

100% Renewable New Zealand Solar Photovoltaic (PV) Contribution?

Allan Miller

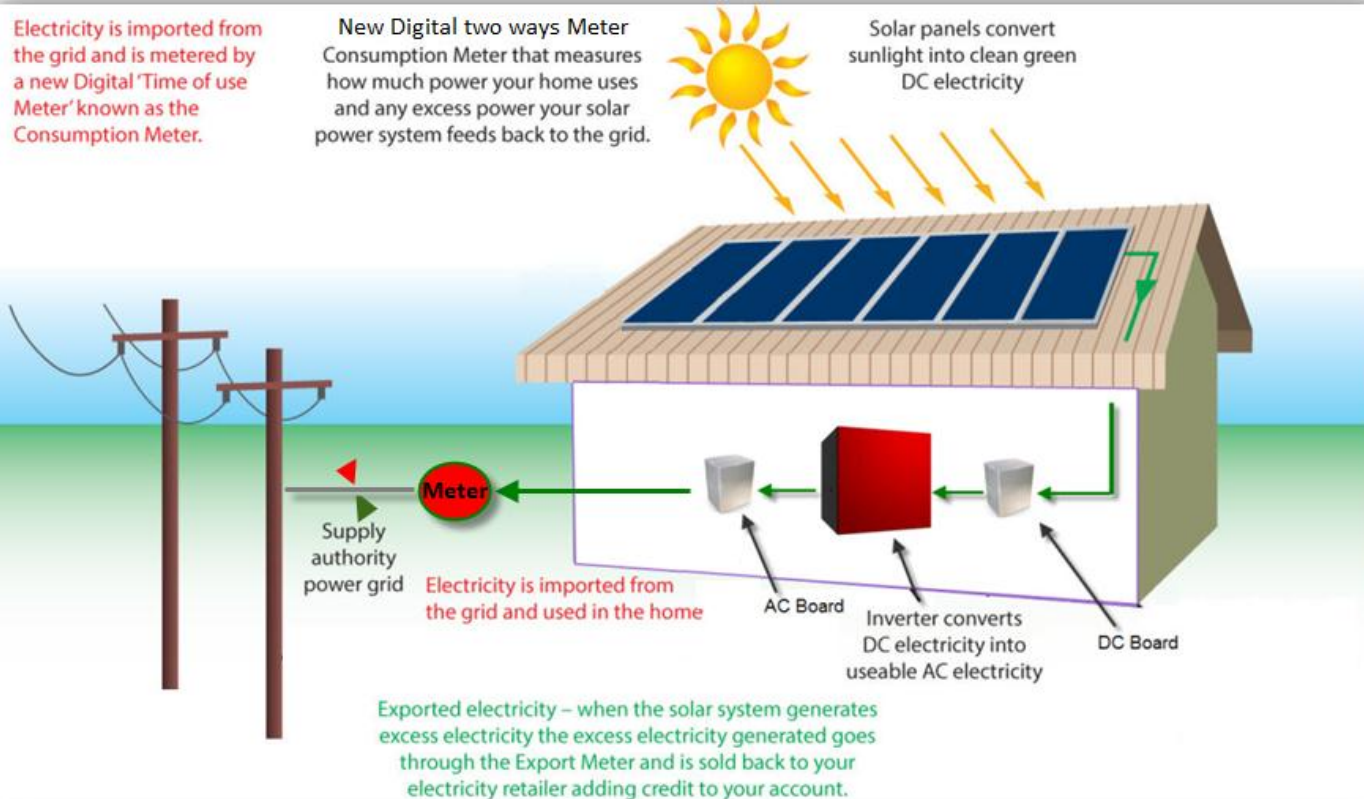
Director, EPECentre and GREEN Grid

1. PV uptake in New Zealand and PV's energy contribution
2. Impact of PV in the Network
3. The global PV industry and new PV technology

Electricity is imported from the grid and is metered by a new Digital 'Time of use Meter' known as the Consumption Meter.

New Digital two ways Meter Consumption Meter that measures how much power your home uses and any excess power your solar power system feeds back to the grid.

