Distributed Generation and Battery Storage

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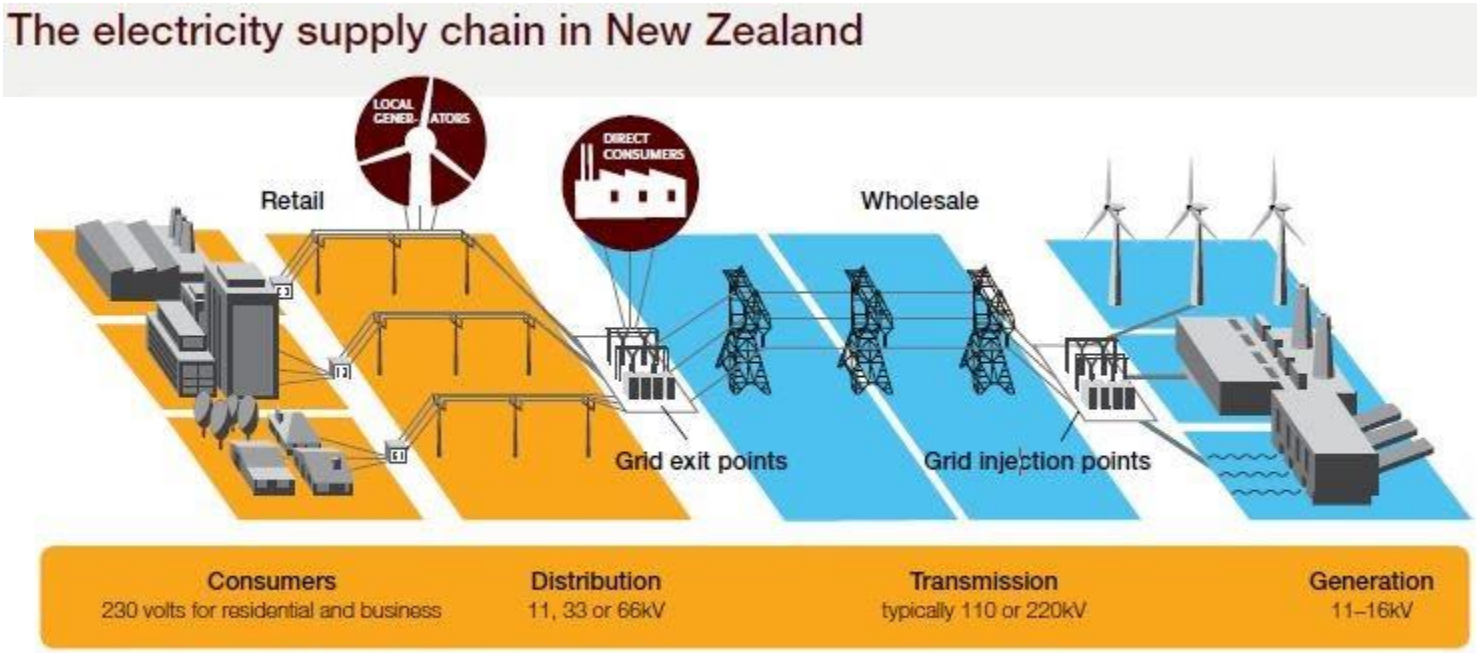
Overview

- Economic Fundamentals
- Distribution networks
- Residential electricity pricing
- Residential demand profiles
- Solar PV generation
- Battery technologies
- New distribution tariffs

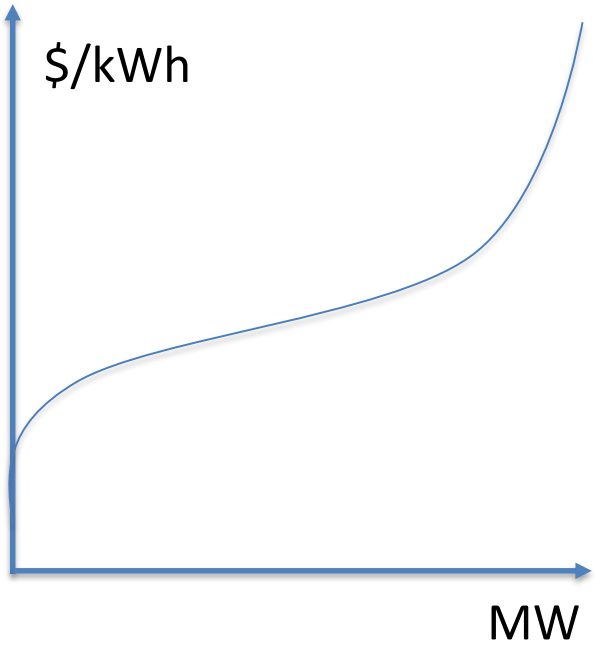
Electricity Systems



Source: Electricity Authority, Electricity in New Zealand 2011

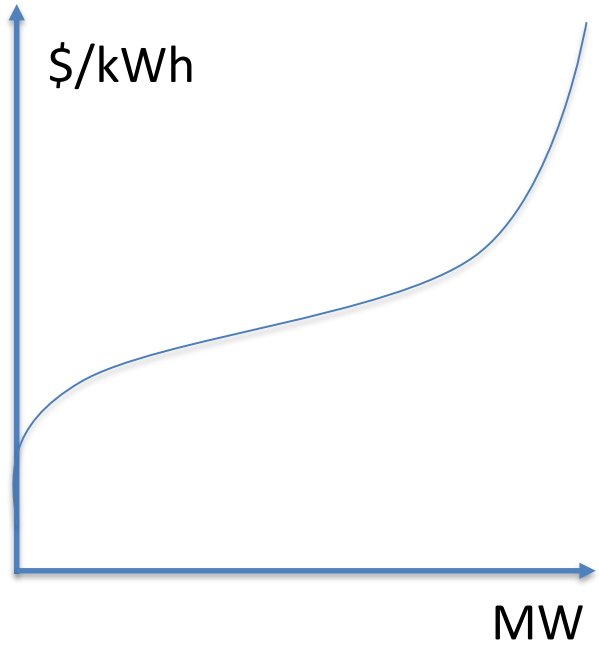
Economic Fundamentals

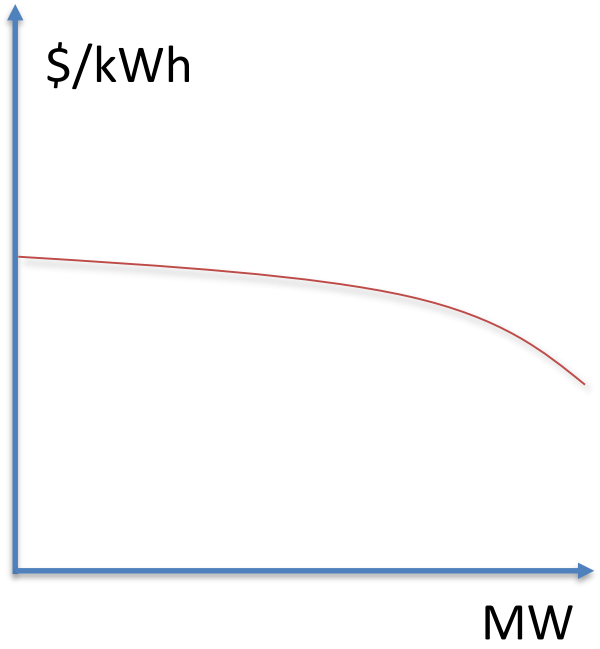
Consider the cost of solar PV (in $/kWh) across all households.



Economic Fundamentals

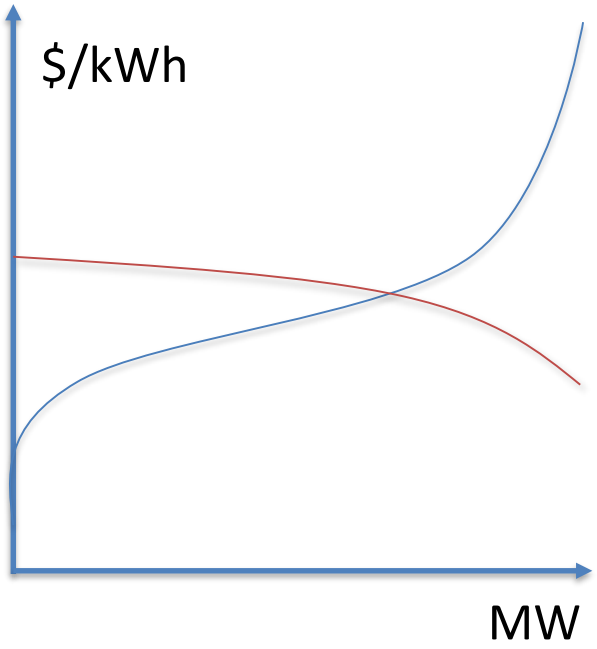
As well as the cost of energy from the grid.





