Stimulating a renewable energy market

the turmoil of RE policy and consumer mass adoption

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Various incentive systems are used in the Renewables industry to stimulate the market and bring about growth:

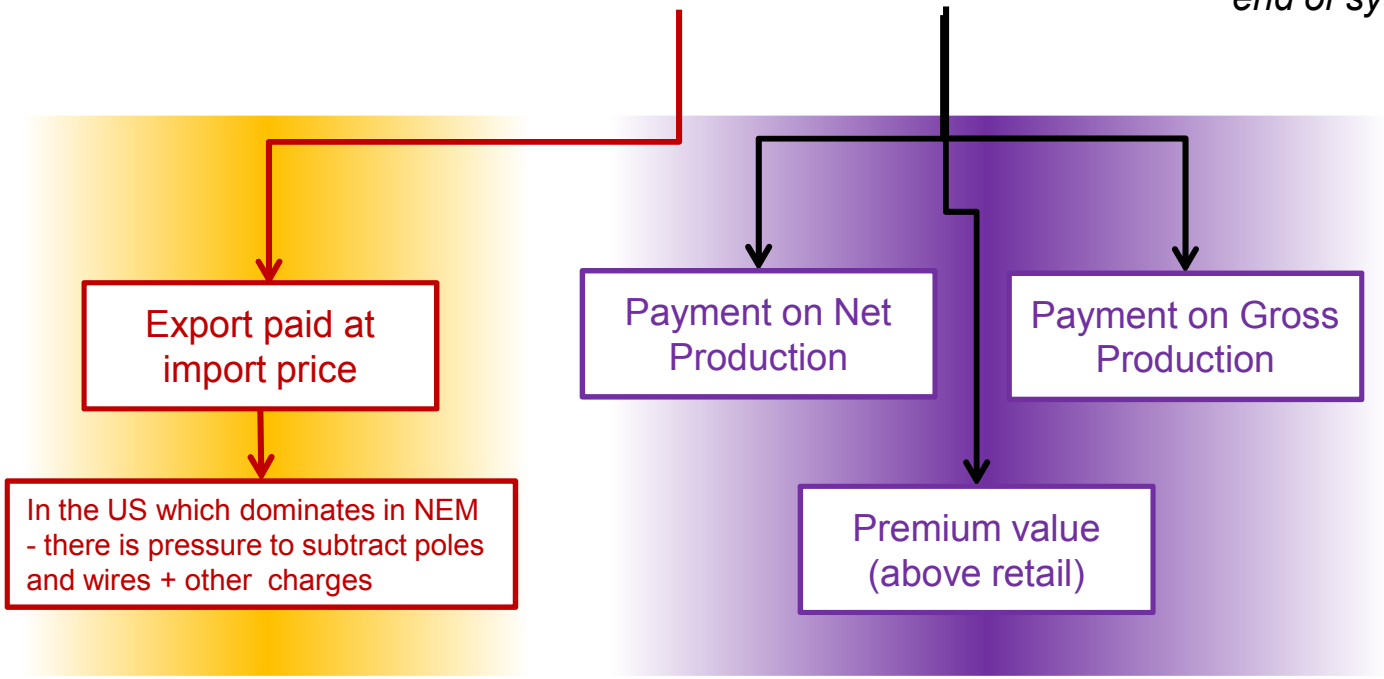
California's Performance based program looks at actual production effectiveness, tilt, orientation, shading etc

Australian situation is that the original credits of up to $8000 per install have been reduced to have multipliers at the low end of system capacity

PURCHASE based incentives

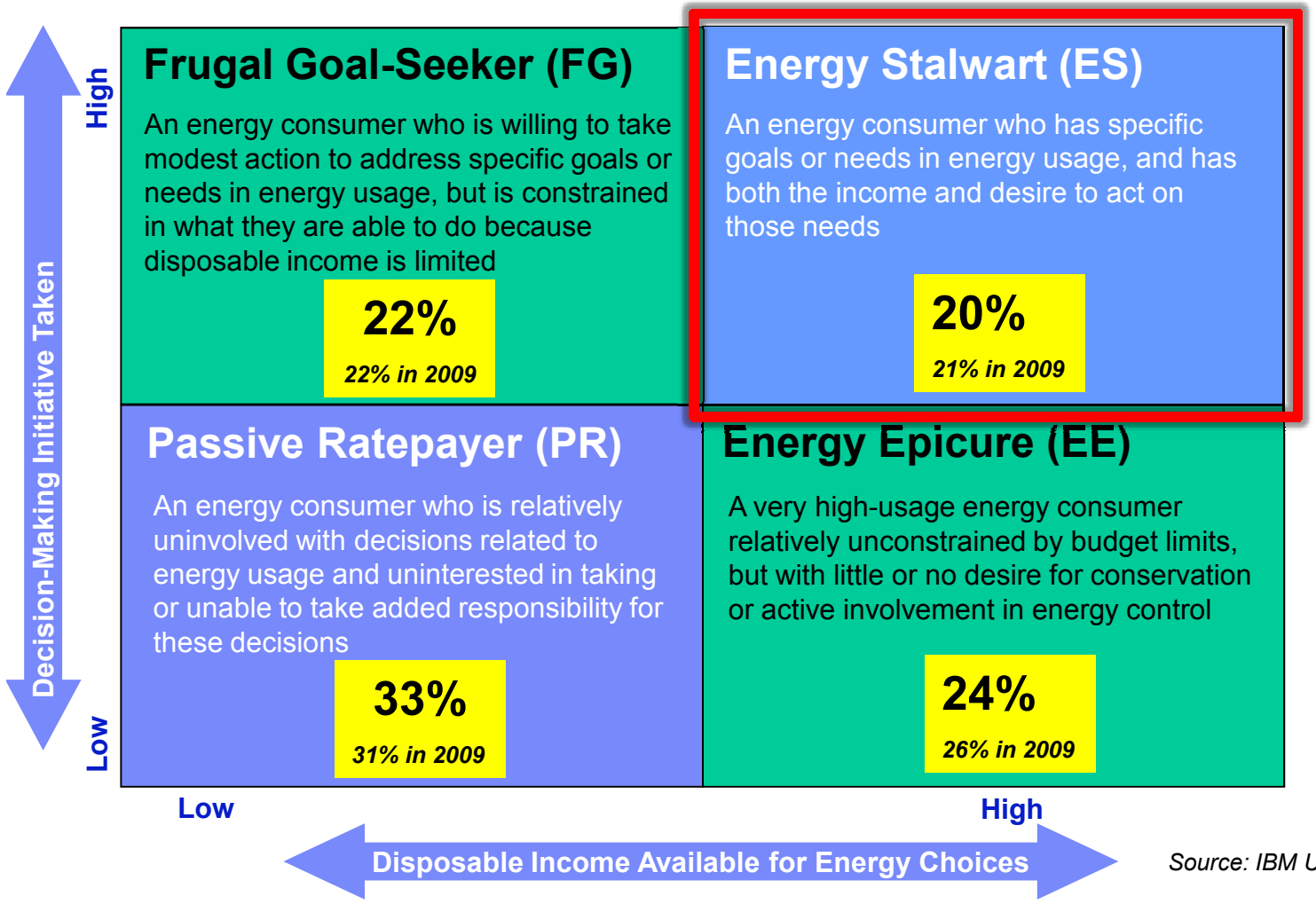
- ✓Assorted rebates, tax credits and incentives
- ✓Solar Renewable Energy Certificates (or Credits)

PRODUCTION based incentives (**Net Metering** & **FiT**)



What we have seen (that an industry in transition needs a kick start):

Customers can be segmented based on their inclination and capacity to be market participative (circa 2011). However incentives can change the market play:



Australia initially rebates of up to RM22,500 per W

Germany similar to Australia (RM20/W) in improving the NPV

USA some utilities offer RM1,800 flat to RM15/watt installed

Denmark uses loan guarantees for initial purchase stimulus

NZ
Zero with a resulting zero market response

Source: IBM Utility Consumer Survey

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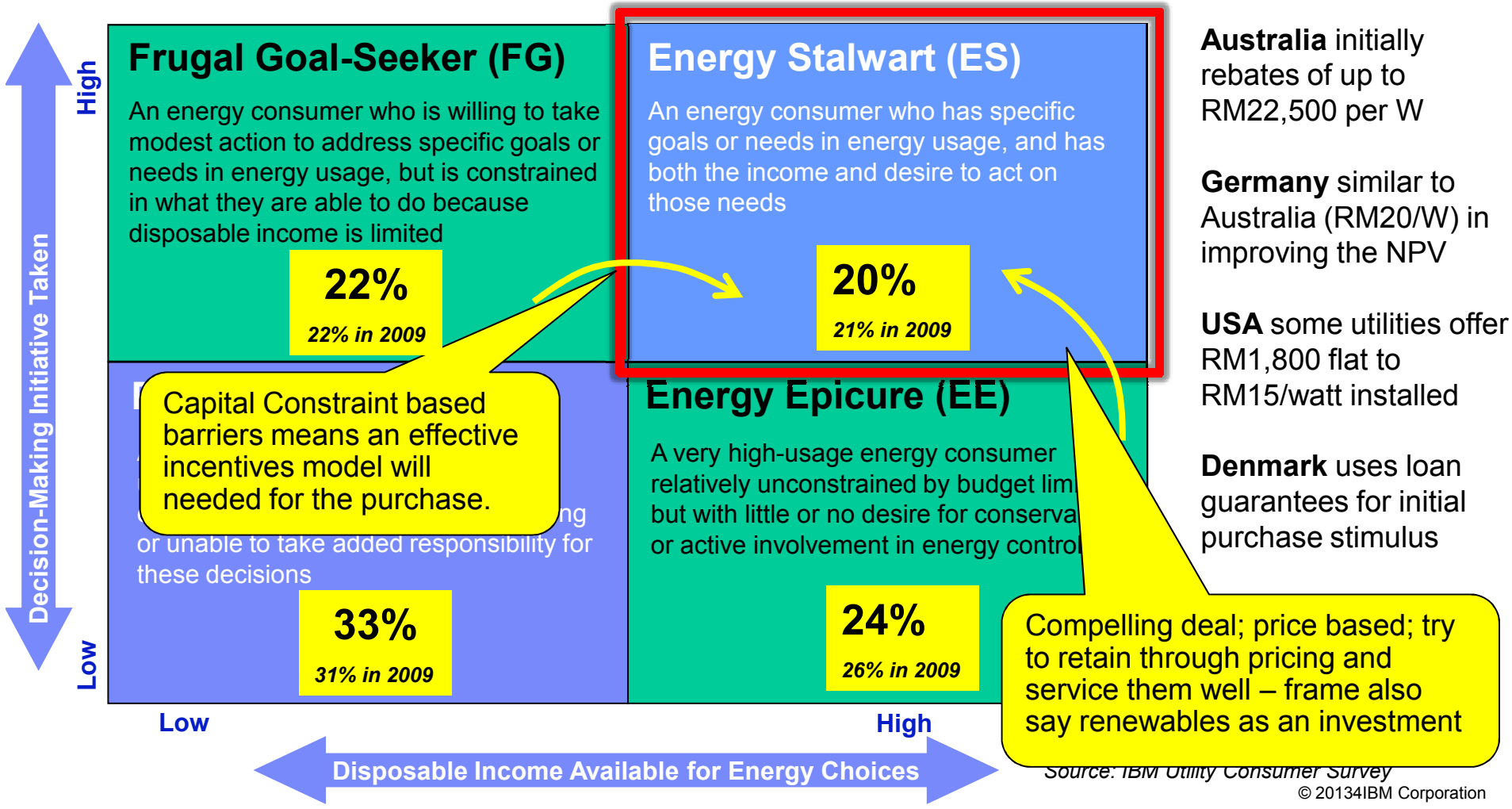

