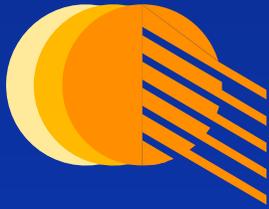


Tariff Implications for the Value of PV to Residential Customers

Muriel Watt

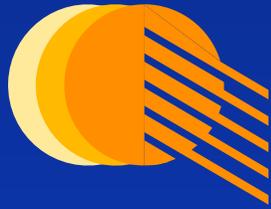
Co-authors:

Marc Pop, Juan Rivier, Andrew Birch



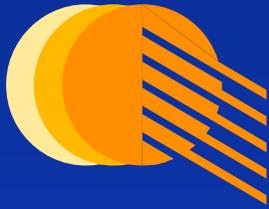
Introduction

- 2000+ grid-connected PV systems installed under PVRP
- This study assesses cost-effectiveness of systems installed & how customers might maximise their return on investment
- Key parameters: system cost, finance, location, electricity tariffs and customer's electricity usage pattern
- Pop (2005) examined data from Country Energy's Queanbeyan PV system to assess PV value against:
 - standard residential, time-of-use and green tariffs available from retailers in SA, NSW and Vic
 - the load pattern of an Adelaide household with 1, 3, 5 and 7 kWp rooftop PV systems
- Results for 1 kWp PV and Energy Australia tariffs are reported
- Analysis also provided of a possible feed-in tariff option



Household Characteristics

- Modern, 180 m² air conditioned Adelaide house with insulation & efficient appliances
- The residents of the home are a family of two adults and two children
- One adult working full-time & one part-time
- Data covers April 2002 to March 2003.

