

The Current Economics of solar, wind and energy efficiency: US, Australia and India

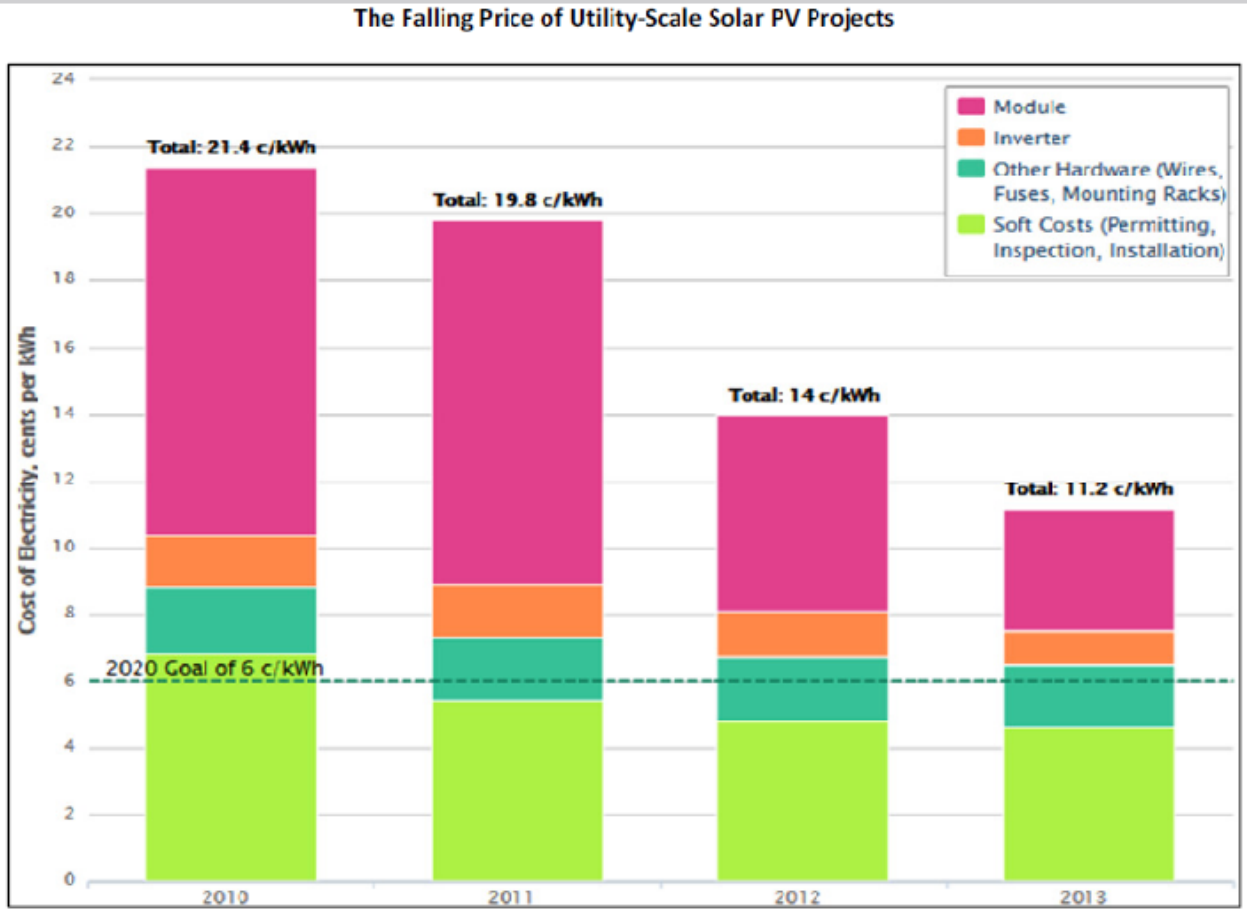


By Tim Buckley, Director of Energy Finance Studies, Australasia
Institute for Energy Economics and Financial
Analysis
March 18th, 2014

Agenda

- Has Solar Cost-down Come to an End?
- Solar Plus Storage – Go SMA!!!!
- US Wind and Solar Costs
- Each Market is Different – Rooftop Solar in Oz
- China – Transformation Underway
- India – Technology Comparison
- India's Plan B

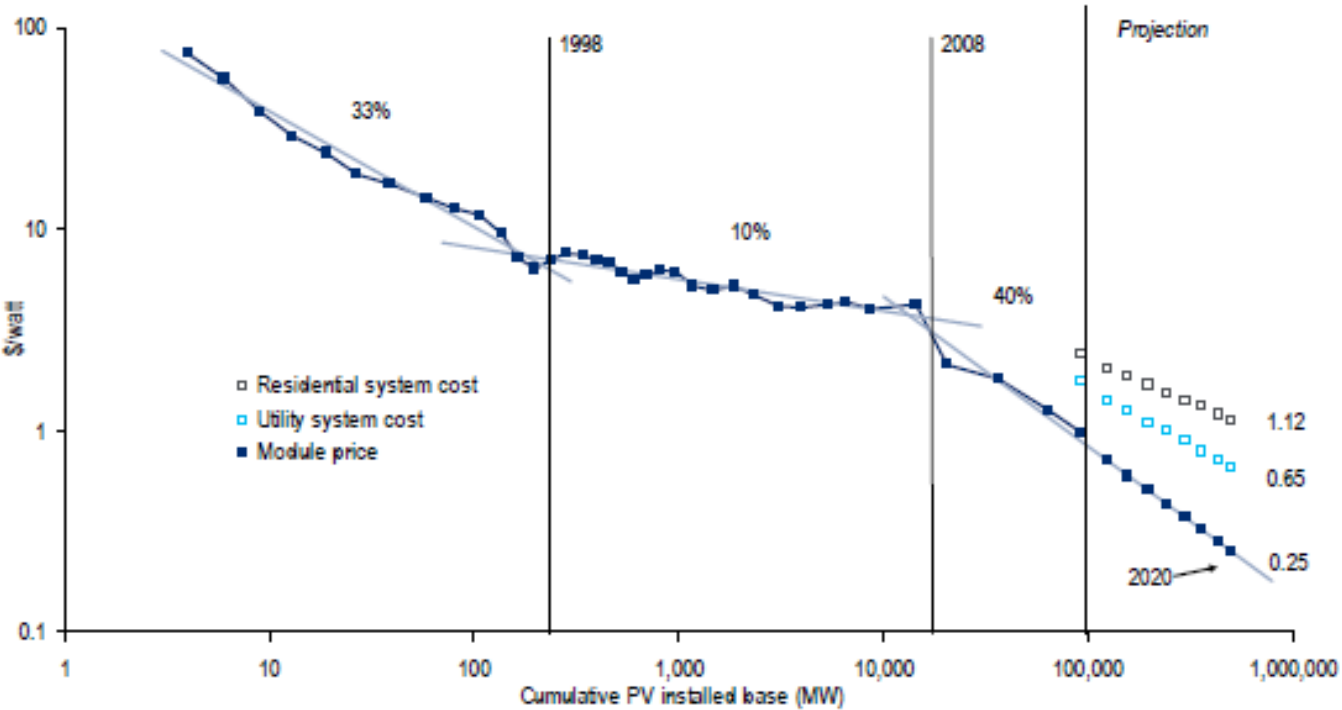
Has Solar Cost-down Come to an End?



Source: Energy.Gov



Has Solar Cost-down Come to an End?



Source: Citi Research, Bloomberg New Energy Finance



Solar Plus Storage – Go SMA!!!!



SMA RADIO-CONTROLLED SOCKET



US Wind and Solar Costs

- US onshore wind in Texas US\$30-40/MWh
(45-50% capacity utilisation rates, post PTC)
- US utility scale solar in Arizona or CA
US\$60/MWh *(peak, post ITC) **

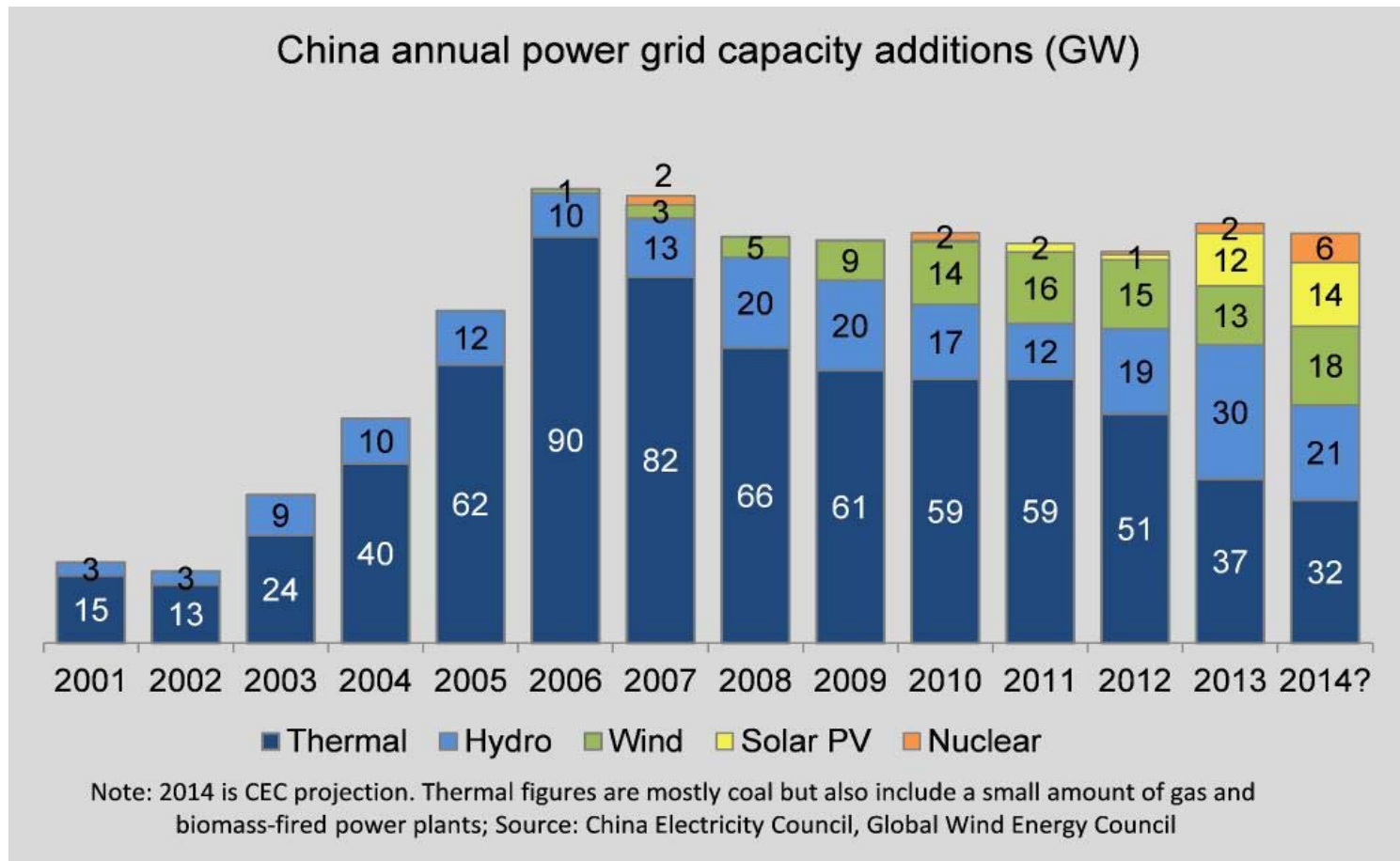
* Julien Dumoulin-Smith – UBS Research, “Examining the Wind & Solar Outlook in TX (Conference Call Transcript)”, 29 Nov’2013



Each Market is Different – Oz Rooftop Solar

- Australia in the space of 4 years has installed 1.2 million rooftop solar systems
- Total distributed energy of 3,000 MW
- At 20% utilisation rate, this is 5.3TWh pa (5,300,000MWh)
- The highest penetration globally per capita.
- Why? We have great solar radiation and a high retail price of peak electricity (US45c/kWh) – due to a very expensive grid. US rooftop solar relatively undeveloped (US12c/kWh)

China: Transformation accelerates



India: Electricity Comparison

Fuel source	Capital cost (1) (2) (US\$m/MW)	Install time	Fuel Supply Risk	Fuel Currency	Wholesale price Rs/kWh	Air polution	Water consumption / pollution	Inflationary Impact	Ongoing Currency Impact
Coal-fired - domestic	0.8-0.9	4-5 yrs	Medium	Rs	Rs3-4	Extreme	High	Low	Nil
Coal-fired - imported	0.8-1.0	4-5 yrs	High	US\$	Rs4-5	Extreme	High	Upward	Negative
Diesel-fired	0.8-0.9	3-4 yrs	High	US\$	Rs12-15	Extreme	High	Upward	Negative
Gas-fired - domestic	0.7	4-5 yrs	High	Rs	Rs5	High	Medium	Low	Nil
Gas-fired - imported	0.7	4-5 yrs	High	US\$	Rs7-8	High	Medium	Upward	Negative
Nuclear	3.0	5-10 yrs	High	US\$	Rs4-5	Low	Extreme	Upward	Negative
Hydro - large scale	1.3	5-15 yrs	Zero	Nil	Rs3-4	Low	Medium	Down	Nil
Hydro - run of river	1.2	4-8 yrs	Zero	Nil	Rs4-5	Nil	Low	Down	Nil
Wind	1.0	1.5 yrs	Zero	Nil	Rs4-5	Nil	Nil	Down	Nil
Solar PV	1.2-1.3	1 year	Zero	Nil	Rs5-7	Nil	Nil	Down	Nil
Distributed Solar	1.3-1.5	1 day	Zero	Nil	n.a.	Nil	Nil	Down	Nil

(1) Source: Mytrah Energy, Nov 2013, assumes a USD exchange rate of Rs60

(2) Source: ESMAP World Bank "Paving the Way for a Transformational Future" Dec 2013 page 61

Electricity Sector – Plan B?

India has huge plans, scope and/or capacity for renewables & EE

- A massive lift in hydro - 41GW currently, scope for 150GW
 - Plans to import 10GW from Bhutan hydro by 2020
- Wind power - 20GW currently, scope for 100GW
- Solar - 2GW currently, a plan for 22GW by 2022, scope for 44GW?
- Grid transmission losses - 24% currently, 8-9% global average
- Nuclear - 6GW currently, plans to treble this
- Gas - 20GW installed, 10GW idle

Electricity Sector – Plan B?

What would be required to sustainably grow India's economy?

- A 5% sustainable real GDP growth target.
- Electricity consumption of 1.0x real GDP growth (i.e. 5% pa)
 - Achievable with energy efficiency initiatives
- 1% pa reduction in grid transmission and distribution losses
- This means only 4% pa growth in gross electricity production
- We estimate India's 2013/14 gross electricity production @ 1,166 TWh – so 41 TWh required annually through to 2022

Electricity Sector – Plan B?

4% pa = 41 TWh required annually through to 2022

- Onshore wind – 3.2 GW pa => 8-9 TWh pa
- Gas – mostly utilising existing capacity => 5-6 TWh pa
- Solar – 3.5 GW pa => 6 TWh pa
- Biomass / CHP / EfW – 0.4 GW pa => 1 TWh pa
- Nuclear – 0.5 GW pa => 4-5 TWh pa
- Hydro – 1.5 GW pa => 4-5 TWh pa
- Imports from Bhutan and Nepal hydro => 4-5 TWh pa

Indian coal fired power capacity peaks by 2019, declines thereafter

Germany

“We’re all caught in the worst structural crisis in the history of energy supply.”

RWE CEO Peter Terium, Jan’2014

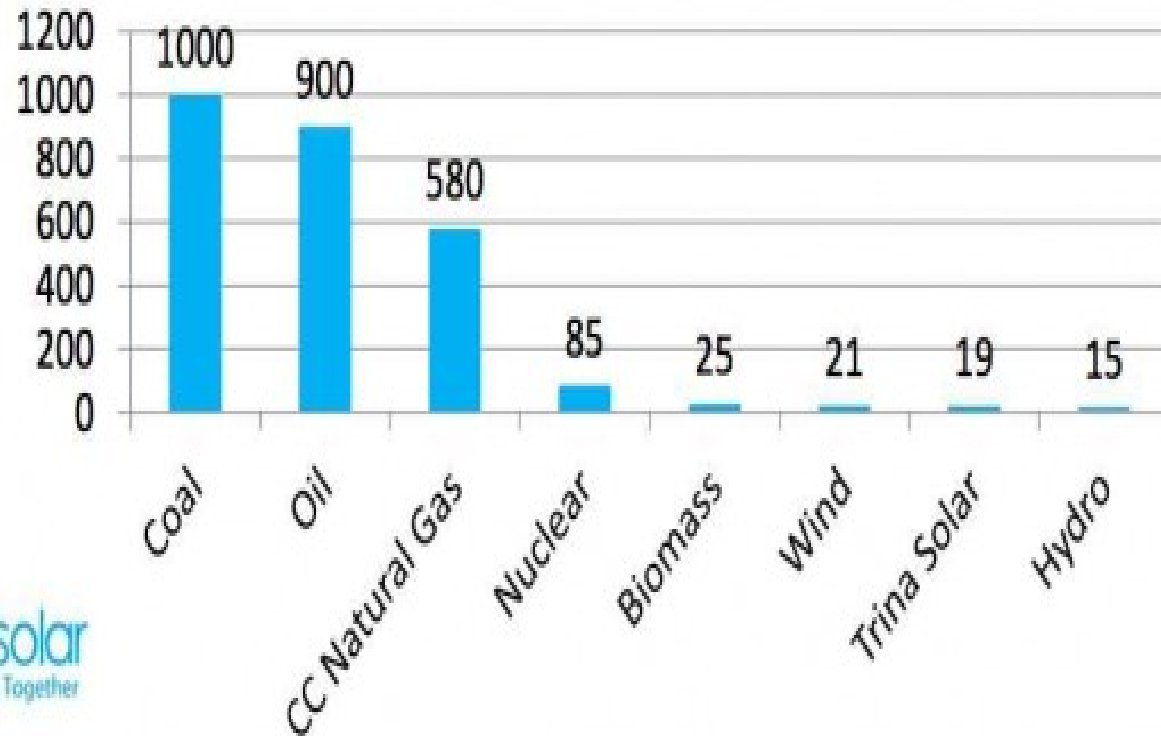
German wholesale electricity prices having fallen 60% since 2008 to Euro0.037/kWh in 2014

[http://](http://www.businessspectator.com.au/article/2014/2/5/energy-markets/germanys-utilities-admit-their-golden-age-over?utm_source=exact&utm_medium=email&utm_content=574310&utm_campaign=cs_daily&modapt=) Christoph Steitz Reuters – 5 February 2014 http://www.businessspectator.com.au/article/2014/2/5/energy-markets/germanys-utilities-admit-their-golden-age-over?utm_source=exact&utm_medium=email&utm_content=574310&utm_campaign=cs_daily&modapt=



Carbon Emissions by Technology

Footprint by technology (grams of CO2 equivalent for every kWh) ^[1]



^[1] <http://reneweconomy.com.au/2014/trina-says-solar-pv-costs-to-fall-but-prices-not-so-much-16851#sthash.HTEWah0G.dpuf>

- **DISCLAIMER**

- The Institute for Energy Economics and Financial Analysis (IEEFA) is a not-for-profit research Institution organized under Internal Revenue Code 501(c)(3) of the United States.
- The authors of this presentation are not brokers, dealers or registered investment advisors and do not attempt or intend to influence the purchase or sale of any security.
- This presentation is intended for informational and educational purposes only. This presentation is not a solicitation, an offer, a recommendation to buy, hold, or sell any securities, products, service, investment or participate in any particular trading scheme in any jurisdiction. The presentation is not and shall not be used as part of any prospectus, offering memorandum or other disclosure attributable to any issuer of securities. No individual or entity is authorized to use the information contained herein for the purpose or with the effect of incorporating any such information into any disclosure intended for any investor or potential investor. This presentation is not intended, in part or in whole, as financial advice.
- The information and opinions in the presentation constitute a judgment as at the date of the presentation and are subject to change without notice. The information and opinions contained have been compiled or arrived at from sources believed to be reliable and in good faith, but the authors do not represent and make no warranty, express or implied, as to the accuracy, completeness or correctness contained in this presentation. The authors do not warrant that the information is up to date. All information provided expressly disclaims any and all warranties, express or implied, including without limitation warranties of satisfactory quality and fitness for a particular purpose with respect to the information contained herein.
- All information contained herein is protected by law, including but not limited to Copyright Law, and none of the information contained herein is to be copied or otherwise reproduced, repackaged further transmitted, transferred, or redistributed for subsequent use for any such purpose in whole or in part, in any form or manner or by any means whatsoever, by any person without prior written consent from the authors.

- **JURISDICTION**

- The authors do not make any representations that the use of information contained herein is appropriate for use in other locations or that may access this information from outside of the United States.
- This document is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state country or other jurisdiction where such distribution, publication, availability or use would be contrary to law or regulation or would subject the Institute to any registration or licensing agreement within such jurisdiction.