GREEN Grid Conference 2019

Load Shifting Extension to the EECA Solar Calculator

Sharee McNab

29 November 2019

Outline

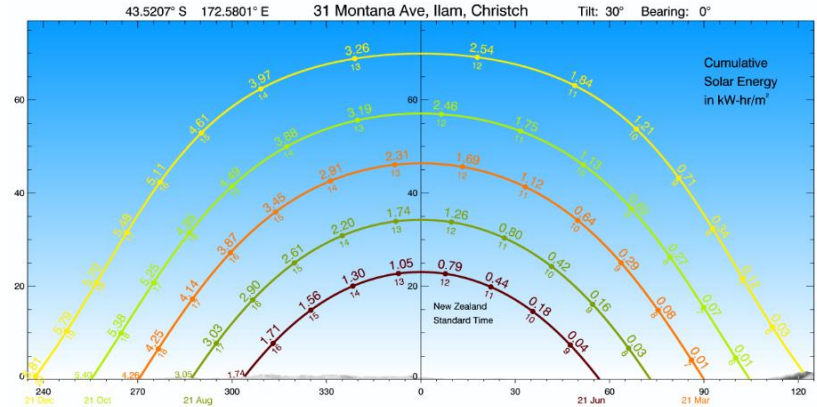- Overview of EECA Solar Calculator
- Implementing load shifting
- Impact of load shifting
- Possible future work

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Overview EECA Solar Calculator

- Generation
  - Address specific
  - Climate data from NIWA
  - Energy calcs

- Household load profile
  - Analysis of 18000 households

- Financial analysis
  - NPV
  - Payback time

Solarview Sunpath

The EECA energywise™ PV Solar Calculator

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https://ir.canterbury.ac.nz/handle/10092/15238

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- Overview of EECA Solar Calculator
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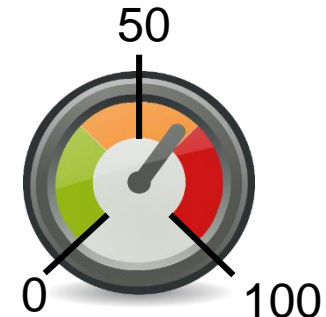CHRISTCHURCH NEW ZEALAND

Load Shifting Feature

- ## What is load shifting?
  – Householder choosing to shift load to times when more generation, increasing self-consumption

- ## Why?
  – Self-consumption of generation an important factor in financial benefit
  – NOT just a knob to dial up higher
  – Link to physical behaviours

- ## Which Loads?
  – Electric hot water (thermal storage)
  – Flexible loads (dishwasher, clothes washer/dryers)

- ## How?
  – Aggregated load data (typical)
  – Where is the load shifted from?
  – Where to shift to?

$$Self\text{-}consumption = \frac{solar\ used\ (kWh)}{solar\ generated\ (kWh)}$$

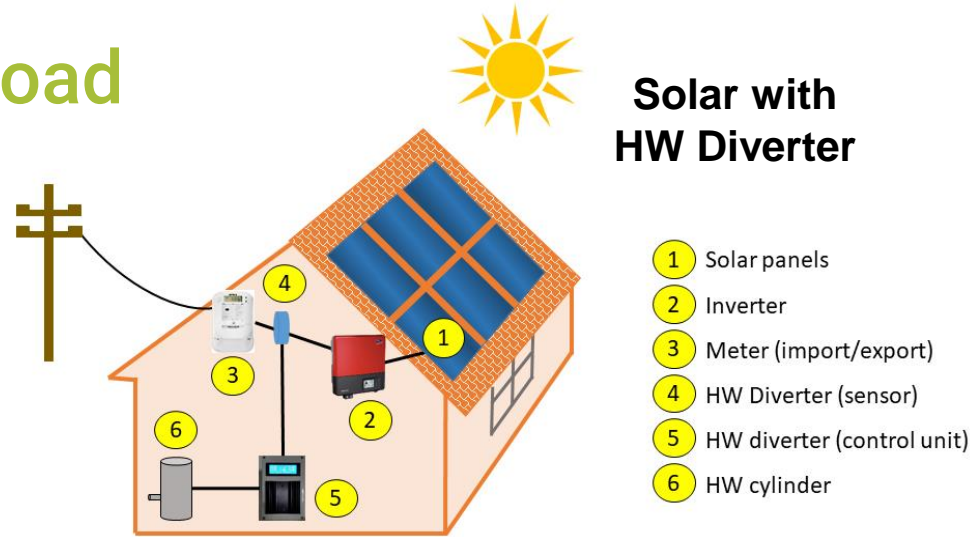Import price ~ 25-35 c/kWh
Export price ~ 8-9 c/kWh