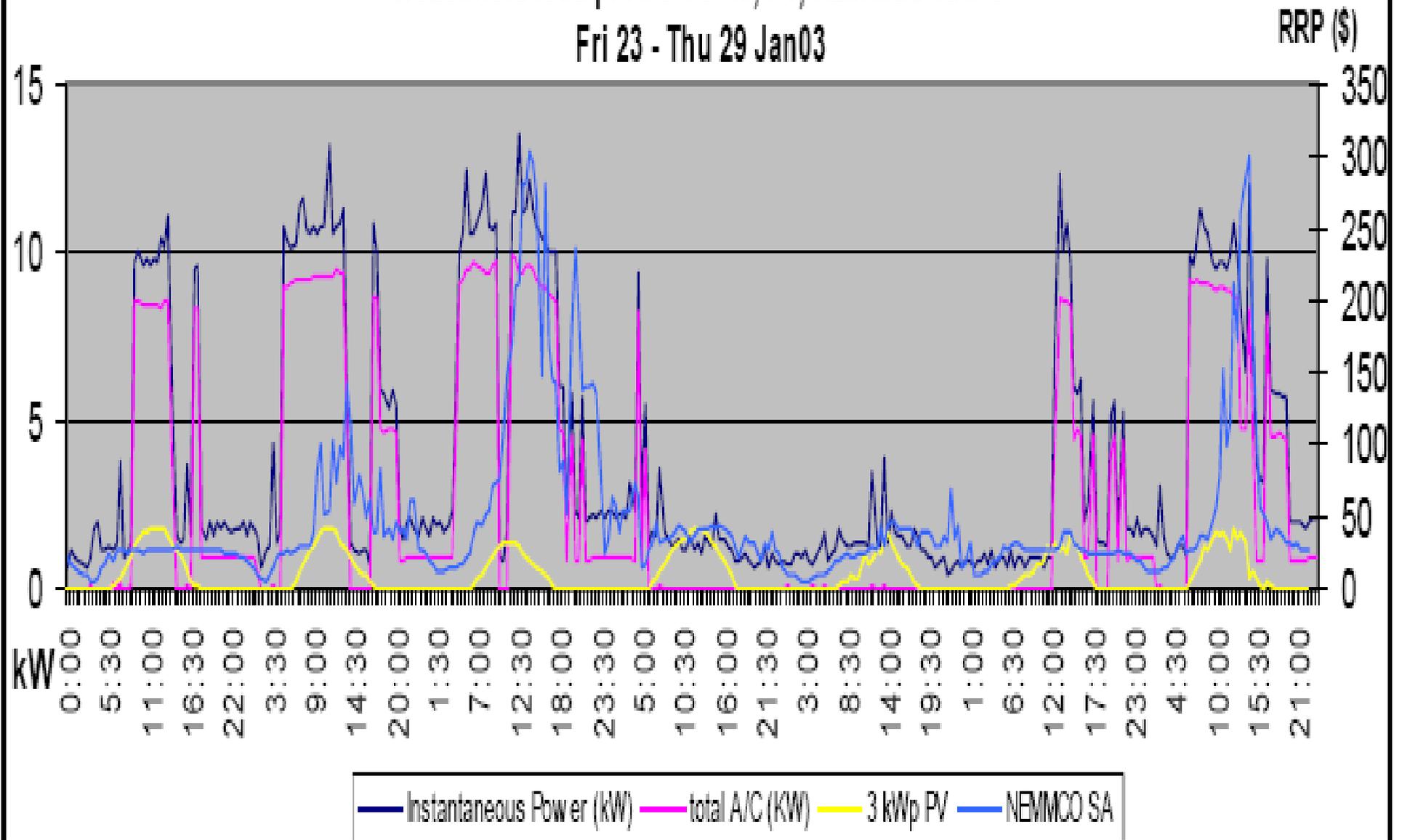


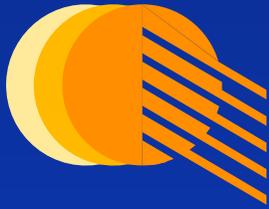
Household Load

- The household monthly average load ranges from 255 kWh in April to 1043 kWh in January
- The total annual household electricity use was 6496 kWh, or about 18 kWh per day
- Summer load (December to February):
 - about 40% of the annual load
 - average daily load of around 30 kWh
 - dominated by air conditioner use
 - loads are high when adults are home, esp. weekends
 - air conditioner often cuts in as early as 5:30am and can keep operating well into the evening

Household load profile vs AC, PV, NEMMCO RRP's

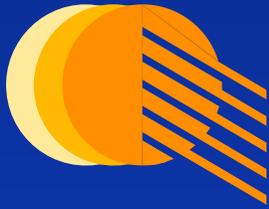
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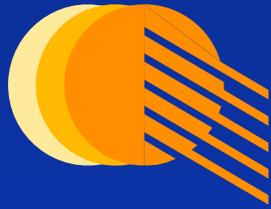
The Queanbeyan PV System

- PV data for April 2002 to March 2003:
 - Latitude 35.45, Longitude 148.56
 - 720 multi-crystalline modules
 - 9 arrays with 9 x 6kW multi-string inverters
 - system capacity 50 kilowatts
 - all data normalised to 1 kWp
- Minimum output June ~ 2.8 kWh/kWp per day
- Maximum output October ~ 4.3 kWh/kWp per day
- Av summer (Dec-Feb) output ~ 4.2 kWh/kWp/day
- Annual output 1400 kWh



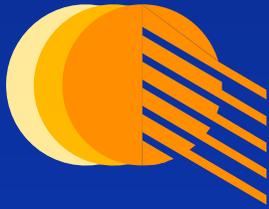
Value of PV Electricity for this household

- Highest PV revenue from highest available tariffs (Green)
- Higher tariffs don't always result in the lowest bill
- ~ 25% of annual PV output is exported to the grid when load is less than PV output
- For this household, a 1 kWp PV system:
 - contributes 22% of the annual load
 - reduces annual electricity bill by 19% from \$775 under Energy Australia's domestic continuous tariff to \$627
 - The lowest bill (\$593) is achieved via the TOU tariff
 - The largest saving (\$235) from Green tariff (assuming net metering)
- Savings of \$182 (23%) per year if customer switches from continuous to TOU tariff when they install PV



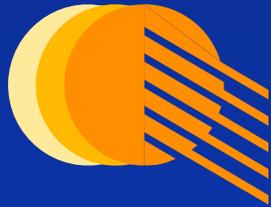
Annual electricity bill with and without a 1 kWp PV system

Energy Australia Tariffs	Continuous	TOU	Green
Annual Bill	\$775	\$732	\$1170
Bill with 1 kWp PV	\$627	\$593	\$935
Saving	\$148	\$139	\$235



Investment Value

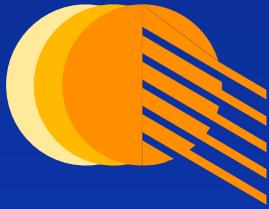
- Installed capital cost \$13,750
- Residential customers may be eligible for a \$4,000 grant from the PVRP
- RECs through MRET may also be available
 - upfront REC payment of \$500 assumed, as per Enviro-Cash Back available for BP Solar systems