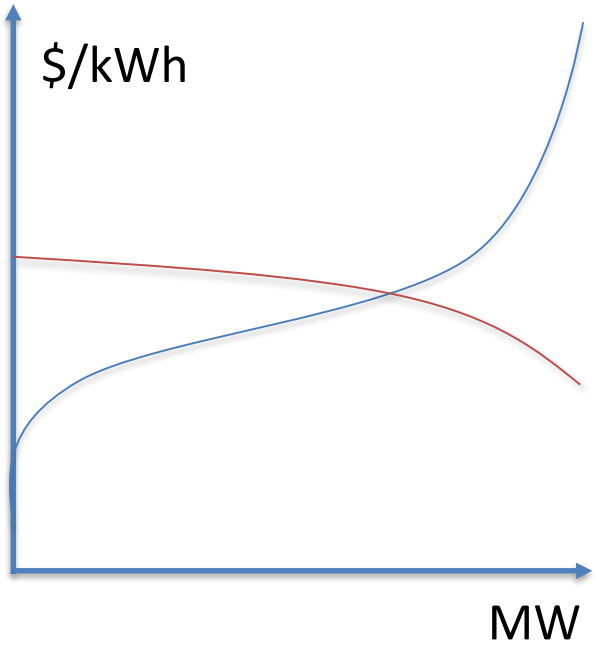
Economic Fundamentals

Where these curves meet, we have an 'equilibrium'. So no household would elect to install



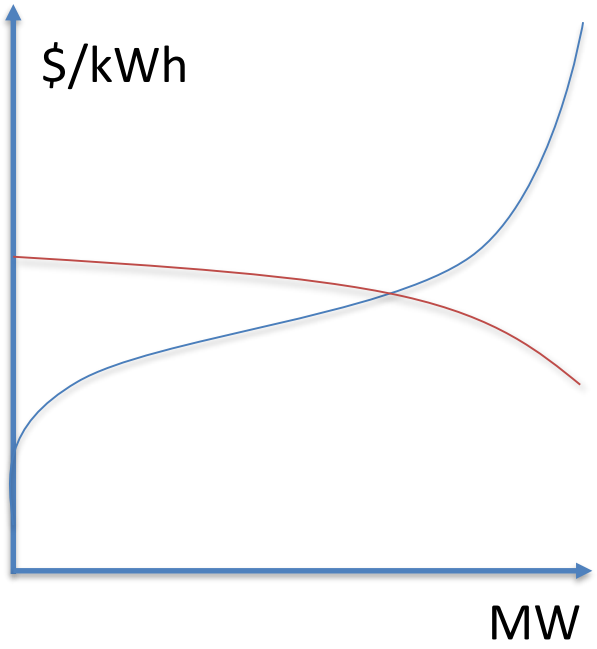
Complications:

The electricity price might be too high, due to a lack of competition in the spot market.



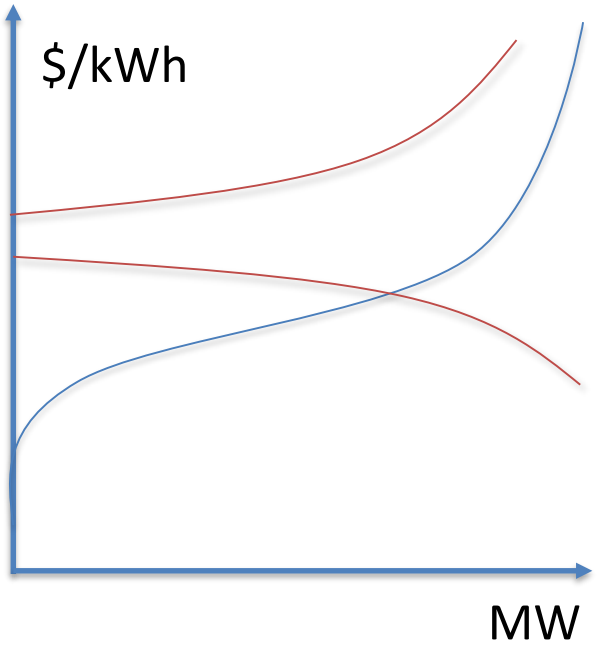
Complications:

The cost of solar PV has been dropping, and it will likely continue.



Complications:

The fixed costs of distribution assets will be spread over fewer customers.



Complications:

We will now consider the effect and regulatory action necessary for each of these complications.

Issue	Effect	Action
Retail prices too high		
Solar prices dropping		
Distribution charges rising		

Distribution and Retail Tariffs

Price plan	Meter no	Previous reading	Latest reading	Units used
Low User - All Inclusive	RX09041710	31962 (actual)	32147 (actual)	185 kWh

VARIABLE USAGE CHARGE			
Low User - All Inclusive		**185 kWh** x 26.28 **cents/kWh**	$48.62
DAILY FIXED CHARGE		**11 days** x 33.33 **cents/day**	$3.67
ELECTRICITY AUTHORITY LEVY		185 **kWh** x 0.15 **cents/kWh**	$0.28
GST			$7.89
TOTALS			$60.46

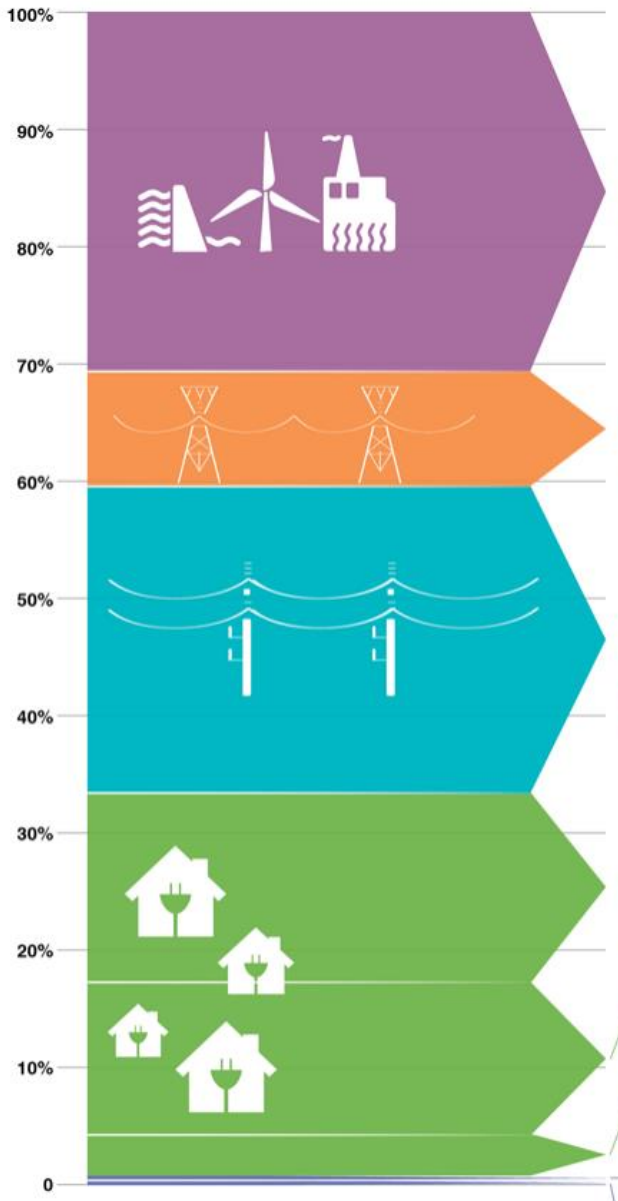
Distribution and Retail Tariffs

Price plan	*Meter no.*	*This reading*	*Last reading*	*Units used*
Low User - Anytime	RX09041710	26591 (actual)	26012 (actual)	579 kWh

Current account details - For the period 28 Feb 16 to 31 Mar 16

Charge type	*Units*		*Energy charges*			*Distribution and Transmission charges*	
Variable usage charge							
Low User - Anytime	579 kWh	@	15.86 cents/kWh	$91.83	@	11.22 cents/kWh	$64.96
Daily fixed charge	33 days	@	16.66 cents/day	$5.50	@	16.67 cents/day	$5.50
Electricity Authority levy	579 kWh	@	0.15 cents/kWh	$0.87			
Subtotals				$98.20			$70.46
GST				$14.73			$10.57
Totals				$112.93			$81.03
Discount for prompt payment *				$11.29cr			$8.10cr

Total current charges $193.96



30.5% GENERATION
In a typical year, this money goes towards the cost of generating the electricity you used.

