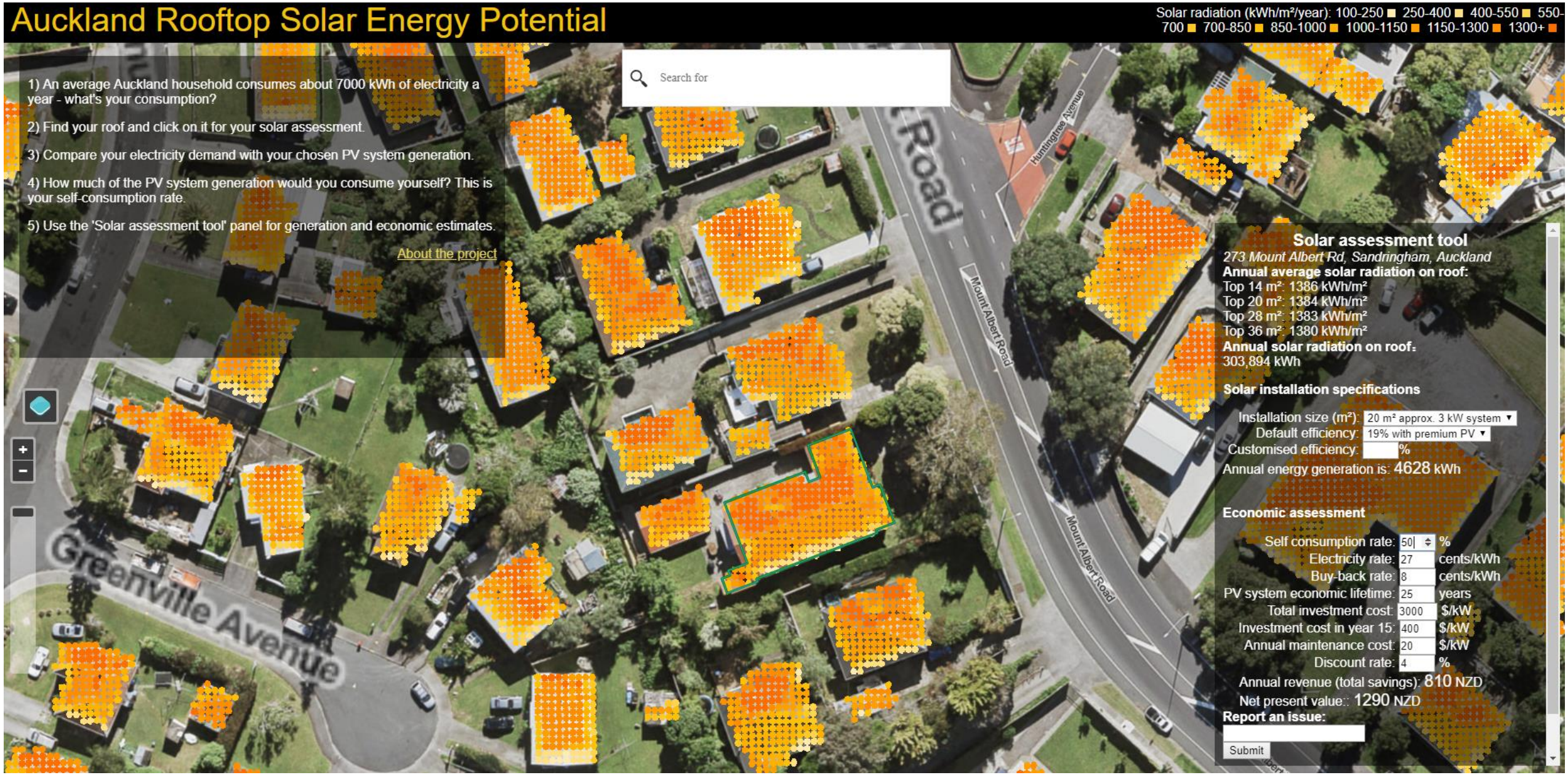
1. Auckland urban area

   Kiti Suomalainen, Sofia Schroder Langhaeuser

2. Solar and Pacific island grids

   Peter Wilson (NZIER), Basil Sharp, Kiti Suomalainen, Gareth Williams (Nexgen Energy Solution)