NPV of 1 kWp PV system

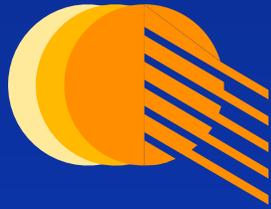
	Continuous	TOU	Green
25 Years	-\$9,800	-\$10,050	-\$7,520
30 Years	-\$8,950	-\$9,260	-\$6,180
25 Years + PVRP	-\$5,800	-\$6,050	-\$3,520
30 Years + PVRP	-\$4,950	-\$5,260	-\$2,180
25 Years + PVRP + RECs	-\$5,300	-\$5,550	-\$3,020
30 Years + PVRP + RECs	-\$4,450	-\$4,760	-\$1,680

Electricity price increase 3% pa, inflation 2.5% pa
 → PV not a cost effective investment with current tariffs



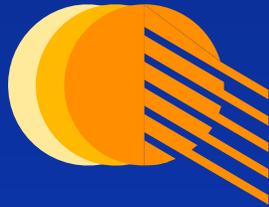
Discussion

- PV prices need to fall ~ 33% for PV to be cost effective for residential use or by ~ 66% without PVRP
- Results indicative only - PV in NSW and household in SA
 - This would result in a lag between PV output and load
 - Were the PV located on the house, the match would be better
 - Also, load & PV output weather dependent but not examined
- West facing PV can enhance summer afternoon output but needs tariff compensation for lower annual PV output
- MRET has not been a particularly useful mechanism for PV
 - Extension of PV deeming period from 5 to 15 years and deeming size to 100kW could change this
 - However, REC prices have already begun to fall