9.9% TRANSMISSION
This money goes towards the cost of building and maintaining the national grid.

26.2% DISTRIBUTION
This money goes towards the cost of building and maintaining the power lines that transport electricity from the national grid to your house.

16.2% RETAIL
This money goes towards the operating costs of the retailer from whom you bought electricity.

13.0% GST*
This money goes towards the goods and services tax that we all pay.

3.4% METERING
This money goes towards the cost of reading and maintaining your electricity meter.

0.4% MARKET GOVERNANCE
This money goes towards energy efficiency programmes and the costs of running the organisations that regulate the electricity industry, including us.

0.4% MARKET SERVICES
This money goes towards the operating costs of the organisations that manage the day-to-day running of the electricity market.

Source: Electricity Authority

**GST is 15% of the pre - GST cost. Therefore it is 13% of the GST inclusive amount.*

Distribution and Retail Tariffs

In 2004, the then Labour government under an agreement with the Greens introduced regulations in the electricity market:
Low Fixed Charge Tariff option for Domestic Consumers

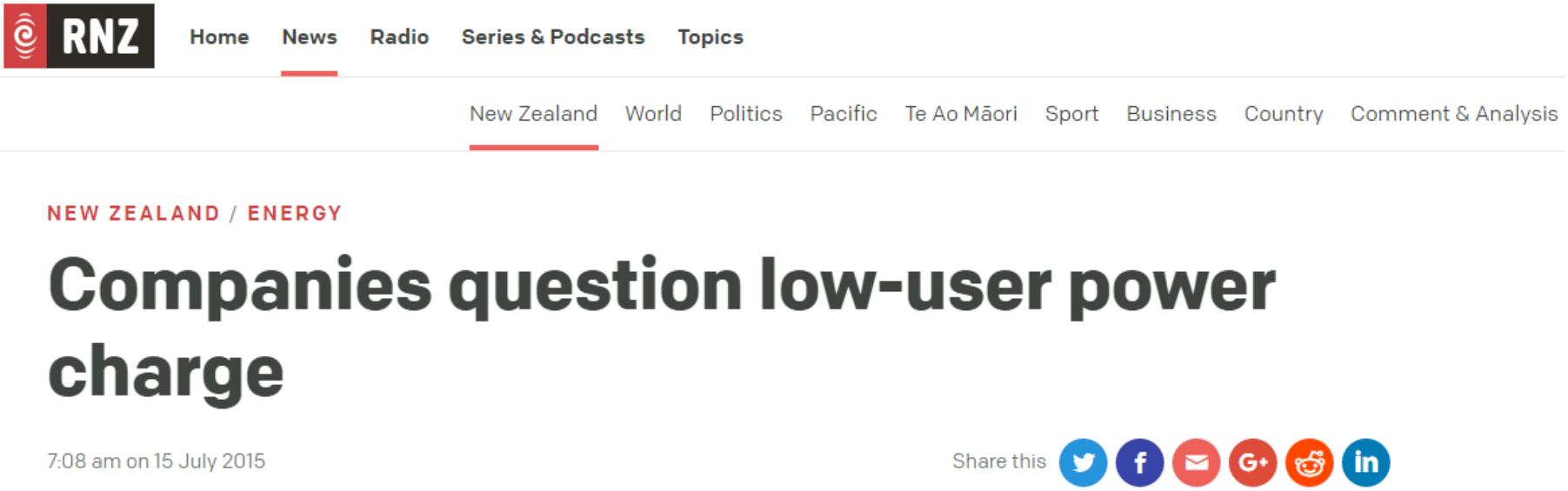
Low User

Total consumption is less than 8000/9000kWh per year
Low daily charge (must be less than $0.30 per day)
High energy charge ($/kWh)

Standard User

High daily charge (>$1.00 per day)
Low energy charge

Distribution and Retail Tariffs



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NEW ZEALAND / ENERGY

Companies question low-user power charge

7:08 am on 15 July 2015

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Pressure is mounting to reverse a 10-year-old scheme that offers cheap connection charges for low-volume electricity customers.

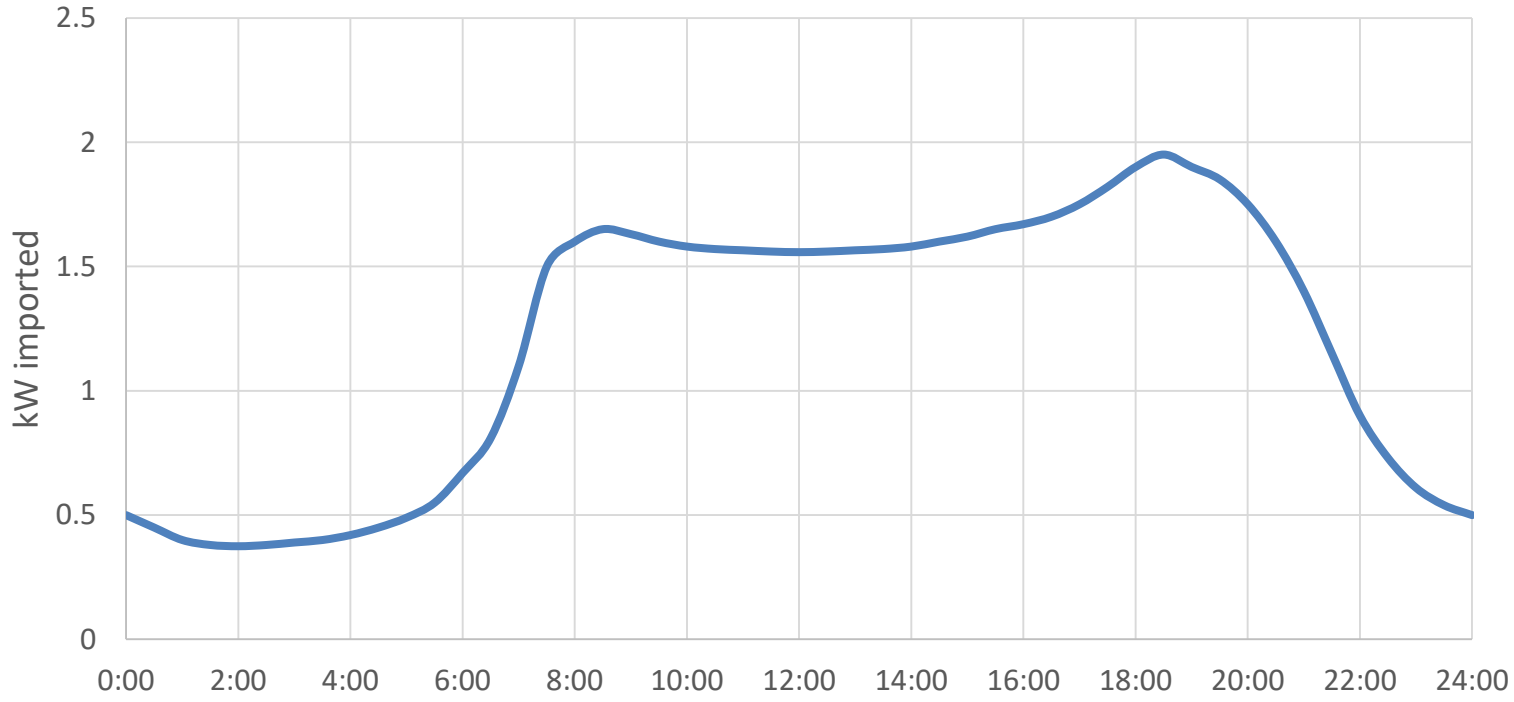
Source: http://www.radionz.co.nz/news/national/278758/companies-question-low-user-power-charge

Distribution Costs

- **Capital costs**
  - transformers
  - distribution lines
- **Maintenance costs**
  - repairs
  - upkeep
- **Staff costs**
  - managing
  - repairing
  - forecasting/planning

Source: TPM Second Issues Paper, Electricity Authority 2016

Residential Daily Demand



Source: http://www.radionz.co.nz/news/national/278758/companies-question-low-user-power-charge

Solar PV Panels

3kW solar PV panels cost approximately $10,000 to have installed on your roof.