Solar panels convert sunlight into clean green DC electricity



Electricity is imported from the grid and used in the home

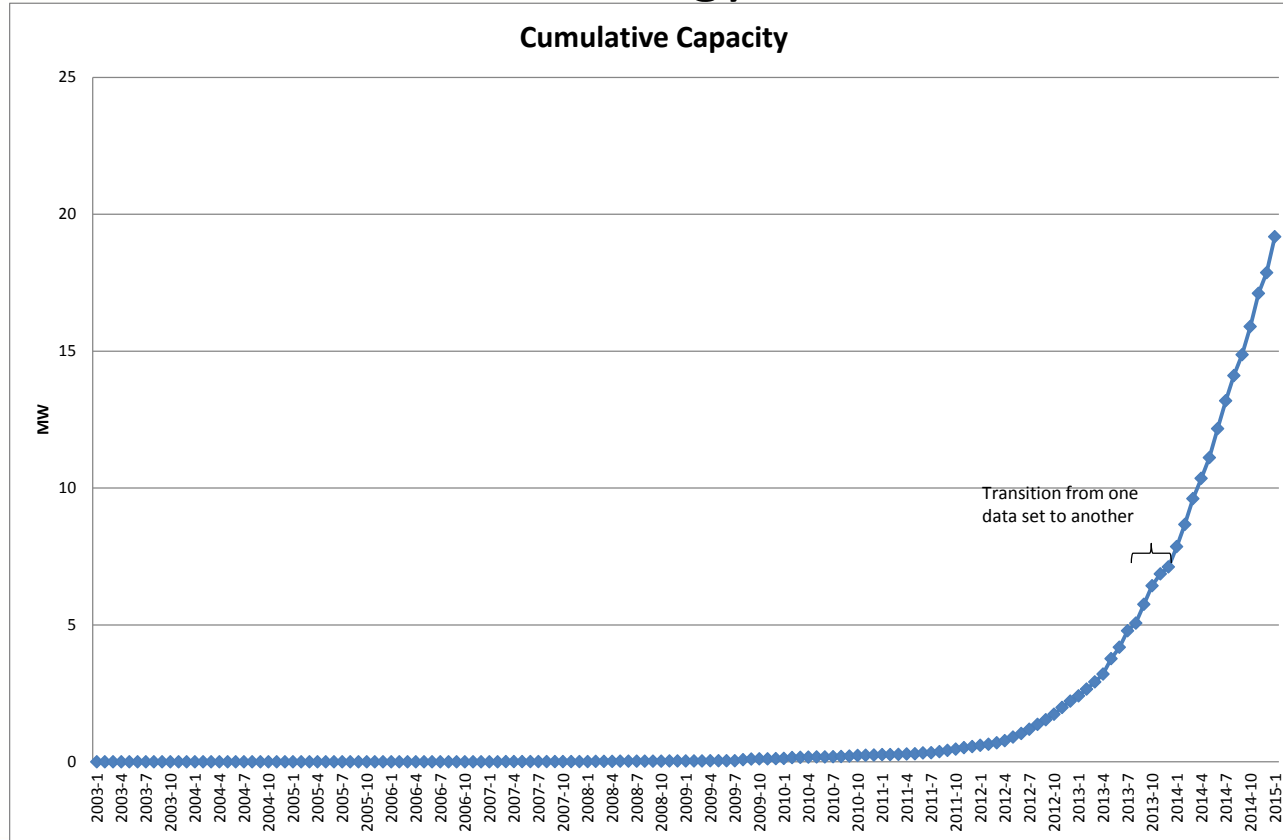
AC Board

Inverter converts DC electricity into useable AC electricity

DC Board

Exported electricity – when the solar system generates excess electricity the excess electricity generated goes through the Export Meter and is sold back to your electricity retailer adding credit to your account.

PV uptake in New Zealand and PV's energy contribution



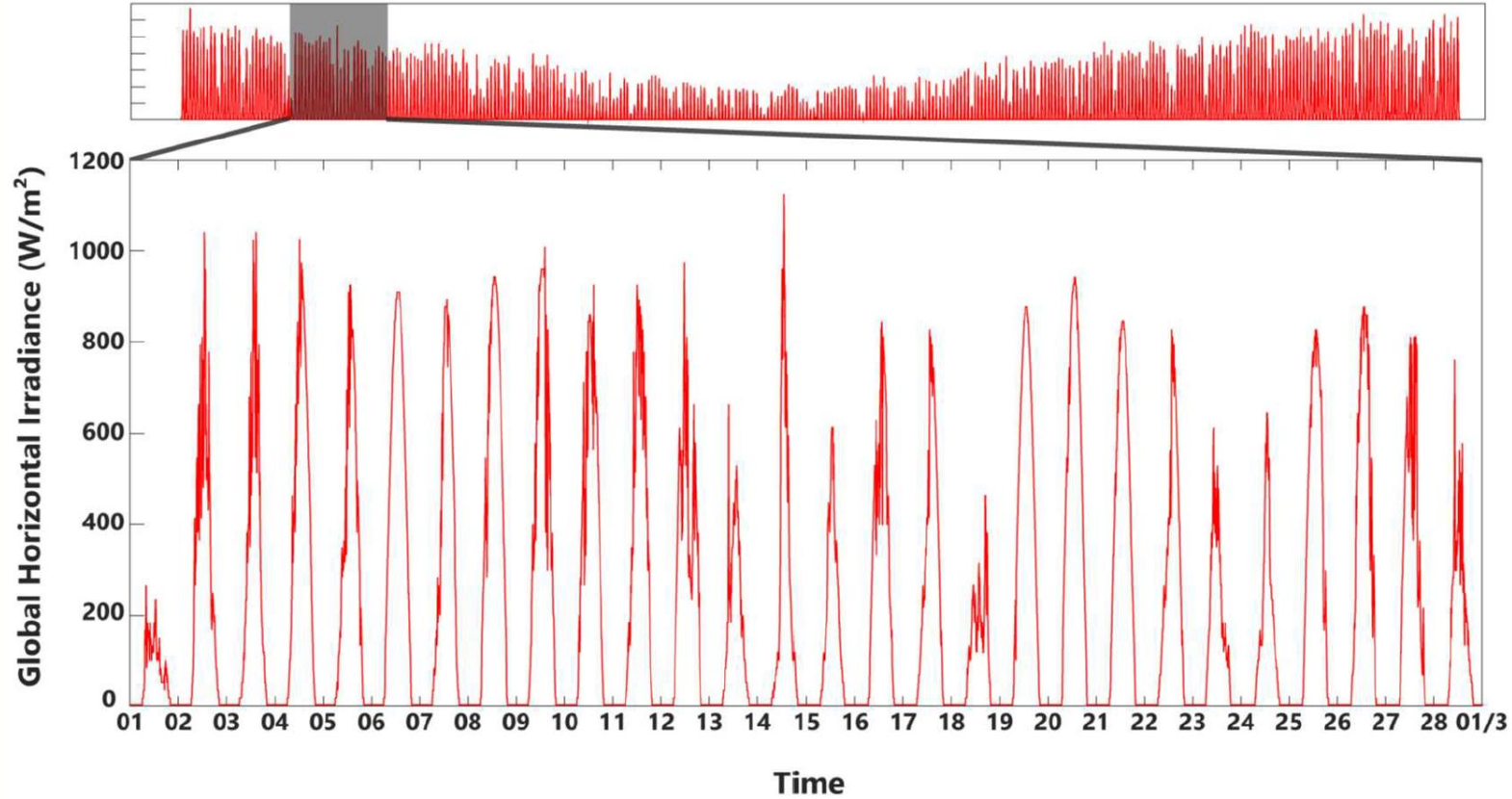
Watts per person comparisons

Country	PV Watts per person
Germany	440
Italy	293
Belgium	267
Bulgaria	140
Australia	139
Spain	119
Japan	107
Denmark	95
Switzerland	91
France	70
UK	46
USA	38
New Zealand (June 2014)	2
New Zealand (Jan 2015)	4

