Assessing the Impact of Household PV Systems on the Profits of All Electricity Industry Participants

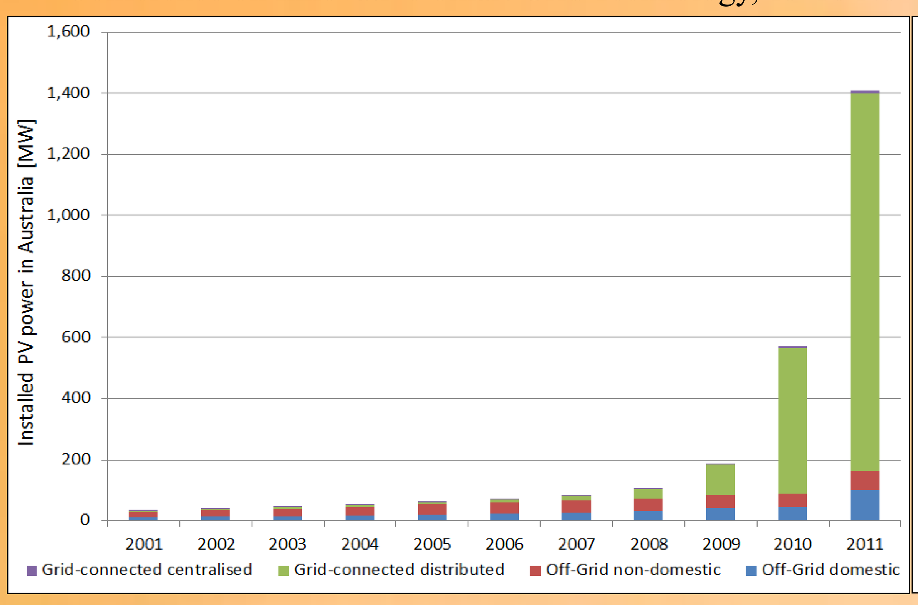
Sebastian Oliva (s.olivahenriquez@student.unsw.edu.au) and Iain MacGill

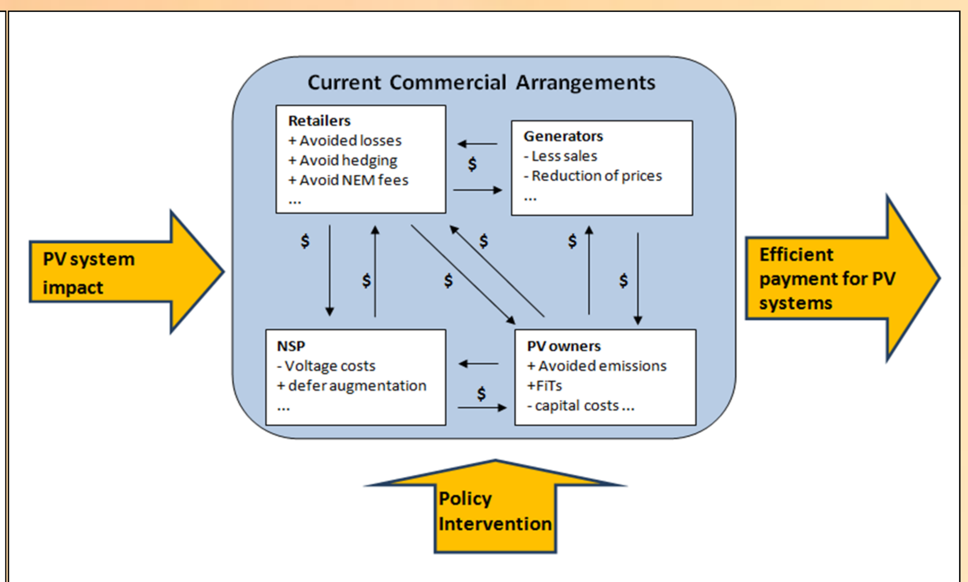
School of Electrical Engineering and Telecommunications, University of New South Wales, Sydney, Australia

