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# Dynamic Model Approach to Assess Feed-in Tariffs for Residential PV systems

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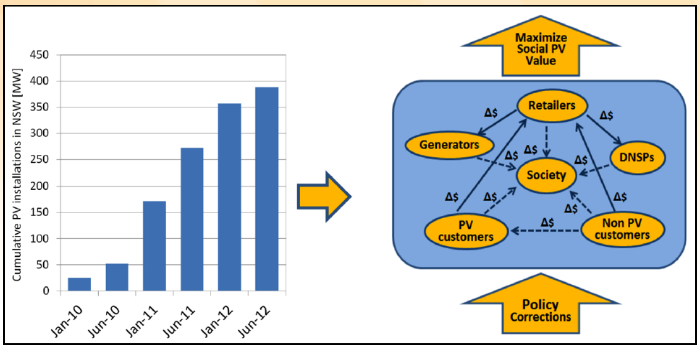
## Presentation Outline

- Australian Policy Context for PV Systems
- The Social and Private Value of PV Systems
- Value of Residential PV for 2013
- Dynamic Model to Project Future PV deployment and the Total PV Value
- Policy Scenarios
- Results: Policy costs and benefits
- Conclusions

# Australian Policy Context for PV Systems

- Rapidly falling PV costs and strong PV policy => explosive and overwhelming deployment of PV systems in Australia. Thus:
  - Sudden cancelation of the FiTs.
  - Significant financial transfers from all energy customers to PV customers.
  - Attention on how the costs and benefits are distributed across electricity industry participants including non PV customers, retailers and network providers (DNSP).




- Policies are justified on the basis that current energy markets do not price the adverse environmental impacts and energy security risks of conventional fossil-fuel generation.
- However PV policies in Australia don't take into account the complex underlying economics of PV electricity => Unsustainable policies and economically Inefficient policies.
- Emerging challenges
  - Strict cost/benefits analysis of PV support
  - How best to design policies to maximize PV value



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# Social and Private PV Value; Aligned?

- Social PV value: PV avoids expensive generation, emissions, power losses, network augmentation, etc.
- Private PV value: For PV customers => FiTs, electricity bill savings,…; for retailers => less sales, save purchasing cost,…; For network providers => less revenues,…
- Alignment: Are private incentives contributing to maximize the social value of PV?
- Policy Goals:
  - Design **PV policy** support that **encourages** private industry **participants** to **maximize** the economic **value** of distributed PV **for society**.
  - **Fair** and reasonable **value** of PV for **participants** in the electricity industry

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# Value of household PV systems for 2013

| Case Study: Australian NEM and the state of NSW | | | |
|---|---|---|---|
| **Household and wholesale price data (2009/10)** | | | |
| **PV elec t** | Actual half-hourly PV generation data from 61 households PV systems in Sydney with an average production of 1,200 kWh/kW/year. | **Wt** | Actual half-hourly wholesale electricity prices for NSW adjusted by loss factors obtained from AEMO. |
| **Exp t** | Actual half-hourly PV exports from households PV and consumption data | **SCt** | Actual half-hourly PV self-consumption from households PV and consumption data |
| **Social environmental value parameters** | | **Private arrangement parameters** | |
| **I** | Half-hourly weighted average $CO_2$ emission intensity factor in NSW. | **Rt** | Origin – Retailer TOU: peak 40 [¢/kWh] , shoulder 30 [¢/kWh] and off peak 15 [¢/kWh]. |
| **SCC** | Social cost of carbon. **Damage cost approach**: \$150/t$CO_2$ for A1B scenario. **Control cost approach**: \$32/t$CO_2$ for High Price Scenario of the Australian carbon Price. | **Nt** | Endeavour Energy - DNSP peak 21 [¢/kWh] , shoulder 12 [¢/kWh] and off peak 5 [¢/kWh]. |
| | | **g** | Regulated green surcharge in NSW=1.15 ¢/kWh. |

