The economic benefits of sharing self-generated electricity in a local community

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Background

Affordable rooftop solar photovoltaic systems (PV) and progress in information technologies give rise to the possibility of local energy markets.

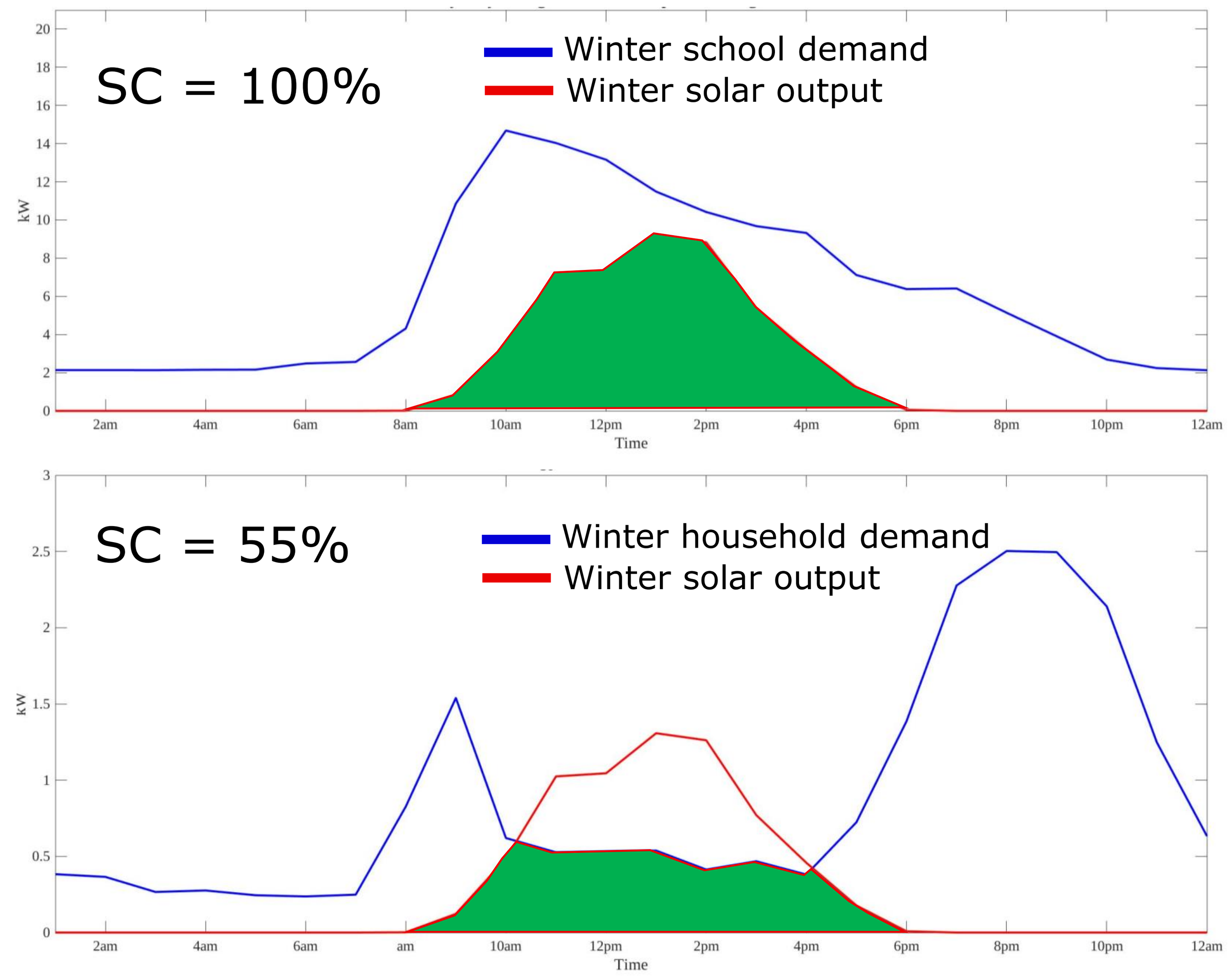
What are the economic benefits of sharing surplus locally generated electricity within a community?