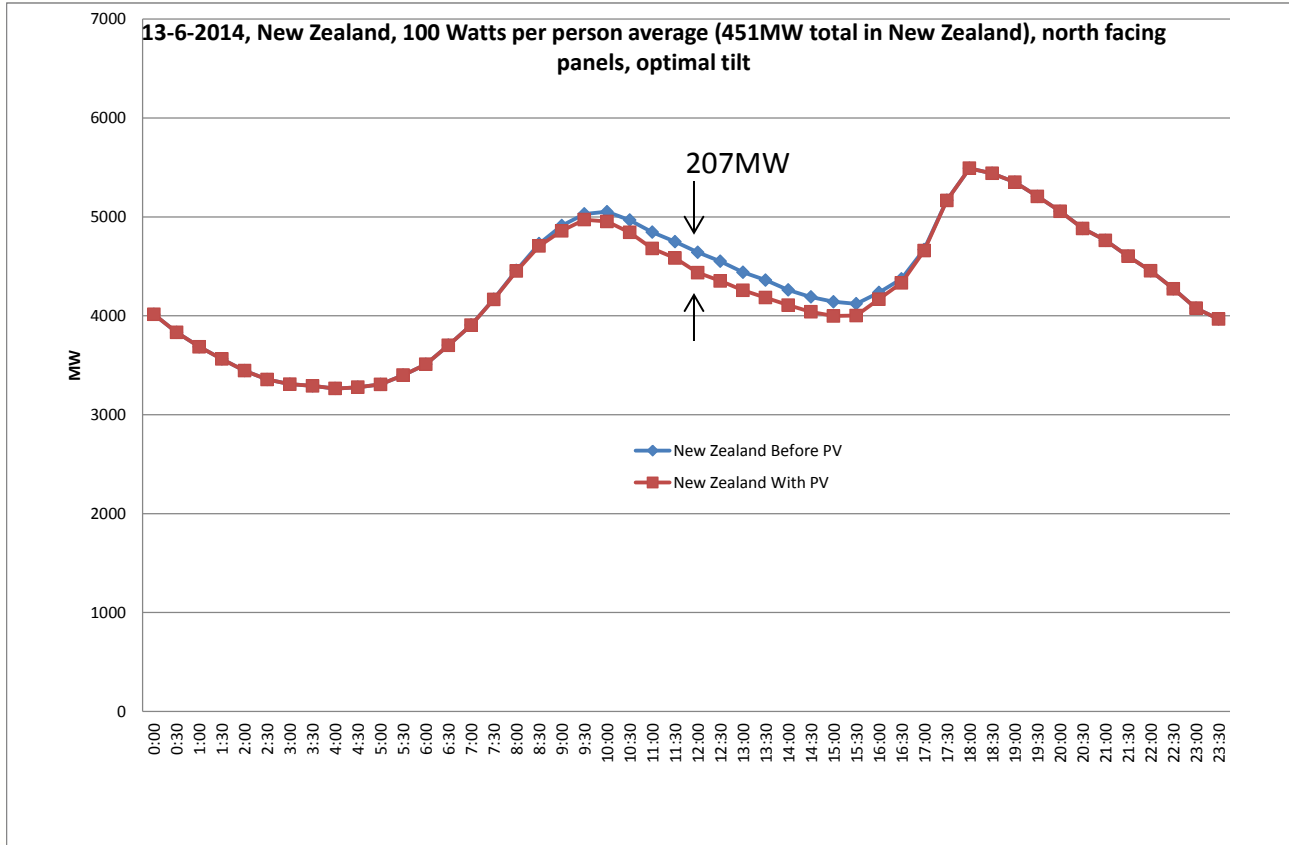
Future renewable energy contribution of PV?

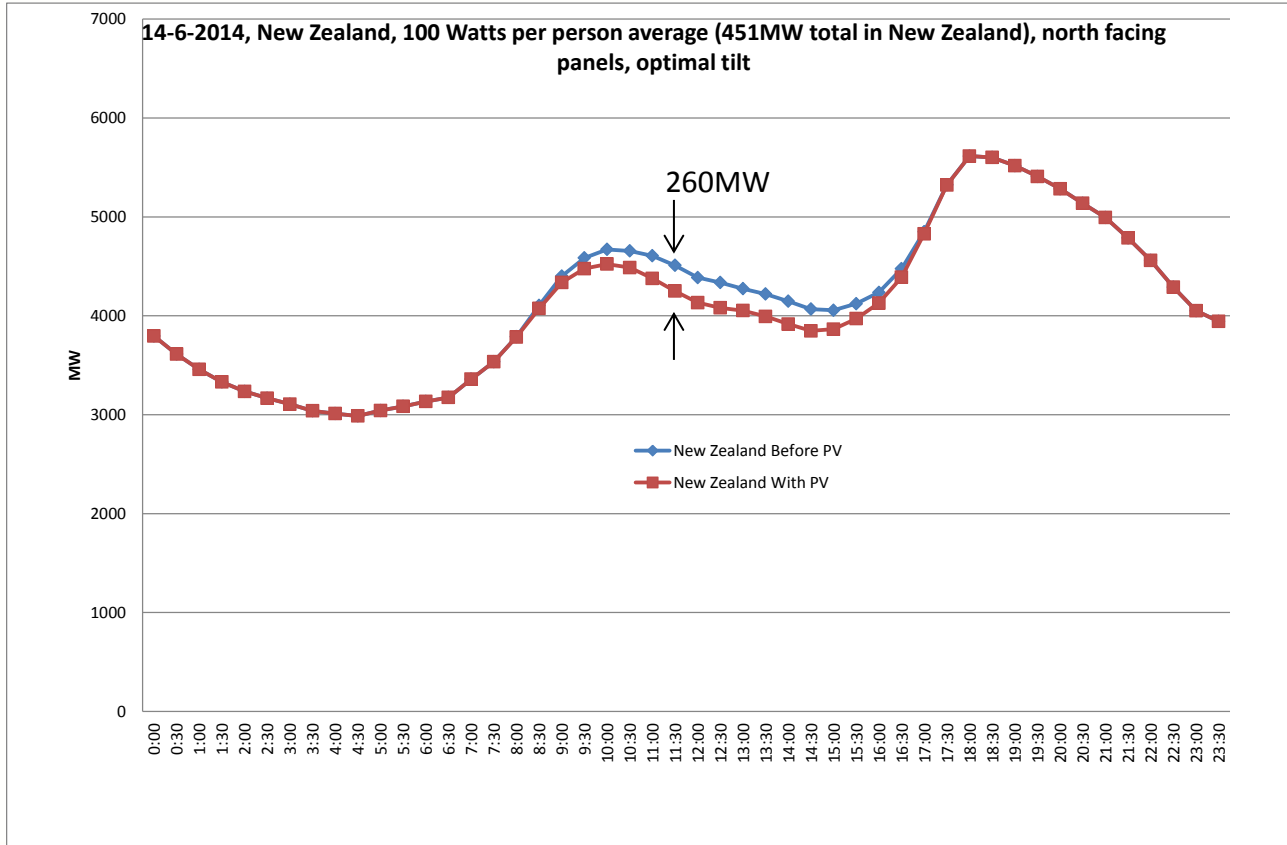
- Assume 100W per person
- Totals 451MWp of generation capacity
- At a 17% capacity factor, gives 672GWh of energy per year
- Contributes 1.6% of renewable energy generation (using 2014 electricity generation figures)