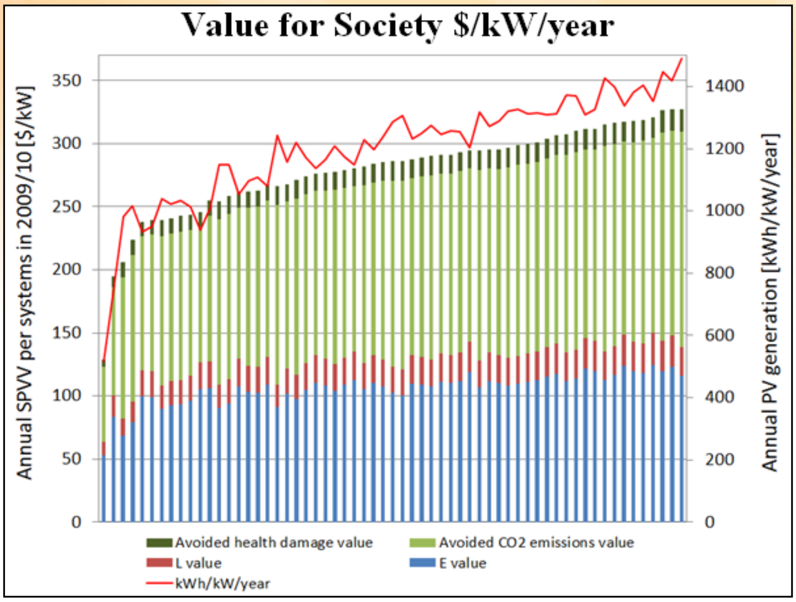
| Value of PV | Equation |
|---|---|
| **Environmental social benefits** | = average NSW $CO_2$ emission intensity x SCC x PV generation |
| **Under GM** | |
| **PV customers** | = FiT x gross PV generation |
| **Retailers** | = (wholesale price – retail contribution) x PV generation |
| **DNSPs** | = 0 |
| **Under NM** | |
| **PV customers** | = Retail tariff x PV self-consumption + FiT x PV Exports |
| **Retailers** | = (-Retail tariff + Network tariff+ green surcharge + wholesale price) x PV self-consumption + (wholesale price – retail contribution) x PV Exports |
| **DNSPs** | = DUOS x PV self-consumption |





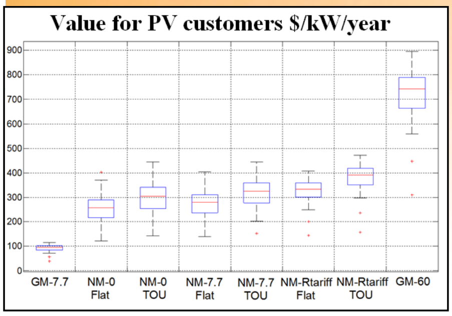
# Value of PV for society

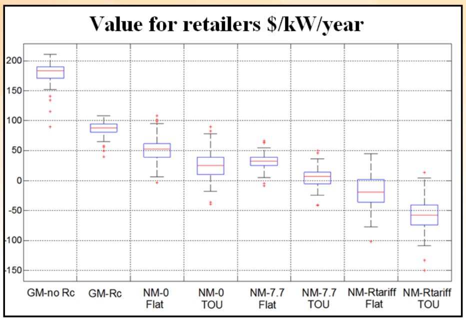
- Annual value for 60 household PV systems in Sydney and their annual generation
- Annual social value is driven by PV performance and social cost of carbon

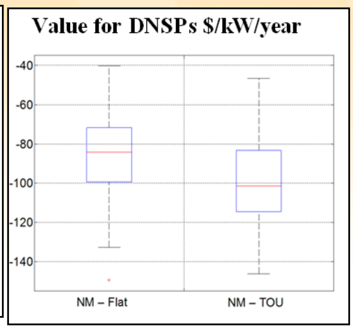


# Value of PV for customers, retailers and DNSPs for 2013

- We explored the financial impact for different PV commercial arrangements




- NSW FiTs allowed PV customers to experience very short payback periods.

- Retailers don't like PV customers with TOU tariffs.
- Retailers experience financial gains even with the recent compulsory contribution set in NSW.

- DNSPs get the financial hit.
- The effect is worst under TOU tariffs.
- DNSPs will likely be increase the charge per kWh next year.