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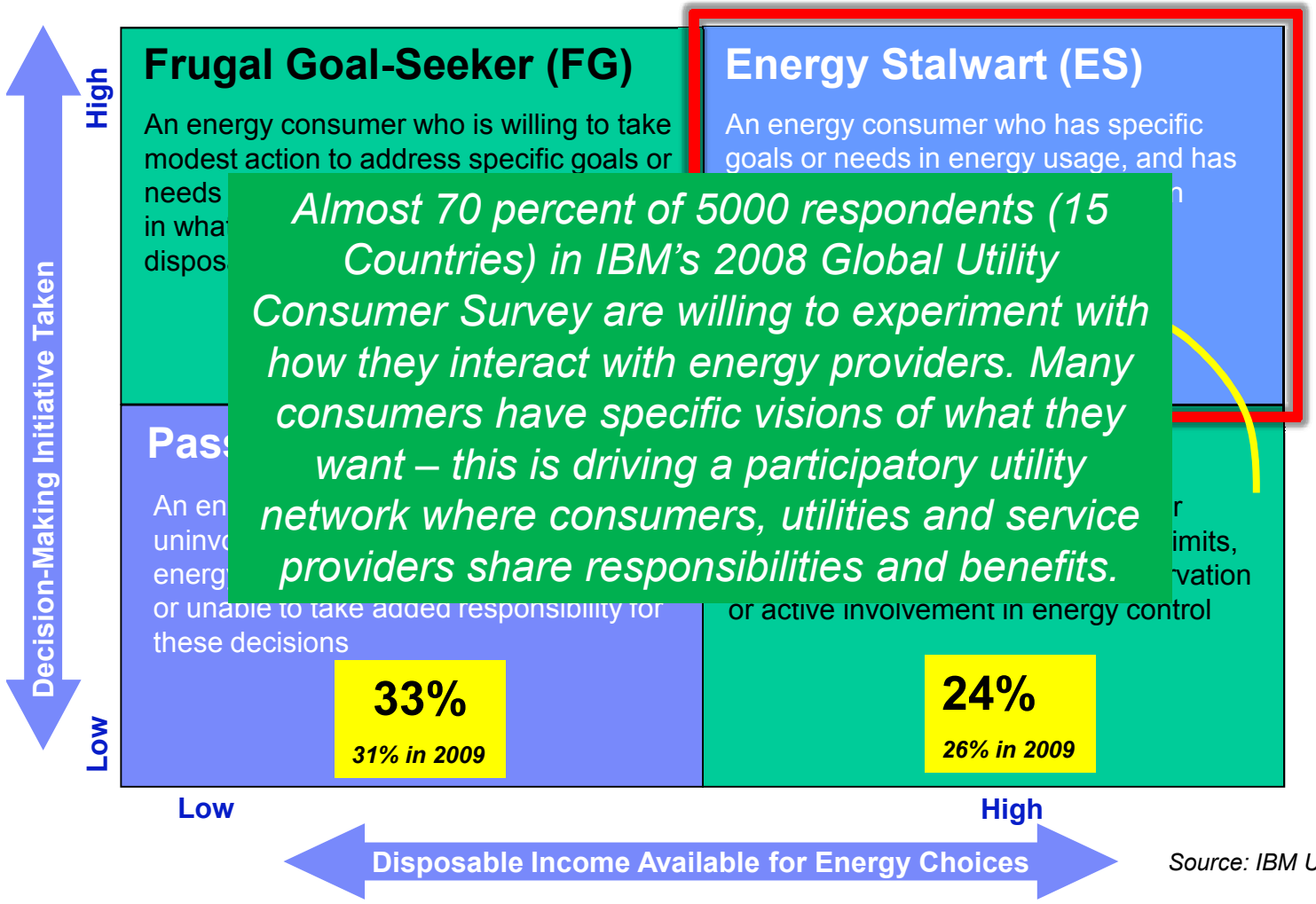
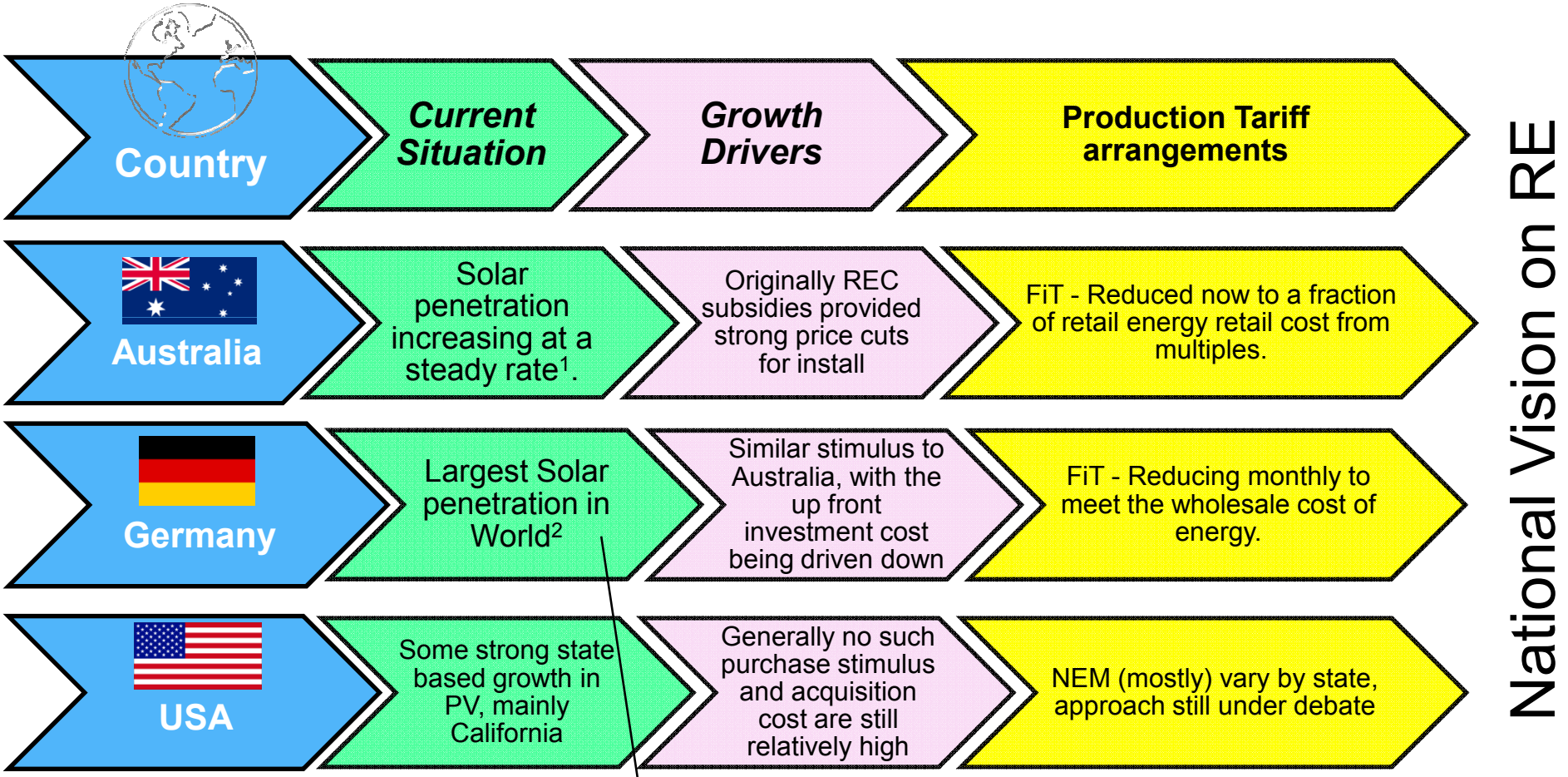


Source: IBM Utility Consumer Survey

In a world of complex differing visions for RE, widely varying public expectations and a spectrum of financial arrangements – there is no clear way forward..... *but there is experience:*



[1]Australian has approx 4GW or PV
[2]Germany has approx 38GW or PV

In 2011 Italy exceeded Germany's rate of solar uptake (which was 7.5GW, driven by high incentives €0.36-0.49.... RM1.50-2.00)

Europe is predominately using feed in tariff (shades of Green) with Net Metering in a few countries (orange) and the occasional lack of RE support.

Policy for a “premium rate” above retail was counted as FiT as it was metered and accounted for separately from the import tariff value.

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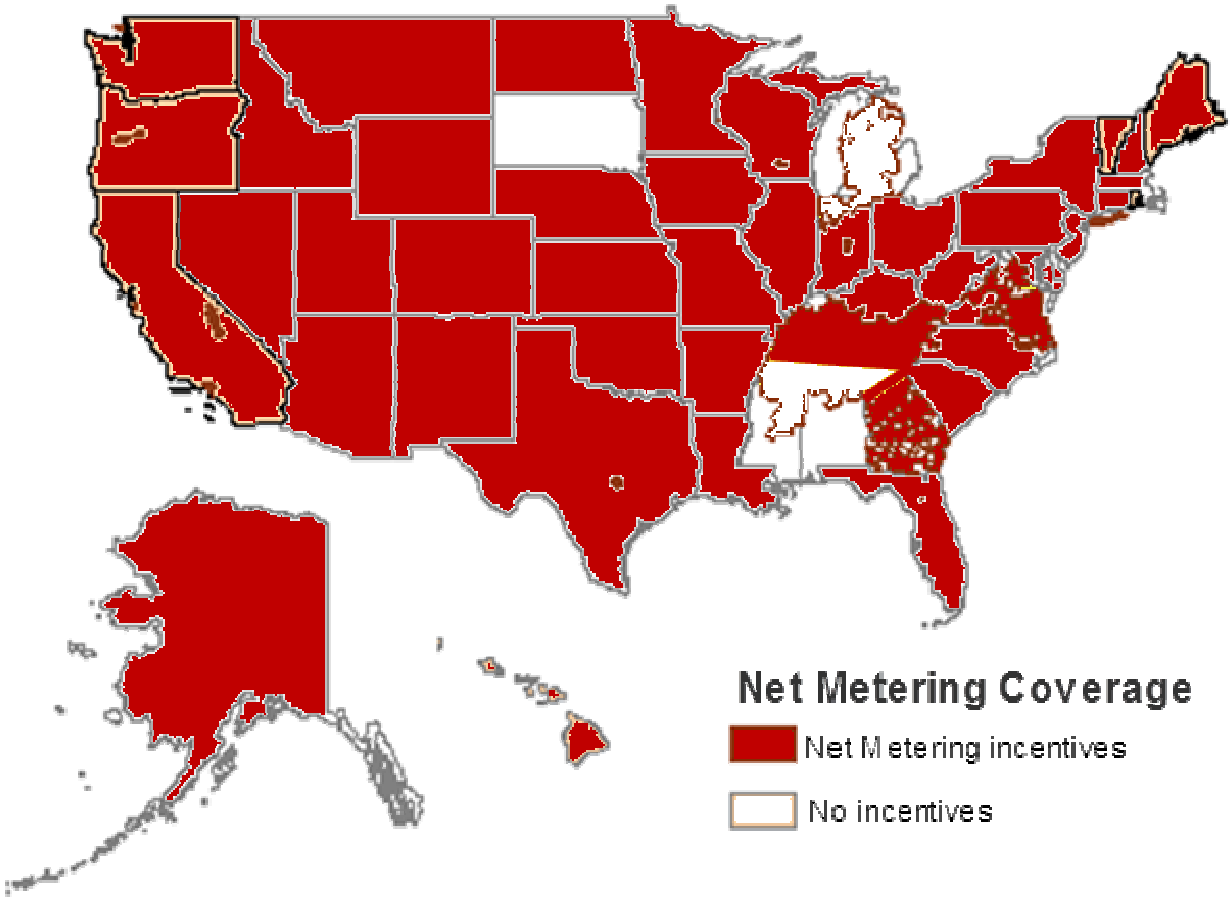
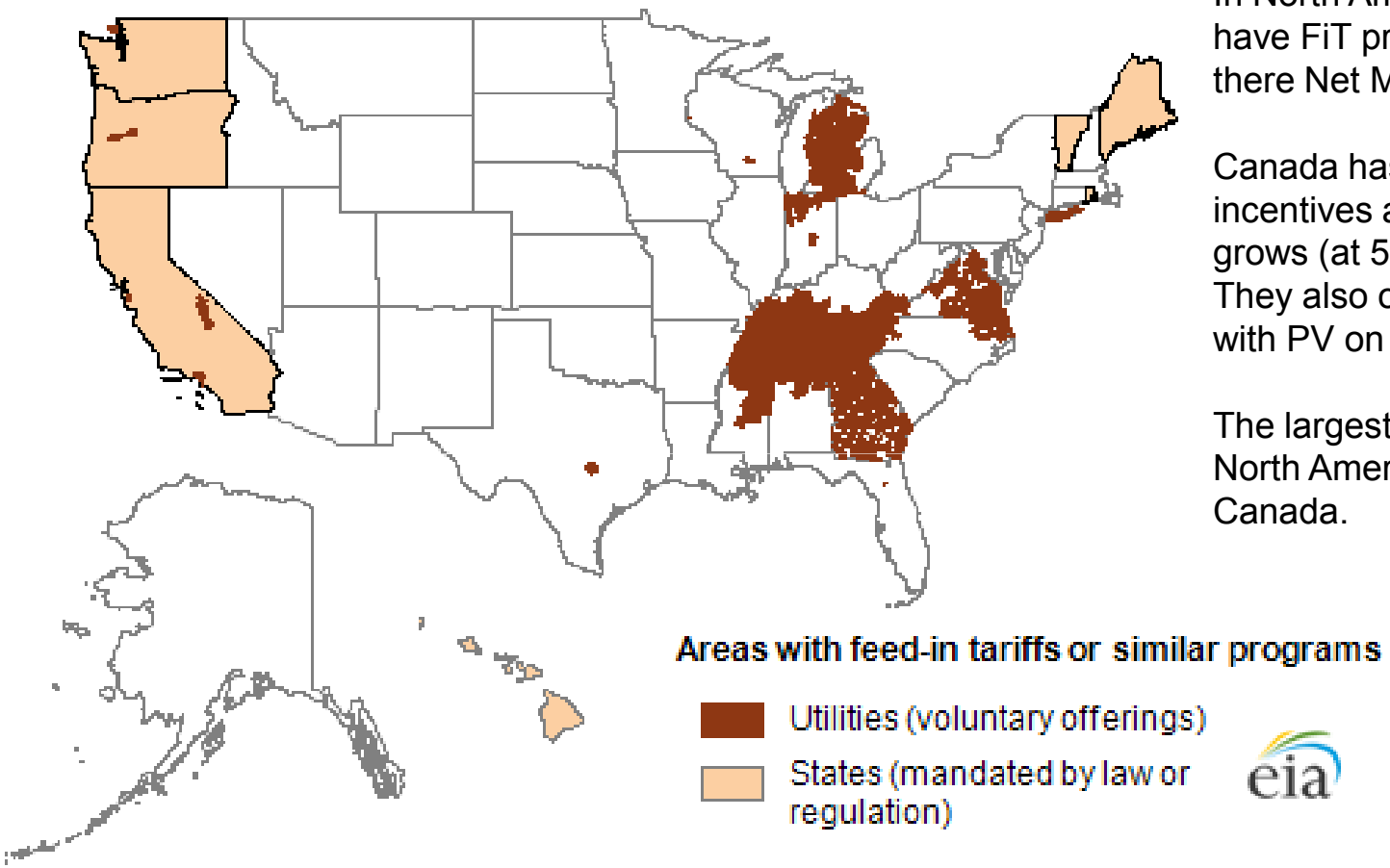
Net Metering in USA