50

0   100

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Different Ways to Shift Load

Solar with HW Diverter

Fixed (eg. timers)

- Hot water

- Flexible loads

|	
1	Solar panels
2	Inverter
3	Meter (import/export)
4	HW Diverter (sensor)
5	HW diverter (control unit)
6	HW cylinder

Smart (eg HEMS, HW Diverters)

- Look for excess generation

- Modulate output

Important – not compatible with controlled circuits!

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Shifting Load From …

- Aggregated data
- HW load removed from load profile assuming typical 27%
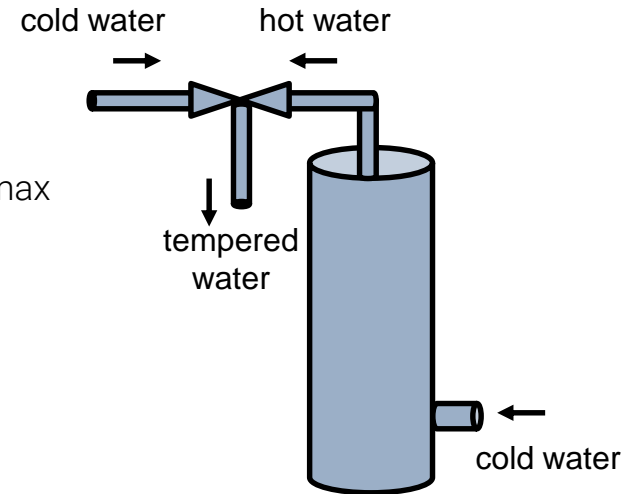- Similarly for appliances, daily appliance load calculated to shift
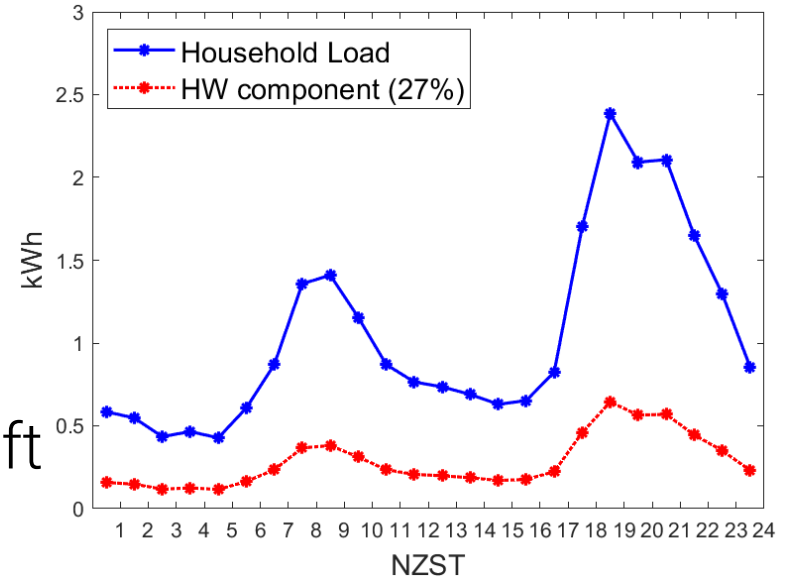
Shifting Load To (Timer) …

- HW (Timer) centred around the max generation time
- Appliances are staggered around max generation time

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Modelling a HW Diverter

Energy State

- Assume initial state at start of year

- Model keeps HW cylinder state, between T_{max} (73°C) & T_{min} (40°C)