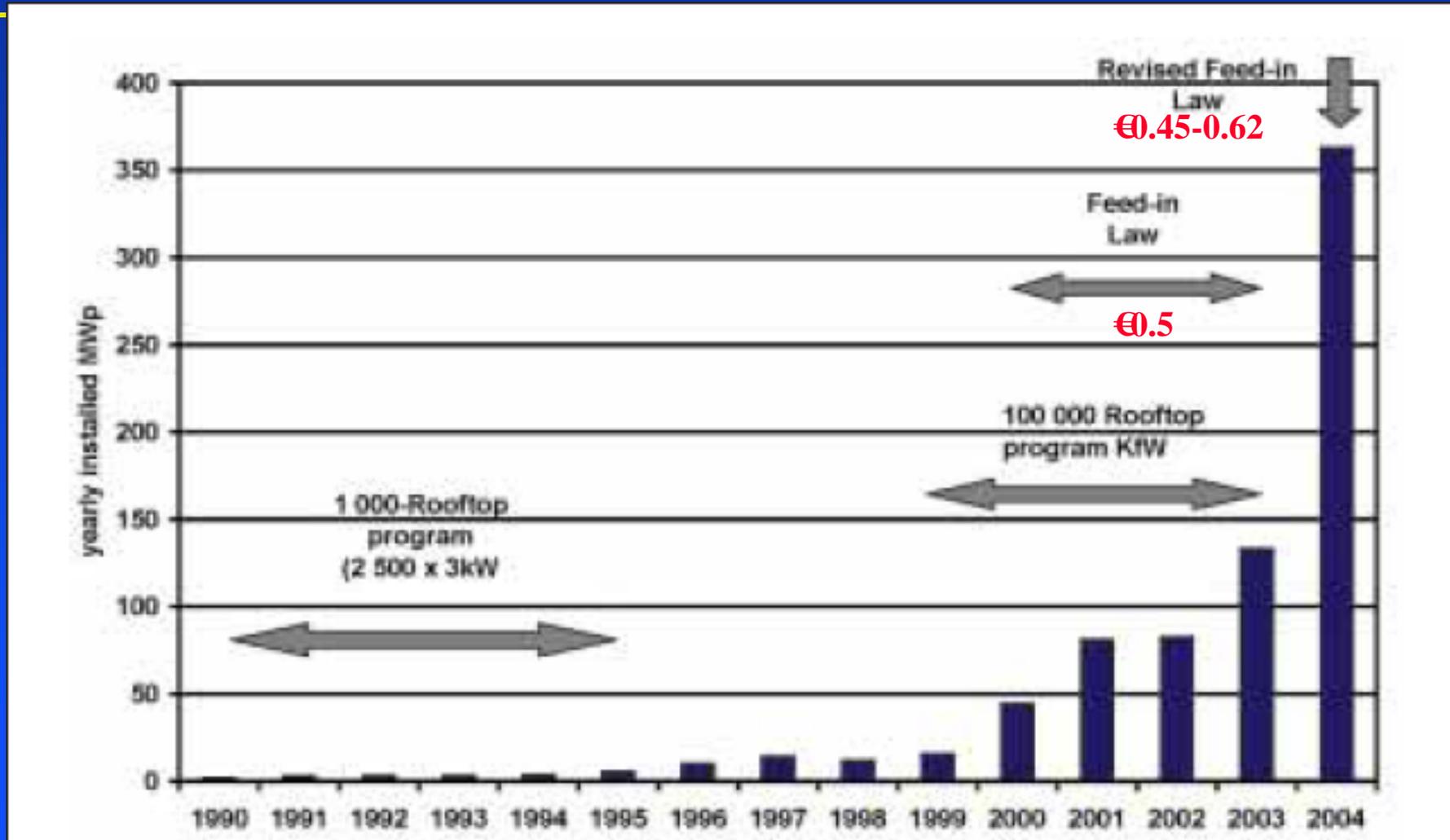


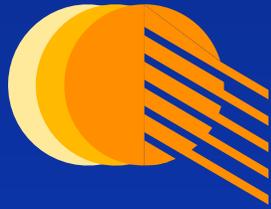
Feed-in Tariffs (FITs)

- PV price reductions of 30-60% not expected this decade
- FITs are an alternative to capital grants and can drive investment
 - Offer customers who invest in PV, or other renewables, an enhanced electricity buy-back rate
 - Tariffs mandated, guaranteed for 15 - 20 years and paid for via a levy on electricity rates
 - This facilitates an economic payback within the system life
 - Provides an attractive investment opportunity and reduces risk
 - Not linked to government grants and hence budget cycles
- FITs have attracted huge investment in PV (& other renewables) where introduced; far greater than achieved to date in Australia under PVRP or MRET