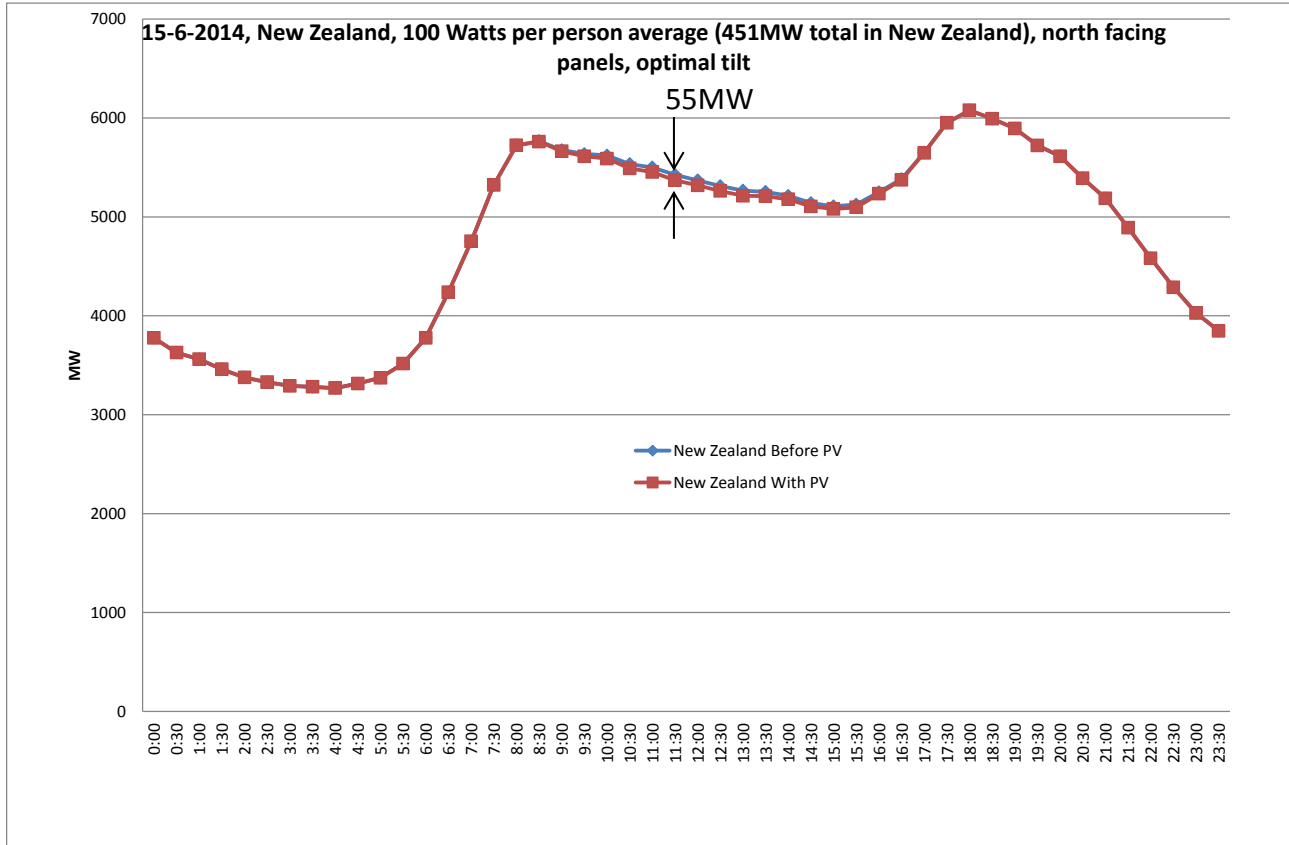
- Load Profile
 - locally and system wide
- Voltage Profile
 - local network
- Frequency
 - system wide