In most Net Metering programs in the US the Distribution (or retail) organisations are forced to buy at the full retail rate (although this rate includes the fixed costs of poles and wires, metering etc). This means that the cost of the fixed costs are being transferred to those without Solar.

There is a fairly strong voice that says Net Metering policy should be updated to allow the poles and wires charge.

FiT in USA

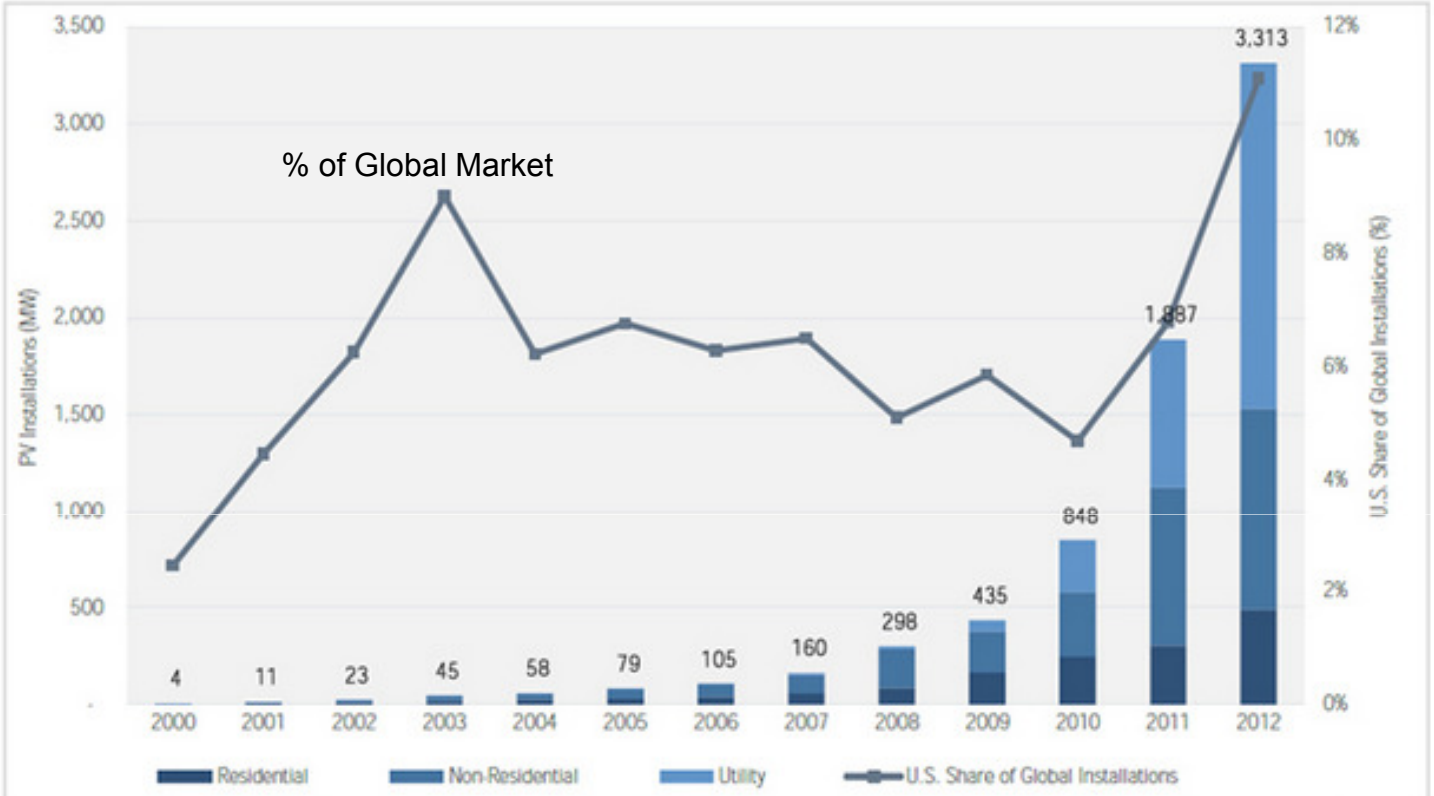


In North America, some states have FiT programs in addition to there Net Metering programs.

Canada has a declining rate of incentives as the amount of PV grows (at 5GW by end 2013). They also over a ¼ M homes with PV on their roof tops

The largest FiT program (in North America) exists in Ontario Canada.

US National total of PV installations

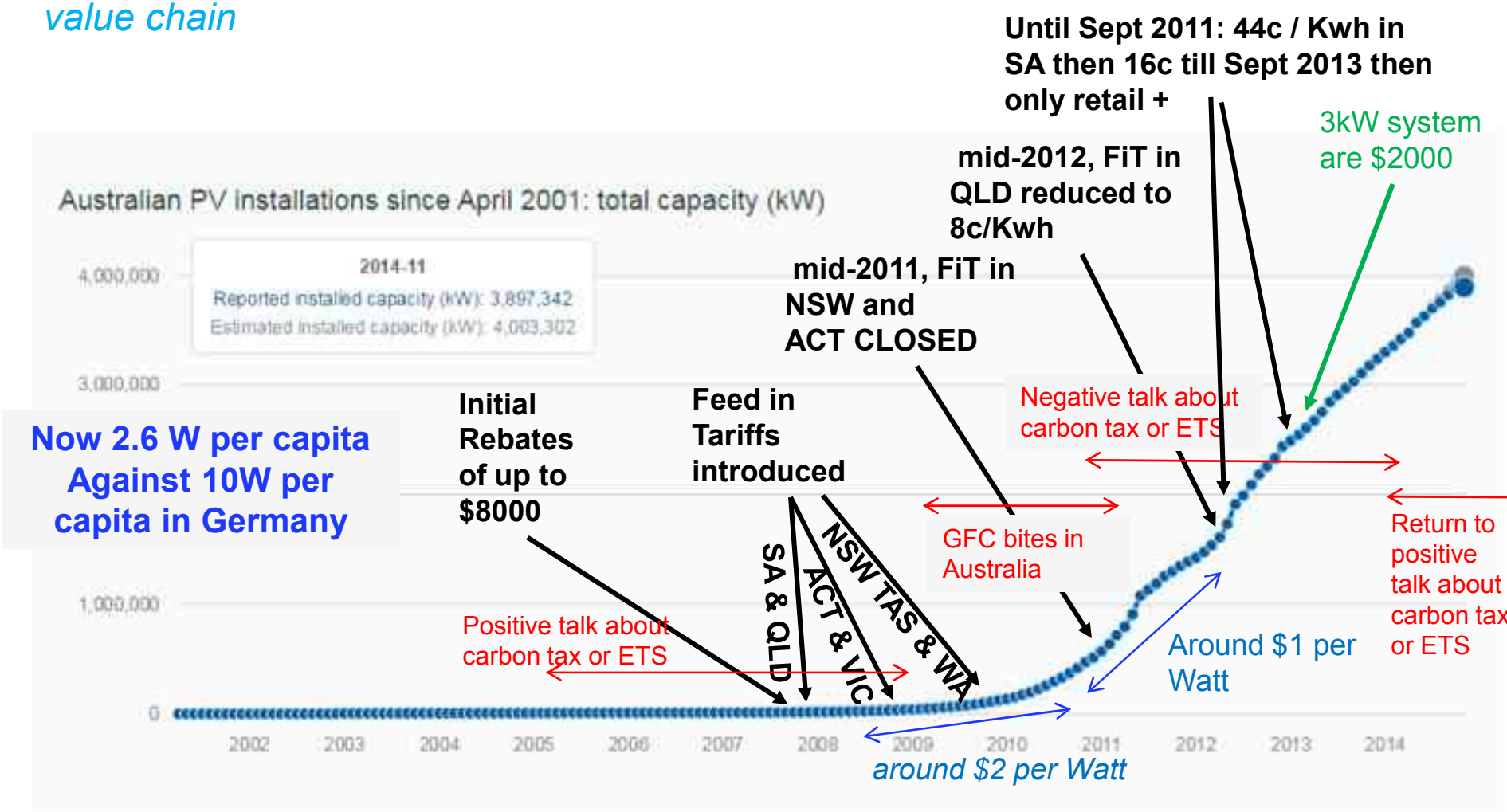


Installations (MWdc)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Residential	1	5	11	15	24	27	38	58	82	164	246	302	488
Non-Residential	2	3	9	27	32	51	67	93	200	213	336	826	1,043
Utility	0	3	2	3	2	1	0	9	16	58	267	760	1,781
Total Installations	4	11	23	45	58	79	105	160	298	435	848	1,887	3,313

Figures from GTM Research and SEIA

REC in Australia; a progressive story

REC – spawns affordability and consumer consideration - *a key consideration of all consumers is cost of entry or barrier to entry into participative position in the energy value chain*



The dynamics of approach and rewards:

Maximum capacity, tariff value

Feed-in Tariff	ACT	NSW	QLD	SA	TAS	WA	VIC
Policy / start Date	Feed-in Tariff commenced 1 March 09	Feed-in Tariff to commence on 1 January 2010. Amended Oct 28 2010	Solar Scheme Bonus commenced 1 July 08	Feed-in Tariff commenced 1 July 2008	Feed-in Tariff to be announced. Currently only retail offering	Feed-in Tariff to commence 1 August 2010. In addition to Renewable Energy Buyback Scheme	Premium Feed-in Tariff commenced 1 Nov 2009. Fair & Reasonable Tariff (1:1) to remain
Generation eligible	Gross	Gross	Net	Net	Current retail offer – Net FiT - TBC	Net	Premium FiT - Net
Tariff Level	Systems installed from 1 July 2010: 45.7 cents / kWh	20[illegible] kW Was 60c KWh	4[illegible] kW 8c/KWh	44 c[illegible] 16c/KWh	Current retail offer – at 20 cents / kWh FiT - TBC	FiT: 40 cents / kWh Renewable Energy Buyback Scheme: *7 cents / kWh (from 1st August 2010)	Pr[illegible] solar PV[illegible] 50 [illegible] Wh F&[illegible] east 1:1 6.2c/KWh
Size / Eligibility	Domestic small business, education for <30kW	Domestic, small business, schools, community organisations with inverter and solar panels 10kW or less.	Domestic and small business for < 10kW - single phase connection < 30kW - three phase connection	Domestic and small business for < 10kW - single phase connection < 30kW - three phase connection. Capacity measured from peak output of solar panels	Current retail offer - no restriction FiT - TBC	FiT – Domestic Synergy:< 5kW Horizon Power: <10kW per phase (30kW total) Buyback - Domestic, educational < 10kW	Premium FiT – Domestic, small business, schools, community facilities < 5kW. Capacity measured from nameplate capacity of panels. F&R Tariff - Domestic and small business <100kW
Duration	20 yrs	7 yrs (end 2016)	20 yrs	20 yrs	TBC	FiT- 10yrs	Premium FiT - 15 yrs
Technologies eligible	Solar, wind	Solar PV Micro-wind	Solar PV	Solar PV	Current retail offer - solar PV FiT - TBC	FiT / Buyback Scheme – solar PV, wind, micro-hydro	Premium FiT - solar PV F&R Tariff - wind, hydro, biomass, solar
Status	Legislated Stage 2 expected mid 2010	Legislated	Legislated	Legislated	FiT - to be announced	FiT- announced May 2010	Premium FiT - legislated F&R – legislated
Website	http://www.environment.act.gov.au	http://www.industry.nsw.gov.au	http://www.cleanenergy.qld.gov.au	http://www.climatechange.sa.gov.au	http://www.dier.tas.gov.au/energy	http://www.energy.wa.gov.au	http://new.dpi.vic.gov.au