1. Background

The recent rapid growth in distributed PV deployment within countries including Australia is now raising important and challenging questions regarding the societal value of PV and the most effective policy options to drive appropriate deployment. A key issue is how the costs and benefits of PV systems are currently shared between different industry participants including of course customers who deploy PV, but also their retailers and network service providers (NSPs) and, more broadly again, other energy customers and large centralized generation. The interaction of different PV support policies such as feed-in tariffs is a further complication. Builds on work [1] this paper presents a study attempting to estimate the operational revenue and costs associated with household PV systems for these industry participants within the Australian State of NSW under current market arrangements and PV support policies.

[1] S. Oliva, and I. MacGill, "Estimating the Economic Value of Distributed PV Systems in Australia," Presented at the IEEE PES Conference on Innovative Smart Grid Technology, 13-16 November 2011, Australia.





2. Research Question and Methodology

- ***Research Questions:***
  - Economic benefits and costs of residential PV systems for **retailers, DNSPs and PV customers**?
  - What is the **contribution** that each of them should make to afford an **economically efficient PV deployment aligned with the social PV value** based on such assessment?

- ***Case Study:***
  - Market arrangements in NSW: **Net metering (NM)** and the **gross Feed-in tariff (*FiT*)** + Domestic flat retail and network tariffs.
  - A case study of three typical household PV systems of 1kW located in western Sydney with an average production of **1,340 kWh/kW/year** and average consumption of **7,046 kWh/year**.

Case Study

PV output and wholesale price data (2009/10)		Commercial arrangements parameters	
$PVelec_t$	Actual half-hourly PV generation data.	R_t	First 1,750 kWh each quarter = 24 ¢/kWh, balance = 26.6 ¢/kWh (Origin Energy - **Retailer**).
SC_t	Actual half-hourly self-consumed PV electricity.	N_t	First 1,750 kWh each quarter = 11.5 ¢/kWh, balance = 14.9 ¢/kWh (Endeavour Energy - **NSP**).
Exp_t	Actual half-hourly PV exports.	P	Retailer payment to PV owners per kWh exported
w_t	Actual half-hourly wholesale electricity prices for NSW adjusted by loss factors obtained from AEMO.	FiT	Feed-in tariff paid by all end-users to PV owners under the NSW FiT through the CCF levy.
		g	Regulated green surcharge in NSW=0.98 ¢/kWh.

NM Model

Retailer → $\Delta RET_t = \left(-R_t + N_t + w_t + g\right)\times SC_t + \left(w_t - P\right)\times Exp_t$

PV customer→ $\Delta PVc_t = R_t \times SC_t + P \times Exp_t$

DNSP→ $\Delta NSP_t = N_t \times SC_t$

FiT Model

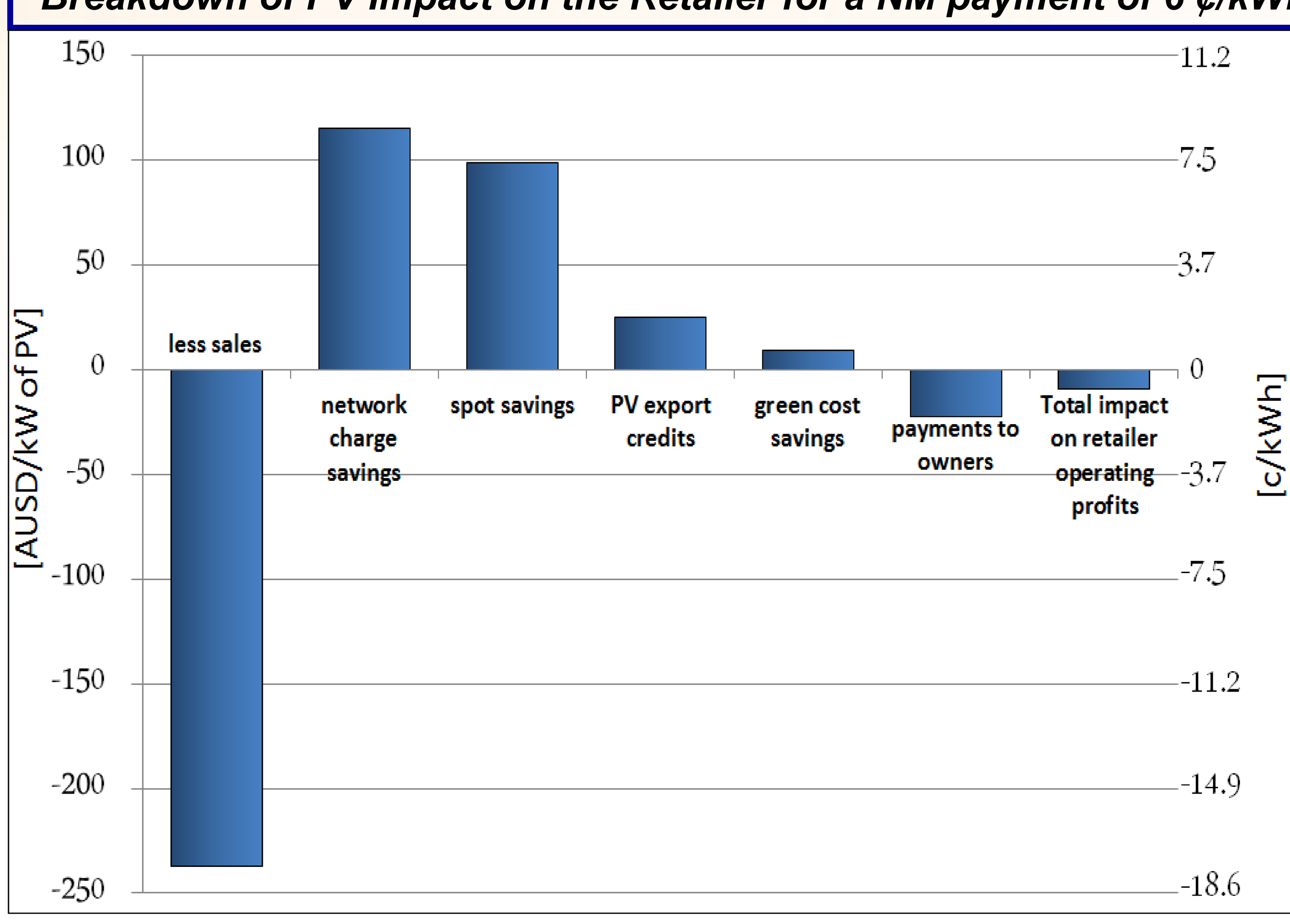
Retailer → $\Delta RET_t = w_t \times PVelec_t$