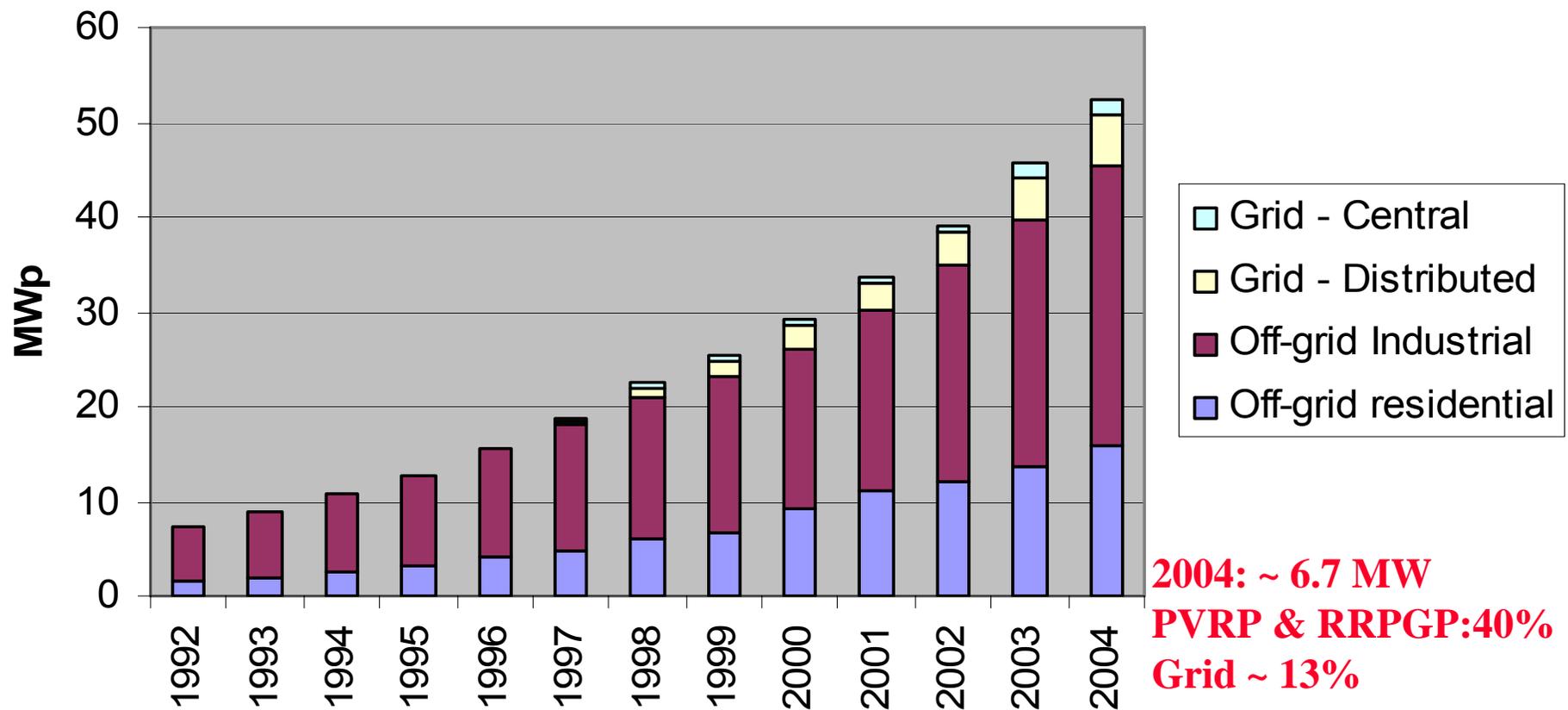


PV installations in Germany

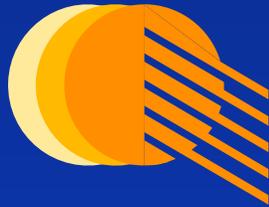




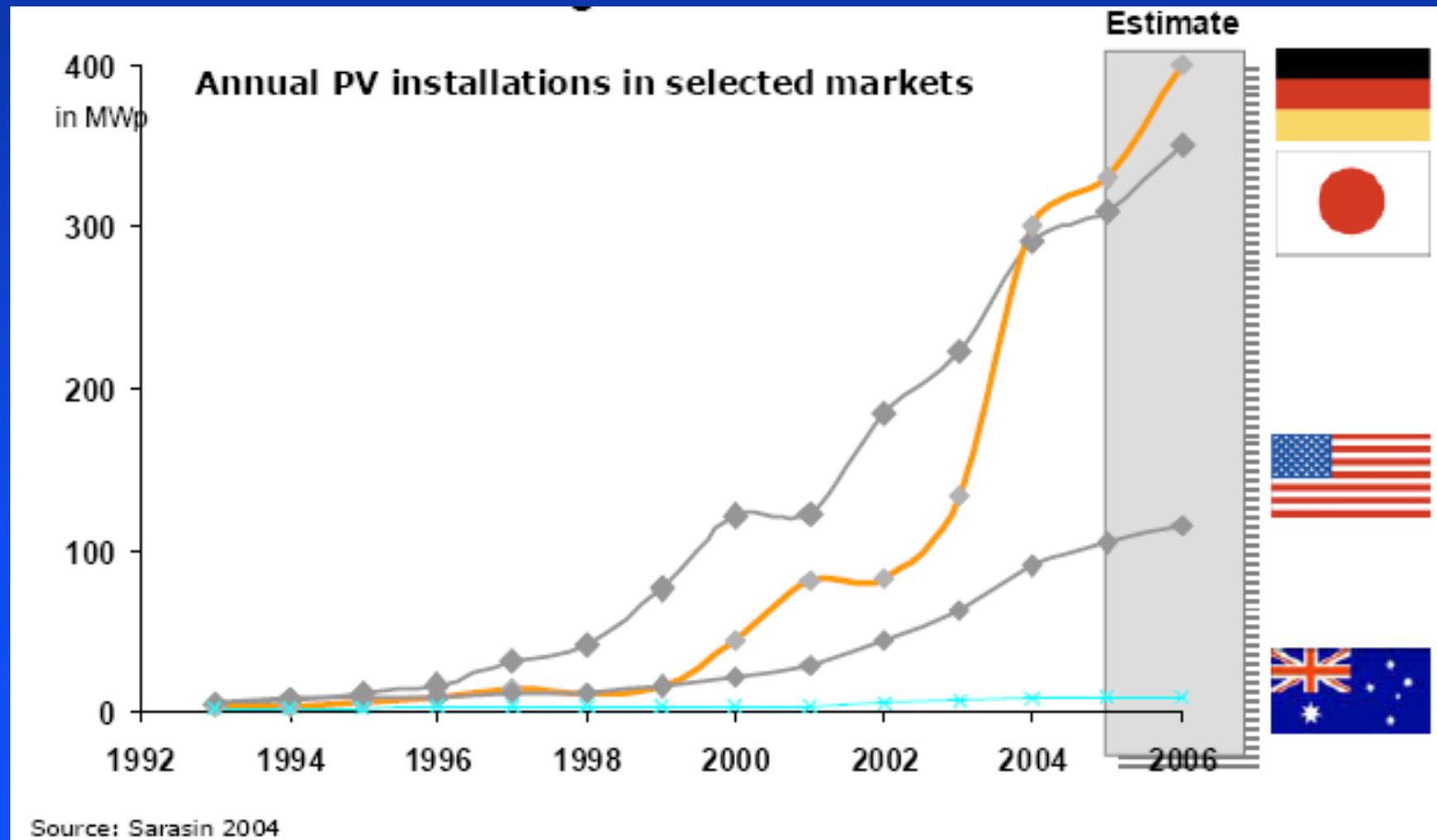
The Australian PV Industry