Synergy Buyback Rate will be 7 cents/kWh. Horizon Power Rate will be REBS buy-back rate

The uptake of Solar is responsive to incentives and stimulus duration

Video
Dynamically showing solar uptake
(can be found on Youtube)

Australian production of Solar, one of the highest days 15th Dec 2014*: % of capacity producing energy*

Video dynamically indicating Capacity factor impact on a maximum production day

Australian production of Solar, one of the highest days 15th Dec 2014*: % of load being supplied*

Video dynamically % of load supplied on a maximum production day

Germany has a policy of Feed in Tariff that provides huge incentives early on; to encourage fast pay back, reducing to allow the FiT to align to wholesale energy prices:

German tariff structure		2004	2005	2006	2007	2008	2009	2010	Jul 2010	Oct 2010	2011
Rooftop mounted	up to 30 kW	57,4	54,53	51,80	49,21	46,75	43,01	39,14	34,05	33,03	28,74
	between 30 kW and 100 kW	54,6	51,87	49,28	46,82	44,48	40,91	37,23	32,39	31,42	27,33
	above 100 kW	54,0	51,30	48,74	46,30	43,99	39,58	35,23	30,65	29,73	25,86
	above 1000 kW	54,0	51,30	48,74	46,30	43,99	33,00	29,37	25,55	24,79	21,56
Ground mounted	conversion areas	45,7	43,4	40,6	37,96	35,49	31,94	28,43	26,16	25,37	22,07
	agricultural fields	45,7	43,4	40,6	37,96	35,49	31,94	28,43	-	-	-
	other	45,7	43,4	40,6	37,96	35,49	31,94	28,43	25,02	24,26	21,11

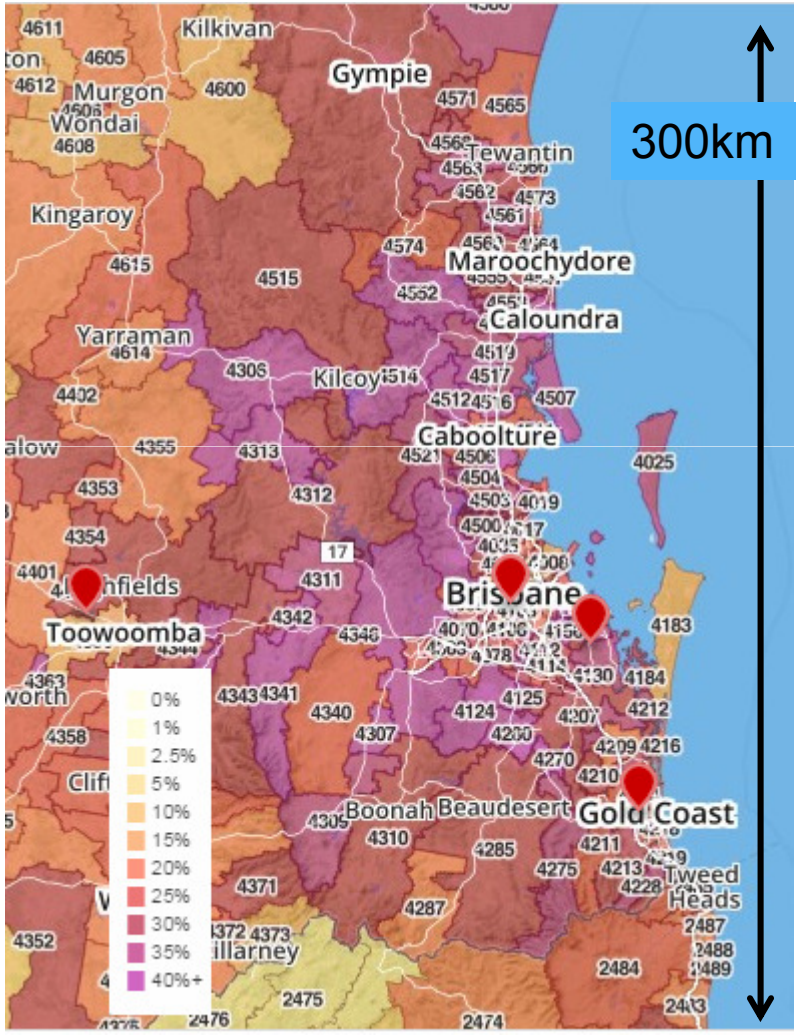
The German feed-in tariffs is referred to as a "tariff degression“:
A mechanism where the price (or tariff) ratchets down over time.
Done in order to track and encourage technological cost reductions

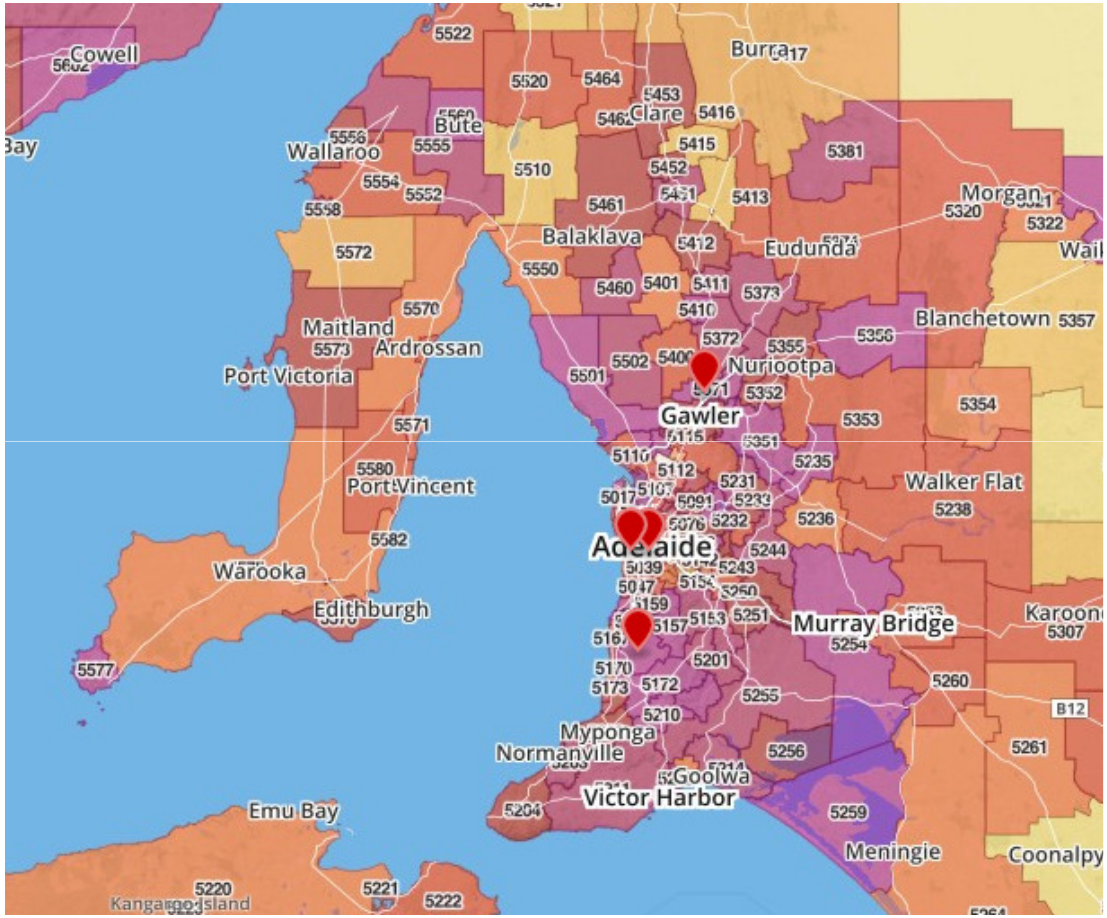
Germany is using a monthly degression to being the FiT value into line with the wholesale cost of energy.

Launch of €25M scheme over 2 years

Year	Month	Degression	Rooftop mounted				Ground mounted up to 10 MW_p
			up to 10 kW_p	up to 40 kW_p	up to 1 MW_p	up to 10 MW_p	
2012	April	-	19.50	18.50	16.50	13.50	13.50
	May	1.0%	19.31	18.32	16.34	13.37	13.37
	June		19.11	18.13	16.17	13.23	13.23
	July		18.92	17.95	16.01	13.10	13.10
	August		18.73	17.77	15.85	12.97	12.97
	September		18.54	17.59	15.69	12.84	12.84
	October		18.36	17.42	15.53	12.71	12.71
	November	2.5%	17.90	16.98	15.15	12.39	12.39
	December		17.45	16.56	14.77	12.08	12.08
2013	January		17.02	16.14	14.40	11.78	11.78
	February	2.2%	16.64	15.79	14.08	11.52	11.52
	March		16.28	15.44	13.77	11.27	11.27
	April		15.92	15.10	13.47	11.02	11.02
	May	1.8%	15.63	14.83	13.23	10.82	10.82
	June		15.35	14.56	12.99	10.63	10.63
	July		15.07	14.30	12.75	10.44	10.44
	August	1.8%	14.80	14.04	12.52	10.25	10.25
	September		14.54	13.79	12.30	10.06	10.06
	October		14.27	13.54	12.08	9.88	9.88
	November	1.4%	14.07	13.35	11.91	9.74	9.74
	December		13.88	13.17	11.74	9.61	9.61
2014	January		13.68	12.98	11.58	9.47	9.47
	February	1,0 %	13.55	12.85	11.46	9.38	9.38
	March		13.41	12.72	11.35	9.28	9.28
	April		13.28	12.60	11.23	9.19	9.19
	May		13.14	12.47	11.12	9.10	9.10
	June		13.01	12.34	11.01	9.01	9.01
	July		12.88	12.22	10.90	8.92	8.92
Maximum remuneration part			100%	90%	90%	100%	100%