This question was addressed by considering electricity sharing scenarios within the Blueskin community. Solar output, self-consumption (SC) and demand data were used to determine net benefit from rooftop solar PV.

$$\text{Net benefit (NB)} = \underbrace{\text{Savings}}_{\%SC\, *\, p_i\, *\, E_{PV}} + \underbrace{\text{Earnings}}_{(1-\%SC)\, *\, p_e\, *\, E_{PV}}$$

%SC = Percentage of self-consumption
p_i = Import price = \$0.28/kWh
p_e = Export price = \$0.08/kWh
E_{PV} = PV Output

Matching of supply and demand

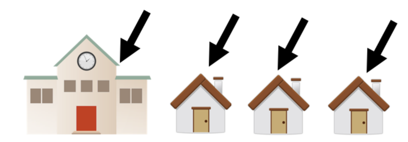


Data used:

- Solar irradiance data (NIWA) – one year, hourly interval
- Household (x 20) demand data (Green Grid Project)
- School demand data, scaled for Waitati school

Energy sharing scenarios

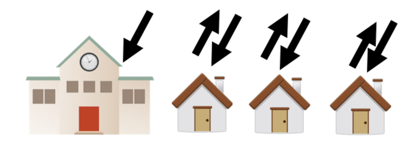
No export



- No PV system
- Electricity imported from the utility grid (UG)

- SC = 0%
- NB = \$0.00

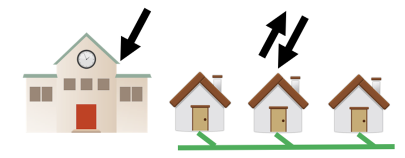
Individual export



- Individual use of PV
- No connection between houses
- School importing from UG

- SC = Individual
- NB = \$4,205

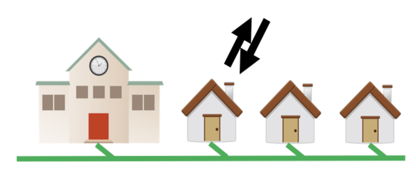
Trading without school



- Shared energy within the community of houses
- School importing from UG

- SC = 41%
- NB = \$4,451

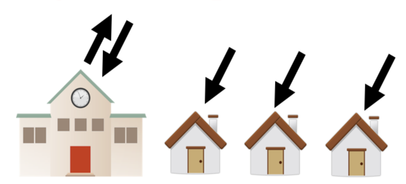
Trading with school



- Houses and school are connected
- PV surplus from houses is exported to the school

- SC = 78%
- NB = \$6,523

Only school exports



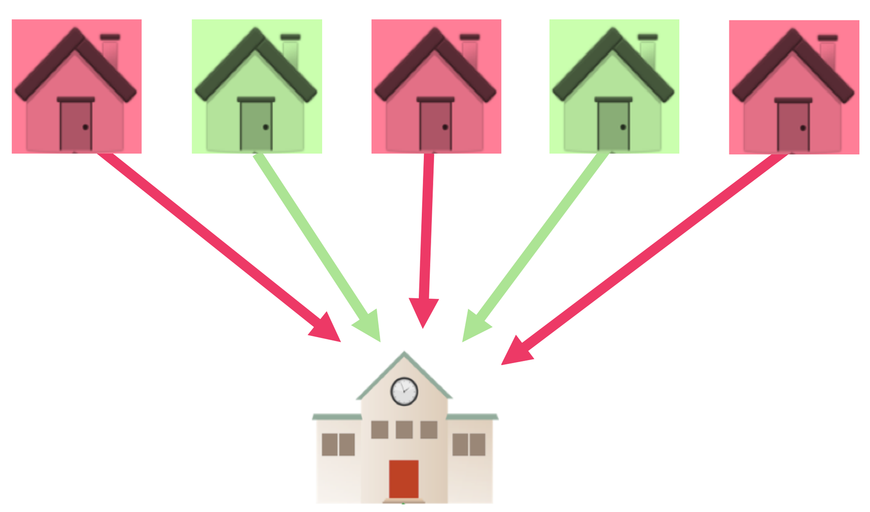
- PV system on school roof
- No connection between school and houses
- Houses importing from UG

- SC = 60%
- NB = \$5,508

NPV of trading with school

Trading with the school (TS) provides the most benefit to the community.

How does trading with the school affect the Net Present Value (NPV) of individual solar installations?