PV customer→ $\Delta PVc_t = FiT \times PVelec_t$

DNSP→ $\Delta NSP_t = 0$

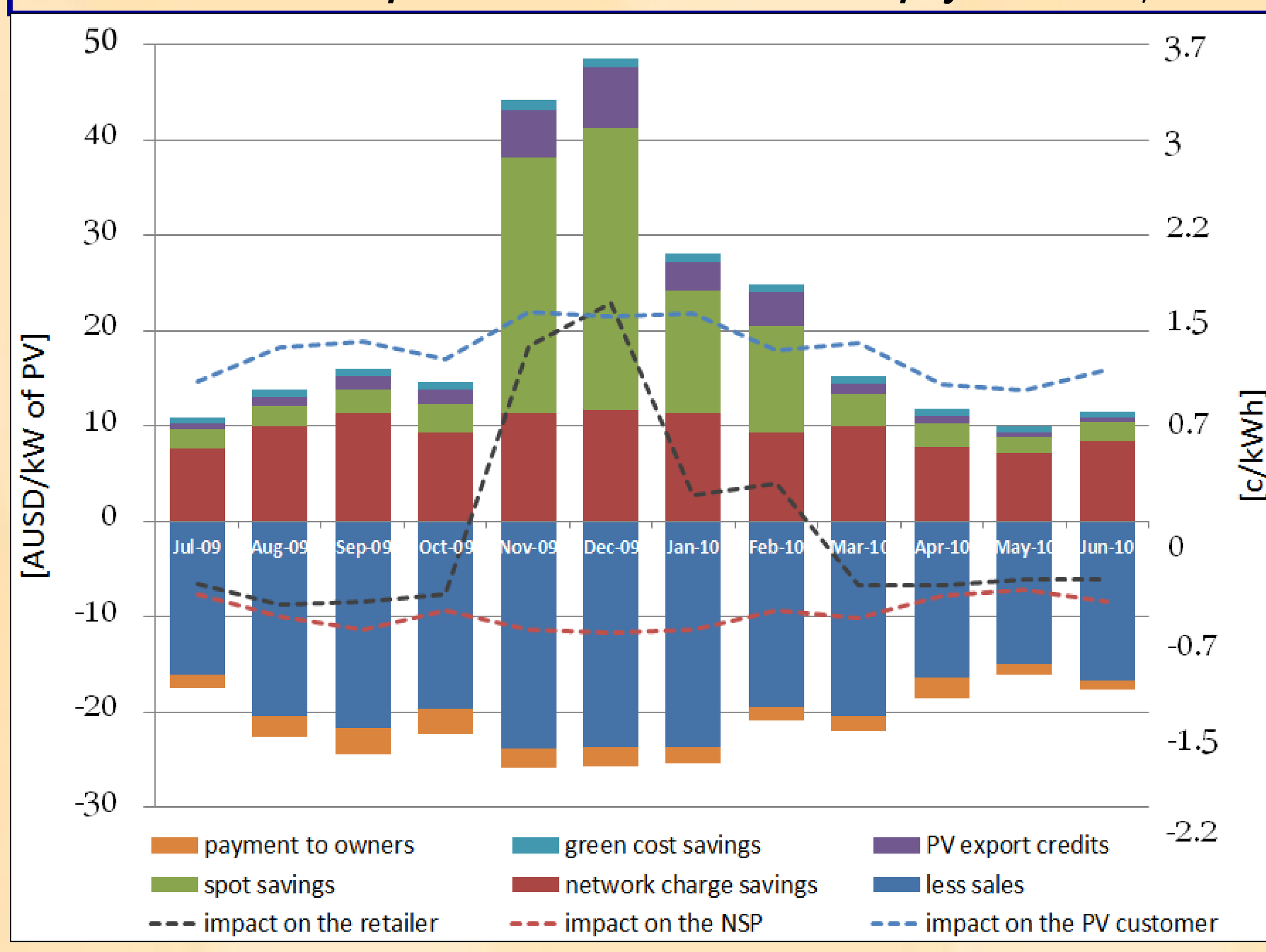
3. Financial Impact on Participants

Breakdown of PV Impact on the Retailer for a NM payment of 6 ¢/kWh for Exports (no FiTs)