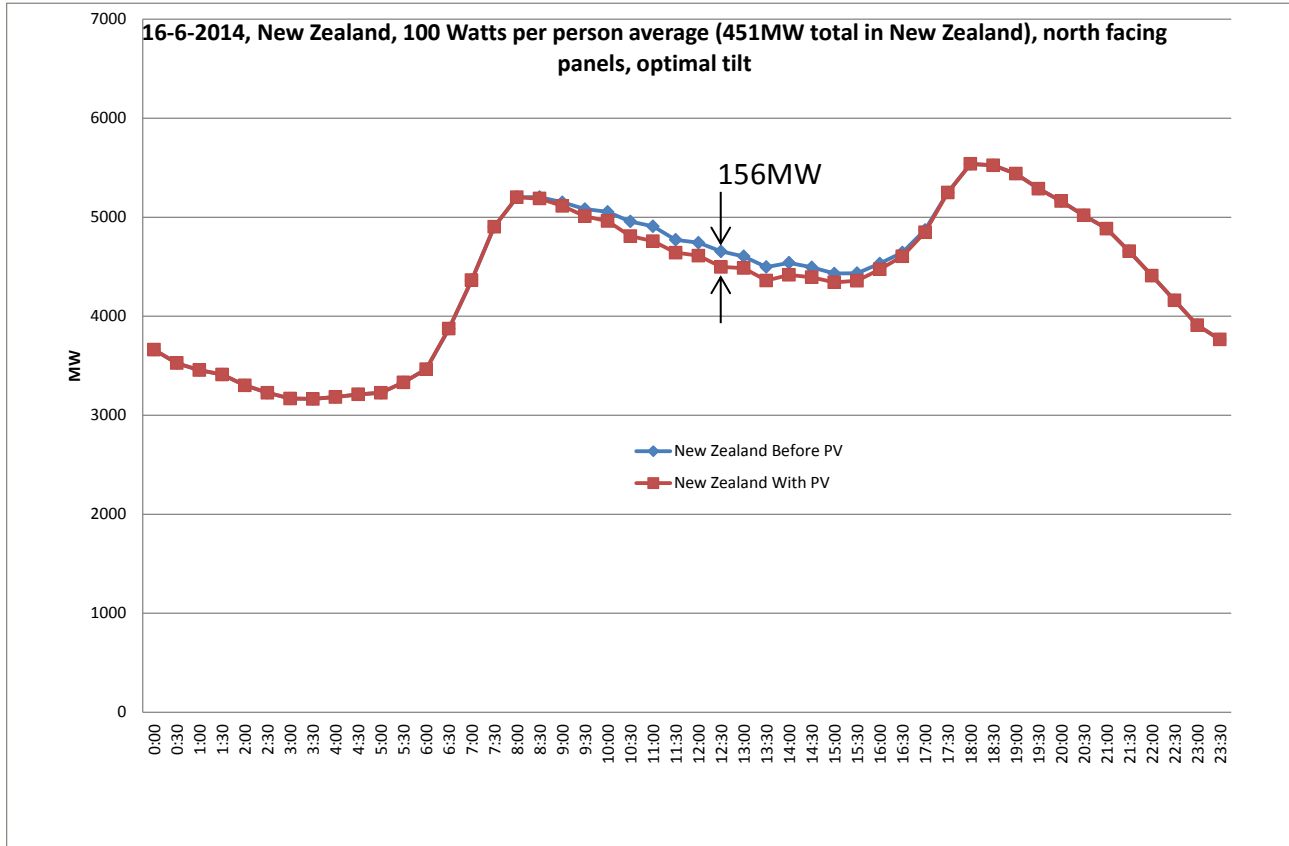


NZ Load Profile: Sequence of winter days with 450MW of PV