cer.solarpower.auckland.ac.nz



Auckland rooftop solar potential: Update

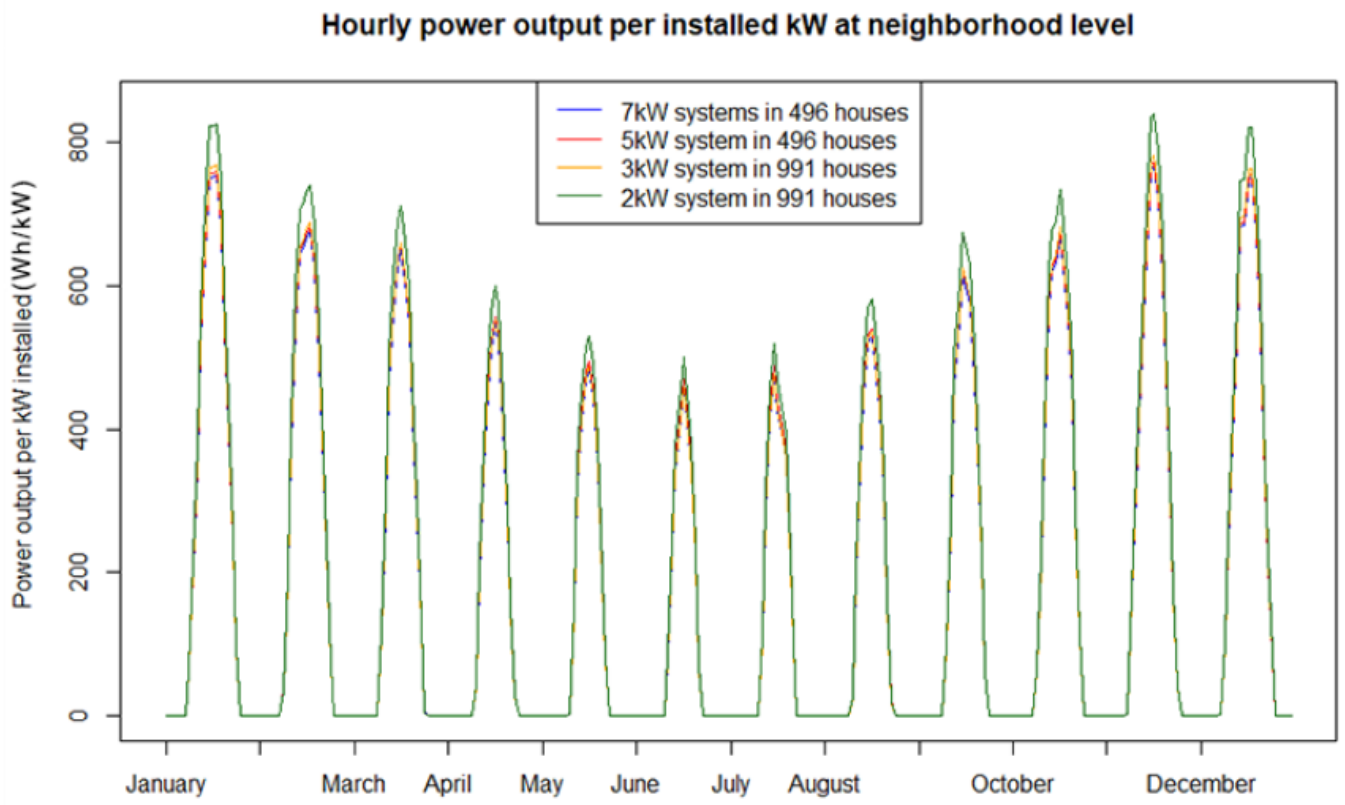
- New approach:
  - Measured solar radiation data as input
  - Results saved at hourly level
  - ➢ 12 representative days for a year

- Tested on 1 suburb: Pinehill
  - Roughly 1000 houses
  - 1m2 spatial resolution

Pinehill, Auckland

Small PV systems on all roofs vs. larger systems on “best” 50% of all roofs?

Results: PV output



Size (kW)	kW installed (kW)	Yearly power output per kW installed (kWh/yr/kW)
7	3472	1604
5	2480	1628
3	2973	1625
2	1982	1752

Small PV systems on all roofs vs. larger systems on “best” 50% of all roofs?

Results: Economic assessment

- Installation of 7 kW solar PV systems in 496 rooftops.
- Installation of 5 kW solar PV systems in 496 rooftops.
- Installation of 3 kW solar PV systems in all 991 rooftops.
- Installation of 2 kW solar PV systems in all 991 rooftops.