Uptake, driven highest in Queensland.....
SA & QLD first to introduce FiT - 2008

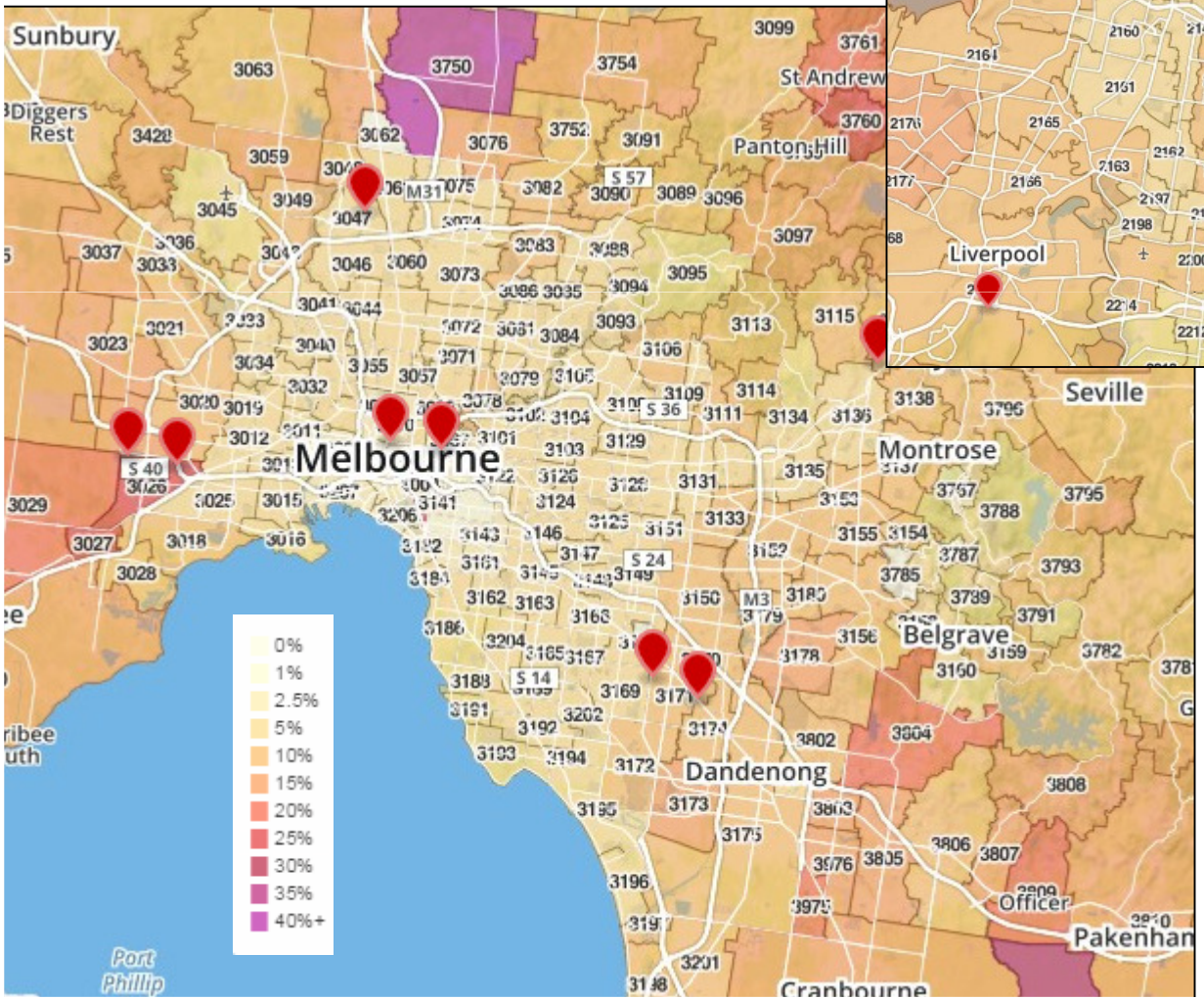


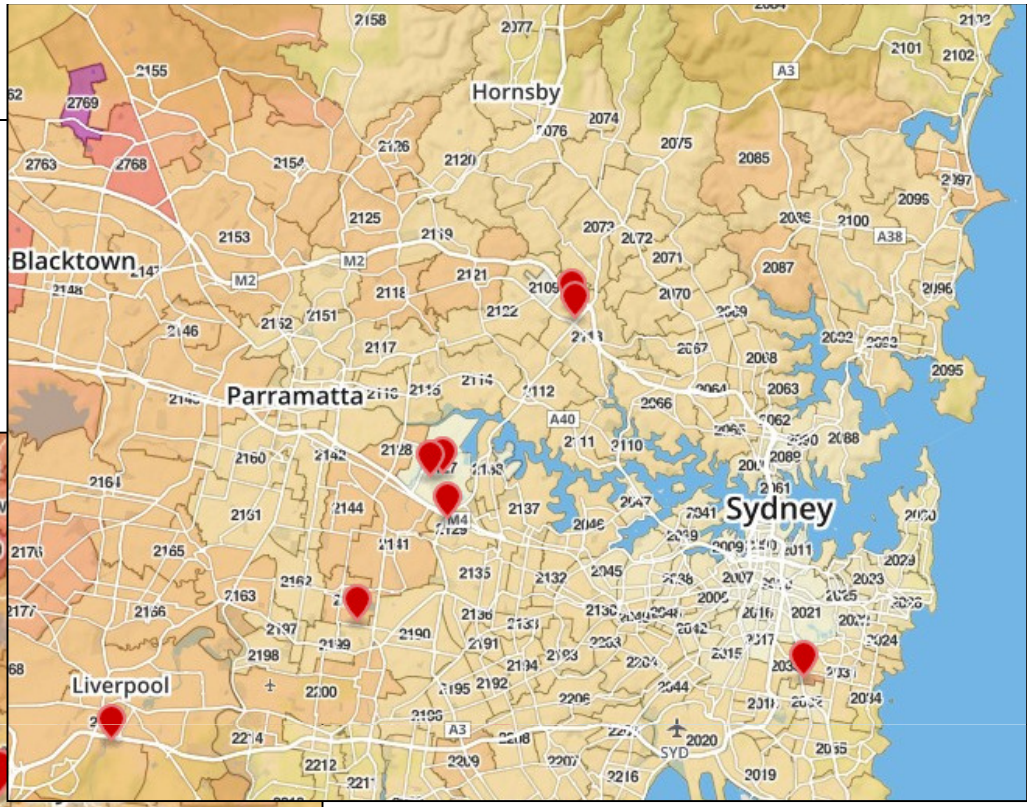


Data from the Clean Energy Regulator plus
The Small-scale Generation Unit (SGU) database
the Large-scale Renewable Energy Target (LRET)

Melbourne (VIC) FiT – 2009

Sydney (NSW) FiT – 2010
and then closed mid 2011

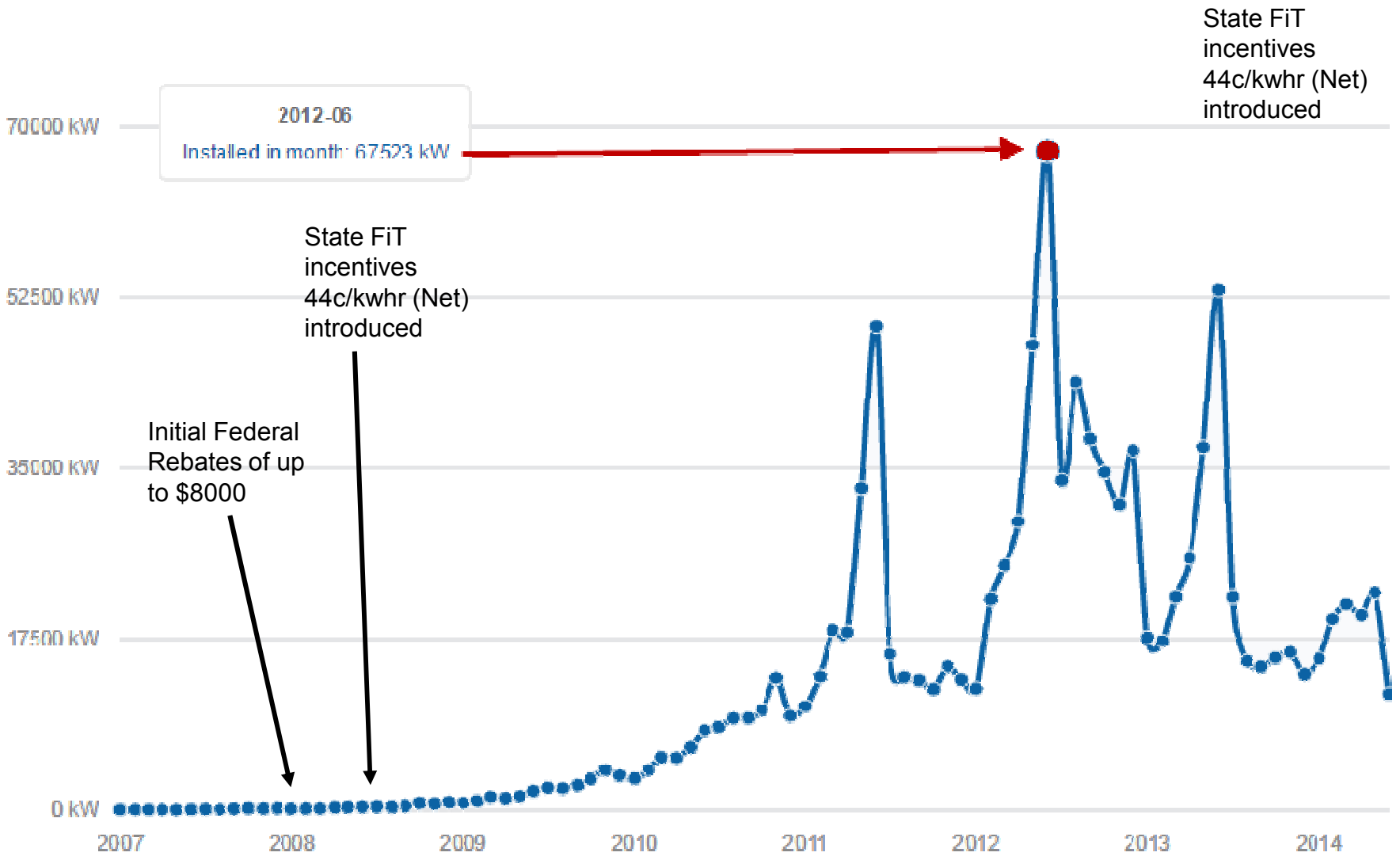




Some demographics issues:
Sydney, one of the most unaffordable housing markets (therefore less discretionary income)?

The MRET will increase from 9,500 gigawatt-hours to 45,000 gigawatt-hours by 2020

Aggregated monthly QLD PV installed capacity per month



Data Source: Australian Renewable Energy Agency

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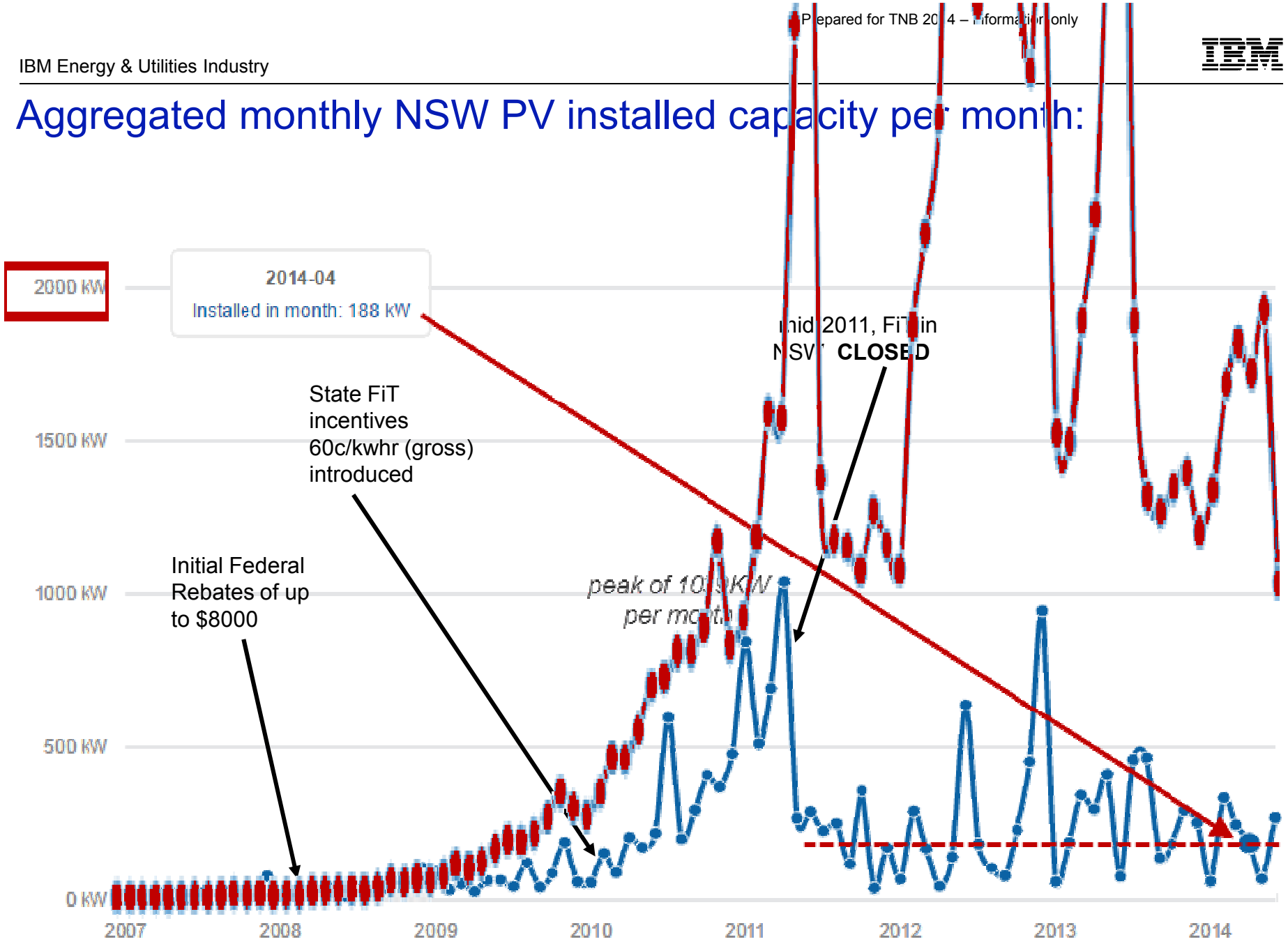


Data Source: Australian Renewable Energy Agency

2014 was a significant time in Australian Energy history:

What happened in QLD on July 7th?