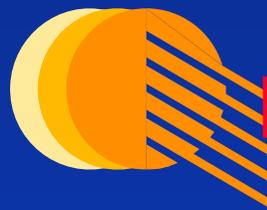


Cumulative Installations

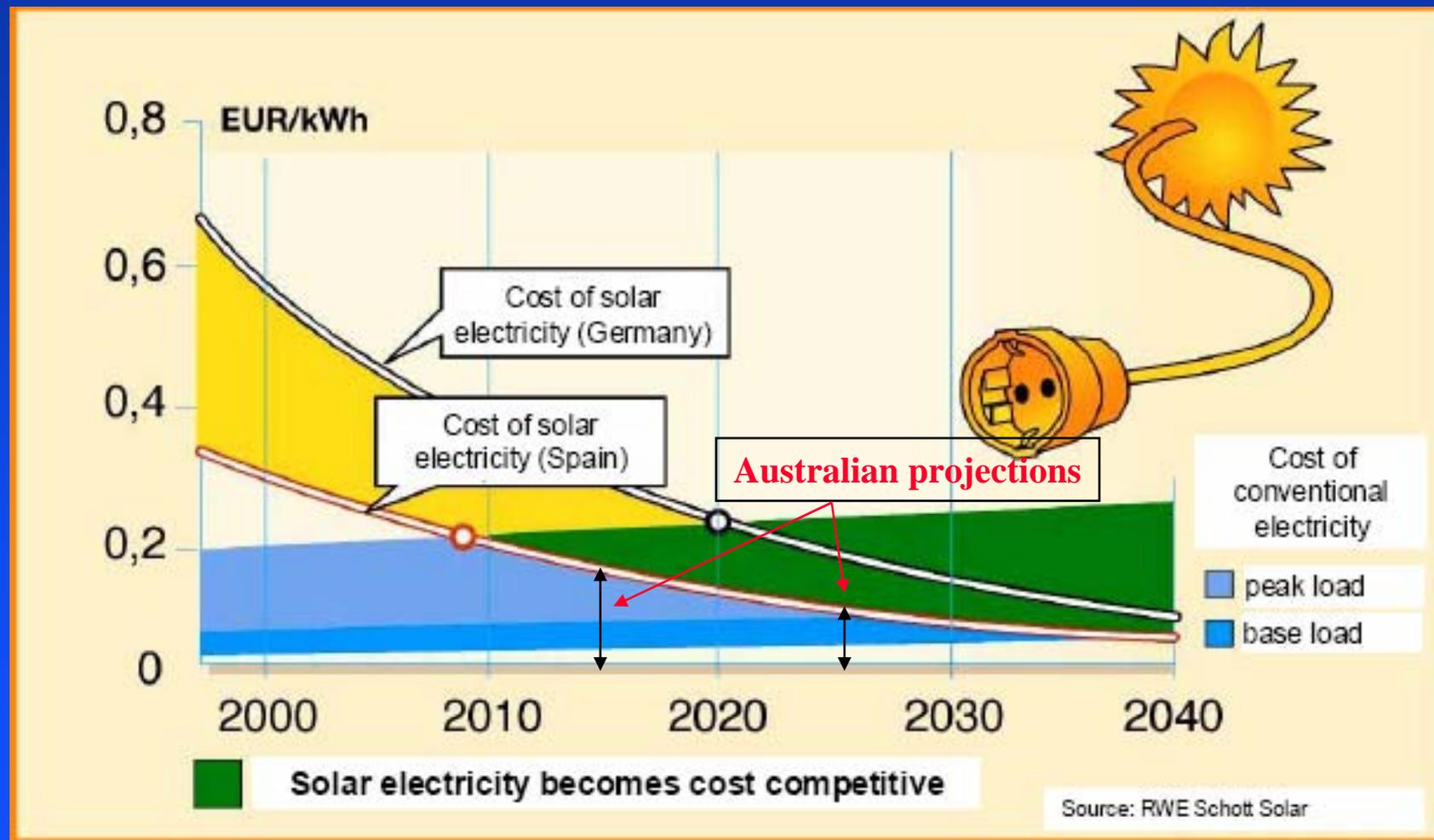


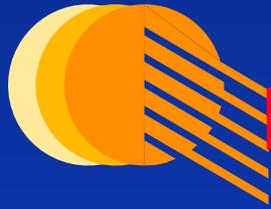
Australian and International PV Installation trends