The precise amount of electricity they produce depends on a number of factors: roof properties, location etc.

Approximately 3700kWh / year.

Source: http://www.onlinesolar.co.nz/wp-content/uploads/2014/02/B-Solar-Panel.jpg

Solar PV Panels

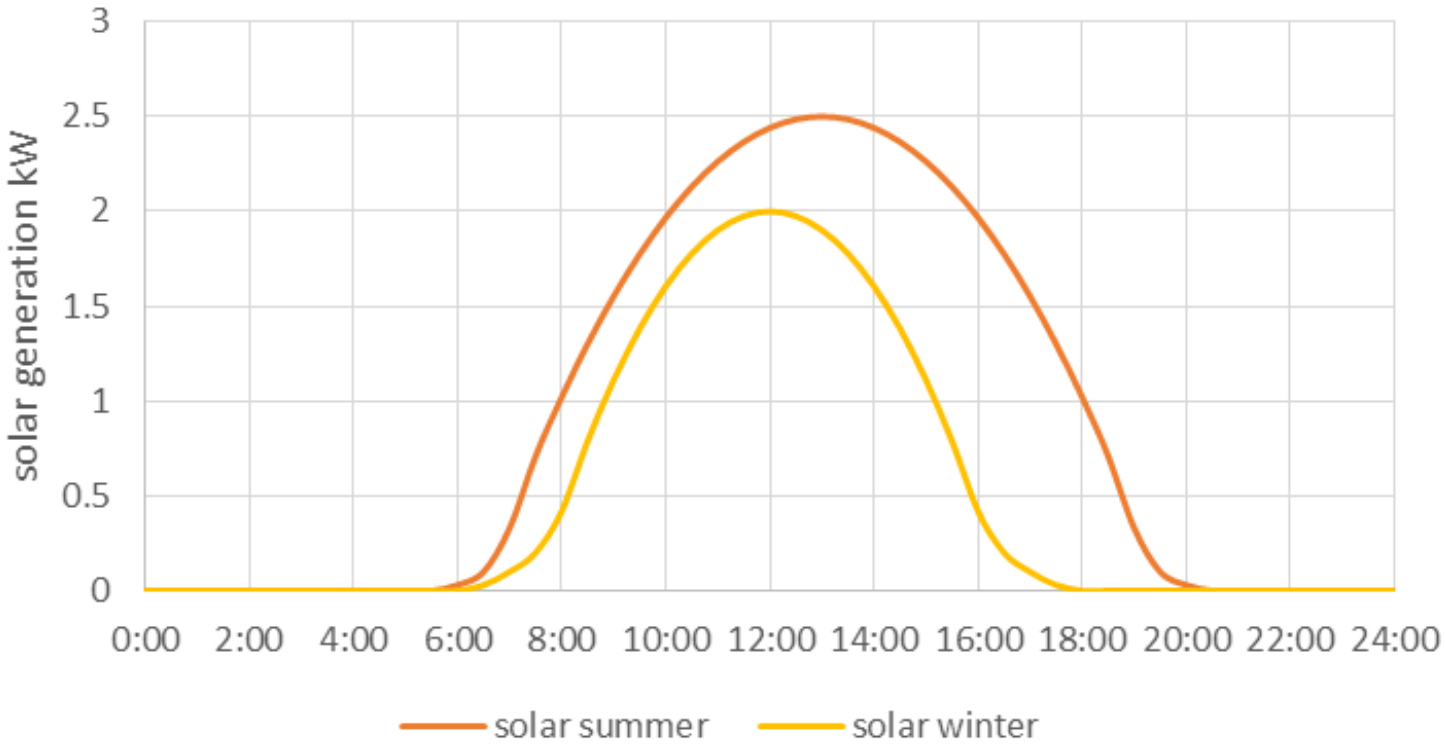
If we do a rough calculation we find:

$0.30/kWh ×3700 kWh/year
= $1118 /year.

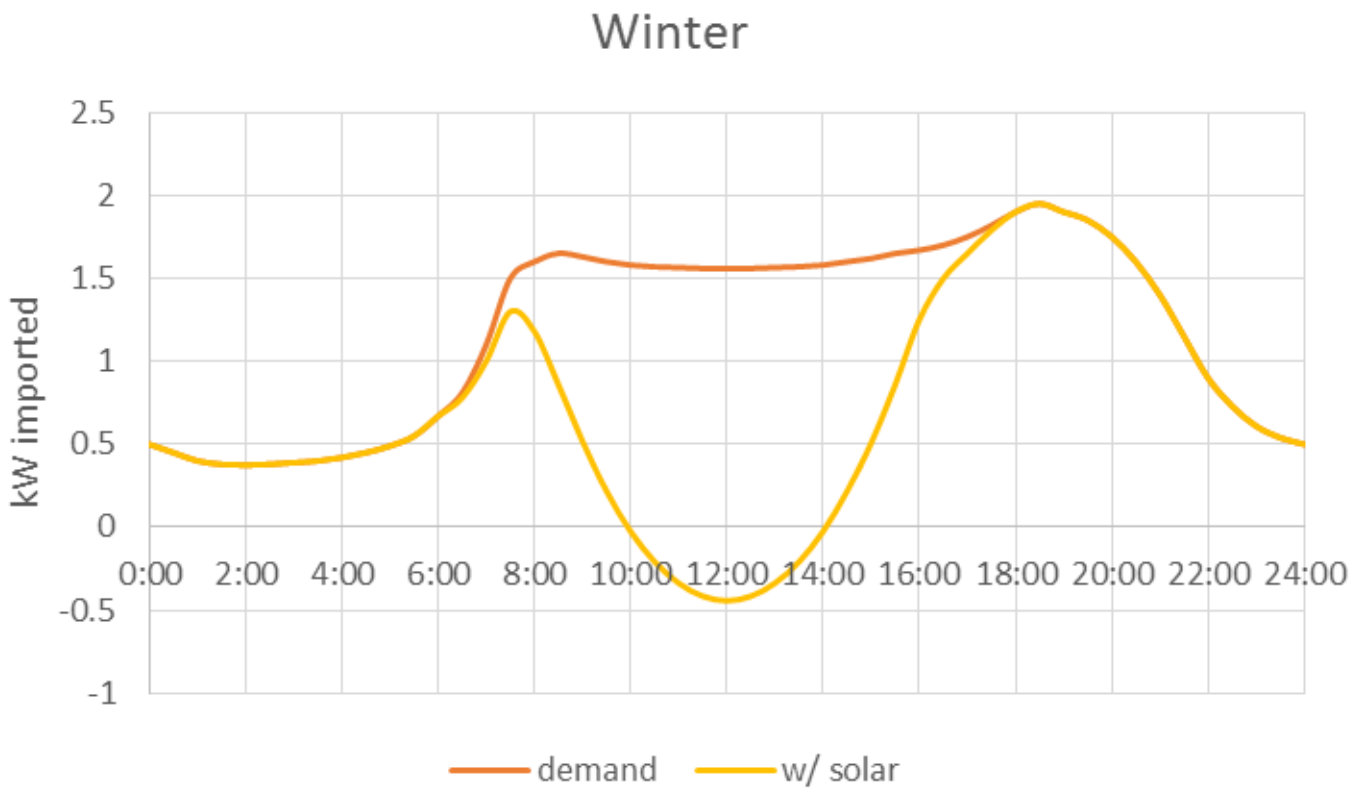
Too good to be true?

Source: http://www.onlinesolar.co.nz/wp-content/uploads/2014/02/B-Solar-Panel.jpg

Solar Generation



Power bought/sold



Summary

Solar can be very attractive if you have a high level of self-consumption.

Solar does not reduce peak-consumption, and therefore does not reduce distribution costs much.

Current distribution pricing rules create a cause a wealth-transfer from customers without solar to those with solar.