The wholesale price of energy fell into negative territory in the middle of the day
For several days the wholesale price hovered around zero....
It can fall into negative territory at night when coal fired operators are reluctant to switch off so they generally pay the pumped hydro operators to pick up the load.

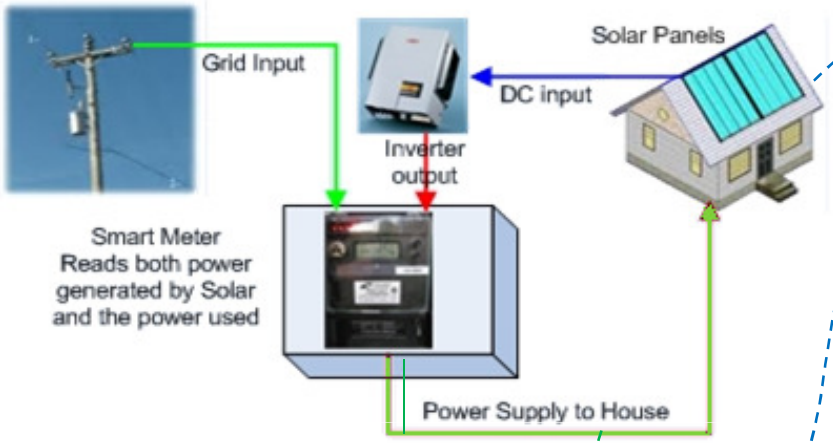
What happened in SA on Sep 30th?

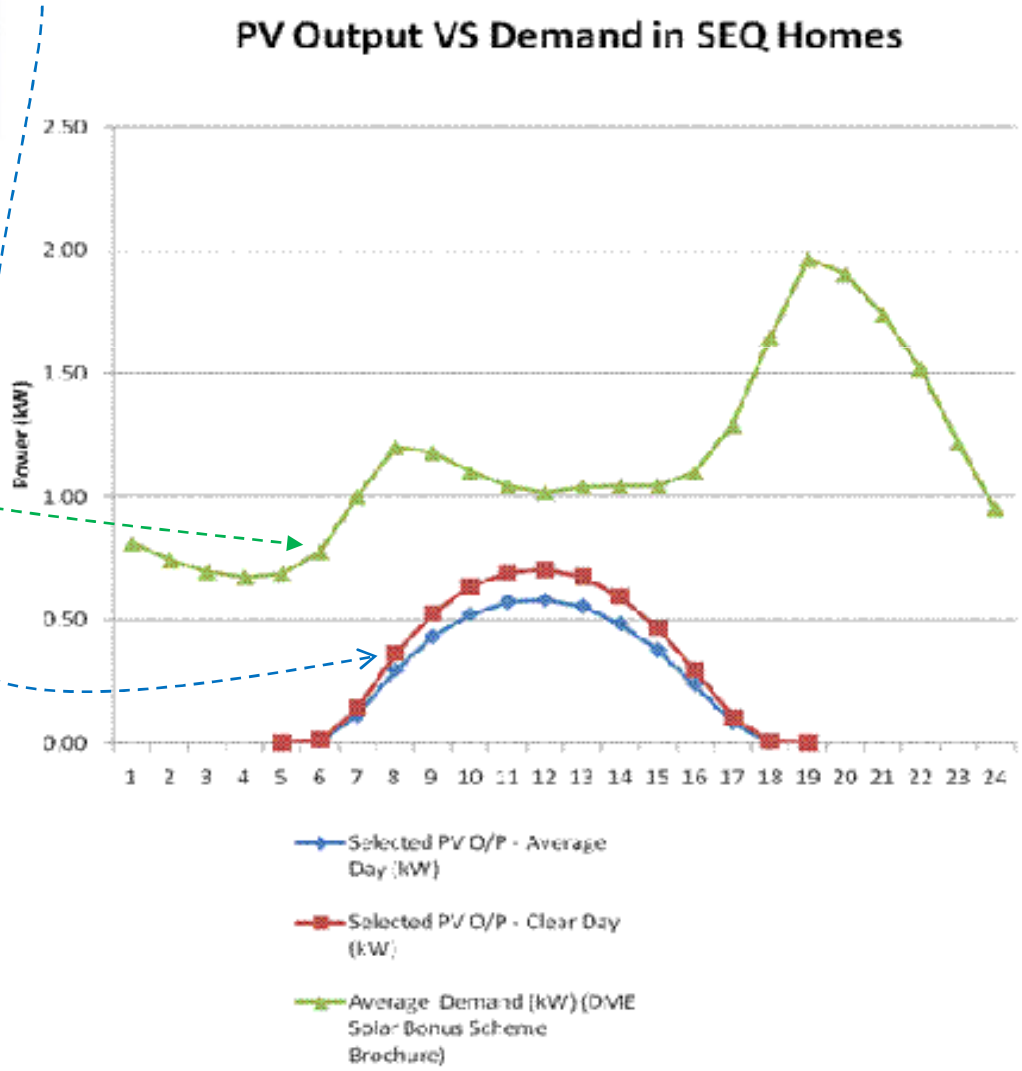
Electricity generated by wind and solar managed to meet all demand for most of the day, and electricity prices went negative for a considerable period that morning.

Having a ***Net*** FiT may also limit flexibility
A ***Gross*** FiT and other combinations may be desirable:

We have seen what happens when FiT pricing can be acted on in a reasonably quick manner with policy flexibility. This would seem to support FiT approaches rather than Net Metering approaches.

There is a disconnect between when power is available and when peak demand occurs in South East Queensland (SEQ)

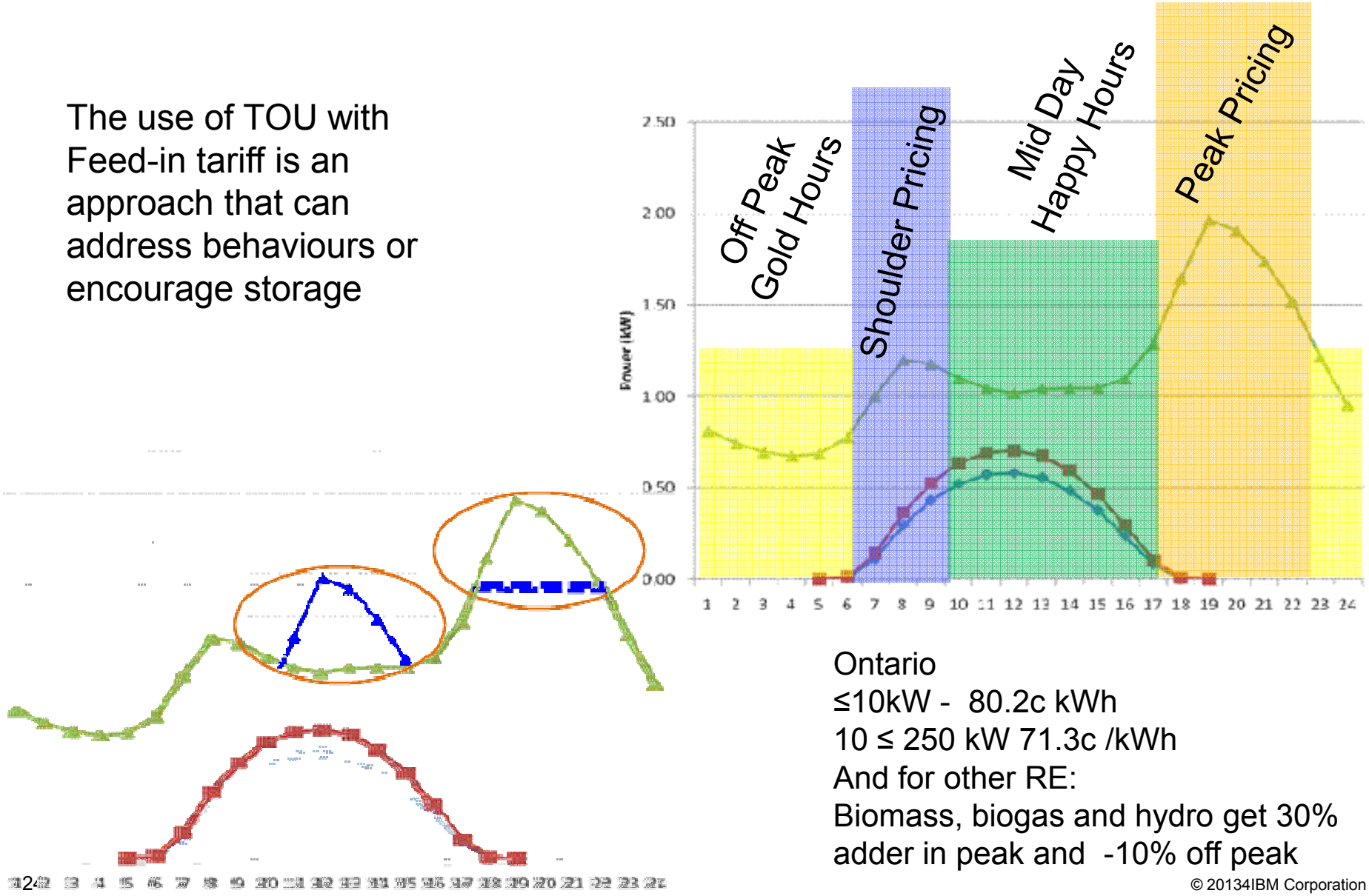




This causes an undesirable behaviour with a FiT based incentive calculated on *Net value* exported rather than *Gross value* exported

There are some things that could be done from a policy viewpoint

The use of TOU with Feed-in tariff is an approach that can address behaviours or encourage storage

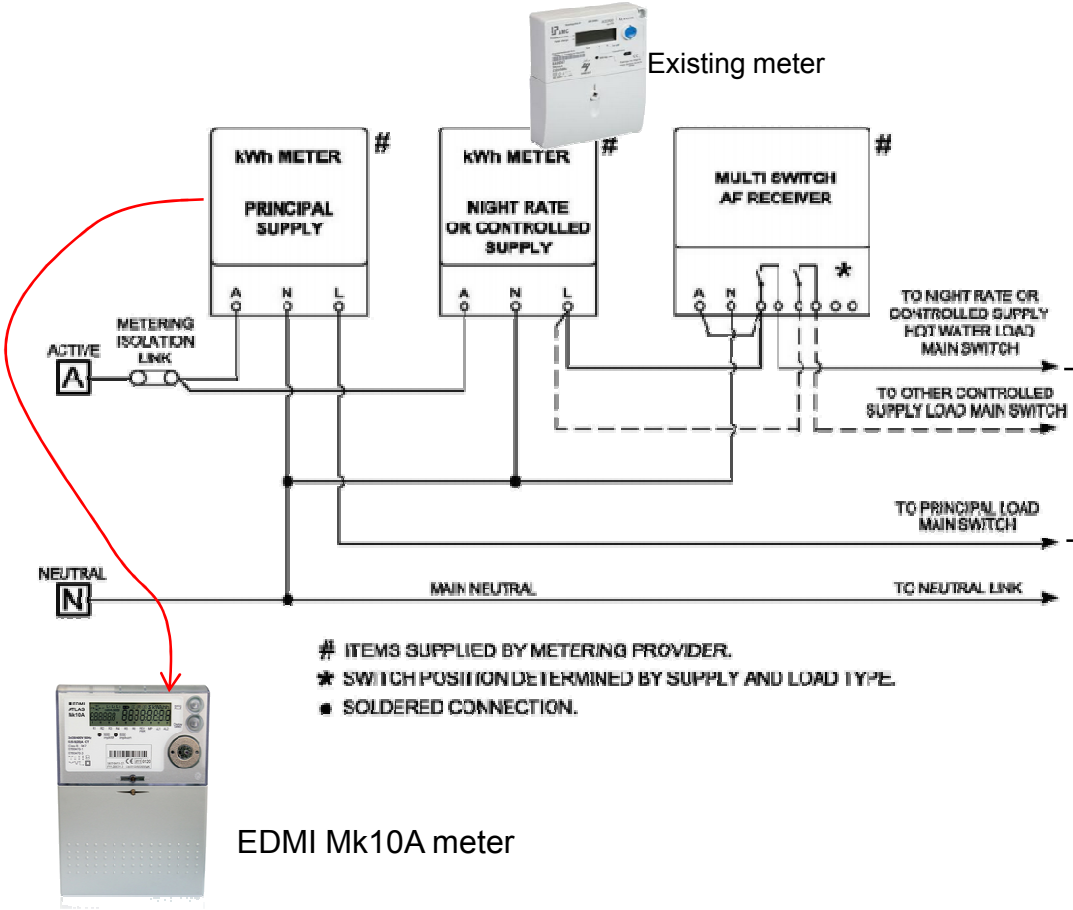


Ontario
≤10kW - 80.2c kWh
10 ≤ 250 kW 71.3c /kWh
And for other RE:
Biomass, biogas and hydro get 30% adder in peak and -10% off peak