0 Individual Export
1 Low SC + TS
2 High SC + TS

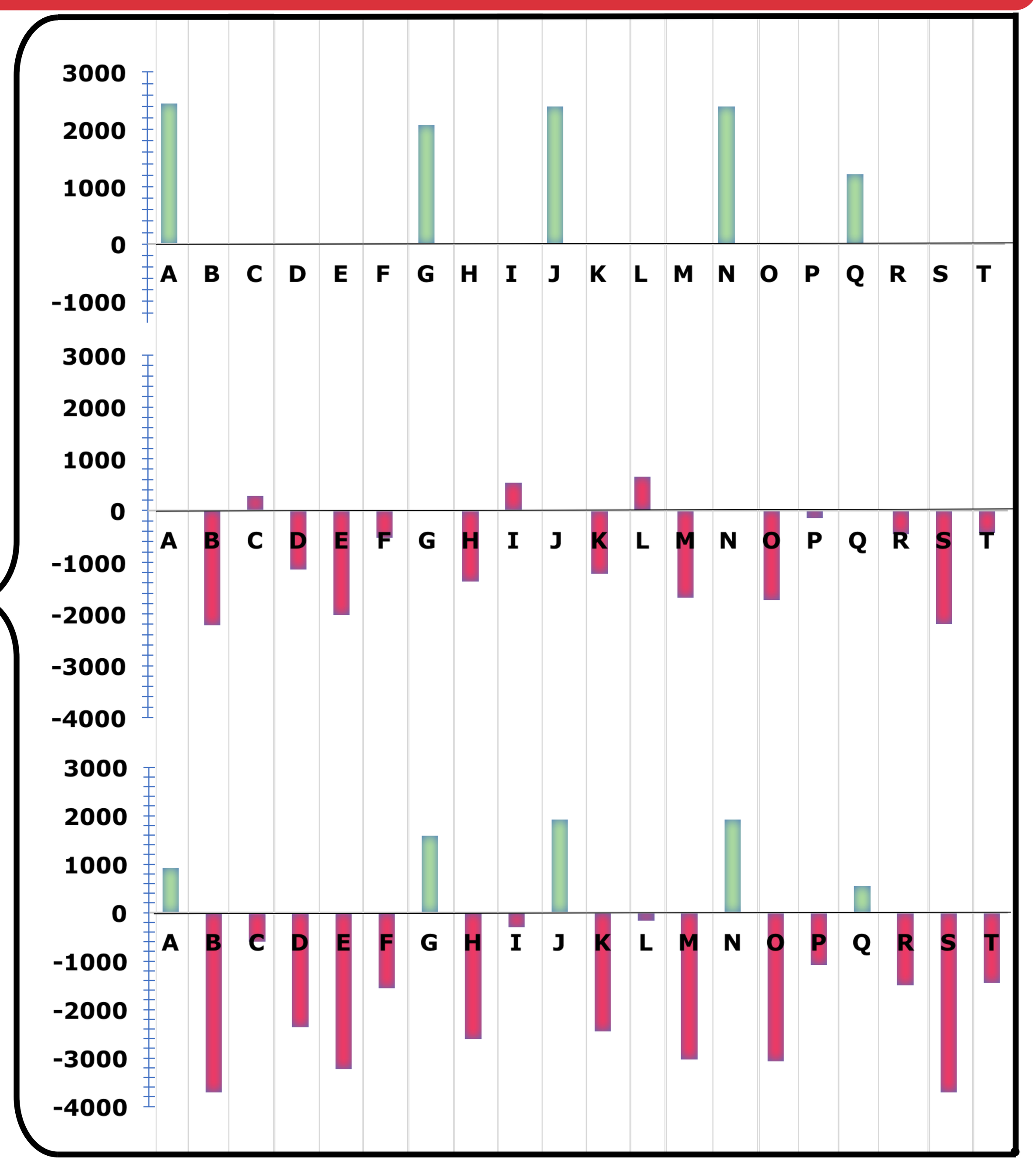
The key assumptions*:
Grid: Price p_i = \$0.28/kWh Buyback rate p_e= \$0.08/kWh
Community: Price p_{cs}= \$0.20/kWh Buyback rate p_c= \$0.16/kWh

Note: $p_e < p_c < p_{cs} < p_i$

System Size = 3 kW_p
System Cost= \$3.2/kW

*Miller, Allan et al. (2015)

NPV results



Key findings

- Self-consumption has large positive impact on net benefit
- Winter school demand matches well with solar generation patterns yielding high self-consumption
- The trading scenario that includes the school scenario provides the most benefit to the community
- Trading with the school increases the NPV of rooftop solar installations for all houses
- Negative NPVs can become positive if trading with school is possible (sensitive to trading price)
- There are benefits for both school and households through trading within the community