Source: http://www.onlinesolar.co.nz/wp-content/uploads/2014/02/B-Solar-Panel.jpg

Battery Storage

Tesla Powerwall

Capacity: 7kWh

Price: $7000

Tesla Powerwall 2

Capacity: 13kWh

Price: $11000

SolaX

Capacity: 15kWh

Price: $9995

Grid-scale

Capacity: 2-3MWh

Price: $1.5m

Source: http://c1cleantechnicacom-wpengine.netdna-ssl.com/files/2015/05/Tesla-Home-Storage-Powerwall.jpg

Battery Storage

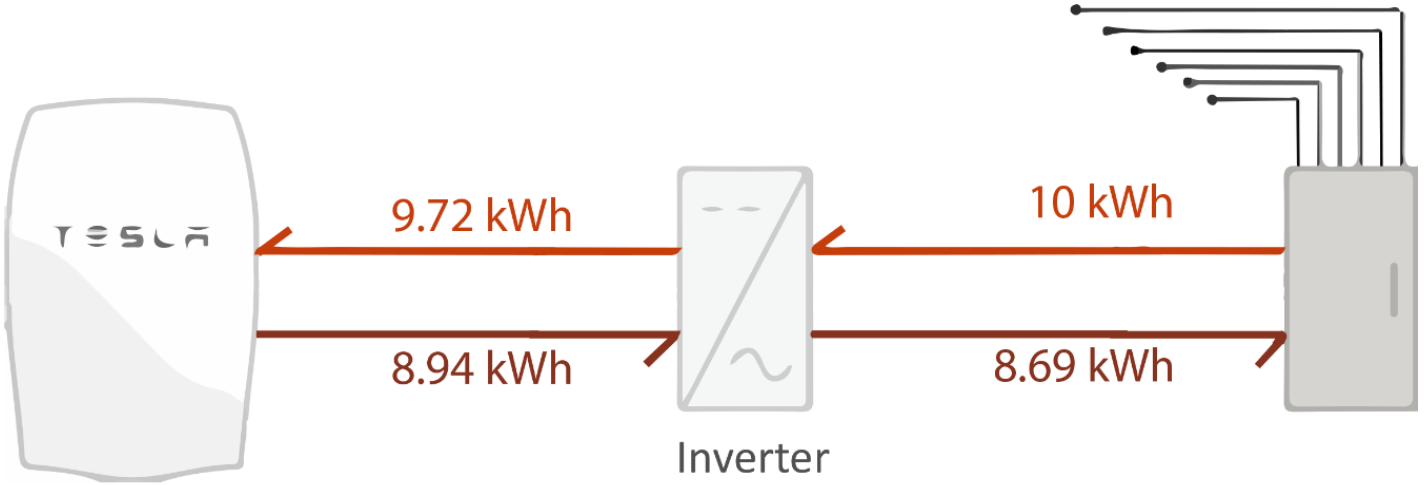
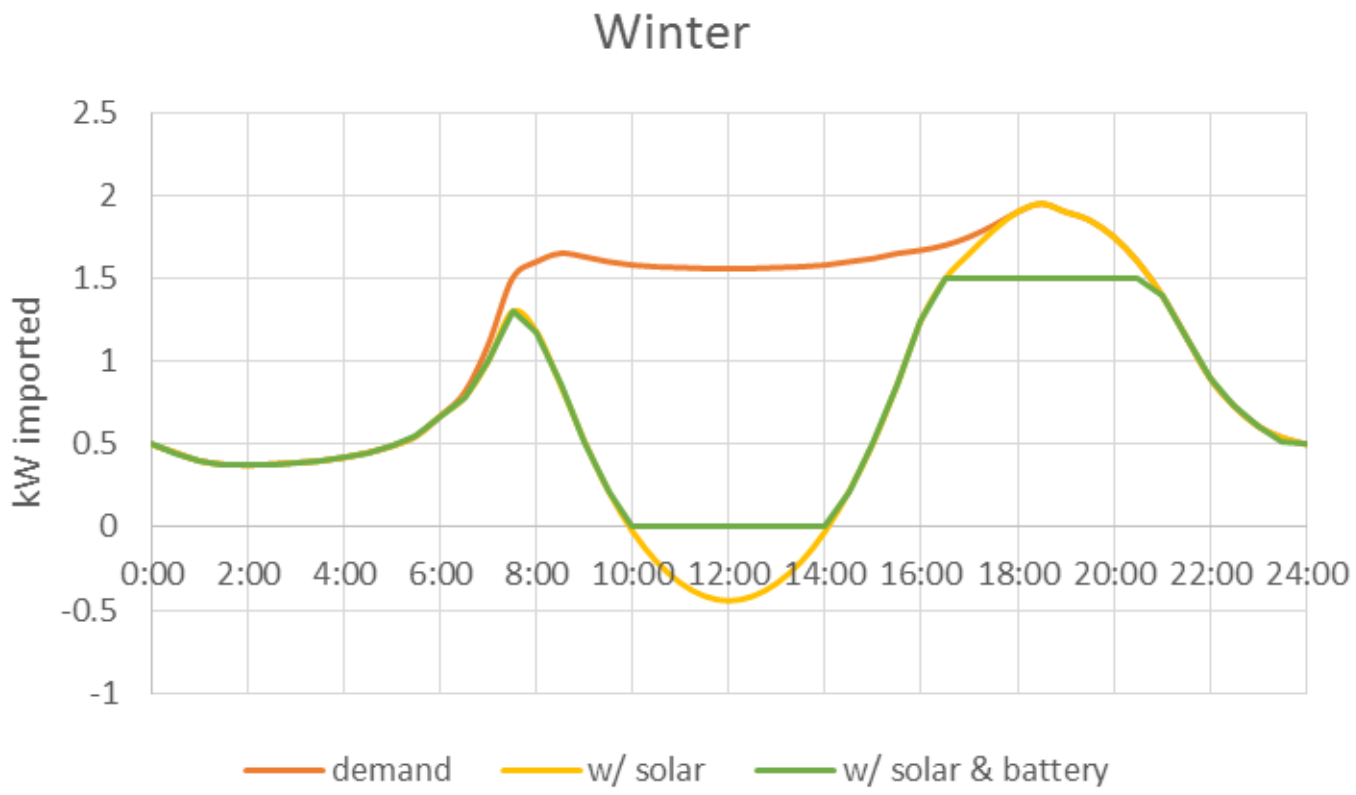
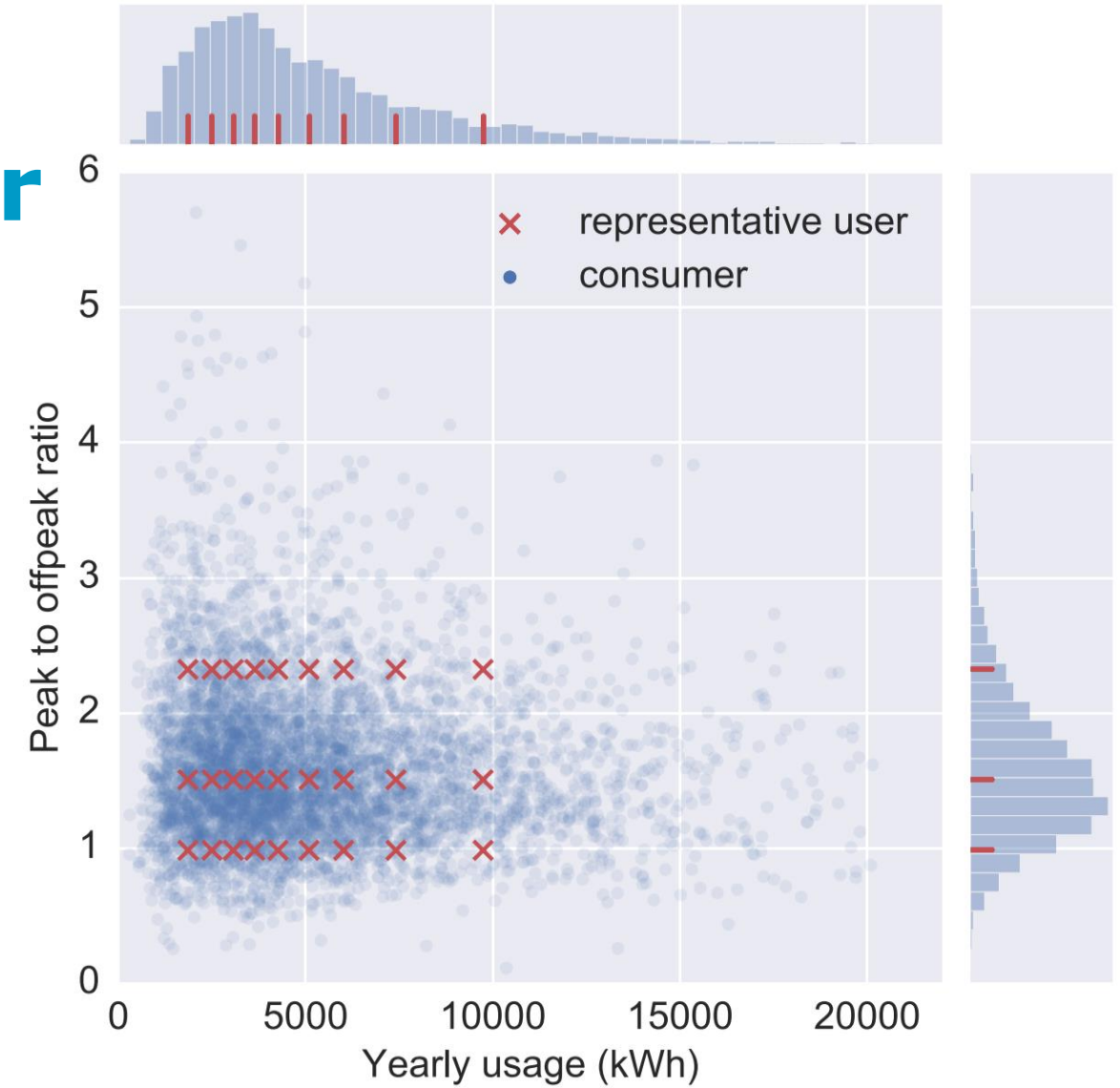