A wide variation of approach abounds; but limits apply throughout:

Country	Eligible Generation Technologies	Individual Generation Capacity Limit	Compensation and Reconciliation	Interconnection Process	Eligible Customer Classes
Australia 	Solar (Residential) + Fuel Cell in Victoria + Solar Wind, Biomass at grid scale	Solar 1ø ≤ 10 kW ≤ 30 kW for 3ø systems	Varies by State. Some states are Gross FiT some are Net FiT. The REC payments come from the federal government and the FiT come from the State Government. Most states now have FiT under retail value	Simplified process – cycle time was 2-3 months at peak time. The connection is paid for with the certified installer.	Res + C&I
Denmark 	Solar PV Wind Biogas Biomass Hydro	**Solar** ≤50kW **Wind** ≤25kW **Other** ≤11kW	Denmark is mainly through Premium Tariff and Net Metering. There is a small unit funding program which leans more toward supporting small consistent generation technologies such as biomass	Prioritised interconnections for small scale generators.	Res + C&I
Germany 	Solar PV Wind Biogas & Biomass Geothermal Hydro CHP (source)	- FiT for ≤500kW Market Premium over this	Germany treats RE relatively the same across a range of RE portfolios. ie The FiT are consistant for Wind, PV, Geothermal, Hydro, CHP (biomethane), Biomass – Biogas limited to 75kW	Simplified and streamlined process for small generators	Res + C&I with varying rates based on category
USA - eg California 	Solar PV Wind Biogas Fuel cells	≤ 1 MW Different per state ie Cal ≤100kW	• Mandatory for utilities to purchase electricity generated. • Credit cycle of 12 months	Some burdens apply depending on state can be difficult to wade through permitting and obstructive utility submission processes	Res + C&I
Mexico 	Solar PV Solar Thermal	≤ 10 kW - ≤ 500 kW	• Perpetual rollover if less than 50 dollars. • Physical monthly compensation if greater than 50 dollars	Simplified and streamlined process for small generators	Res + C&I

Off peak (or controlled load tariffs). – using dual element meter



EDMI Mk10A meter

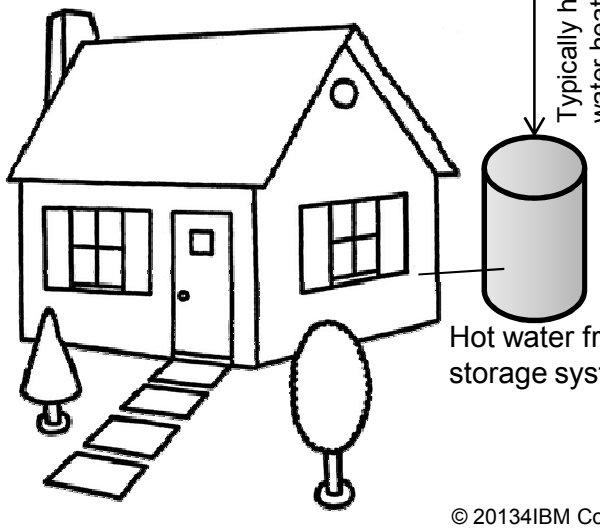
Tariff 31 is hot water

Available for up to 18 hours per day (not at peak time)

Typically hot water (about 50% of water heaters in QLD) and some pools

Tariff 11 is normal household

Standard supply



Hot water from storage system

Up to 8 Rates plus Unified Rate

- Separate Import & Export Registers (meters current into imported to home and exported from home)
- 61 Previous Periods plus Period Totals
- Time of Use and Maximum Demand capable (but not used)

Comms capable (via GSM but not used)

Typical situation:

12 X 230W panels

2.6kW inverter

Nominal 2.76kW

3ø supply

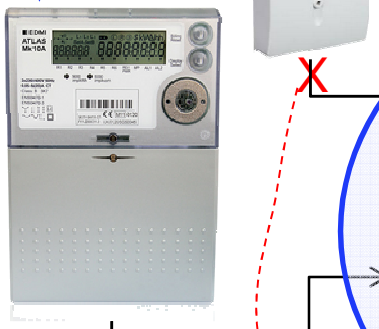
Single ø

Typical capacity factors of 14% in QLD

Net = PV O/P – load

Feed in tariff (FIT)
Where net enables export to the grid then this a tariff agreed with the retailer and is applied each bill

Tariff = 44c /kWh from the government and a mark up from the retailer (in my case FIT = 52c)



Single ø

Hot water or say pool can be a tariff 33 load ("off peak")

Load

3 phase load (central air-conditioning)

Single ø Rest of the house

Switched by ripple control by Energex

Energy Plan type: AGL Select® 7% - Electricity

Billing Frequency: Electricity every 3 months

Fixed Benefit Period: 2 years

Supply Commencement Date: See General Terms clause 2.2

Fixed Benefit Period End Date: Second anniversary of the Supply Commencement Date

Early Termination Fee (subject to Cooling-off Period):
> Within the first 12 months: $75.00 GST Incl. ($68.18 GST Excl.)
> Within the second 12 months: $50.00 GST Incl. ($45.45 GST Excl.)

Discounts & Rewards:
> 7% Guaranteed Discount

Important Notice to the Consumer.

You have a right to cancel this agreement within 10 Business Days from and including the day after you
agreement. Details about your additional rights to cancel this agreement are set out in the information

Your Electricity rates.

AGL changes its rates periodically; we may change the below rates with notice to you.

Electricity usage per quarter	Unit	GST excl.	GST incl.
Tariff 11**	c/kWh	26.73	29.403
T31 controlled load^	c/kWh	12.37	13.607
Feed-in tariff#	c/kWh	52.00	
Supply charge	c/day	50.21	55.231

** Tariff 11 - Residential all consumption.
^ Tariff 31 night rate is applicable to customers who have storage water heaters and permanently connected heat bank
hot water heater. Electricity supply is made available for a minimum of eight hours per day at times determined by your
QLD government solar feed-in tariff and additional AGL credit.
Your bills will show the GST exclusive rates and GST will be added to the totals. See your terms and conditions for how

Important things you should know about your Energy Plan.

> A discount equal to 7% of the amount payable for your applicable Energy usage Charges applies as part of this Energy
separate credit (GST exclusive) on your bills. The discount does not apply to fixed daily Energy supply Charges, dema
Choice™ Charges.
> Your Energy Plan has no fixed term. At the end of the 2 year Fixed Benefit Period your Energy Plan, including all appli
credits, will continue for a further 2 year Fixed Benefit Period, unless we contact you otherwise or your Energy Plan i
> Enclosed is a $50 voucher for AGL Smarter Living in store and in home appliances and services. Not redeemable for p
AGL Smarter Living online store. Conditions apply - see voucher.

306101 / 0004480 / 002729

Notes:

All tariffs are unique to AGL retailer – some variation exists across the retailers

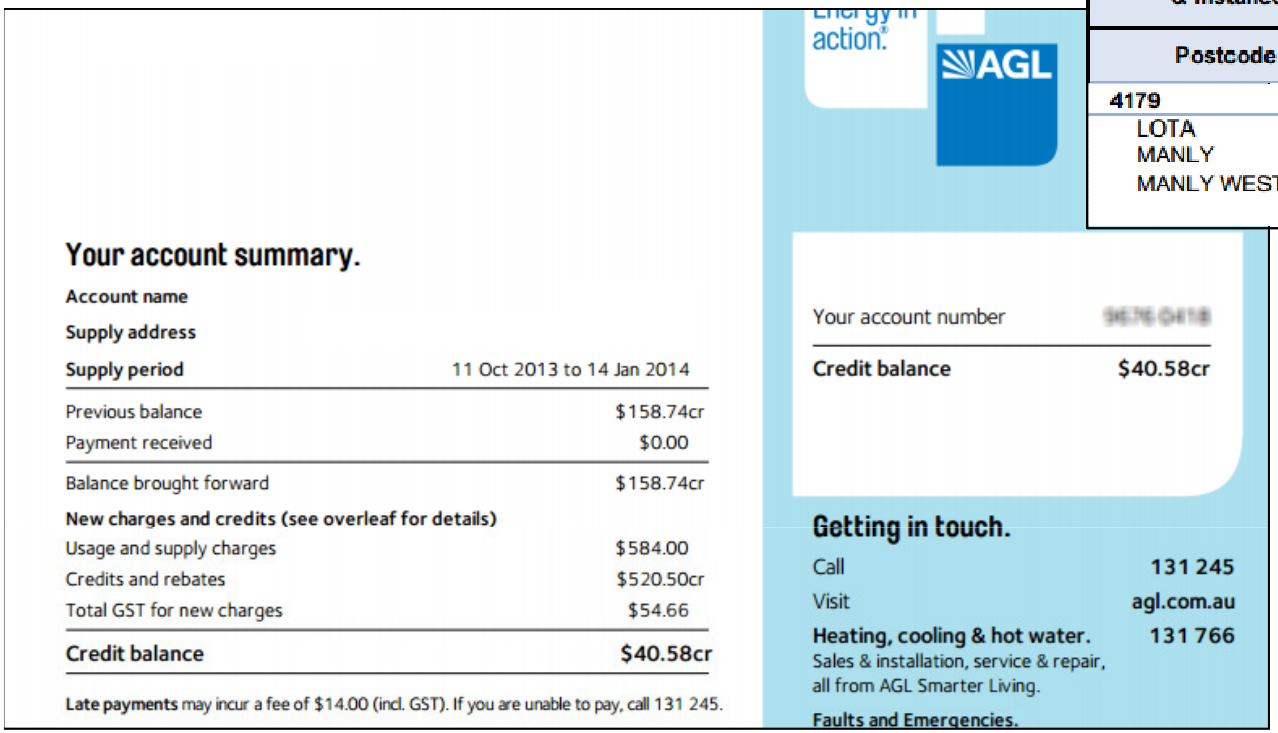
The meters are still manually read each 3 months by a meter reader

The old meter is not changed for the controllable load; so the load control relay operated by ripple control from Energex remained intact (cheapest option for Energex) This meter measures off peak load (billed at 12.37 c/kWh)

The new meter measure the gross imported power (billed at 26c/kWh – tariff 11)

The new meter measures the gross exported to the grid (credited at 52c/kWh)

The net energy is what is billed for with the above rates applied to imported and exported energy



Your account summary.

Account name	
Supply address	
Supply period	11 Oct 2013 to 14 Jan 2014
Previous balance	$158.74cr
Payment received	$0.00
Balance brought forward	$158.74cr
New charges and credits (see overleaf for details)	
Usage and supply charges	$584.00
Credits and rebates	$520.50cr
Total GST for new charges	$54.66
Credit balance	**$40.58cr**

Late payments may incur a fee of $14.00 (incl. GST). If you are unable to pay, call 131 245.

action.

AGL

Your account number [redacted]

Credit balance **$40.58cr**

Getting in touch.

Call **131 245**

Visit **agl.com.au**

Heating, cooling & hot water. **131 766**
Sales & installation, service & repair, all from AGL Smarter Living.

Faults and Emergencies.

ENERGEX's Distribution Network South East Queensland Solar Installations & Installed Inverter Capacity by Postcode up to December 2013

Postcode / Suburb	Sum of Capacity (kW)	Number of Solar PV Installations
4179		
LOTA	624.54	218
MANLY	810.75	265
MANLY WEST	3105.61	1042
	4540.9	**1525**

Amount of PV:

In Queensland the PV is now over 1000MW capacity – A typical suburb Manly West chosen for an example

The typical suburb is a suburb with no high rise houses, many sitting on about 700 – 1000sqm of land. Roof space is plentiful!

The sampled suburb is approximately 5 square kilometres. The population of Manly West is was 11,189 in 2011 with about 5000 homes. So from the above statistics solar is installed on approx 1 in 3 homes.

Meter no.	Read date	Read type	Rate description	Start read	End read	kWh
807906	19 Jan 15	Actual	Controlled load	21,226	21,898	672
1376032	19 Jan 15	Actual	Peak	22,122	24,125	2,003
1376032	19 Jan 15	Actual	Solar	5,825	6,635	810

Your next meter read is due between **17 Apr 15 and 23 Apr 15**. Please ensure easy access to your meter on these days.

