New Financial Trends From Fossil Fuels to Renewables

"The transition is underway and I see it as my job to ensure there is a smooth transition"

Josh Frydenberg Australian Minister of the Environment & Energy, August 2016

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Renewable Energy Institute / Bloomberg – Tokyo, Japan

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Institute for Energy Economics and Financial Analysis
IEEFA.org

AGENDA

The Global Electricity Market Transformation

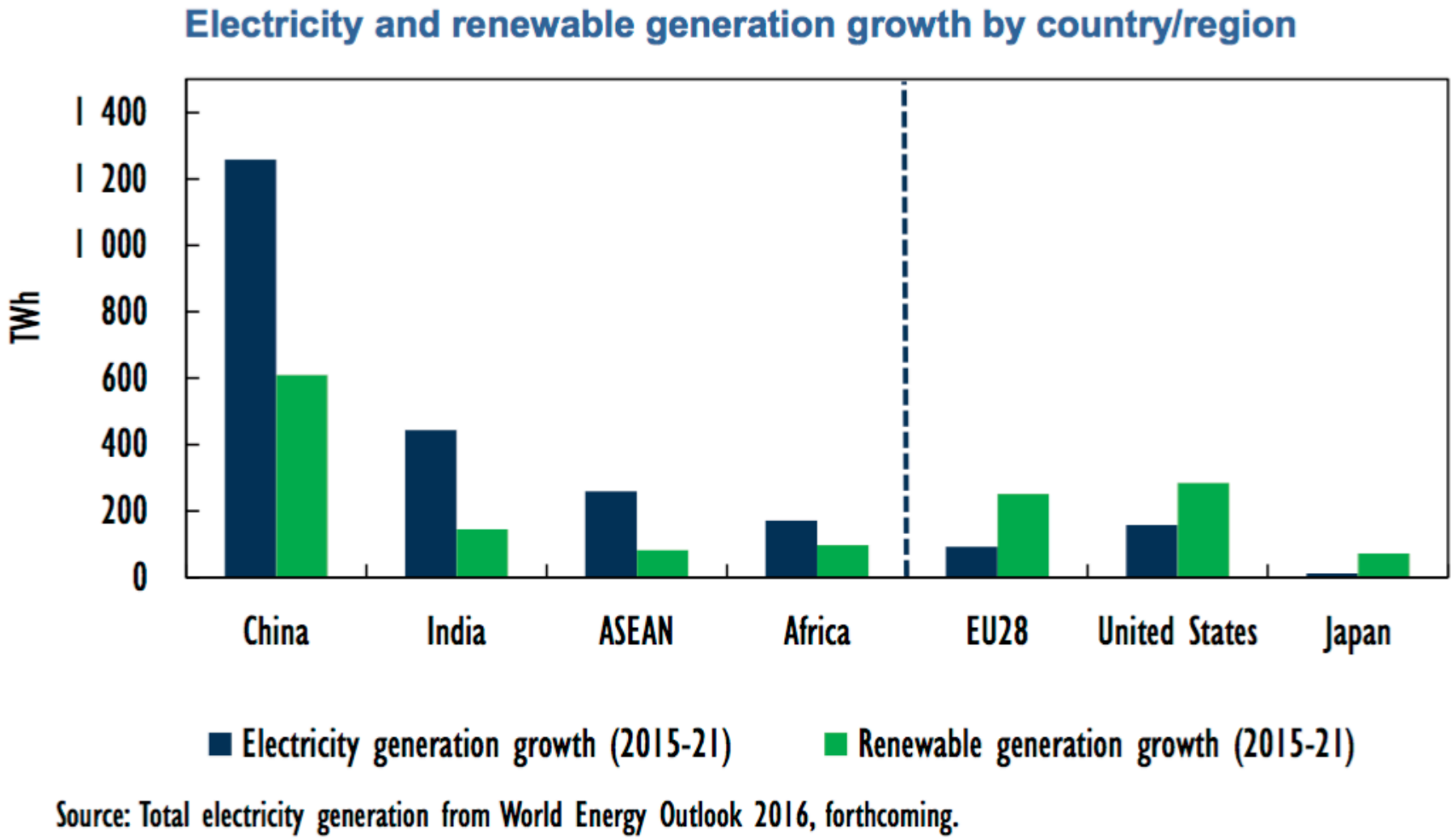
1. **Setting the Scene – Global Policy: Momentum is building**