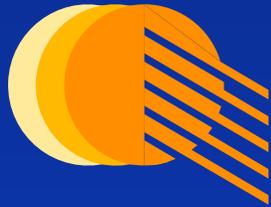
European Projected Break-even points





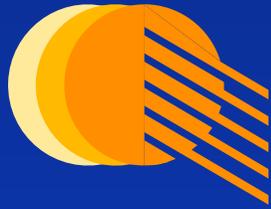
Results for PV in Germany by 2004

- Germany overtook Japan with the highest annual PV installations – 363 MWp
- Installed capacity in Germany 794 MWp
- Industry turnover €1.7 billion
- 20,000 people employed in the sector
- Average electricity bill increased by 0.16% (~ A\$1.78 per annum)



Spanish National Plan for 2010

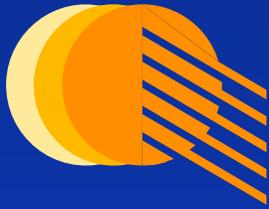
RES	Targets set by the National Plan to support RES for the year 2010 (MW)	
	Published in 1999	Revision in 2005
Wind	13,000 (initially 8,974)	20,155
Photovoltaic	115	400
Solar Thermal	200	500
Hydro < 10 MW*	720	2,199
Hydro 10 - 50 MW*	350	3,257
Biomass	1,708	2,039
Solid Wastes	168	189



Spanish Feed-in tariff

Former Framework (RD 2818/1998)

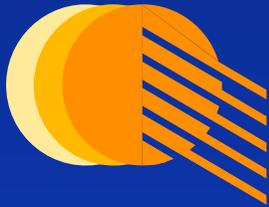
- Definition of “Special Regime”
 - CHP, renewables, wastes
- Feed-in tariff model or market price + premium
 - Specific to each technology
 - PV: 0.66 A\$/kWh for < 5kWp & 0.36 A\$/kWh for > 5kWp
 - Revised every 4 years
 - No market participation: right to be dispatched
 - Limited technical obligation
- Power factor = 1
- Results:
 - Wind: 9,000 MW (success story)
 - PV: 21MW (grid connected)
 - Total “Special Regime”: ~17,000 MW



Spanish Feed-in tariff

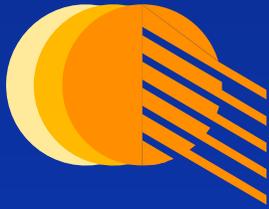
New Framework (RD 436/2004)

- Aimed at better integration of established technologies (namely wind)
 - Mandatory output prediction for > 10 MW
 - Modulated Reactive Energy incentive
 - Improving previous mechanism for the rest
- Options:
 - Stable Feed-in tariffs
 - PV: 0.66 A\$/kWh for < 100kWp & 0.36 A\$/kWh for > 100kWp
 - Possibility of full integration in the wholesale market
 - Market price + premium = ~feed-in tariff
 - + incentive for joining the market & facing market costs
- Expected results by 2010
 - Wind: 20,000 MW
 - PV: 400 MW
 - Total "Special Regime": ~30,000 MW



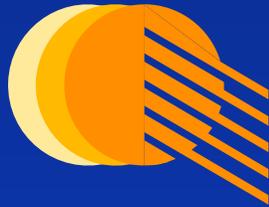
General Issues for Australia

- FIT could be set at State or national level
- Need clear objectives – industry development, distributed generation, emissions reduction etc
- Appropriate starting tariff needs to consider installed costs, expected PV output and timing, electricity tariffs, interest rates etc
- FIT should be decreased each year but available for a set period of time
- The FIT cost could be spread across selected customer types (eg. residential and/or commercial only), to avoid the more sensitive industry sectors
- Target (if set) is critical – Italy, Austria & others have reached long term targets within months