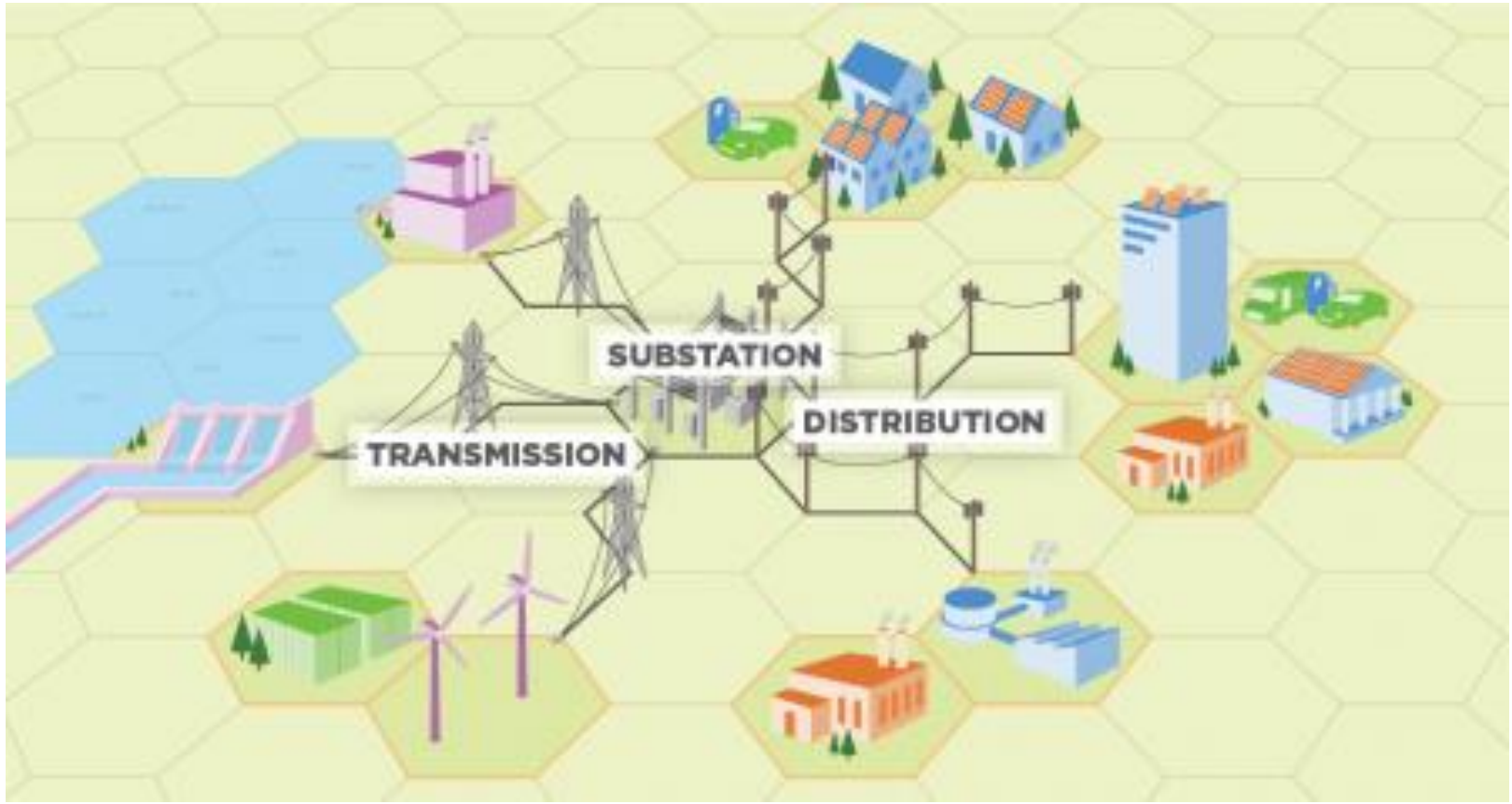
System size (kW)	Cost (NZD)	Total cost Pinehill (NZD)	Total yearly power output (kWy)	Total yearly power output per NZD invested (kWy/NZD)
7	21000	10,416,000	5,567,533	0.535
5	15000	7,440,000	4,036,929	0.543
3	9000	8,919,000	4,830,080	0.542
2	7000	6,937,000	3,471,958	0.500

Solar and grids: Challenges in island energy systems

Many island states have high renewable energy targets, 100%: e.g. Cook Islands, Samoa, Tuvalu, Vanuatu.

Projects focused on isolated solar/wind/battery systems – omitting (economic) impacts on grid.

Where should the new tech go?



Source: www.epa.gov

Solar and grids: Economic assessment

Asset	Economic valuation parameters
Diesel generators	Capacity Remaining economic life Salvage value
Transmission	Remaining economic life of asset Salvage value Annual OPEX Expected costs of upgrade Weighted cost of capital
Distribution	Salvage value Partial retirement Upgrade costs

Source: adapted from Caldecott et al., 2013

	Samoa	Tonga	Cook Islands
Domestic solar + battery	NPV $438 Payback 21.1 years	NPV -$592 NA	NPV $17,139 Payback 9.3 years
Commercial solar + battery	NPV $102,660 Payback 7.9 years	NPV $14,907 Payback 10.5 years	NPV $157,699 Payback 4.4 years
Commercial solar without battery	NPV $81,885 Payback 3.7 years	NPV $13,850 Payback 5 years	NPV $115,403 Payback 2.3 years

Grids are costly to build and maintain.
Solar + battery project costs vary significantly by location.

We need to understand how to transition to a resilient, low-carbon energy system at lowest system cost.

Next steps

- Develop economic assessment model for exploring optimal deployment path for solar/distributed generation.
- Test for one island, produce a model that can be applied to other islands.
- Introduce stochasticity for uncertainty in fuel/carbon price, technology costs, climate change impacts.

Take-home messages

- Time resolution matters: residential solar economics
- Size matters: larger systems of fewer roofs may be the most economic way forward
- Islands: Local energy system has big impact on solar economics
- Systems perspective needed to plan for a secure, economic transition to a low-carbon energy system