2. **Electricity Markets are Transforming – different pressures, same outcome**
   - China
   - India
   - America
   - Japan
   - Germany

3. **Thermal Coal Price**

4. **Renewables are deflationary**
   - Technology gains and economies of scale
   - Batteries will transform distributed solar on rooftops from 2018.

1.1 IEA



Source: Total electricity generation from World Energy Outlook 2016, forthcoming.

IEA figures released in Nov 2016 – upgrading world wind electricity forecast by 50% to 5,394TWh by 2040.

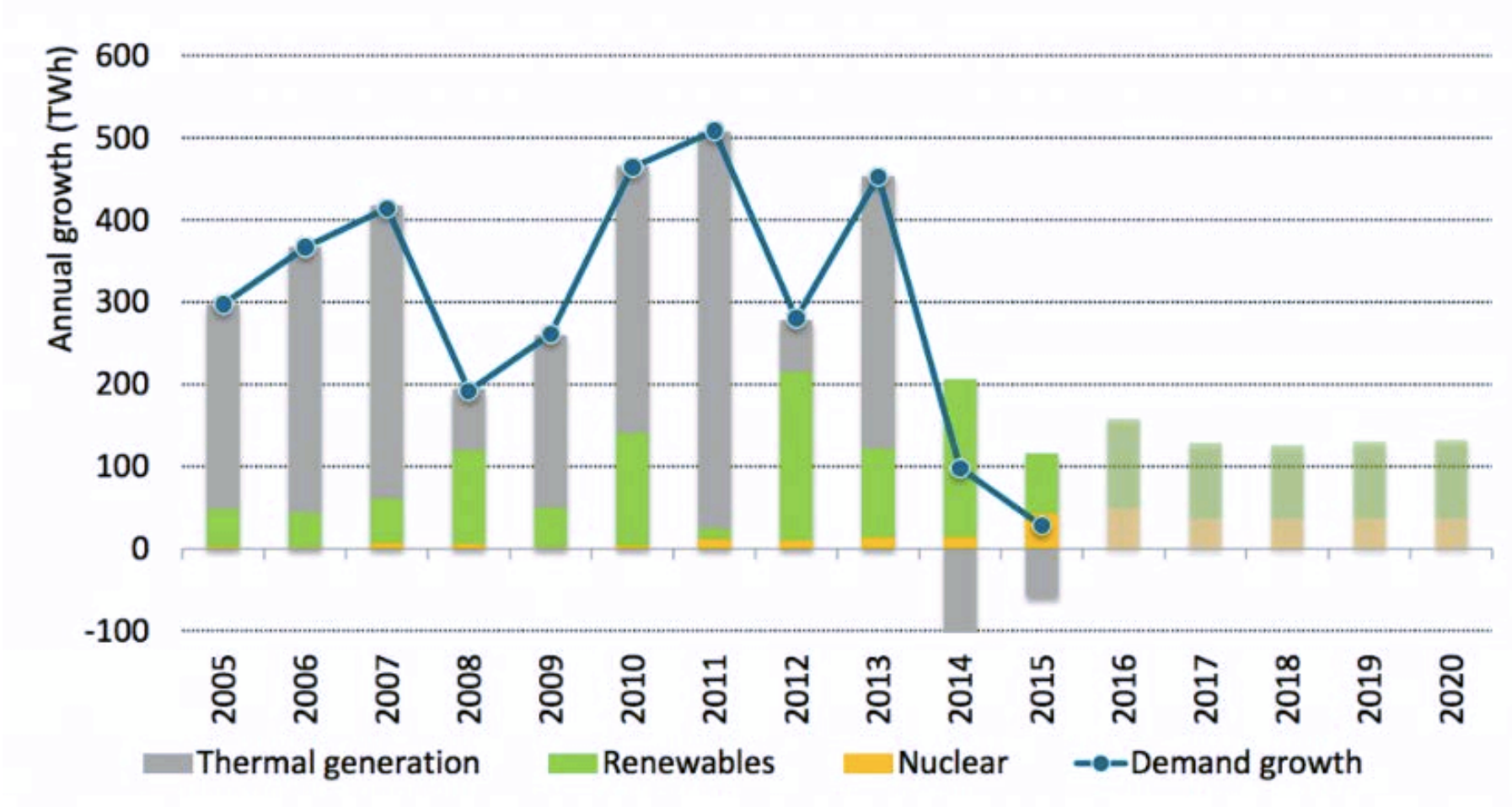
2. Electricity Markets are Transforming

China State Grid's Chairman in February 2016 stated:

The only hurdle to overcome is "mindset," Liu said. "There's no technical challenge at all."

http://www.eenews.net/energywire/2016/02/26/stories/1060033055

2.1 IEA – China Electricity 2005-2020



China's power generation growth (bars) and demand growth (line). Source: World Energy Investment 2016, IEA.

IEA figures released Nov 2016 – upgrading world wind electricity forecast by 50% to 5,394TWh by 2040.

2.1 IEA Energy Productivity - China

Energy Productivity	2003-2013	2014	2015	2016