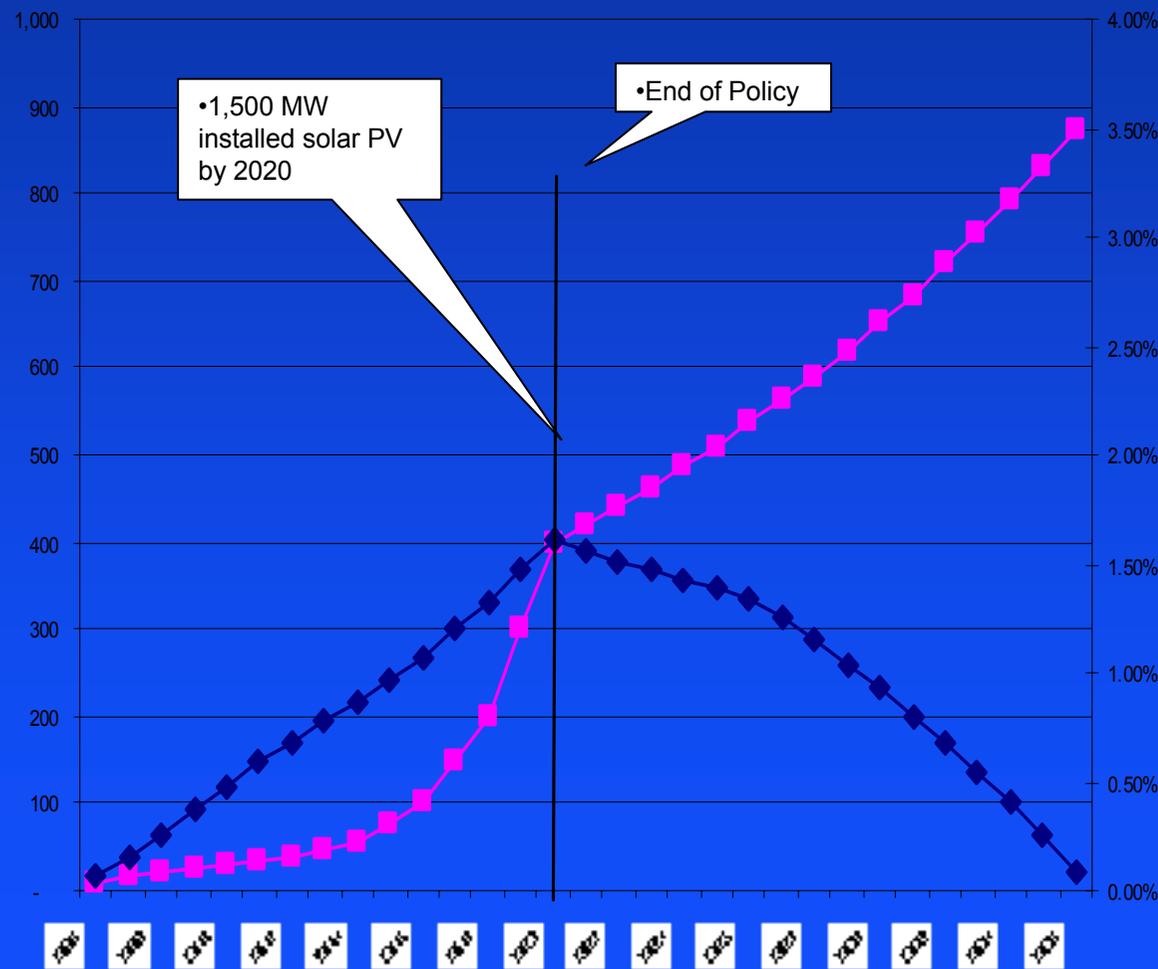


Example – NSW FIT

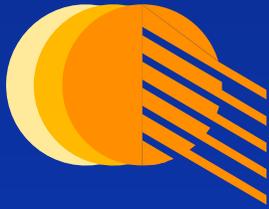
- FIT starts at 55c/kWh maintained real value for 20 years
 - For our household = \$15,400
- FIT decreased by 5% per annum for 15 years to 27c/kWh
- Standard tariff - flat retail 12c/kWh, inflating at 4% pa
- Incremental FIT begins at 43c/kWh and ends at 7c/kWh
- FIT cost spread across all NSW customers – exempt energy intensive industry (30% of industrial use)
- Install 100MW by 2010; 1,500MW by 2020
- Average net increase in electricity costs 0.9% (max 1.6%)



Net Cost Increase from FIT for NSW versus annual MW



- Solar PV installed per annum
- ◆ Net % Increase in Retail Cost of Electricity



Implementation issues

- Finance
- Likely public take-up
 - Germany (green interest, local self reliance, disposable income, age profile)
 - Spain (Kyoto target, local self reliance, rapid elect increase)
- Fast tracking trade skills
- Insurance / liability issues
- Utility response - OK with small penetrations, more issues once PV starts to be noticeable
- Not compatible with net metering → need for electronic or 2nd meter