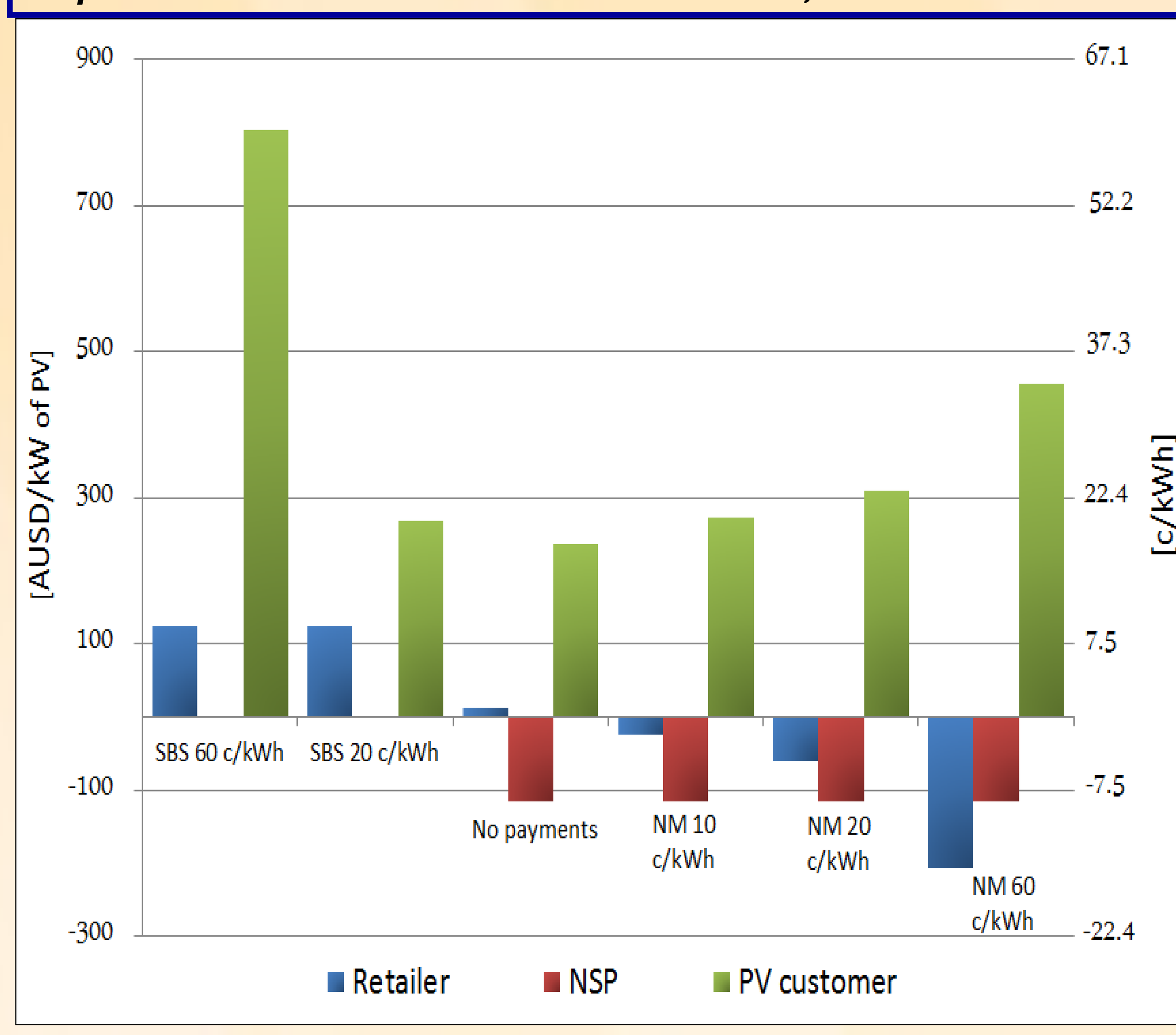
- The overall average impact on the retailer is a loss of 9 \$/kW or 0.7 ¢/kWh which represent around 50% the allowed regulatory margin per kWh.
- Under TOU tariffs the retailer loss will be higher because of the good match between high TOU tariff rate and PV output.

Seasonal PV Impact on the Retailer for a NM payment of 6 ¢/kWh for Exports (no FiTs)



- Value of export credits to retailers and avoided purchases from the NEM are much higher in summer since the coincidence between high PV generation and high wholesale electricity prices.
- PV impacts vary during the year. The retailer experience by far the most significant seasonal variations.