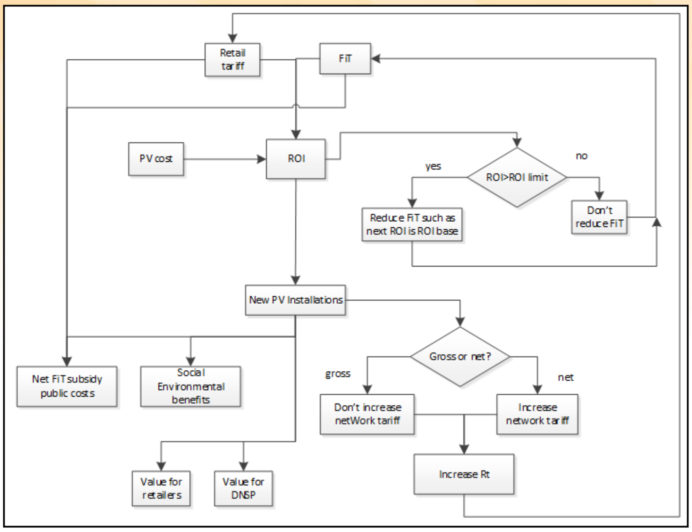
# Dynamic Model to Project PV Deployment

- Estimates future PV deployment using a linear PV uptake model respect to a referential historical uptake scenario in NSW.

**1. Annual ROI** = Income / PV costs

**2. New PV Installations** = (annual ROI / NSW reference ROI) x NSW reference new installations

- Then we estimates the social environmental benefits of these new installations for the whole life of the system.
- We multiply this new PV installed capacity by the value of PV for retailers and DNSP in $/kW.




- DNSPs annual less revenues under net metering are recovered in our model the next year period through increased network tariffs.

# Policy Scenarios

| PV policy | Description |
|---|---|
| NM-0 | NM arrangement with no retailer contribution for exports. |
| NM-7.7 | NM arrangement with a retailer contribution of 7.7 ¢/kWh for exports. |
| FiT-2013 | FiT payment to PV customers for the gross PV generation at 60 ¢/kWh for 7 years for systems installed in 2013. |
| FiT-2013-14 | FiT payment to PV customers for the gross PV generation at 60 ¢/kWh for 7 years for systems installed in 2013 and 40 ¢/kWh for 7 years for systems installed in 2014. Retailers contribute with 7.7 ¢/kWh for exports. |
| 4xFiT | FiT payment to PV customers for the gross PV generation for 7 years for systems installed in 2013, 2014, 2015 or 2016. PV customers get paid a constant FiT rate over the 7 years, however such FiT rate depends on which year the system is installed. Systems installed in 2013 get paid a 60 ¢/kWh FiT rate whereas for systems installed in the next years the FiT rate decrease such as the ROI is around 15%. Retailers contribute with 7.7 ¢/kWh for exports. |
| 7xFiT | FiT payment to PV customers for the gross PV generation for 7 years for systems installed from 2013 till 2019. PV customers get paid a constant FiT rate over the 7 years, however such FiT rate depends on which year the system is installed. Systems installed in 2013 get paid a 60 ¢/kWh FiT rate whereas for systems installed in the next years the FiT rate decrease such as the ROI is around 15%. Retailers contribute with 7.7 ¢/kWh for exports. |



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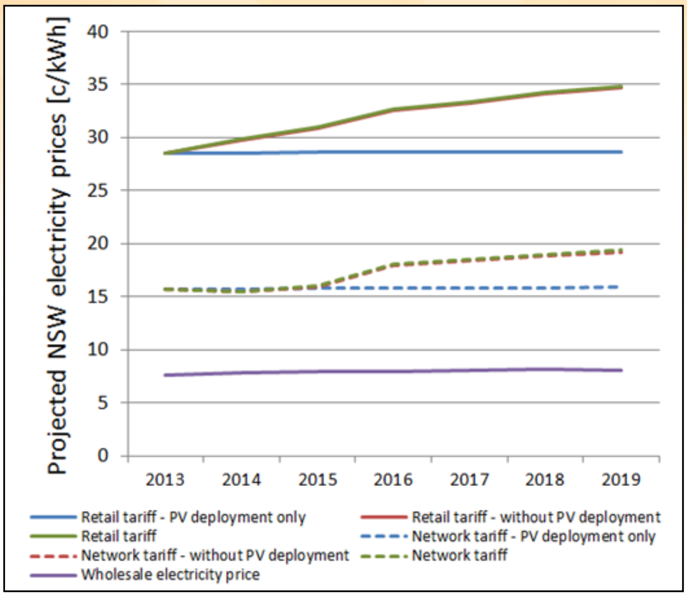
# Impact DNSP less revenues on NSW Electricity Prices