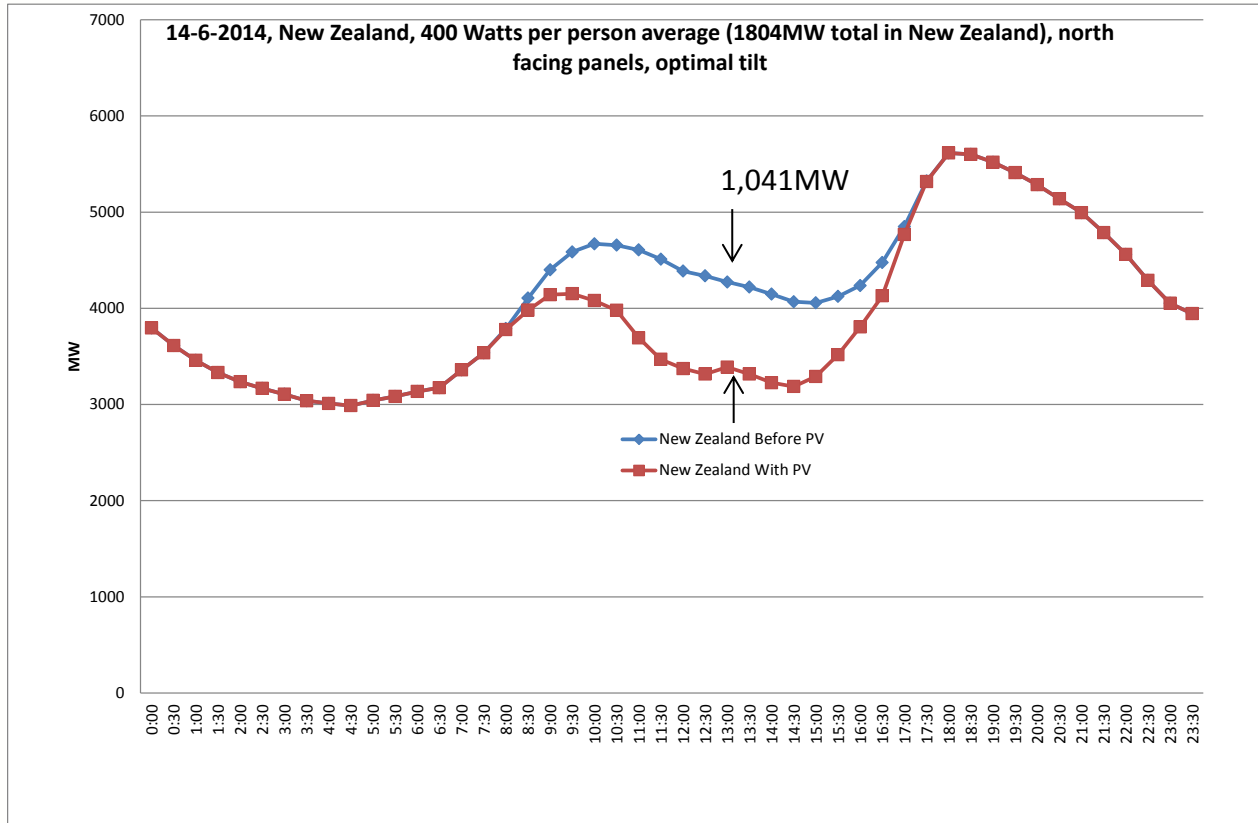




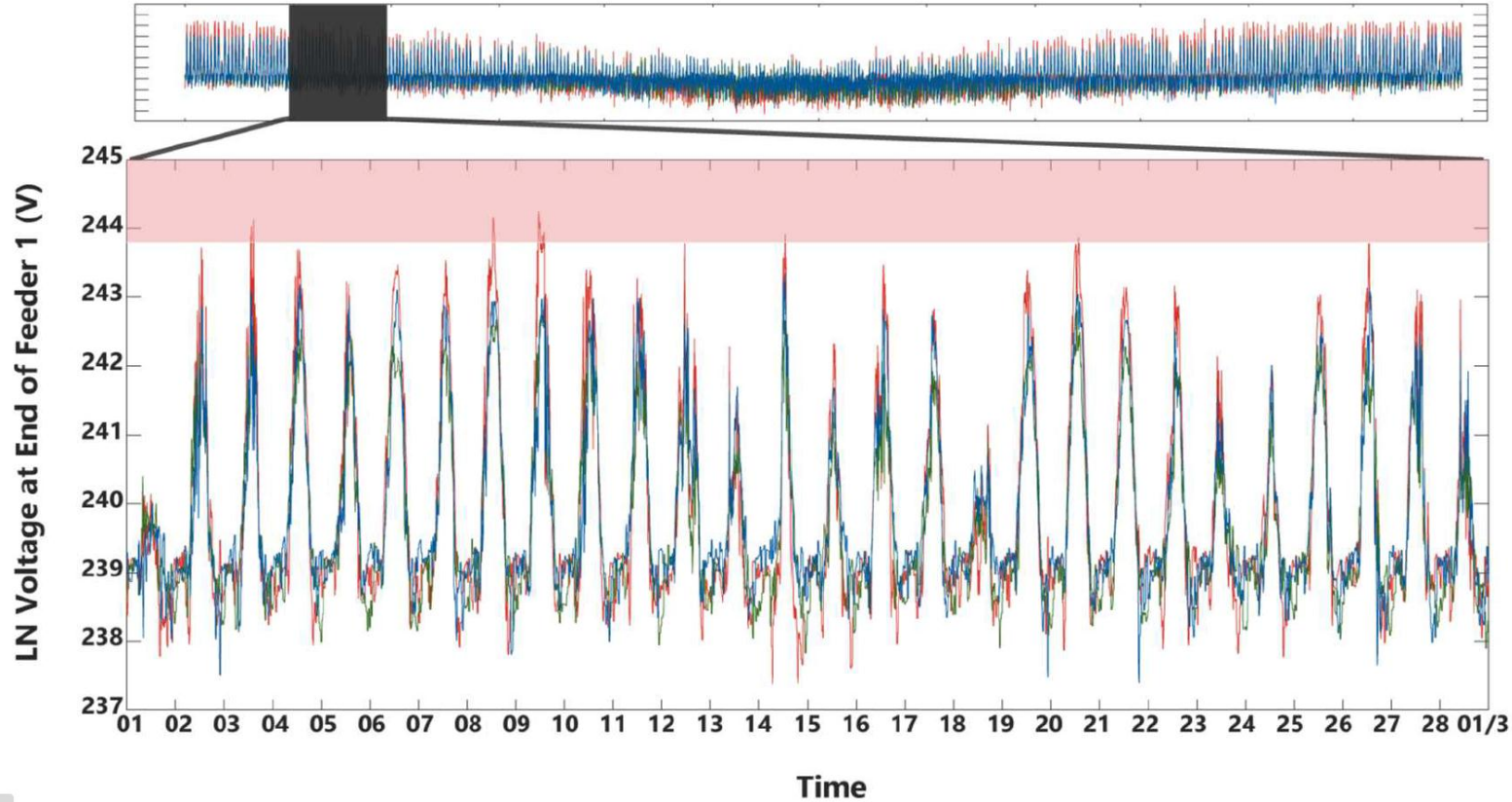




What if New Zealand reaches 400Watts Per Person?