- When export and $T < T_{max}$ heat cylinder

- When $T < T_{min}$ heat cylinder

- Assumes tempering valve installed

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Load Shifting Assumptions

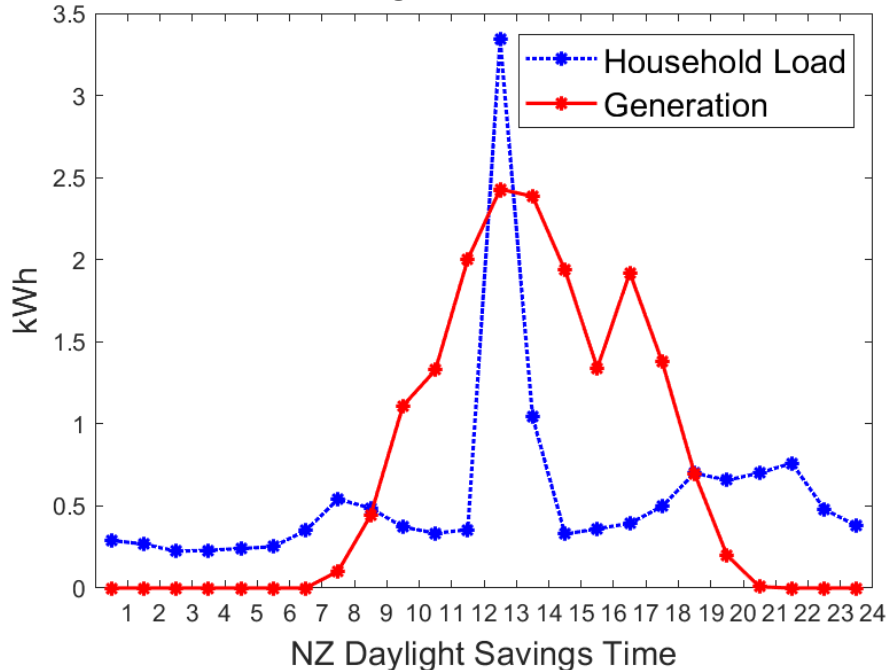| Parameter	Value	Reference
Hot water load component	27%	EECA 2018
Hot water element size	3kW Important in timer analysis	GREEN Grid sample houses
Hot water cylinder size	180L (HW Diverter)	GREEN Grid sample houses
Max/Min hot water temperature (assumes a mixer)	73/40° C	HW Diverter only (Paladin)
Hot Water min. diversion	0W	Best case
Dishwasher load (typical)	0.78 kWh	EECA Sales and Efficiency Data 2018
Clothes washer (cold / hot)	0.21 / 1.32 kWh	EECA Sales and Efficiency Data 2018
Clothes dryer	4.39 kWh	EECA Sales and Efficiency Data 2018

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- **Impact of load shifting**
- Possible future work