- Increase of electricity prices in NSW due to the PV deployment is very little.
- Unlikely that PV will cause an increase in retail electricity prices making PV more attractive for households.

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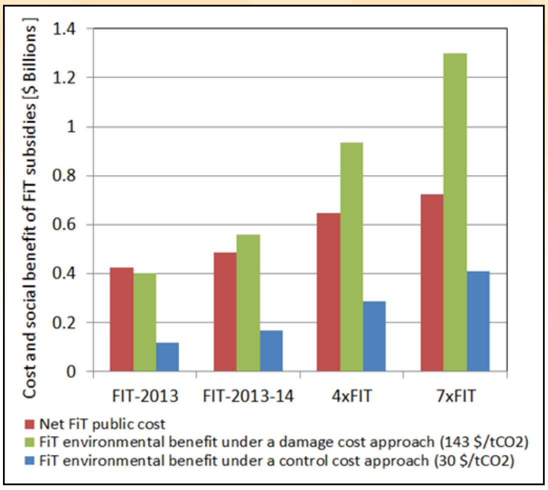
# Environmental benefits and net FiT costs

- Net FiT costs: cost of FiT minus electricity retail tariff.
- Environmental value considers benefits not all the new PV installations but only the FiT subsidy added new installation.
- FiT-2013-14, 4xFiT and 7xFiT net subsidy cost are in between the lowest and the highest value of FiT environmental benefits.
- Social benefits are largely driven by the value of the social costs of carbon which complicate the assessment.



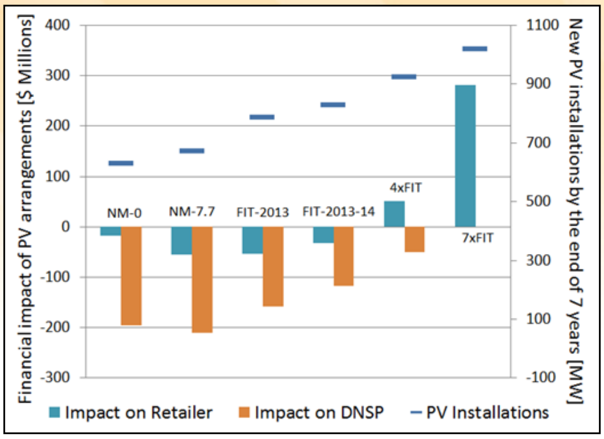

- FiT-2013 (similar to the 2010 NSW case), suggests that this scheme would be the least socially beneficial given its high subsidy net cost and low environmental benefits.





# Fair value for private participants?

- Retailers and DNSPs generally experience losses under NM arrangements.
- Retailers experience significant financial gains under gross FiT subsidies.
- DNSPs reduced revenues under NM are significant.




- DNSPs loss in revenues goes ultimately to all end-users as a form of another indirect subsidy, this time for the network usage.

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# Conclusions

- Highlight the need of aligning FiT rates with the environmental PV benefits whilst controlling the public FiT subsidy costs.
- Benefits depend considerably on what are still highly variable and controversial estimations of the social cost of carbon.
- DNSP less revenues under net metering adds new indirect cross-subsidies for the network usage.
- The challenge of using carbon 'control' costs is that current carbon prices are almost certainly well below the levels required to achieve the emission reductions goals that appear required to effectively address our climate challenges



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**Thank you,**

**and**

**Questions?**

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