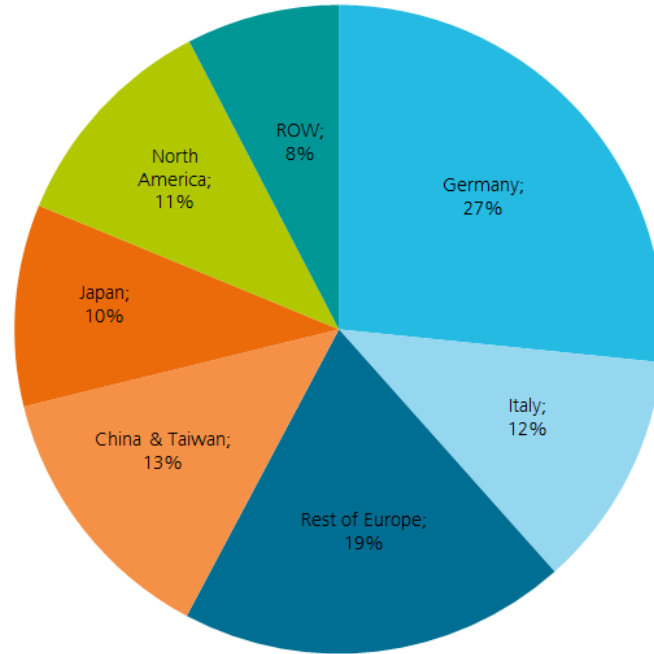


Voltage profile – local network



The global PV industry and new PV technology

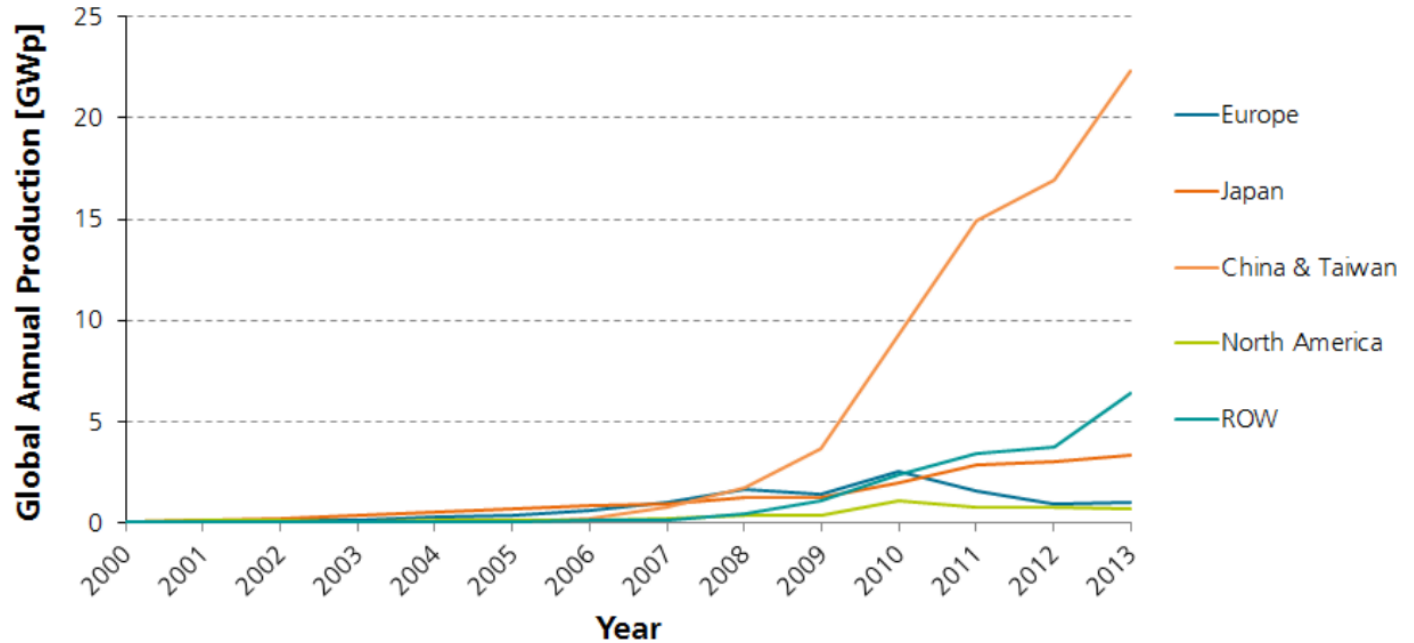
Global Cumulative PV Installations until 2013



The total cumulative installations at the end of the year 2013 were about 134 GWp.

50 GWp installed
in 2014

PV Industry Production by Region (2000-2013)