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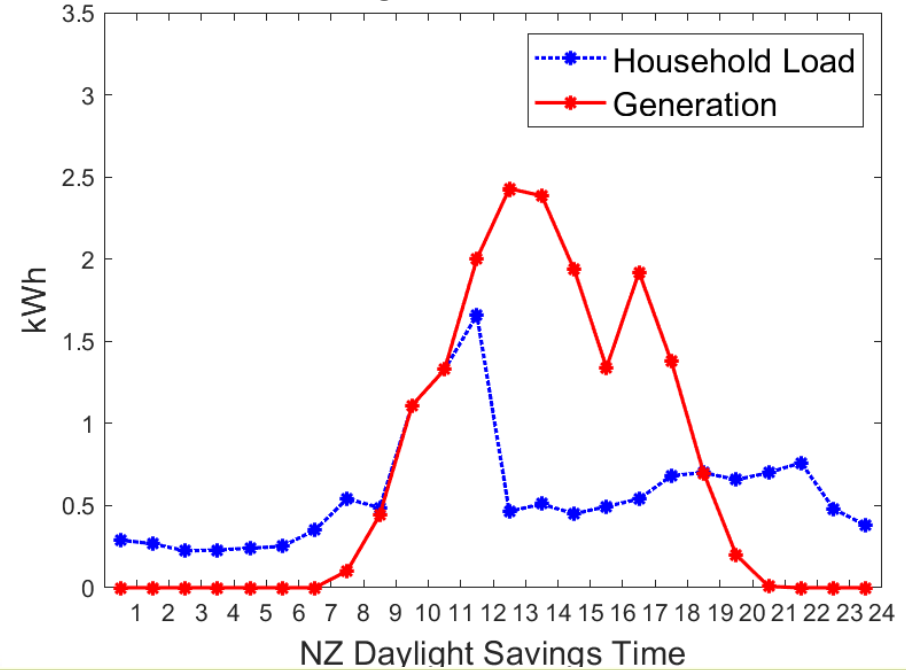
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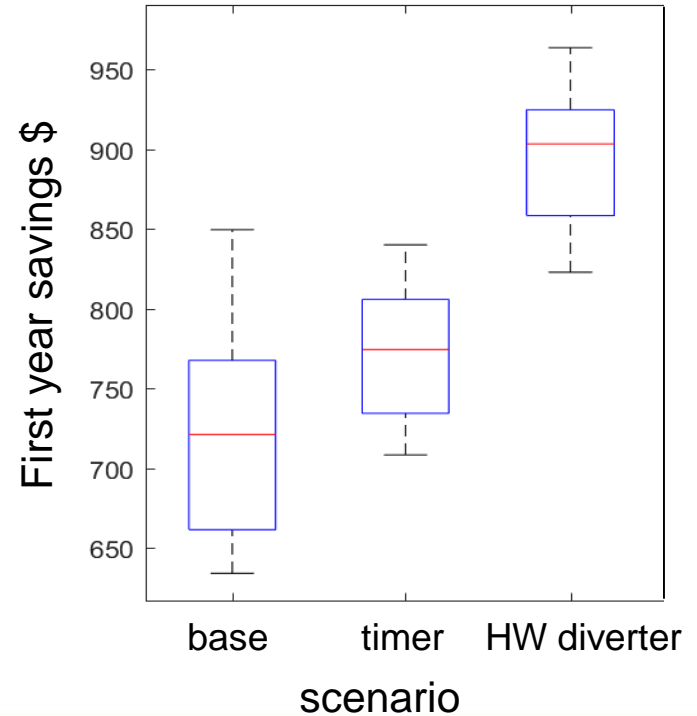# Summer Day Generation/Load Comparison

3 kW PV Array, electricity consumption 7500 kWh p.a.

Load shifting impact (hot water)

3 kW array, electricity consumption 7500 kWh p.a.
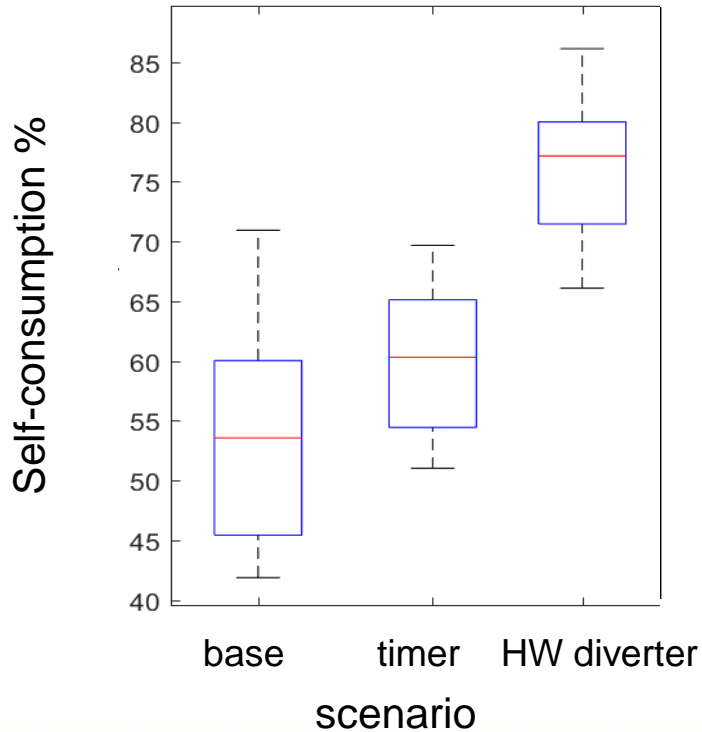
Possible Future Work

Short term

- Further validation of solar systems

- Implications of the Electricity Pricing Review

Longer term

- Battery Energy Storage

- Changing loads
  – EV charging,
  – air-conditioner

- Upload personal smart-meter data

- Advances in PV technologies
  – Bifacial, smart solar modules

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EECA Solar Calculator

https://www.energywise.govt.nz/tools/solar-tool/

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