Image adapted from: **Tesla Motors**, http://www.teslamotors.com/powerwall

Power bought/sold



Types of Consumer



Source: John McIvor

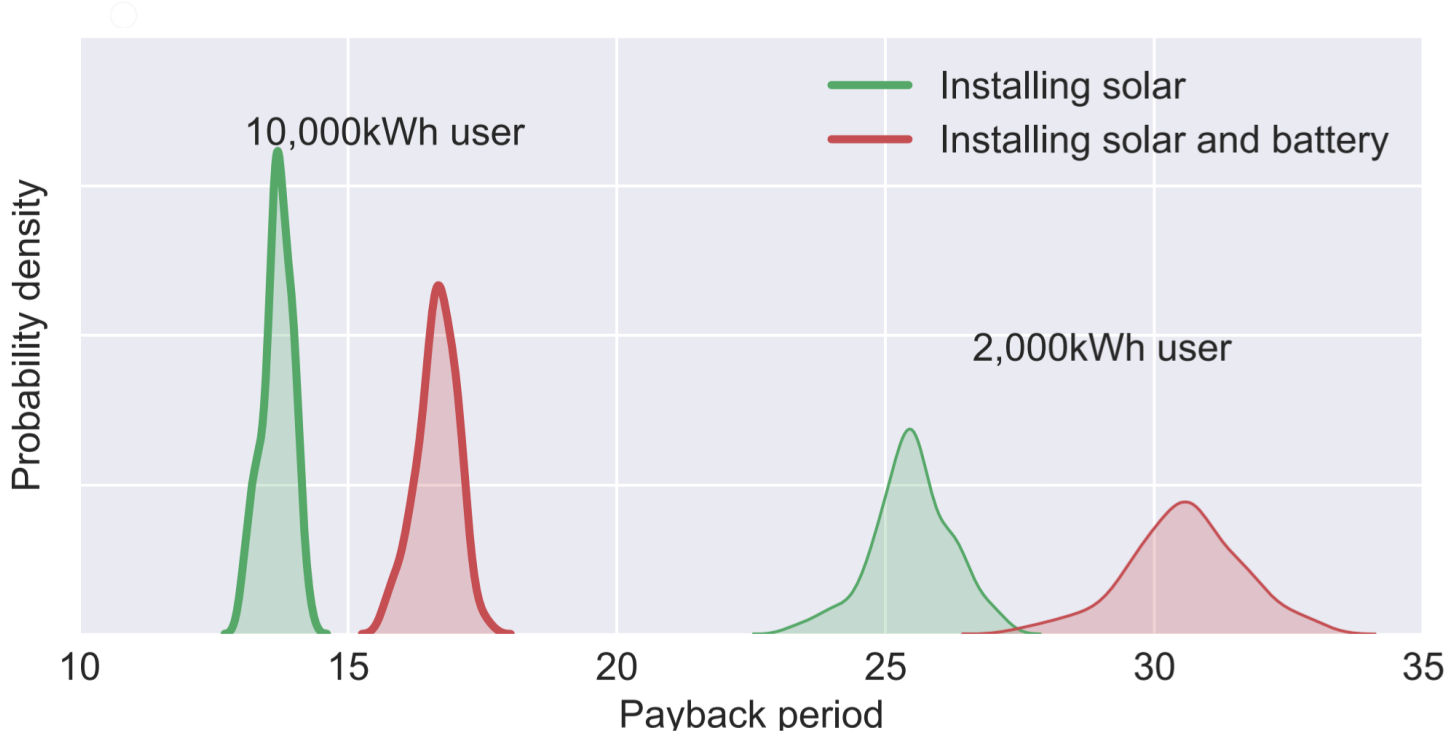
Payback Period for Solar/Battery

Things to consider:

- Retail electricity price inflation
- Discount rate
- Amount of self-consumption
- Amount of solar energy

Source: http://www.onlinesolar.co.nz/wp-content/uploads/2014/02/B-Solar-Panel.jpg

Payback Period for 3kW PV Panels



Source: John McIvor

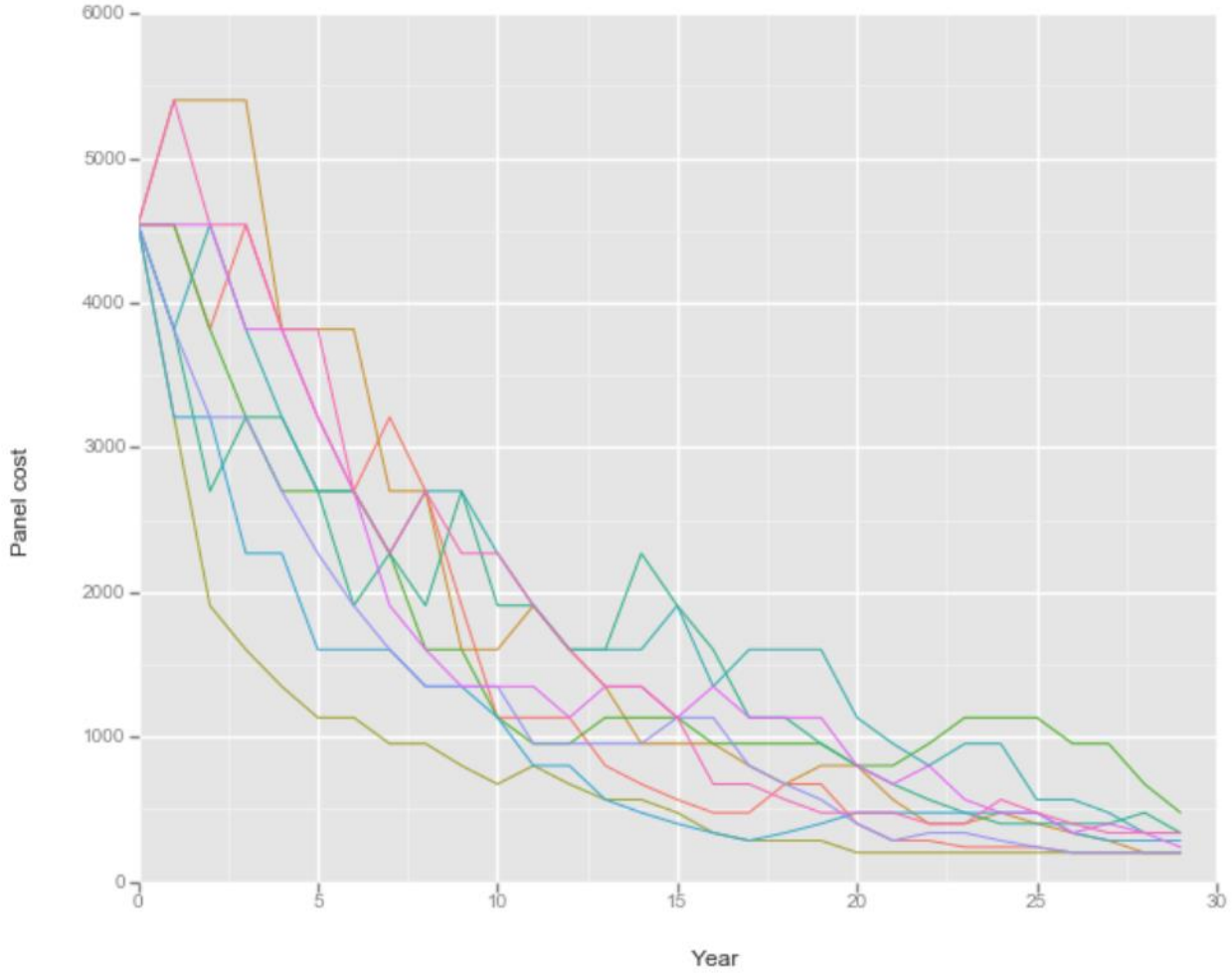
Summary

Batteries enable the user to reduce their peak-consumption, by storing the solar energy until the evening peak.

Given the price of batteries and the *current* distribution tariffs, batteries increase the time it takes to recover the investment costs.

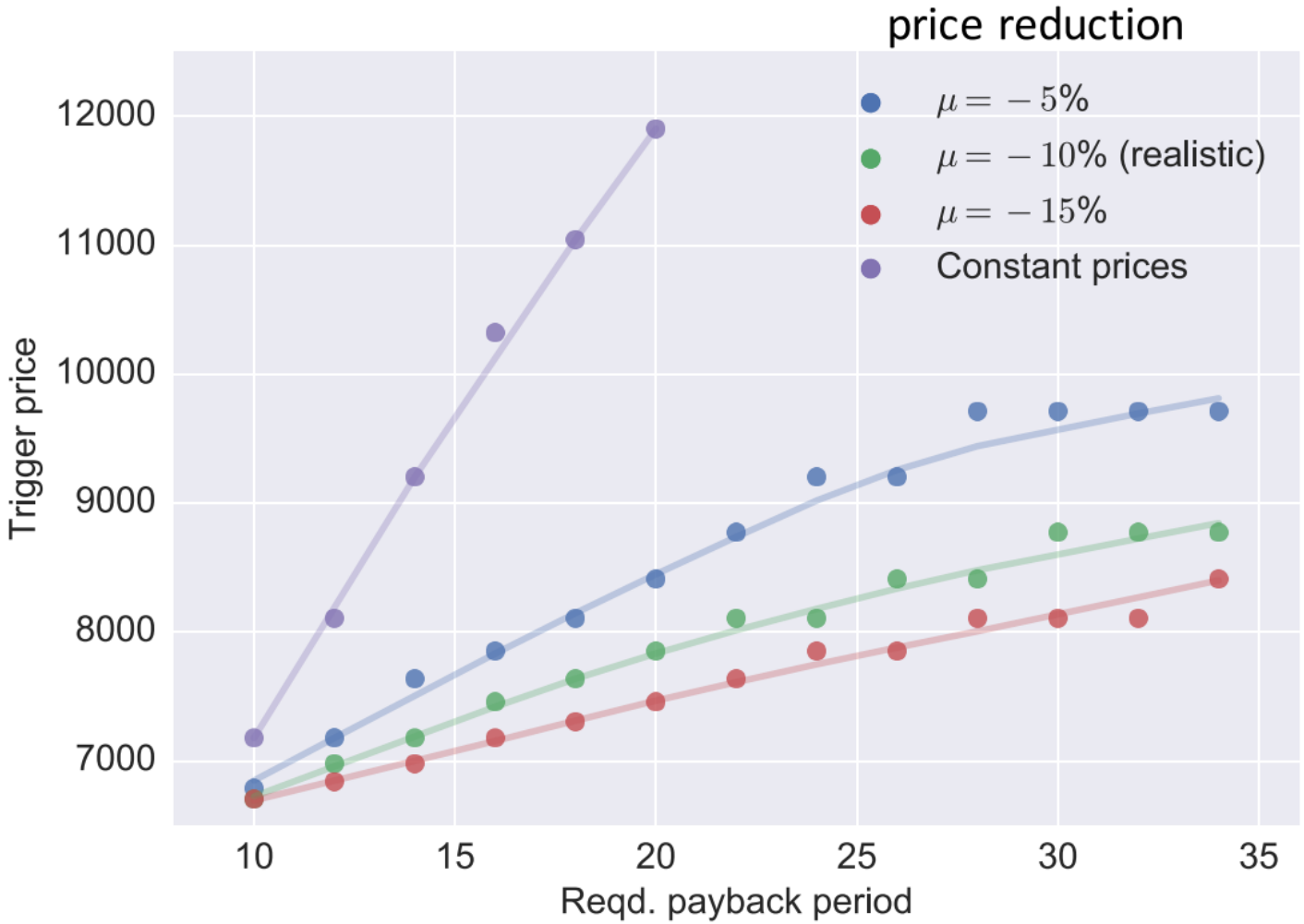
Source: http://www.onlinesolar.co.nz/wp-content/uploads/2014/02/B-Solar-Panel.jpg

Panel Prices



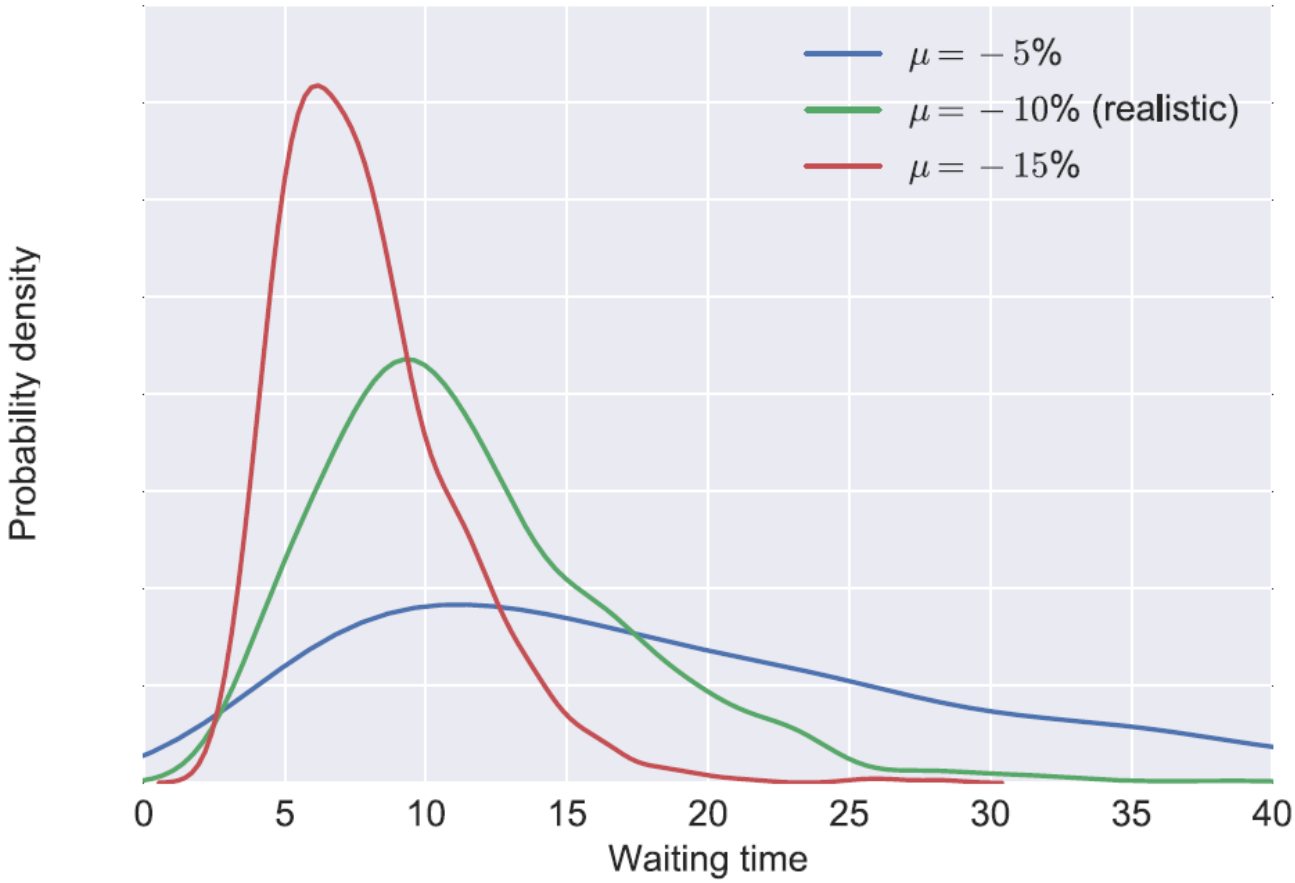
Source: John McIvor

Solar investment policy



Source: John McIvor

Solar investment policy



Source: John McIvor

Alternative Solar/Storage Ownership Models

Yeloha

solarZero

Source: http://www.onlinesolar.co.nz/wp-content/uploads/2014/02/B-Solar-Panel.jpg

New Distribution Pricing Structures

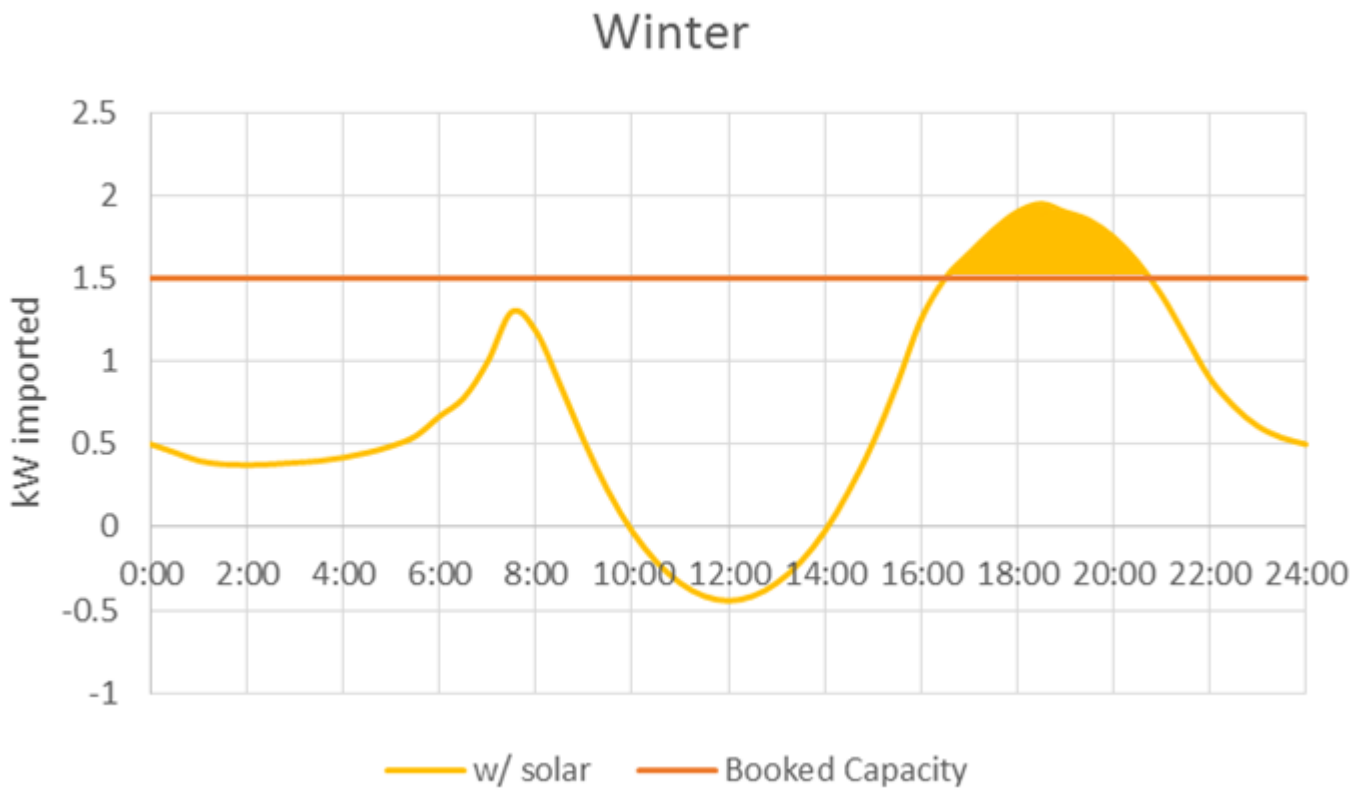
The Electricity Authority has been consulting with the industry for a number of years about changes to the regulations around distribution charges.

Different pricing schemes have been considered:

- Time-of-use pricing
- Network peak demand
- Customer peak demand
- Installed capacity
- Booked capacity

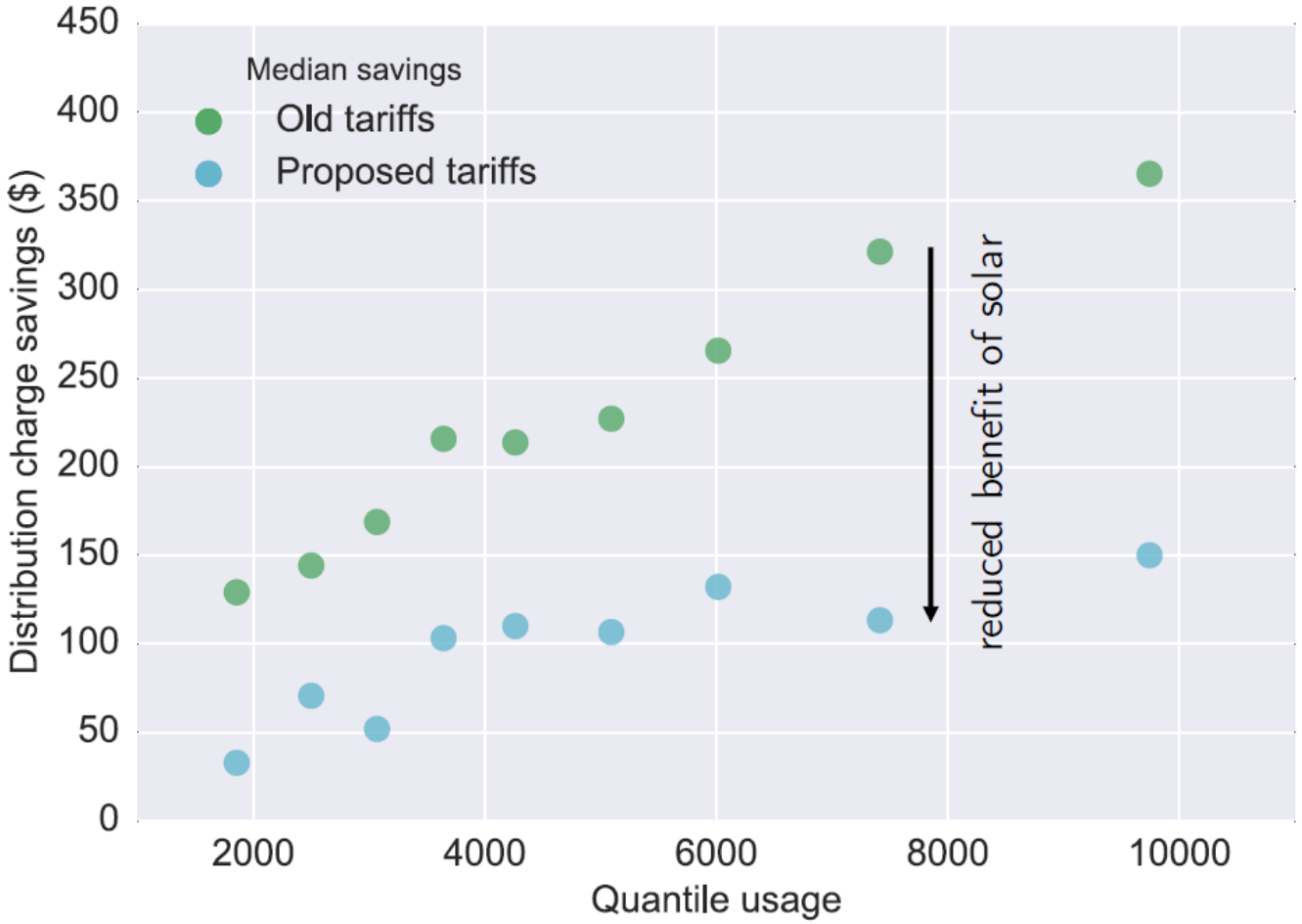
Source: https://nationaldebtadvisors.co.za/wp-content/uploads/2016/02/nersa5.jpg

Booked Capacity Tariff



Source: John McIvor

Booked Capacity Tariff



Source: John McIvor

Conclusions

Solar panels and batteries are becoming cheaper each year, and under the current tariff structure they will soon become economically attractive for a large number of households.

However, the current tariff structure does not adequately reflect the value / cost of the grid for these users, and will mean that households without solar will bear more of the costs.

New tariffs are needed to address this issue, although this may result in delaying the uptake of solar, it will also encourage load shifting (or the installation of batteries) to maximize the benefits and therefore the savings.

Source: John McIvor

Email: a.downward@auckland.ac.nz

Thank you.