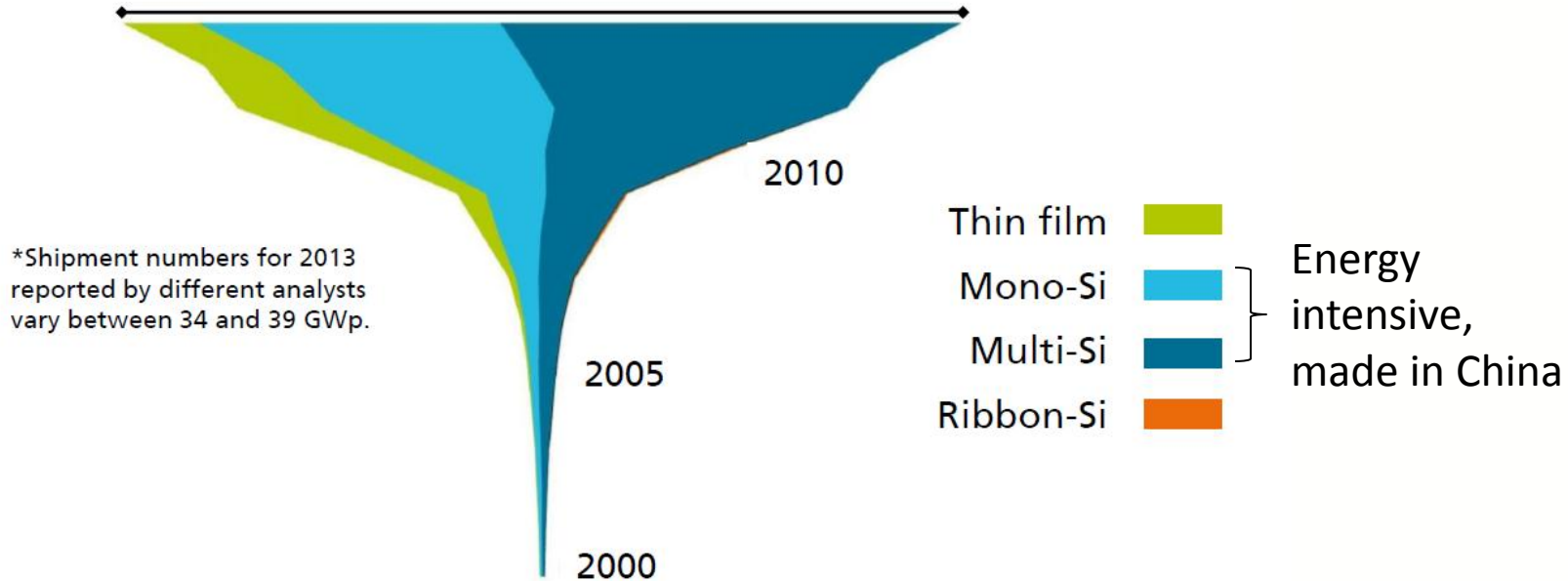


Fraunhofer Institute for Solar Energy Systems, Photovoltaics Report 24-10-2014

Data: Navigant Consulting and Paula Mints. Graph. PSE AG 2014

Global Annual PV Production by Technology

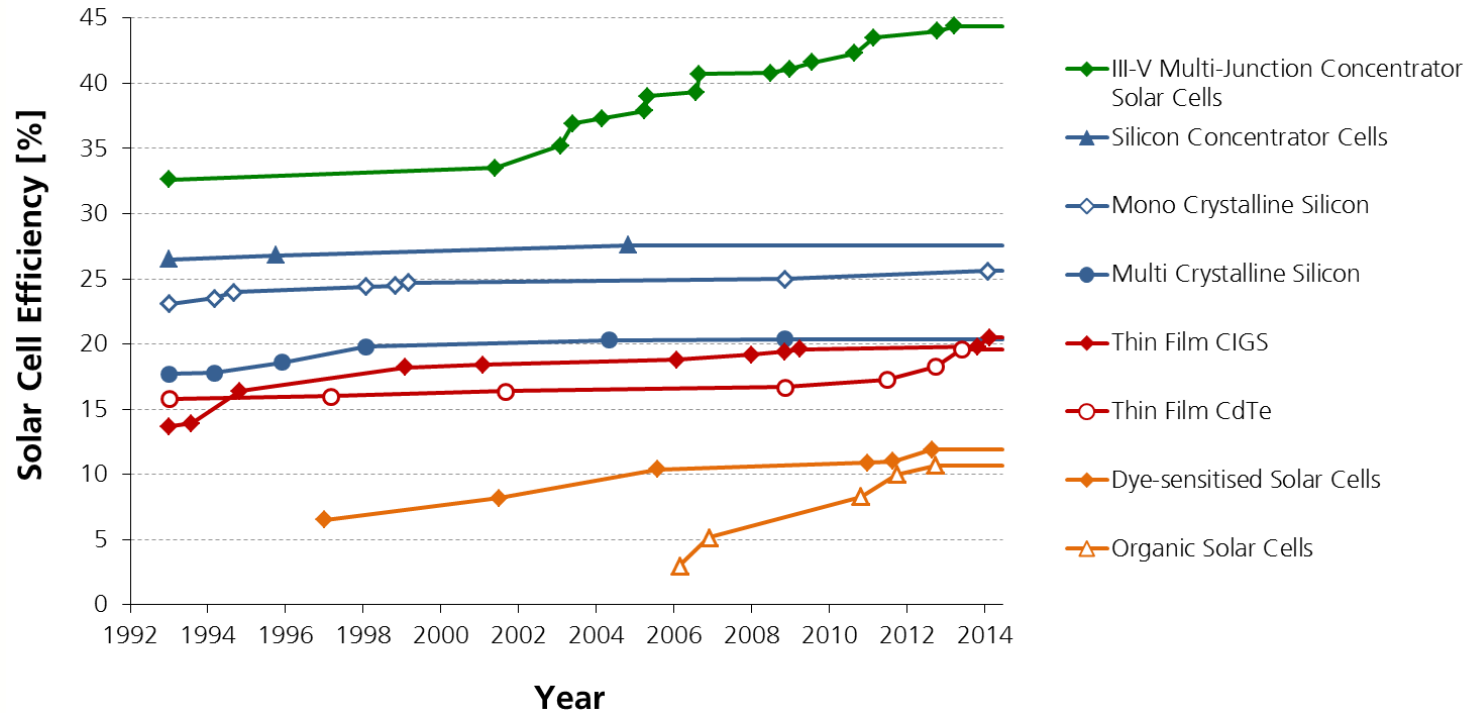
About 39* GWp PV module shipments
in 2013



Fraunhofer Institute for Solar Energy Systems, Photovoltaics Report 24-10-2014

Data: from 2000 to 2010: Navigant; from 2011: IHS (Mono-/Multi- proportion estimated). Graph: PSE AG 2014

Solar Cell Efficiencies



Fraunhofer Institute for Solar Energy Systems, Photovoltaics Report 24-10-2014

Data: Solar Cell Efficiency Tables (Version 1-43), Progress in PV: Research and Applications, 1993-2014. Graph: Simon Philipps, Fraunhofer ISE 2014

- Solar Photovoltaics will make only a small contribution to New Zealand's renewable energy future to ~2025
 - Nearly 3,000MW of wind consented and ~300MW of geothermal consented, which have the potential to deliver far more energy
 - Photovoltaics has a poor capacity factor, so even if New Zealand did have 450MW of PV, for example, it would only deliver about 1.6% of New Zealand's electrical energy (based on 2014 consumption)
- However we cannot ignore PV
 - It will be manifest as a changing load and load profile
 - will make a large change to load due to its poor capacity factor
 - will do nothing to reduce New Zealand's system peak load, which occurs in winter
 - It has the potential to cause significant power quality issues in the distribution network
 - It is a consumer driven change, not an industry driven change, with a huge global industry behind it. It is therefore inevitable
 - 1.6% renewable share not relevant to households, only their generation is of interest to them
 - Beyond ~2025 panels will become more efficient, approaching 20-30% capacity factor in NZ (currently ~17%). Battery technology may also become economical, making PV more attractive to households.
- Best solution for New Zealand?
 - New Zealand's wind and geothermal resource
 - PV's high GHG payback time

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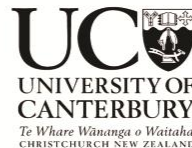
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