Impact of Different PV Policies on Retailers, NSPs and PV Customers (no capital cost included)

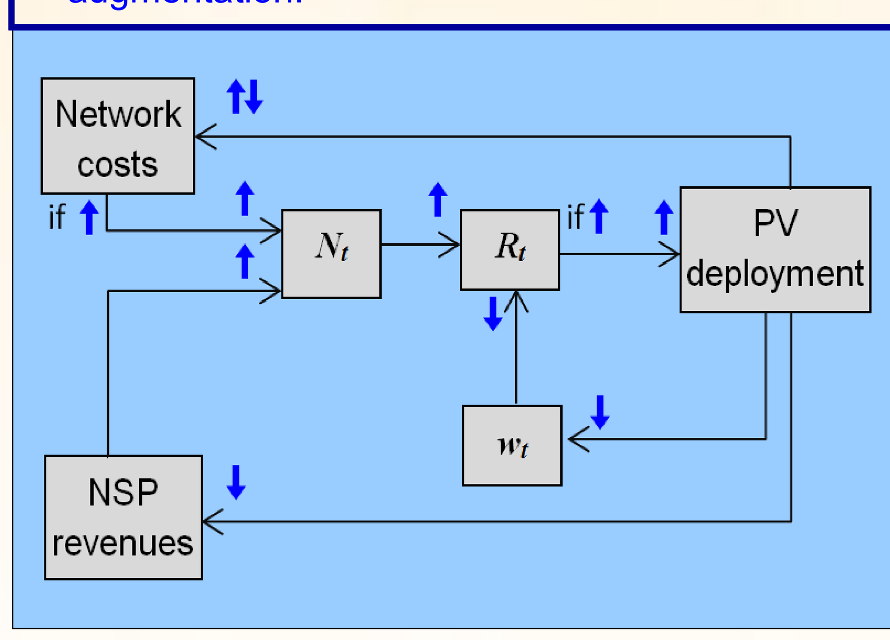


- The reduction of the SBS to 20 ¢/kWh and to NM arrangements decrease PV customer revenues considerably.
- DNSPs lose revenues under net metering arrangements around 15% of what they recover from households.
- A NM payment of 3.5 ¢/kWh cancels the overall PV impact on retailers while a payment of 7 ¢/kWh only for exports would offset the retailer financial gain from selling PV exports.
- For higher level of NM payments the cash flow goes from retailers to PV customers.

4. Dynamic Impact of High PV Penetration

General Dynamic PV economics

- Reduction of total demand which in turn reduces wholesale prices.
- Potential deferred or avoided the network augmentation.
- Better security of supply through greater fuel diversity and decentralized infrastructure.
- Movements in network and retail electricity prices.



Highlights

- *Reduction of NSPs revenues with not necessarily cost reduction*: NSPs will likely be granted permission to increase the charge per kWh to retailers which ultimately will be passed through to end-users.
- PV potentially provides financial savings to NSPs for deferral of network augmentation. Also PV may cause additional costs fro NSPs to manage power quality issues.
- *Potential vicious cycle under current tariff arrangements*: growing network charges make PV more attractive whilst imposing greater costs on customers who don't have PV.

5. Conclusions and Future Work

- Alignment between social economic PVelec values, commercial arrangements and any PV support policies is crucial to have an efficient deployment of these systems.
- Modest impacts on the customer profitability for retailers depending on whether, and to what extent, they pay their PV customers for their exports.
- NSPs would seem to clearly experience a loss of revenue due to reduced sales to households with PV under net metering arrangements.
- Future work: How these arrangements can be made to better align PV incentives with the wider economic costs and benefits that they bring.

Acknowledgments

The authors gratefully acknowledge the contributions of Simon Lewis in helping provide PV output data from residential houses connected to Endeavour Energy distribution system. This work is supported in part by Australian Solar Institute (ASI) research funding to support research on solar forecasting and renewable energy integration, and managing high PV penetrations.