How we've worked out your bill.

Previous balance and payments.

		Total
Previous balance	$268.49	
10 Nov 14 payment	$268.49cr	
Balance brought forward		**$0.00**

New charges and credits.

Usage and supply charges	Units	Price	Amount		
Peak	2003kWh	$0.2537	$508.16		
Tariff 31 Controlled Load	672kWh	$0.1174	$78.89		
Supply charge	96 days	$0.8341	$80.07		
Other charges					
Total charges				+	*$679.85*
Credits					
AGL Solar Rebate*	810kWh	$0.52	$421.20cr		
7% Guaranteed Discount			$41.09cr		
Total credits				-	*$462.29cr*
Total new charges and credits				=	*$217.56*
Total GST				+	*$62.60*
Total due (includes GST)				=	**$280.16**

Moderate use QTR's:

Invoiced for $584.00 in energy on the two tariffs (tariff 11 and 31)

The previous bill was from a moderate QTR where not much air-con but plenty of sunshine! So there was an accumulated $150 credit. This bill had $520.50 cr from the FIT so in the end the account was:

Previous: $158.74cr
Import: $584.00
Tax: $ 54.66
Export: $520.50
Current: $40.58 cr

Some observations comparing US and Australia on penetration:

Glen Garner
Senior Managing Consultant – Global Energy & Utilities
Feb 2015

Prices are reducing in the US, but transformation of the fuel source has been slower than many other places in the world

Figure 3: States Currently at Grid Parity

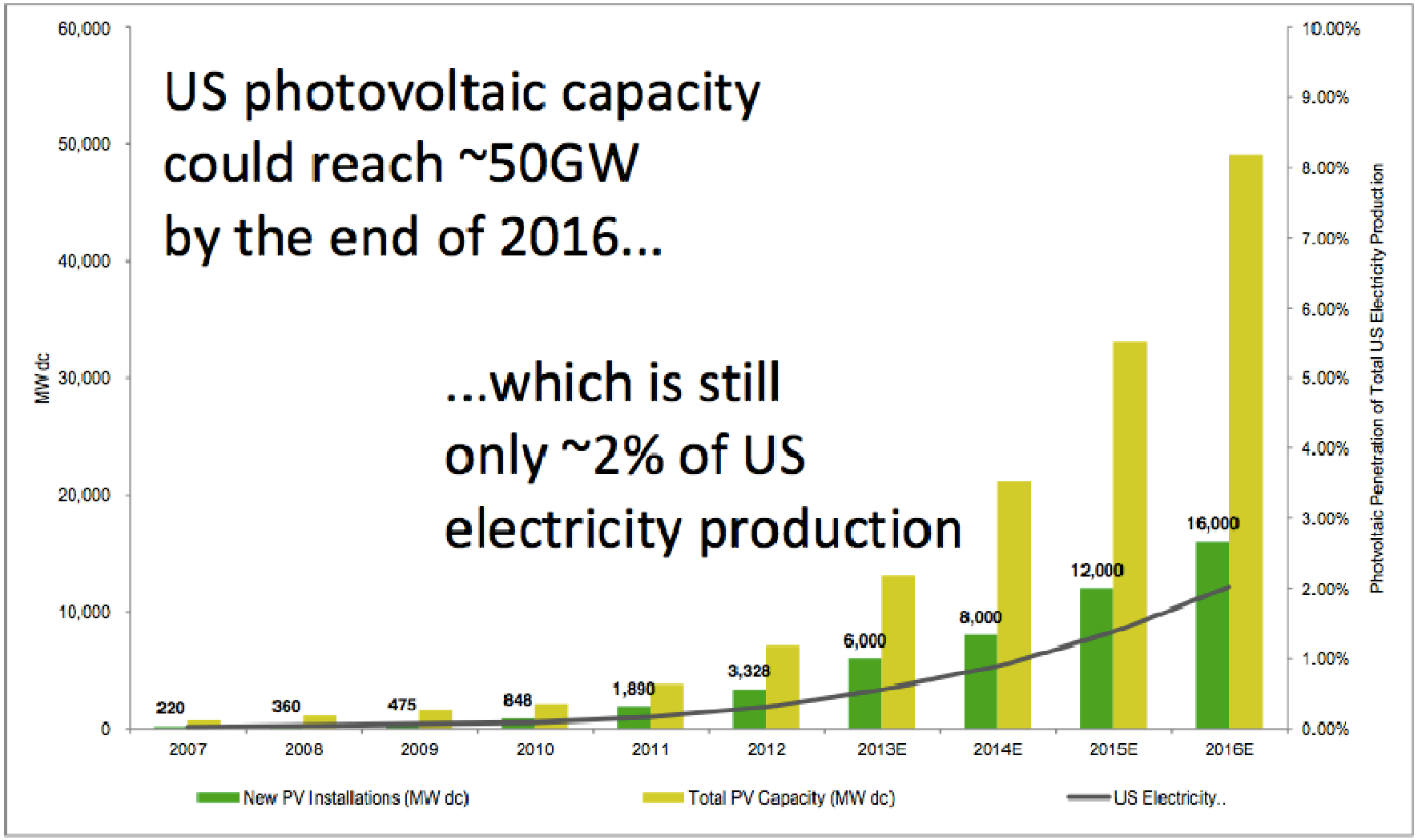
Grid Parity at $3.00 ($2.10 w/ ITC)	LCOE ($/KWh)	Average Cost of Electricity ($/KWh)
Arizona	$0.11	$0.11
California	$0.12	$0.16
Connecticut	$0.15	$0.17
Hawaii	$0.12	$0.37
Nevada	$0.10	$0.12
New Hampshire	$0.15	$0.16
New Jersey	$0.15	$0.16
New Mexico	$0.11	$0.11
New York	$0.15	$0.18
Vermont	$0.16	$0.17

Source: Deutsche Bank

Figure 4: Additional States Poised to Reach Grid Parity

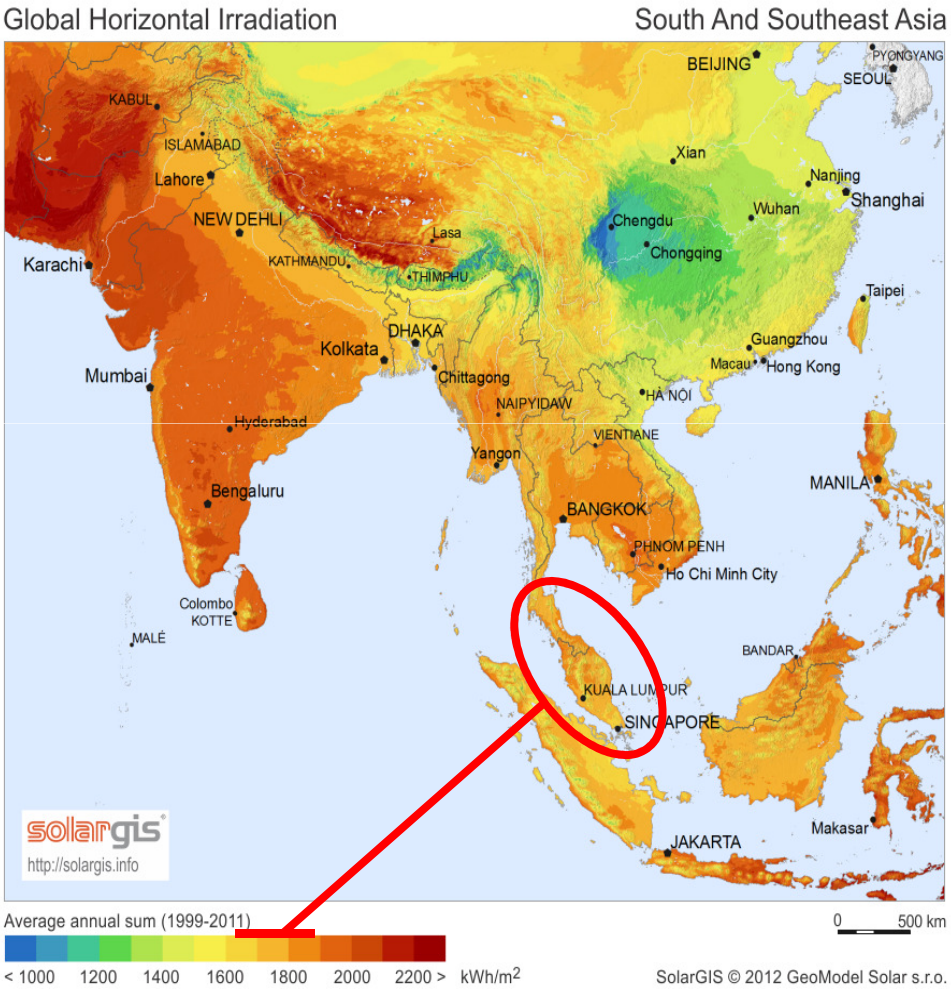
Grid Parity at $2.50 ($1.75 w/ ITC)	LCOE ($/KWh)	Average Cost of Electricity ($/KWh)
Colorado	$0.10	$0.12
Delaware	$0.12	$0.13
Washington, DC	$0.12	$0.12
Florida	$0.11	$0.11
Kansas	$0.11	$0.11
Maryland	$0.12	$0.13
Massachusetts	$0.13	$0.15
Michigan	$0.14	$0.14
Pennsylvania	$0.13	$0.13
Rhode Island	$0.13	$0.15
South Carolina	$0.11	$0.12
Wisconsin	$0.13	$0.13

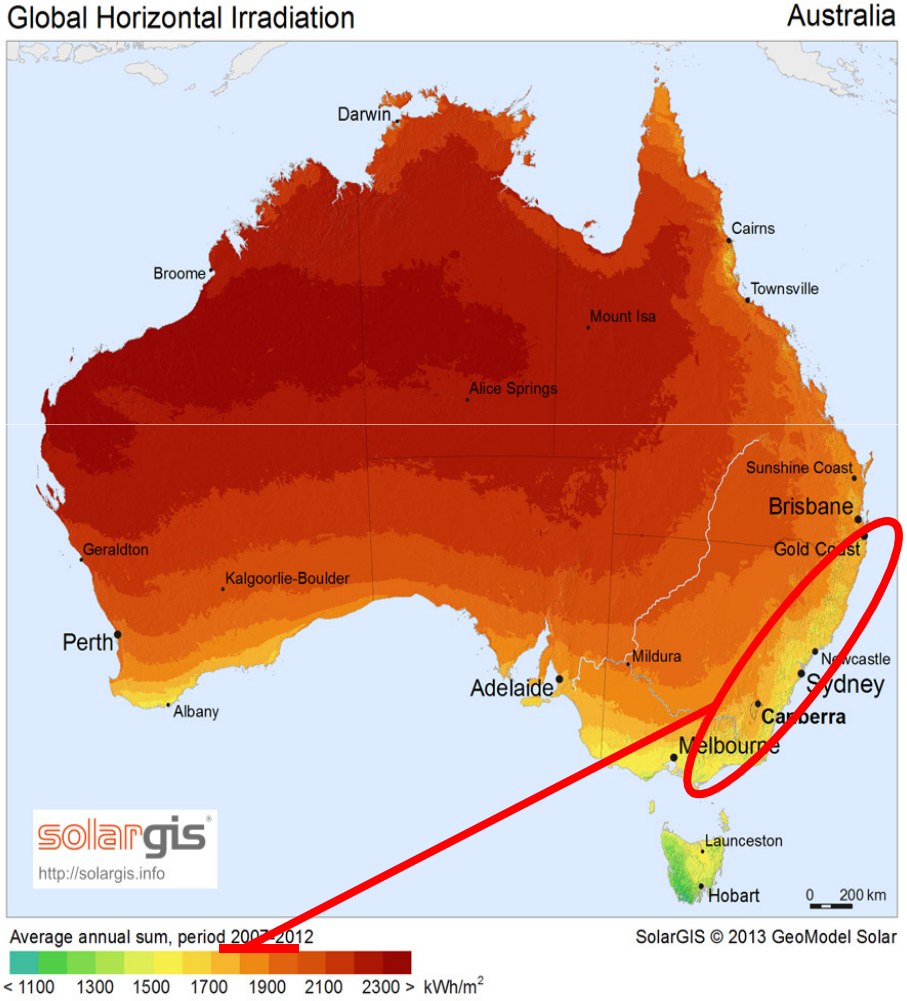
Source: Deutsche Bank



Source: Deutsche Bank, EIA, SEIA

Asia has a good energy resource capability:





Every KWh produced in Malaysia was cheaper to produce, and cheaper to replace: