Decentralized Energy Revolution

Implications for electricity supply industry

UNSW Seminar

22 October 2013

Kensington, NSW

Fereidoon P. Sioshansi

Menlo Energy Economics

San Francisco CA

www.menloenergy.com

Pleased to be here, again

- Annual pilgrimage to UNSW
- Pleased to see familiar faces
- Thanks to Iain MacGill & colleagues
- Enjoy continued collaboration

This seminar?

- Embarking on 8th book since 2006
  - Flavor of the book
- Australia at the forefront

ELECTRICITY MARKET REFORM

AN INTERNATIONAL PERSPECTIVE

Edited by
Fereidoon P. Sioshansi and Wolfgang Pfaffenberger

Electricity market reform initiatives have been implemented in a number of countries, states and provinces around the world, starting in the late 1980s. These reforms, which vary in complexity and scope, have worked reasonably to remarkably well in some cases, resulting in efficient and transparent competitive wholesale markets delivering lower costs to retail consumers. In other cases, the results have proven problematic to disastrous. In nearly all cases, the original reforms have been followed by 'reform of the reforms' to address problems associated with the original design of the market.

With passage of time and accumulation of evidence, policy makers, the industry researchers, and academics are increasingly interested to draw useful lessons from a growing body of literature on electricity market reform. Among the key questions is why some market reforms have succeeded while others have not. More importantly, what can be drawn from this experience to design future market reforms, now gaining momentum around the world and how to avoid the pitfalls.

This book, covering virtually every interesting electricity market around the world, provides the definitive answers under one volume. It offers the most comprehensive and up-to-date compendium of articles on electricity market reform by some of the best experts and academics from around the world.

CONTENTS

'Many books and papers have analyzed experience in individual countries, especially the UK and US. There have been some comparative studies within wider geographical areas, such as Europe. But the present volume is perhaps the first – certainly the most extensive and up-to-date – systematic comparison of experience on a world-wide basis with the aim of identifying what works and what does not and why.'

PROFESSOR STEPHEN LITTLECHILD, FORMER HEAD OF OFFER

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Sioshansi
Pfaffenberger

ELECTRICITY MARKET REFORM
AN INTERNATIONAL PERSPECTIVE

Elsevier Global Energy Policy and Economics Series

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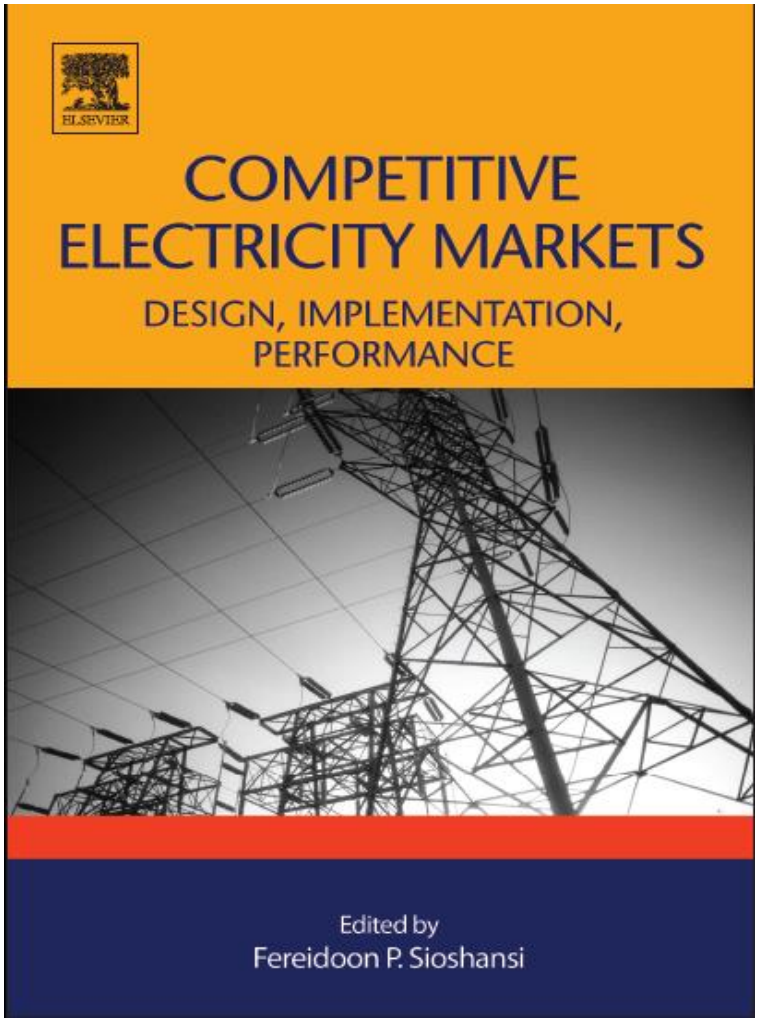
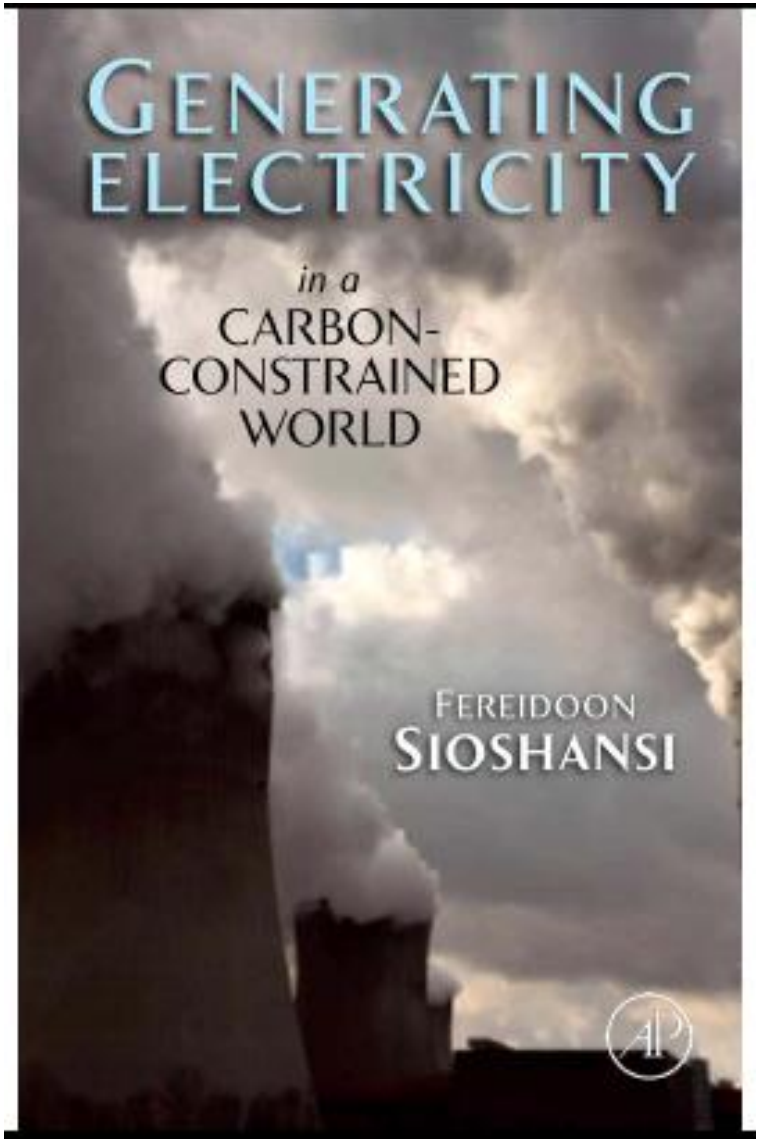
Sequel book, 2008




GENERATING
ELECTRICITY
in a
CARBON-
CONSTRAINED
WORLD
FEREIDOON
SIOSHANSI

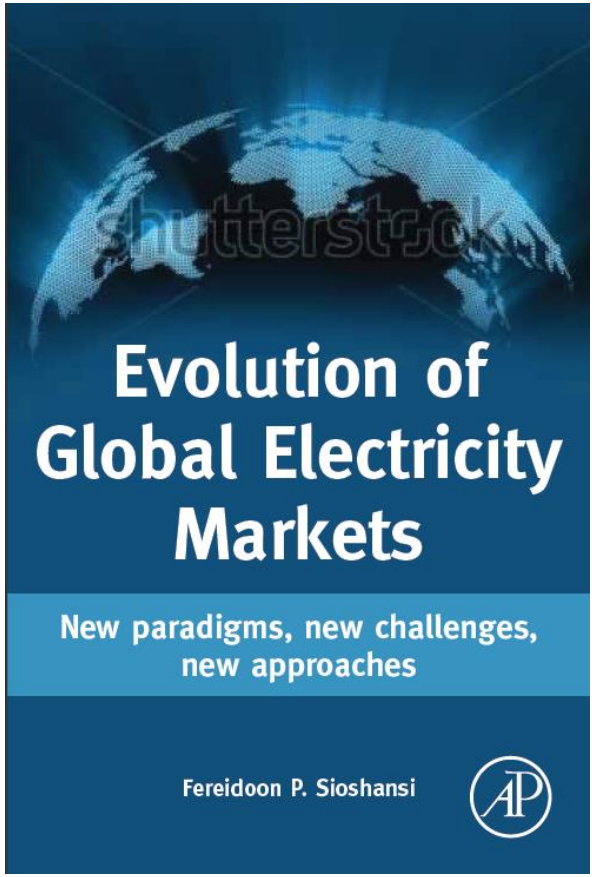
Smart Grid

Nov 2011

Energy Efficiency:

Towards the end of demand growth

June 2013


Evolution of Global Electricity Markets
New paradigms, new challenges, new approaches
Fereidoon P. Sioshansi

Volume 8, July 2014

- **The rise of decentralized energy:** What is at stake for the electricity supply industry?
- Mostly focused on decentralized generation
- Variety of perspectives
- Global coverage with 3 key regions
  - Germany
  - CA
  - Australia

Main message

- ESI approaching a significant tipping point
  - End of demand growth in sight?
  - For the first time in history, consumers may be able to generate cheaper than ESI can
  - Traditional business model “unsustainable”
- Implications?
  - For industry?
  - For consumers/*prosumers*?
  - For policymakers/politicians?

Limited so far

- Currently applies to regions with
  - High & rising retail tariffs
  - High & rising renewable targets
  - Generous/supportive self-generation policies
    - Germany, California & Australia
- Speculation
  - Trend will spread …
  - … and accelerate
  - It may be too late to do much about it
    - Disruptive technology

Outline

- Electricity consumption
- Renewables
- Distributed energy resources
- Rethinking business model
- Discussion

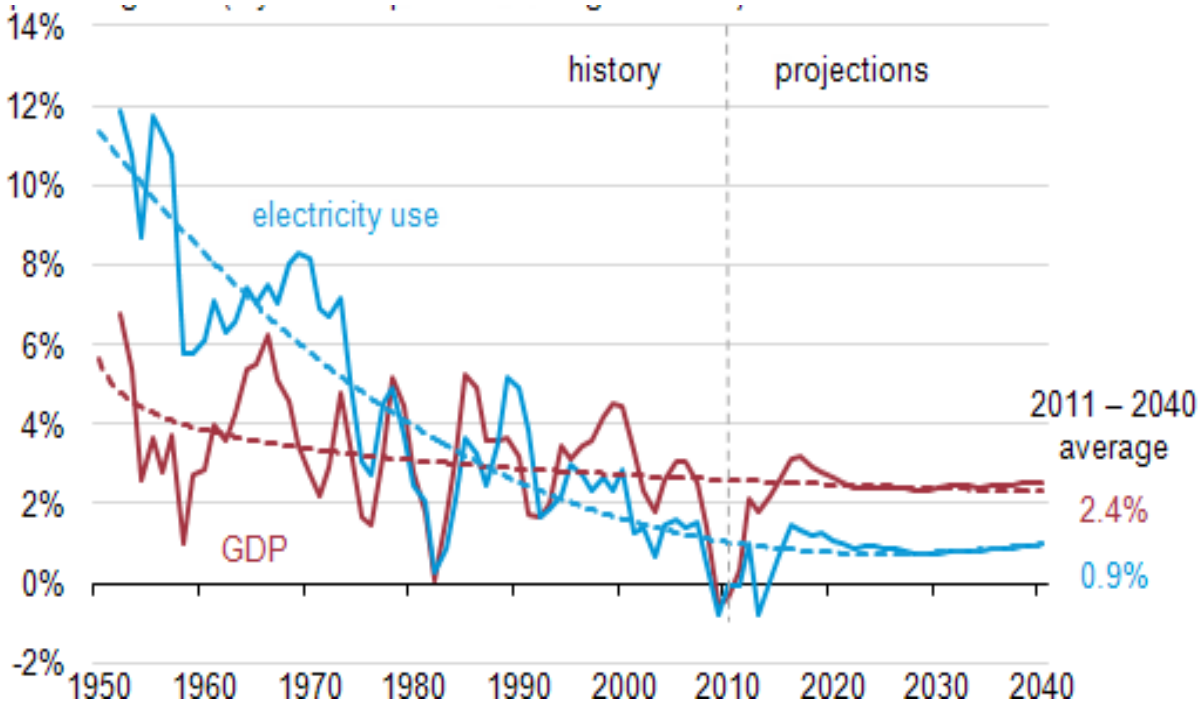
1st Electricity consumption falling

- Why?
  - Structural change
  - Demand approaching saturation
  - Negawatts cheaper than megawatts
  - Retail rates high/rising
  - Everything getting more efficient
  - Codes & standards matter
  - ZNE-type mandates prevalent

Structural reasons

Economic growth sustained w minimal electricity growth

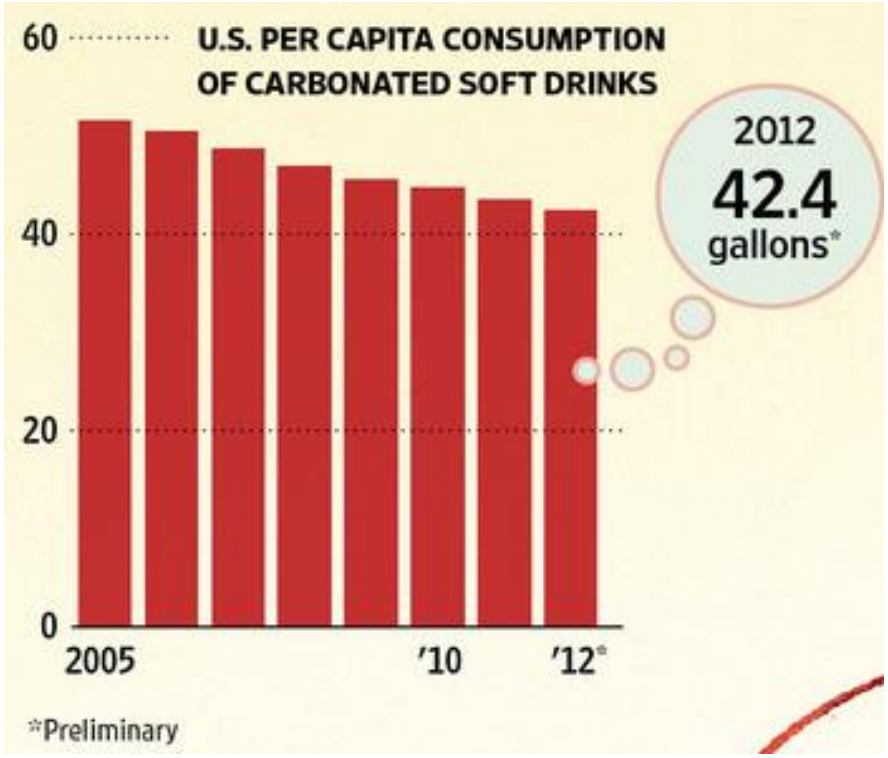
U.S. electricity use and economic growth, 1950-2040, percent growth (3-year compound annual growth rate) and trend lines



Source: U.S. Energy Information Administration, Annual Energy Outlook 2013 Early Release

Demand saturation

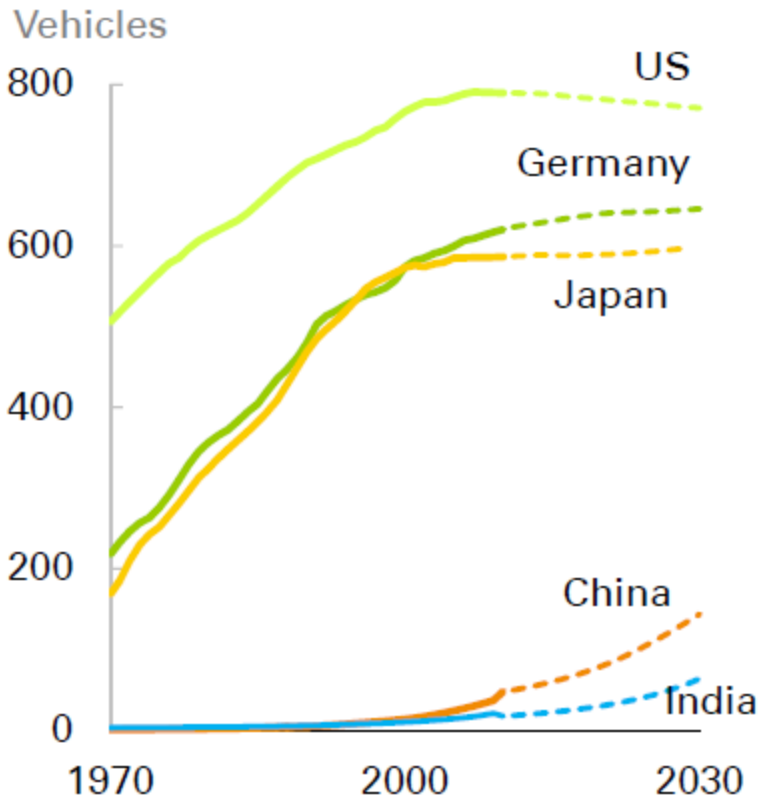
How much more soda can Americans possibly drink?



Source: The Wall Street Journal, 19 Jan 2013

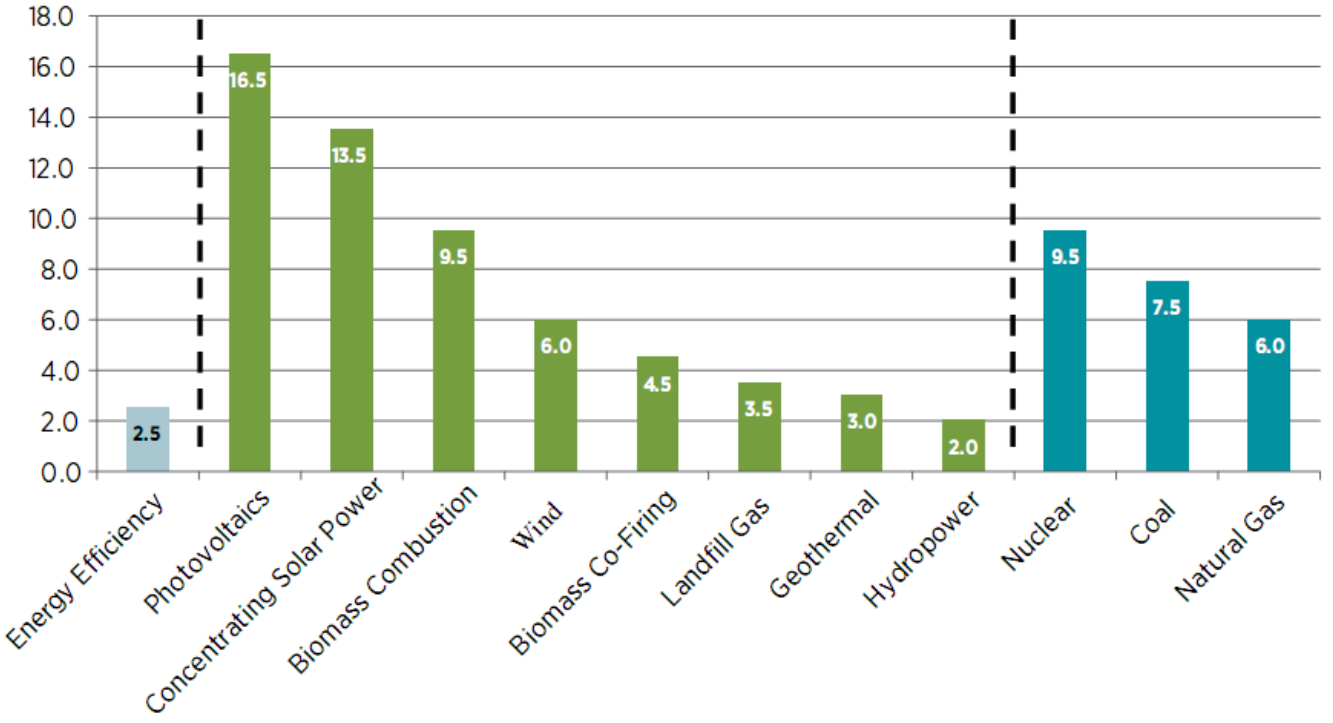
More cars than licensed drivers

Vehicle ownership per 1,000 people, 1970-2030



Source: BP Energy Outlook 2030, Jan 2012

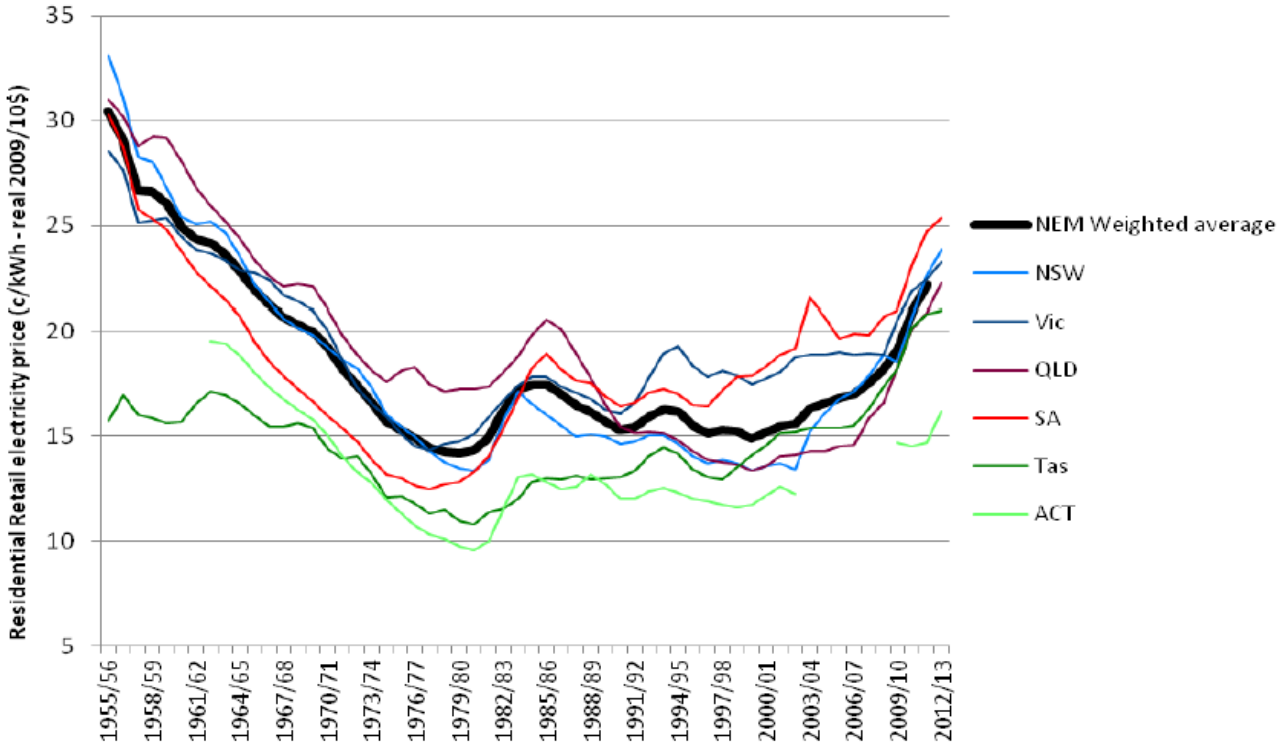
Negawatts cheaper than megawatts



*** Includes current federal & state level incentives, natural gas price is assumed at $4.50/MMBTU**
Source: US Renewable Energy Quarterly Report, ACORE, Oct 2010

Rising

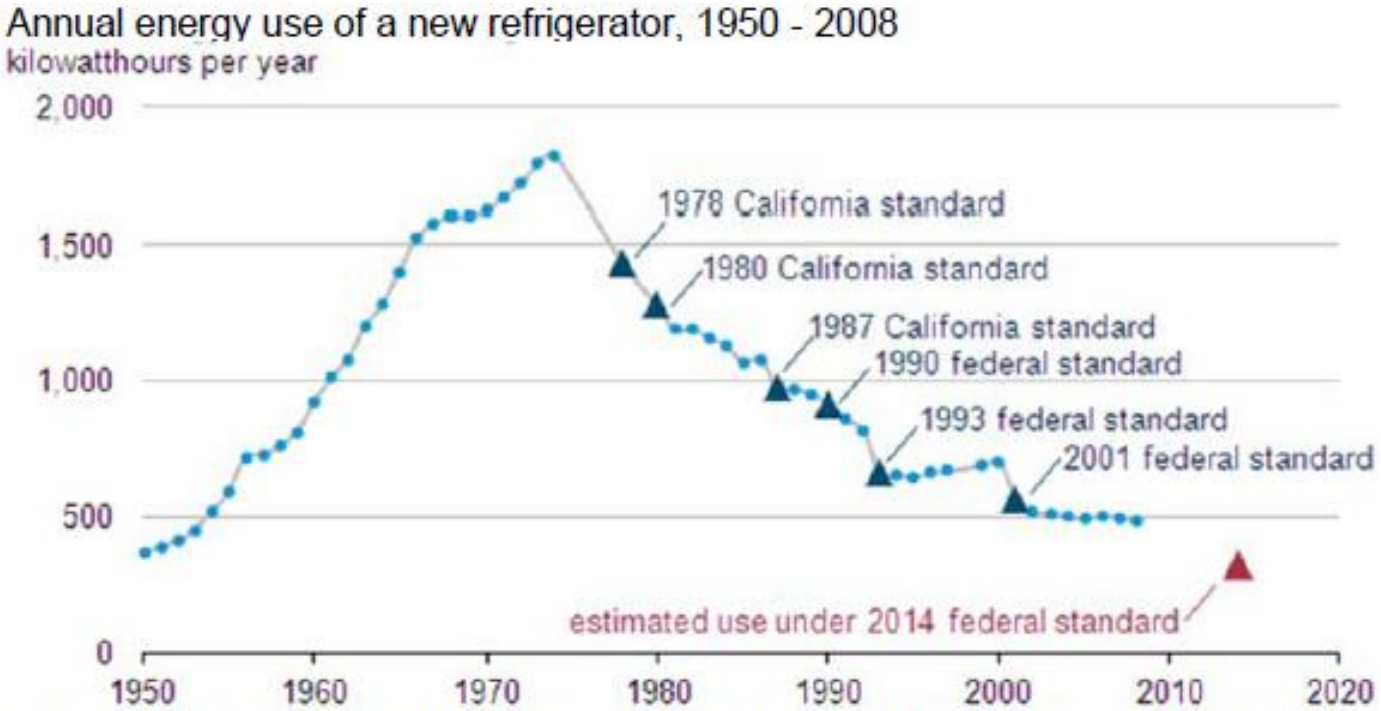
Residential Australian electricity prices



Source: ISF, NEM Report Card, 2011

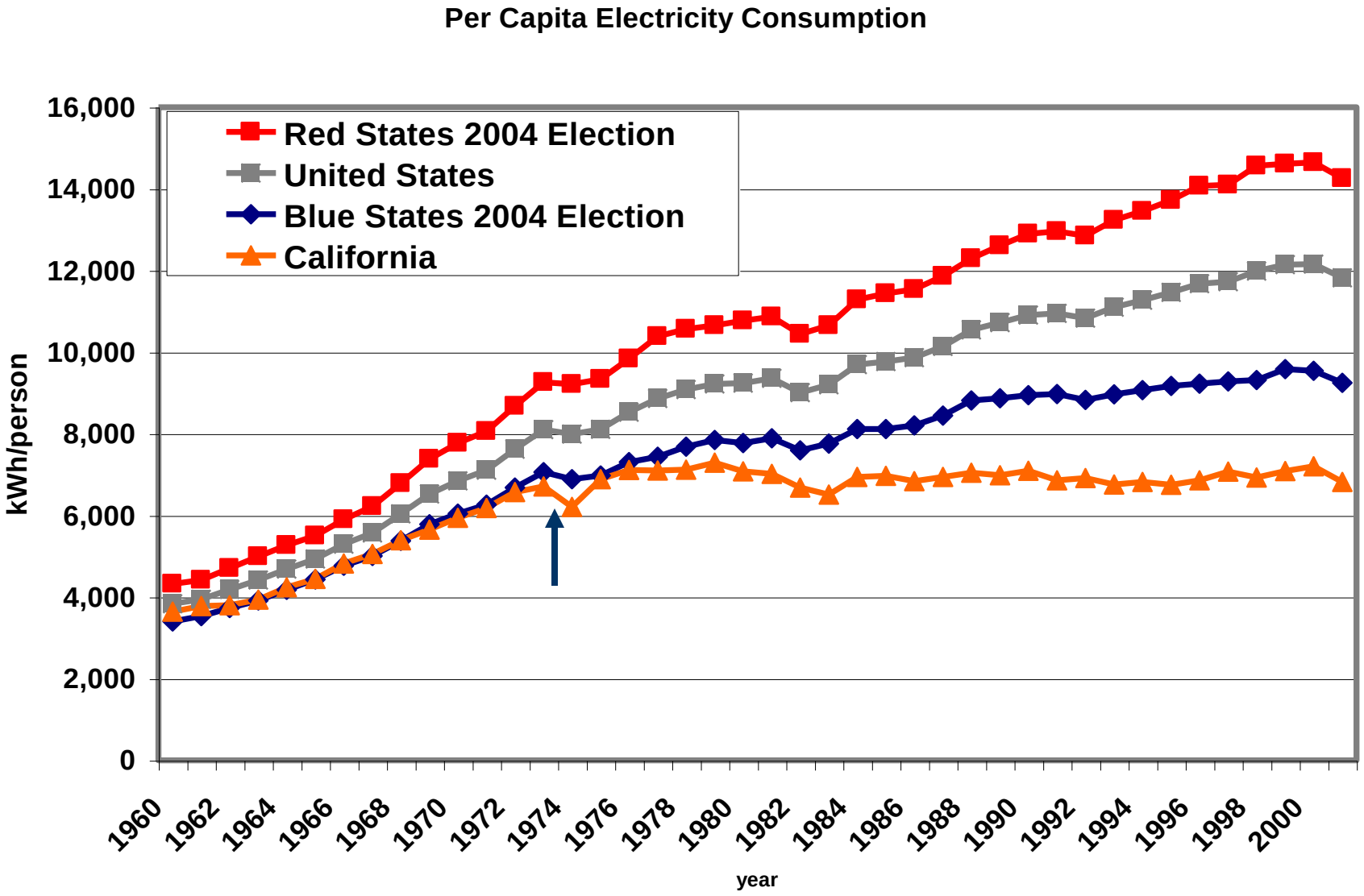
More efficient

Avg. US refrigerator is 3 times larger yet uses less electricity



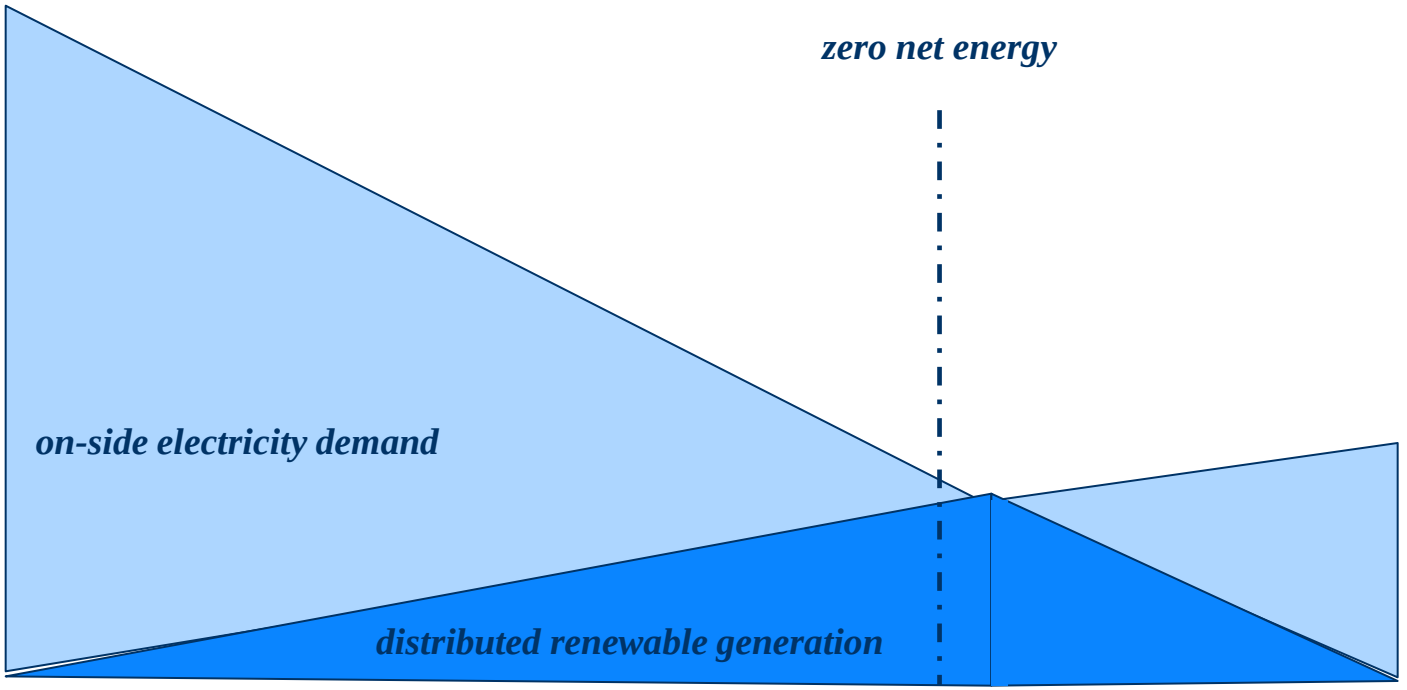
Source: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office

Codes & standards matter



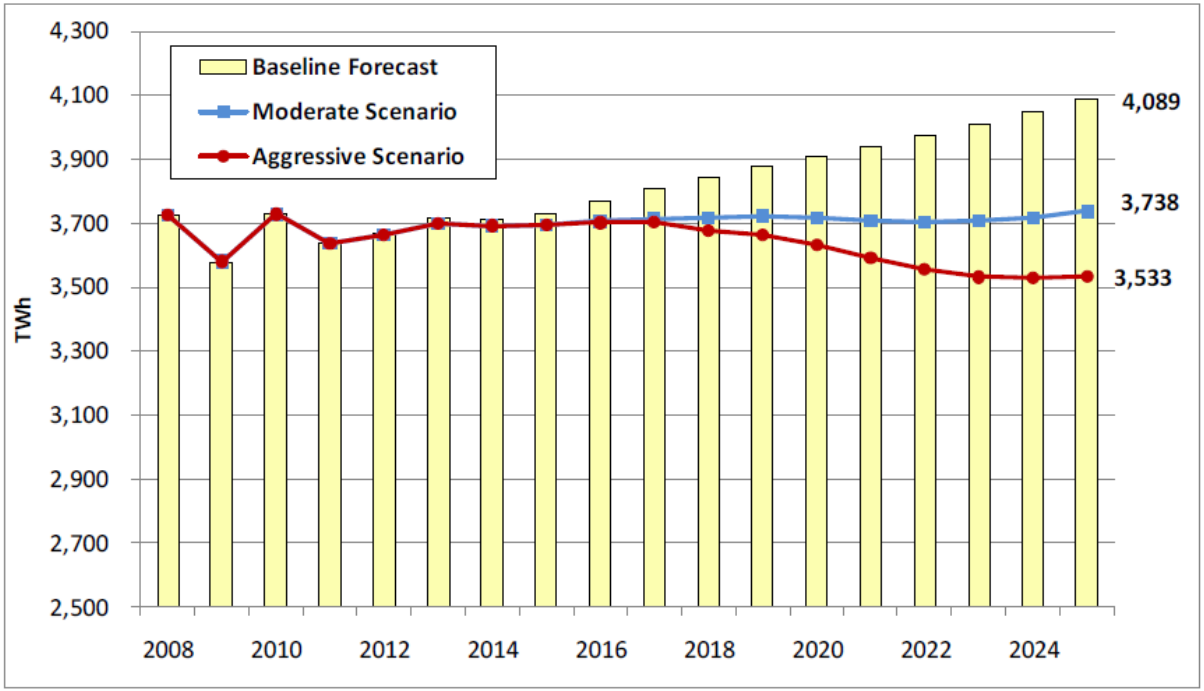
Zero Net Energy

How would it work? Consuming less, generating more



End of US demand growth?

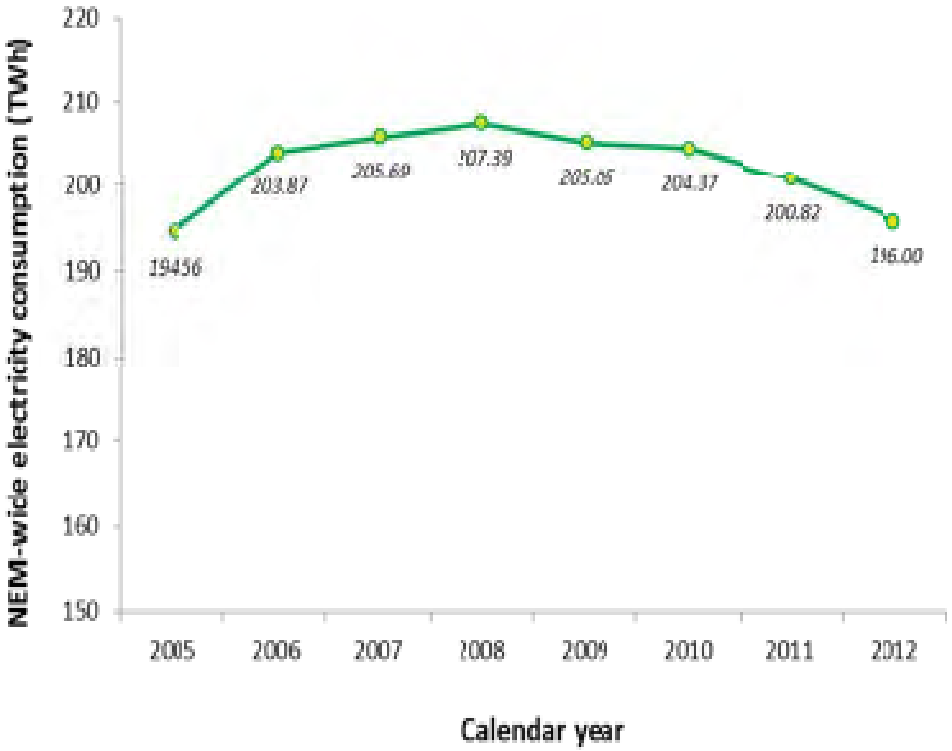
Energy efficiency "feasible & cost-effective"



Source: IEE white paper, May 2011

End of Oz demand growth?

Elect. consumption in Australia's NEM, 2005-12, in TWhrs



Source: AEMO data; graph courtesy of greenmarkets.com.au

2nd Renewables

- Inevitable growth
- Result:
  - Depressing wholesale and rising retail prices
  - Growing headache for grid operators

Who'll get there first?

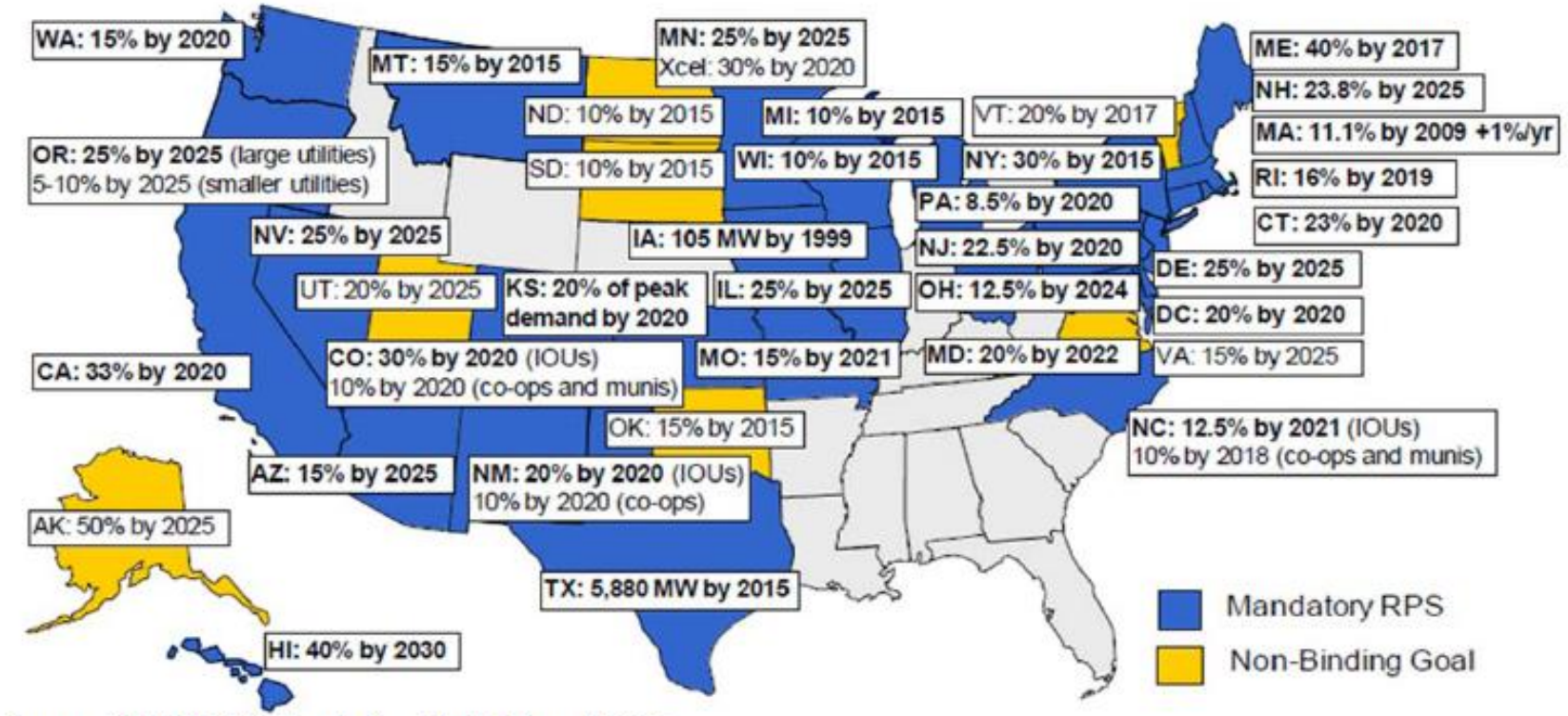
Renewable targets for selected countries*, current, 2020 and 2050 target as % of total generation

Country	Current	2020 renewable target % of total generation	2050 renewable target % of total generation
Denmark	22.2	50%	100%
Sweden	47.9	49%	100%
Spain	13.8	20%	100%
Germany	11	35%	85%
California*	11.6	33%	80
Australia	9.6	22.5	85
UK	7.4	30	no target

* California is not a country, yet, but it has the world's 10th largest economy if it were

Source: New Scientist, 22 June 2013

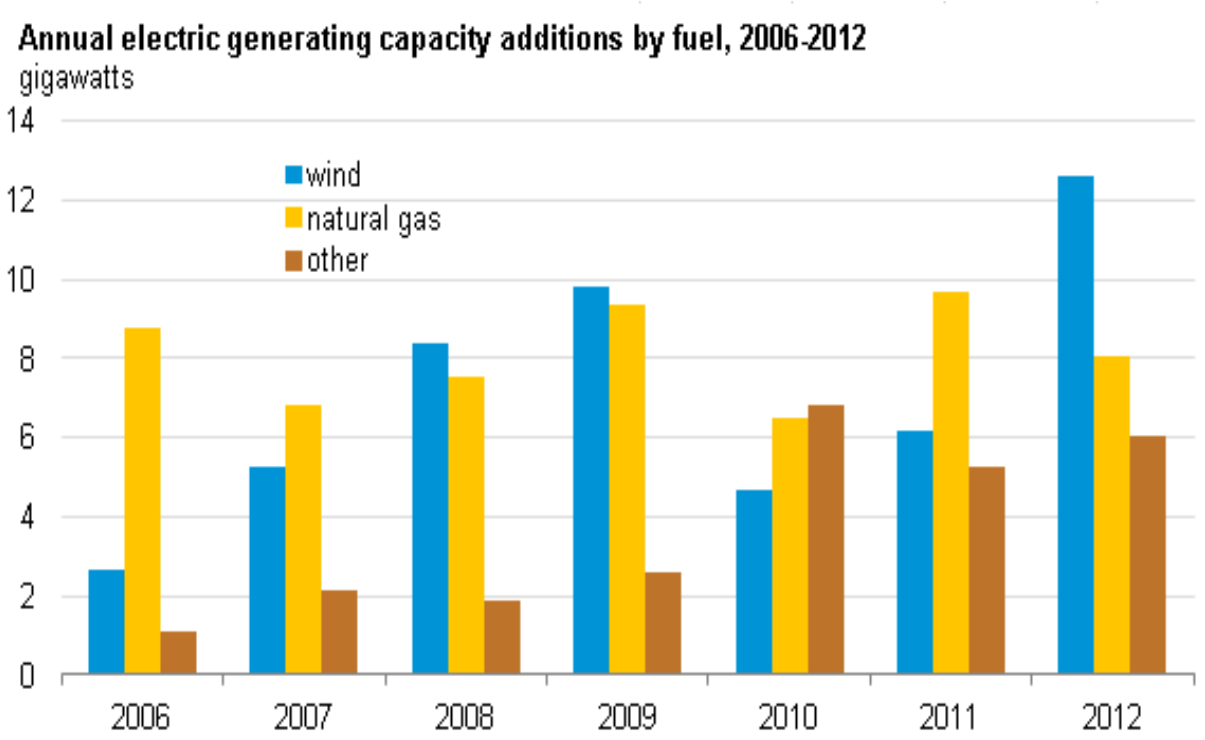
Renewable Portfolio Standards



Source: 2011 Wind Technologies Market Report, DOE

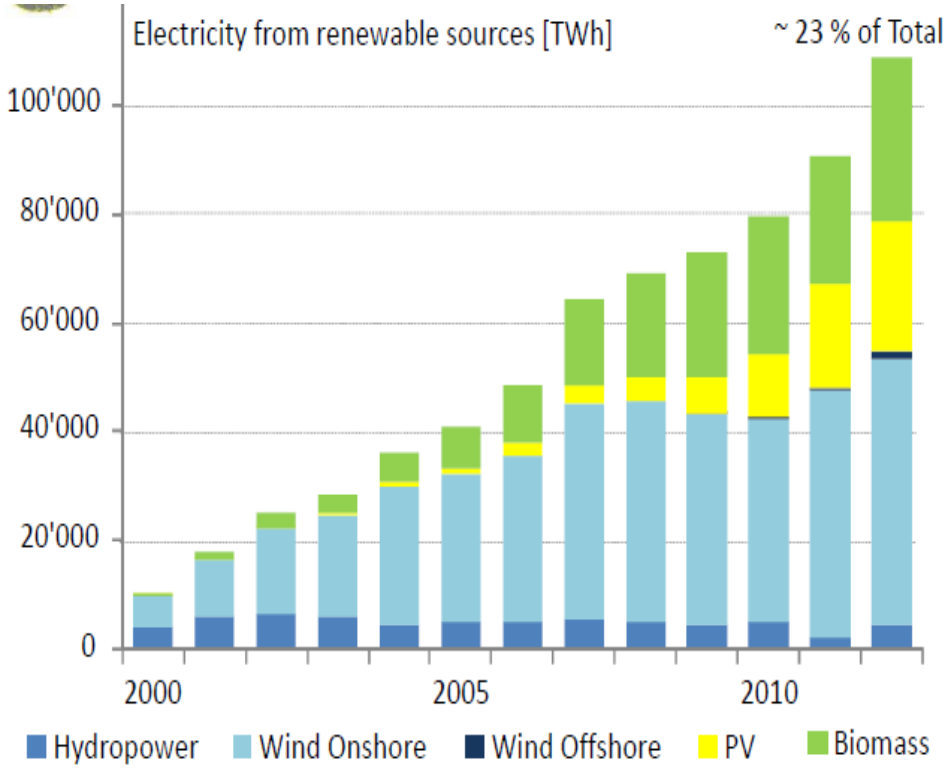
Rise of renewables

New US capacity additions, 2006-12, in GW



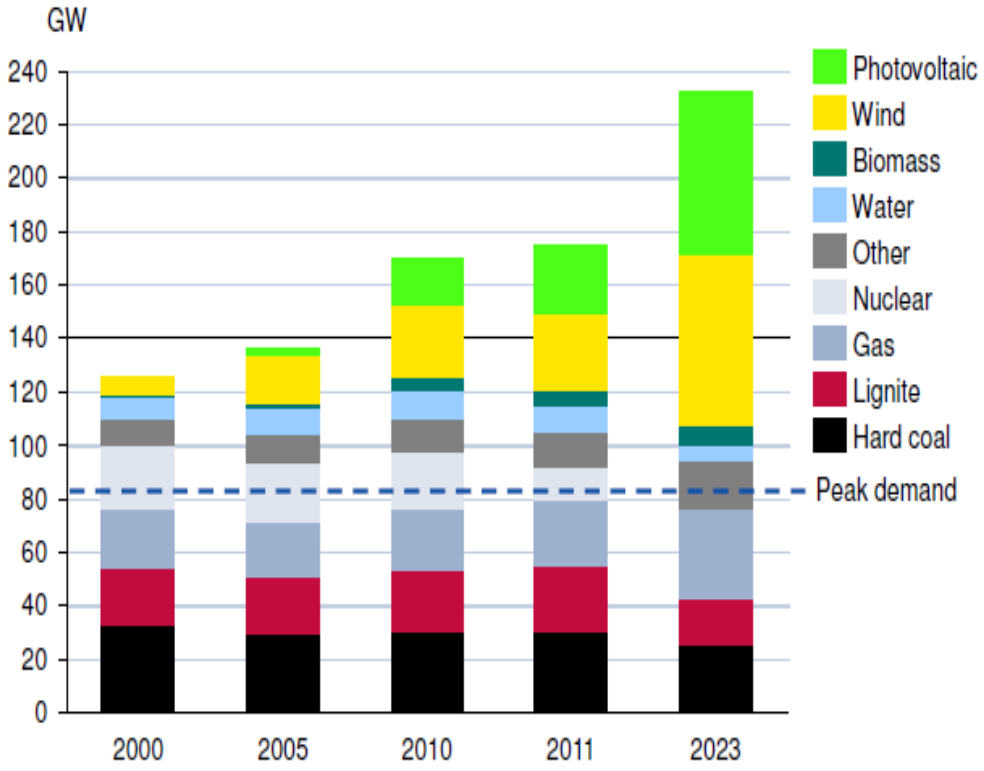
Source: Energy Information Administration, Annual Electric Generator Report, Form EIA-860

Germany: Flooding the market



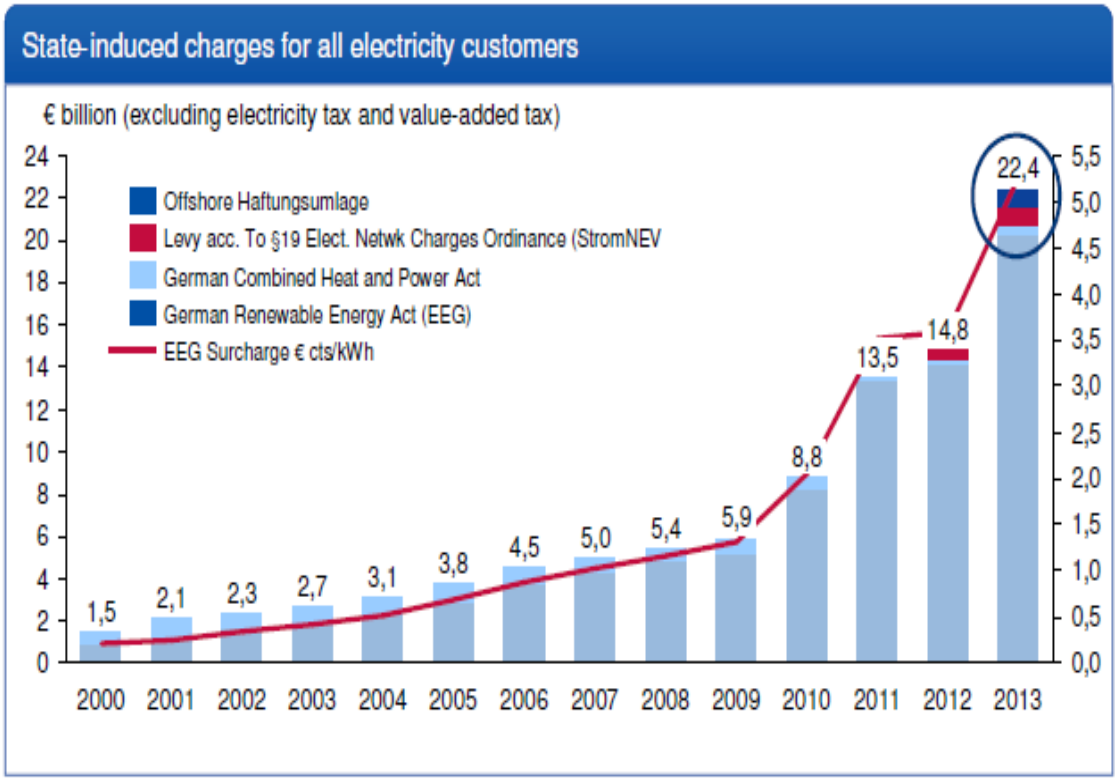
Source: Macroeconomics of German Energiewende, Prof. Georg Erdmann, Aug 2013

Too much capacity



Source: Bundesnetzagentur

German renewable drag



Source: BDEW January 2013, preisvergleich, de, BDEW Emeuerbare Energien und das EEG: Zahlen, Falden, Grafiken (2013)

3rd Distributed Energy Resources

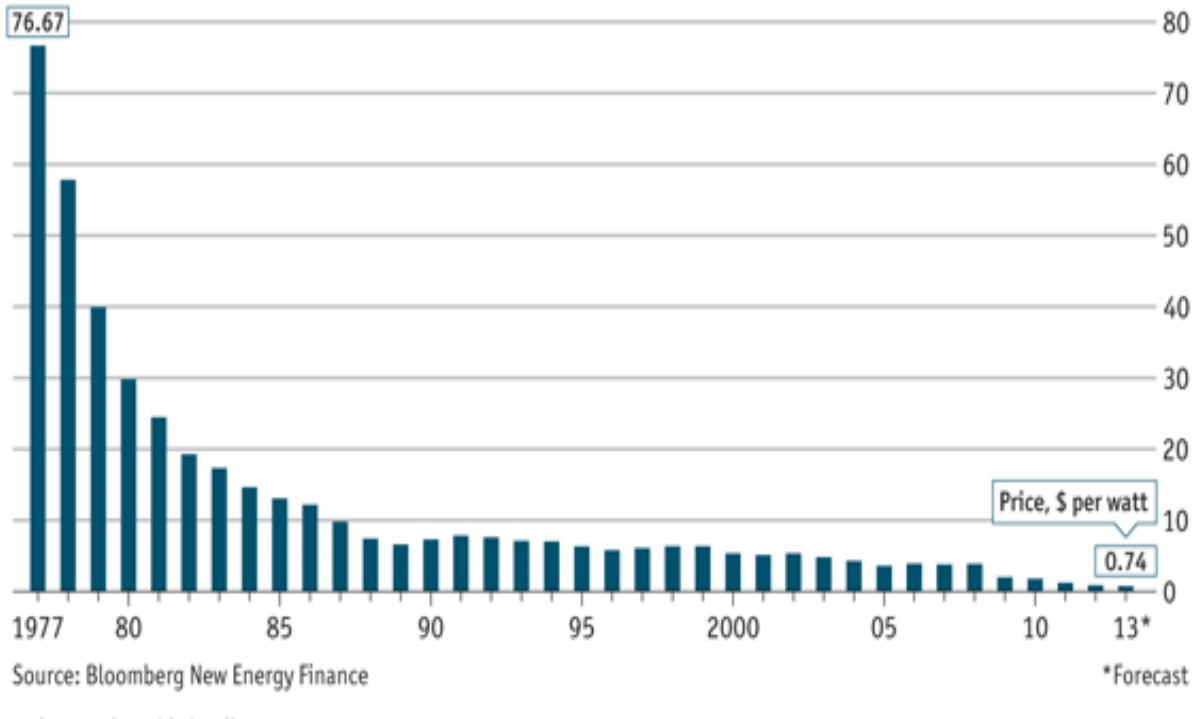
- First
  - Customers don't want/need energy but energy services
- Second
  - DER two sided coin
  - One side: energy efficiency
  - Other side: distributed generation
- Third
  - Sales fall if consumers use *less &*/or generate *more*

Why use less/generate more?

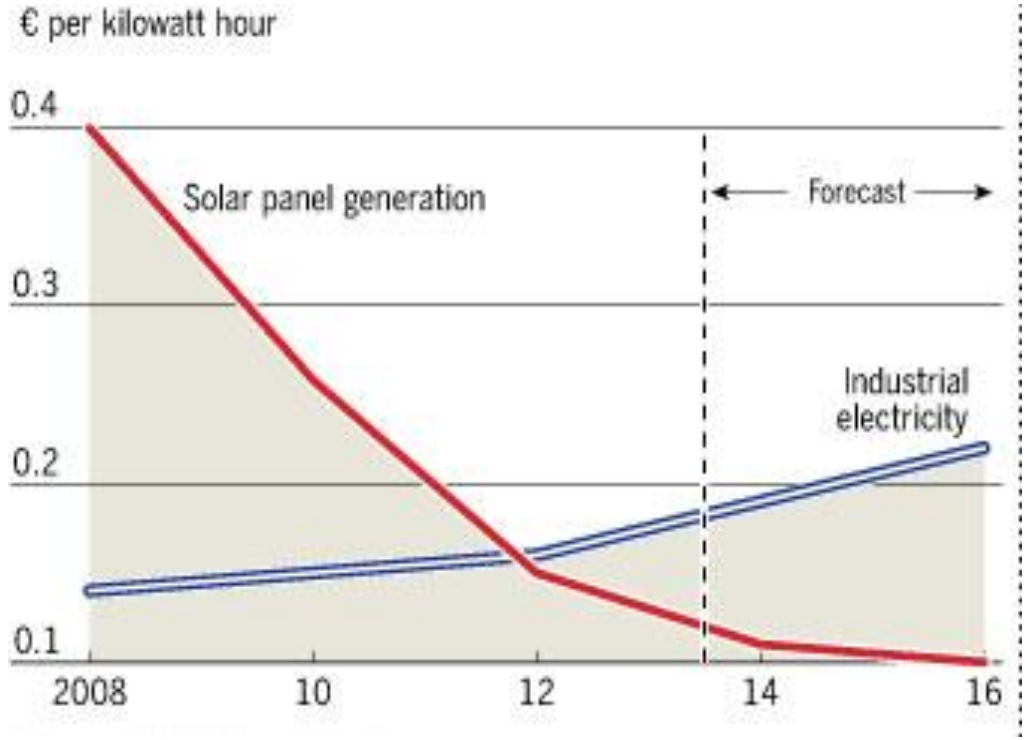
- Why use less?
  - Already covered
- Why generate more?
  - Grid parity is near or already here
    - Cost of self generation keeps falling
    - Retail tariffs high/rising
    - May become mandatory (e.g., city ordinances)

Solar PV prices keep falling

Price of solar PVs, 1977-2013, in $/W

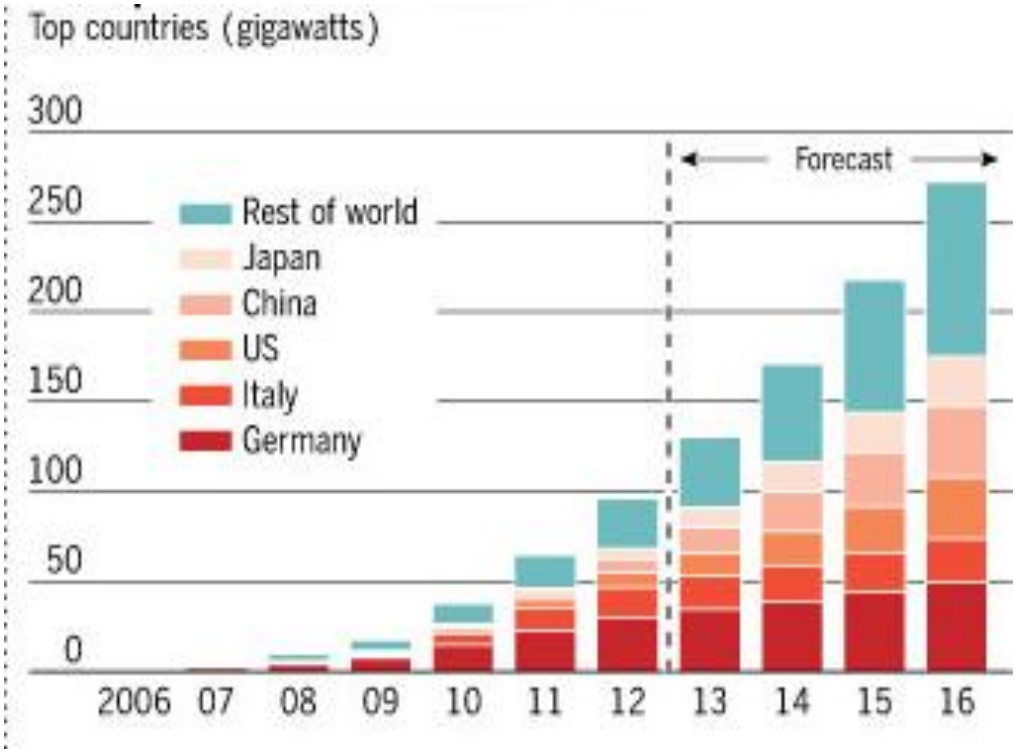


German solar grid parity



Source: Renewables: A rising power, Financial Times, 8 Aug 2013 based on data from IHS Solar Demand Tracker

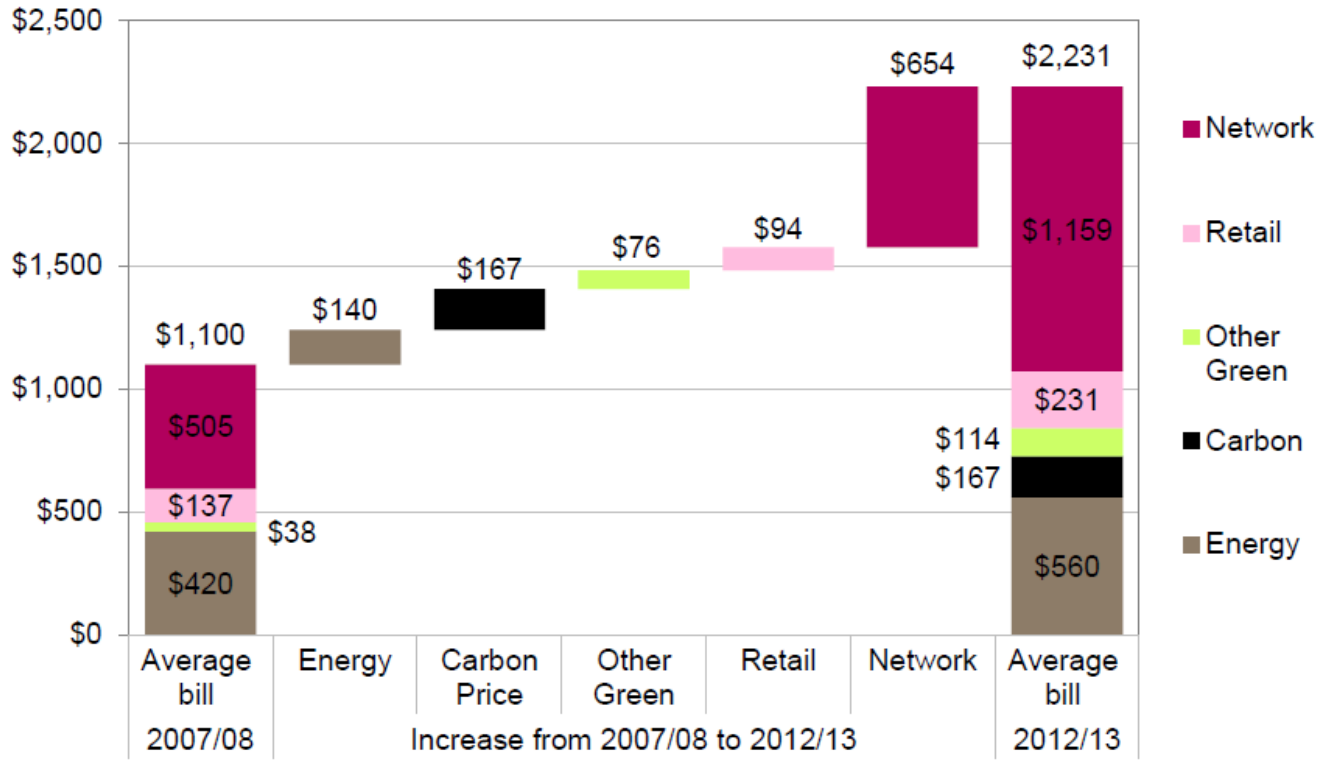
Solar PV installations



Source: Renewables: A rising power, Financial Times, 8 Aug 2013 based on data from IHS Solar Demand Tracker

Doubled in 5 years

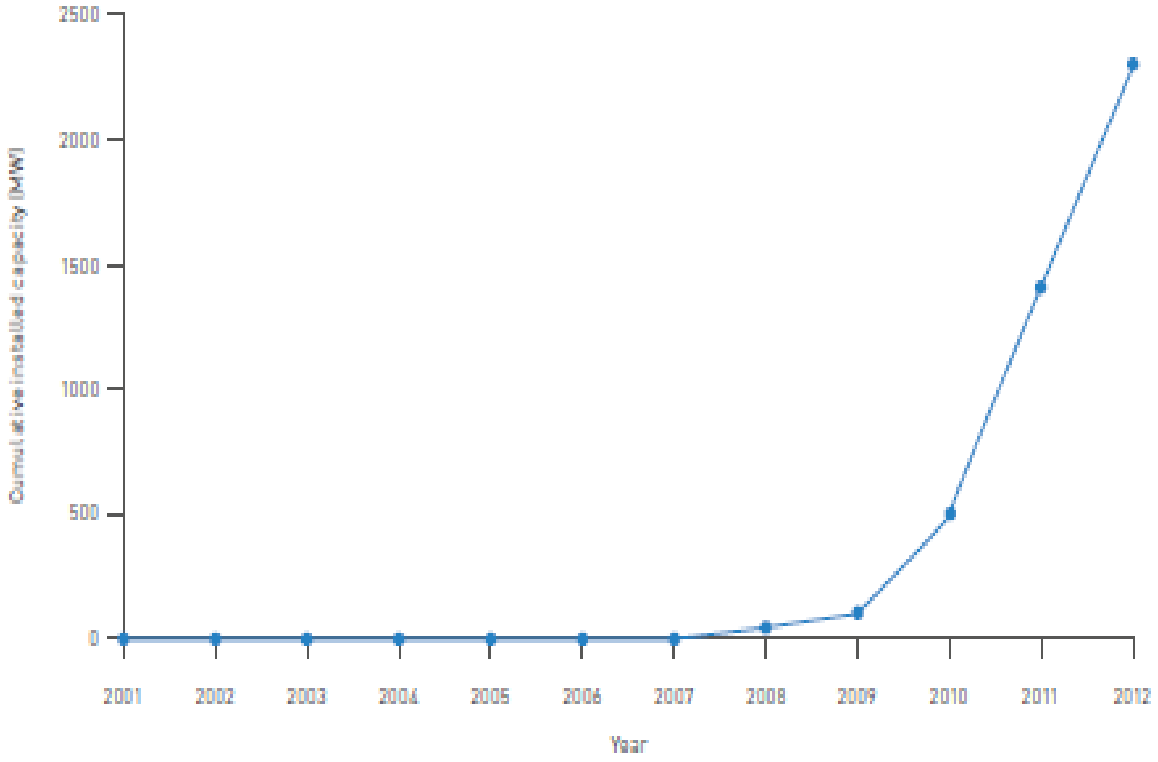
Components of annual electricity bill in NSW, 2008 and 2013



Source: IPART, Review of regulated retail prices and charges for electricity 2013 to 2016, (2012).

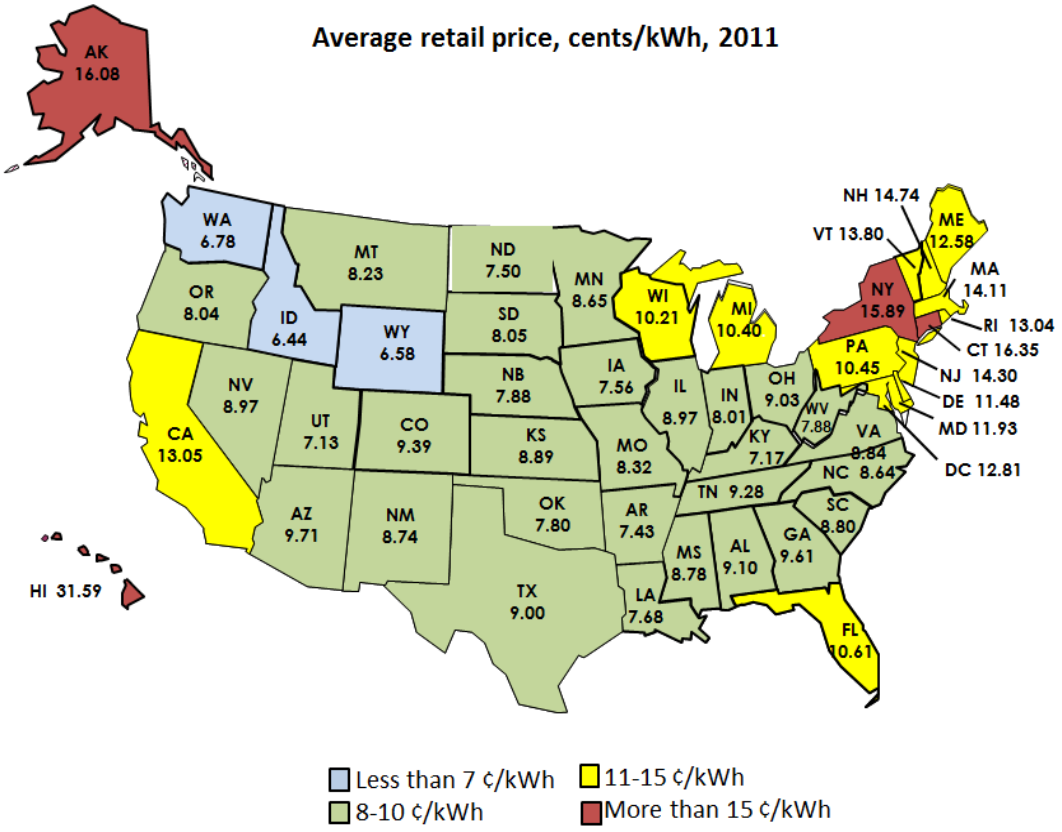
14% penetration in QLD

Cumulative installed capacity of solar PVs in Australia, 2001-2012, in MW



Source: Clean Energy Council of Australia

High cost states at parity



What makes DERs attractive?

CA's tiered rates

This is California: High consumption, rising rates
CA's current tiered residential rates, in cents/kWh

Tier	Volume of use	PG&E	SCE	SDG&E*
Tier 1	Within baseline	13	13	14
Tier 2	101-130%	15	16	16
Tier 3	131-200%	30	24	24
Tier 4	201-300	34	28	31
Tier 5	>300%**	34	31	NA

* SDG&E has slightly different rates for summer and winter, making it more complicated for consumers
** PG&E shows 5 tiers but the price for the top 2 tiers is shown as the same
Source: Utility websites

Sunny California

California Gov. envisions 12 GW of DG by 2025

Residential Retrofit

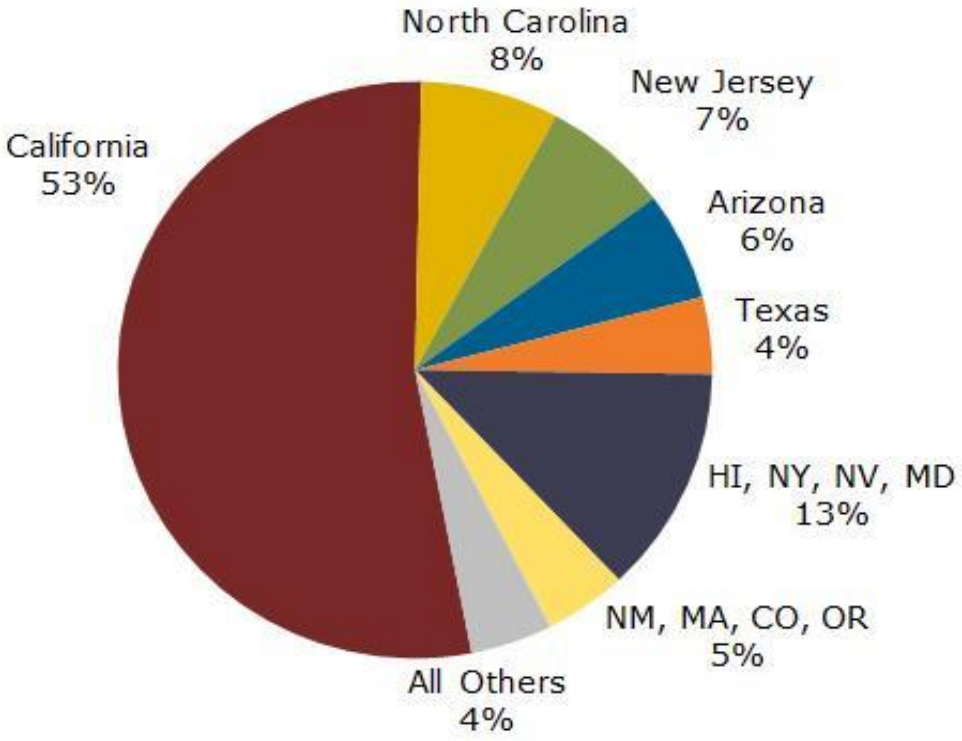
New Production Homes

Commercial & Public

Power Plants

California: More than half

Of 976 MW of new solar PV installations in 2nd Qtr. 2013, 53% was in California

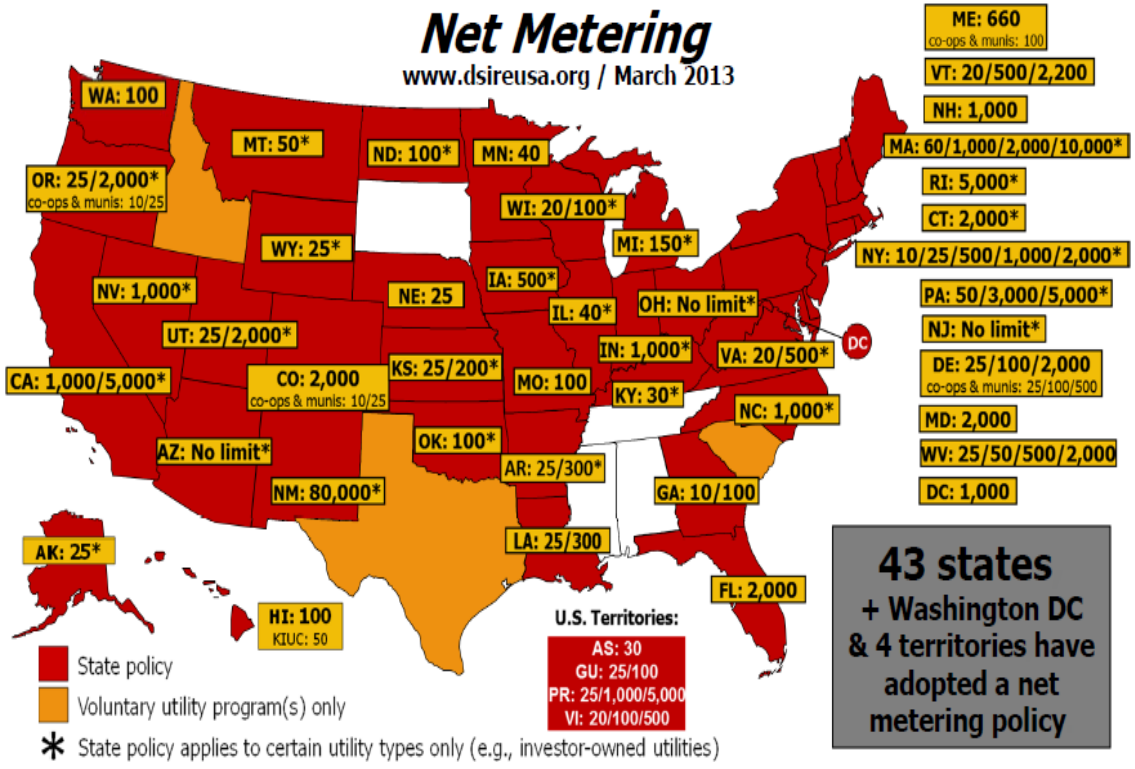


Source: NPD Solarbuzz North America PV Markets Quarterly report

Net Energy Metering

The battleground

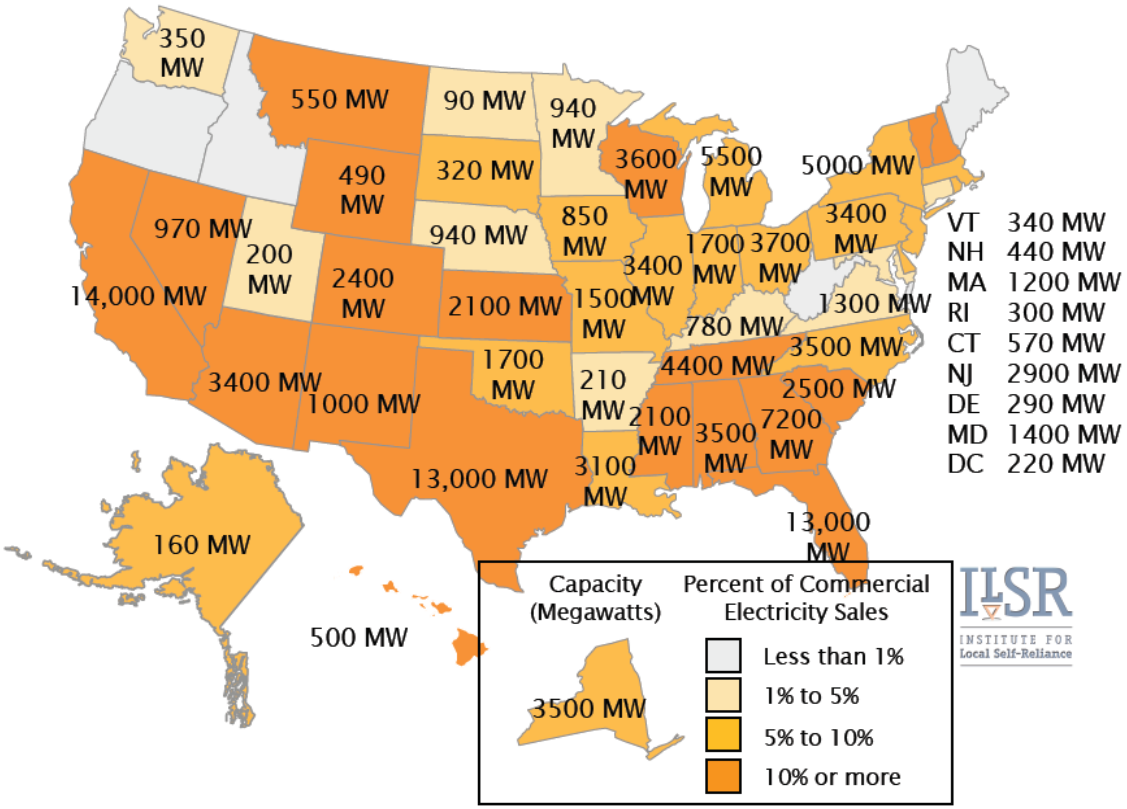
Net metering spreading across the land



Source: DSIRE USA

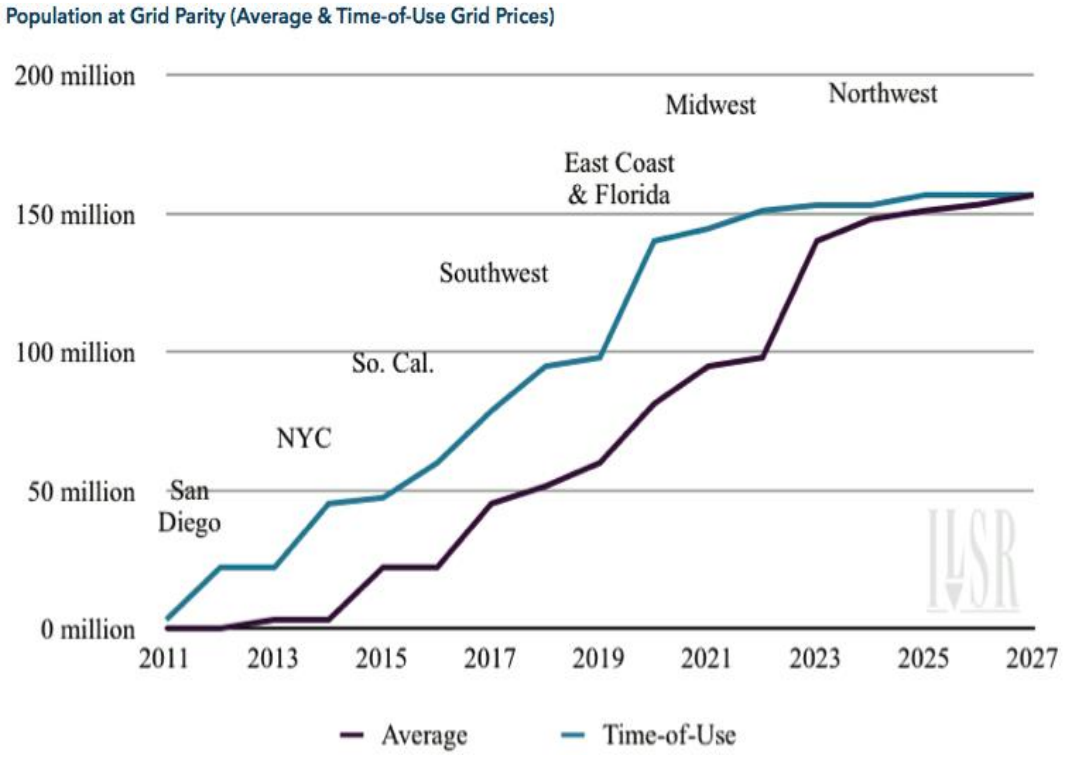
US grid parity

Energy Potential from Unsubsidized $3/W Commercial Solar (Capacity and % of Sales)



Source Commercial Rooftop Revolution, Institute for Local Self-Reliance (ILSR), Dec 2012

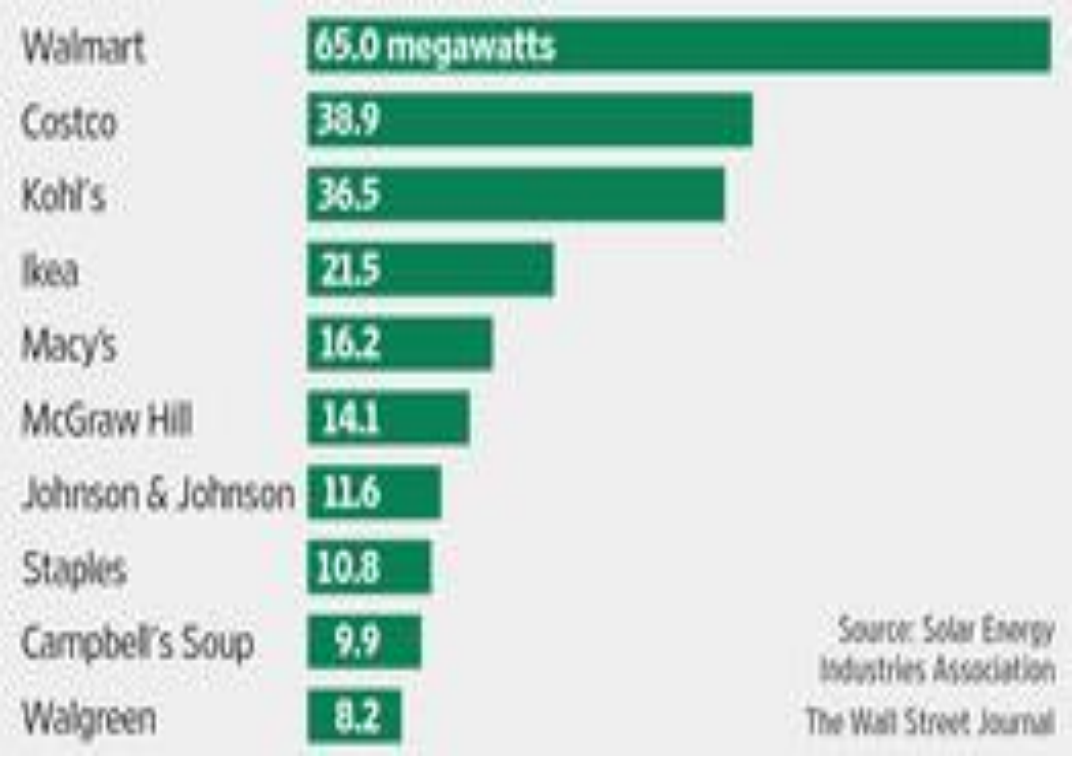
Promise of solar grid parity?



Source: John Farrell, Renewable Energy World.com, 9 July 2013

Plenty of flat roofs for solar PVs

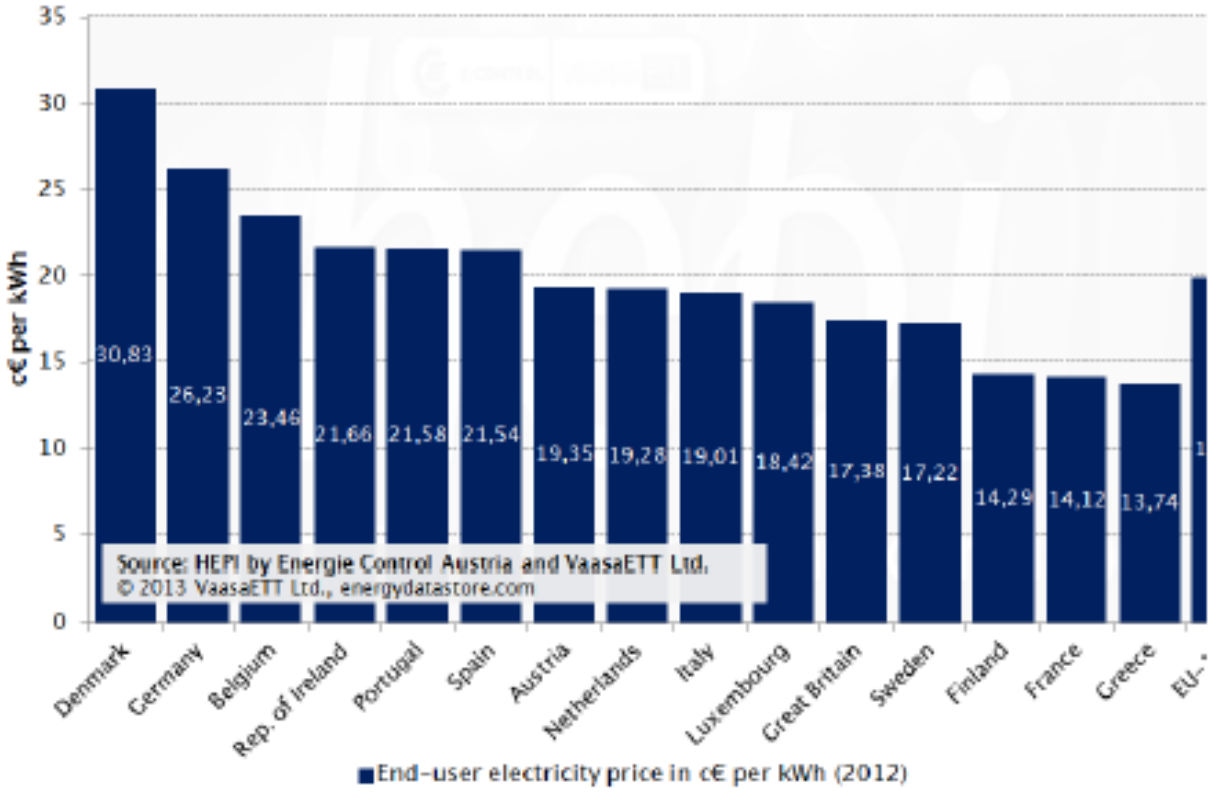
Top 10 solar users in US, current installed capacity in MW



Source Wall Street Journal, 18 Sept 2013 based on data from Solar Energy Industries Assoc. (SEIA)

High & rising in EU

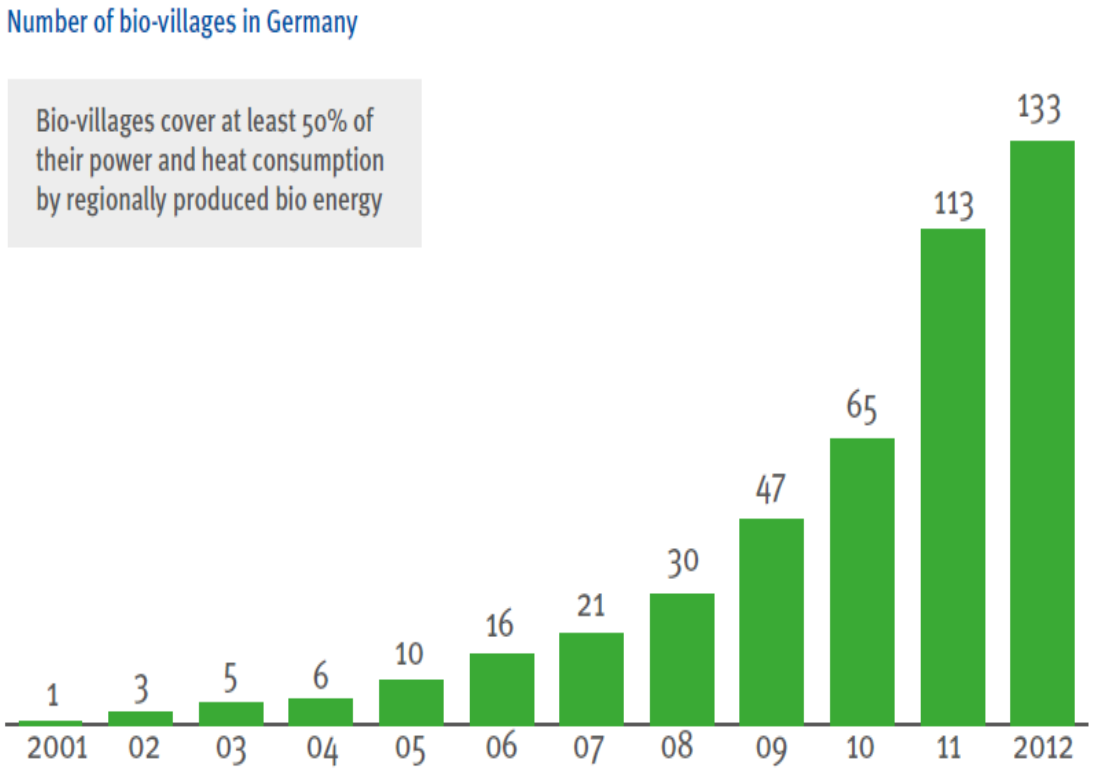
Avg. residential electricity prices including taxes, 2012



Source VaasaETT

Going off-grid, one village at a time

German “bio energy” villages



Source Utilities: Powerhouses of innovation, Eurelectric, May 2013

Disruptive technology?

Another Kodak analogy

- Fight NEM laws tooth & nail
  - May not succeed
- Reconsider rate design to accommodate growing DERs
  - Introduce dynamic prices for off-take/injection to grid
  - Will help, but may not be enough
  - Regulatory barriers, consumer resistance
- Expand definition of service to include DERs
  - Industry not known for innovative thinking, decisive moves
- It may be too late
  - "We did not get ahead of the game, it may be too late" EPRI's Clark Gellings

Thank you

- Happy to take questions