GDP Growth	10.0%	7.3%	6.9%	6.7%
Energy Intensity	-2.2%	-4.8%	-5.6%	-5.2%
TPES *	7.6%	1.6%	0.9%	1.1%

* TPES - Total Primary Energy Supply

Something fundamentally shifted post 2013

Source: IEA October 2016 Energy Efficiency Study, IEEFA calculations

2.1 China's Electricity Sector

China's thermal coal's share of electricity generation:

2012 76.4%
2014 72.2%
2020 59.8%
2030: 50-55%
2040: 42% (IHS)

China's Power Industry

Installed Capacity (GW)	End 2014		2020	
	GW	%	GW	%
Thermal (coal)	855	61.8%	1,018	53.3%
Thermal (gas)	53	3.8%	80	4.2%
Biomass / CHP / EfW	9	0.7%	23	1.2%
Hydro	303	21.9%	364	19.1%
Nuclear	20	1.4%	47	2.5%
Wind - Onshore	111	8.0%	240	12.6%
Wind - Offshore	1	0.0%	9	0.5%
Solar - Utility Scale excluding distributed	32	2.3%	123	6.5%
Total Generation Capacity	**1,384**		**1,909**	
CAGR in coal-fired power generation for 2014-2020 (TWh)			0.8%	
CAGR in thermal coal use for power for 2014-2020 (Mt)			-0.4%	
CAGR in power demand for 2014-2020 (TWh)			3.1%	
CAGR in power capacity for 2014-2020 (GW)			5.5%	
GDP Growth for 2014-2020 (%)			6.3%	

2.2 India

India's Energy Minister Goyal stated December 2016:

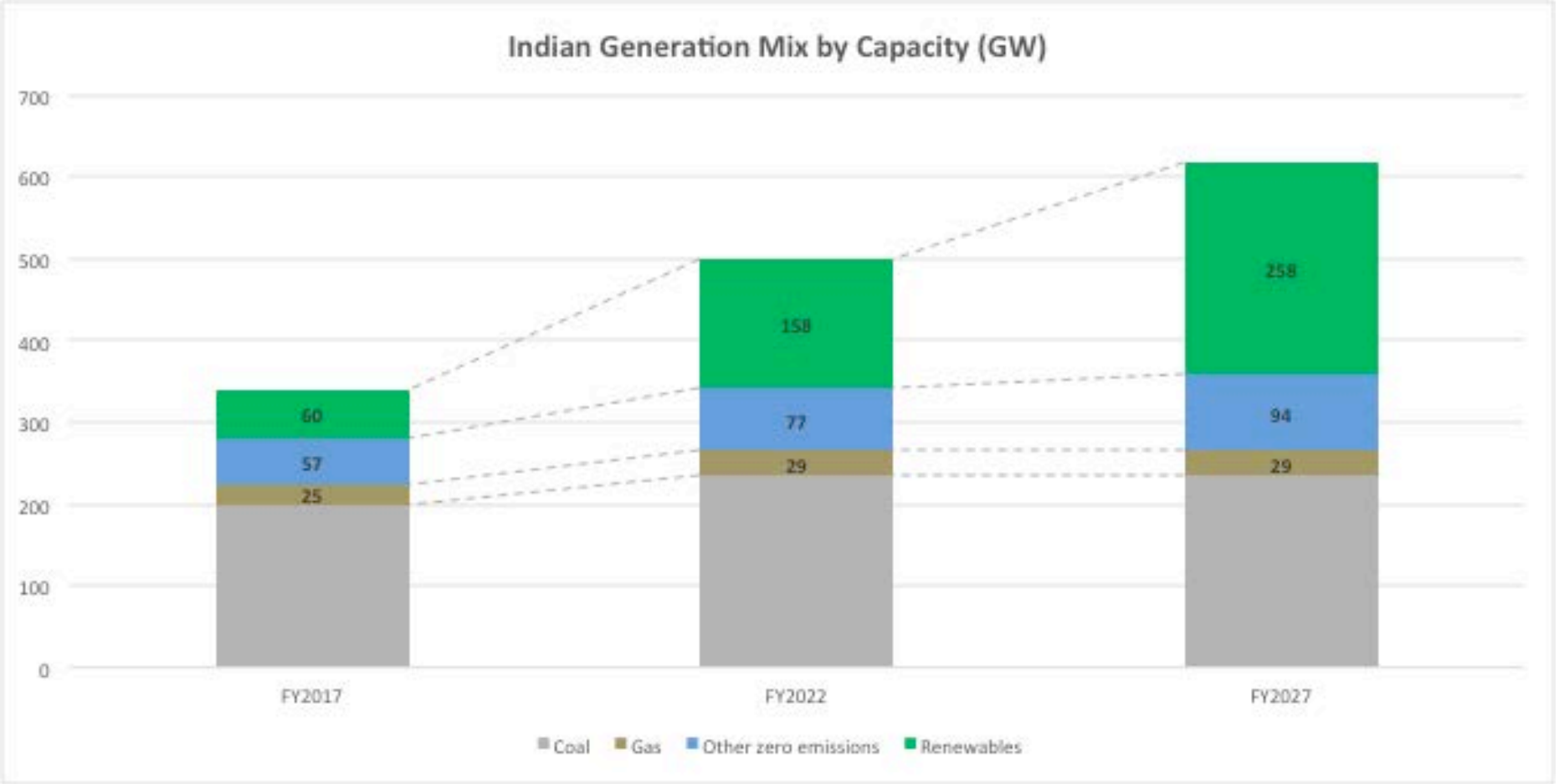
1. *A plan to transformation the entire Indian electricity system with 258GW of renewable energy installs by FY2027 vs 43GW in FY2016. This involves a doubling of wind installs to 6GW pa and lifting solar installs trebling to >10GW pa.*

2. *Thermal power of 265GW in FY2027 would represent just 43% of total system capacity, down from 69% in FY2016. The CEA concluded no new coal fired capacity was needed this coming decade.*

1. *Plans to more than double India's domestic coal production to 1.5Bn tpa by 2021, requiring a massive investment in rail infrastructure, CH&PP plus major new domestic mine development.*

Source: India's CEA, draft National Electricity Plan", December 2016
http://www.cea.nic.in/reports/committee/nep/nep_dec.pdf

2.2 India



Source: India's CEA, draft National Electricity Plan", December 2016
http://www.cea.nic.in/reports/committee/nep/nep_dec.pdf

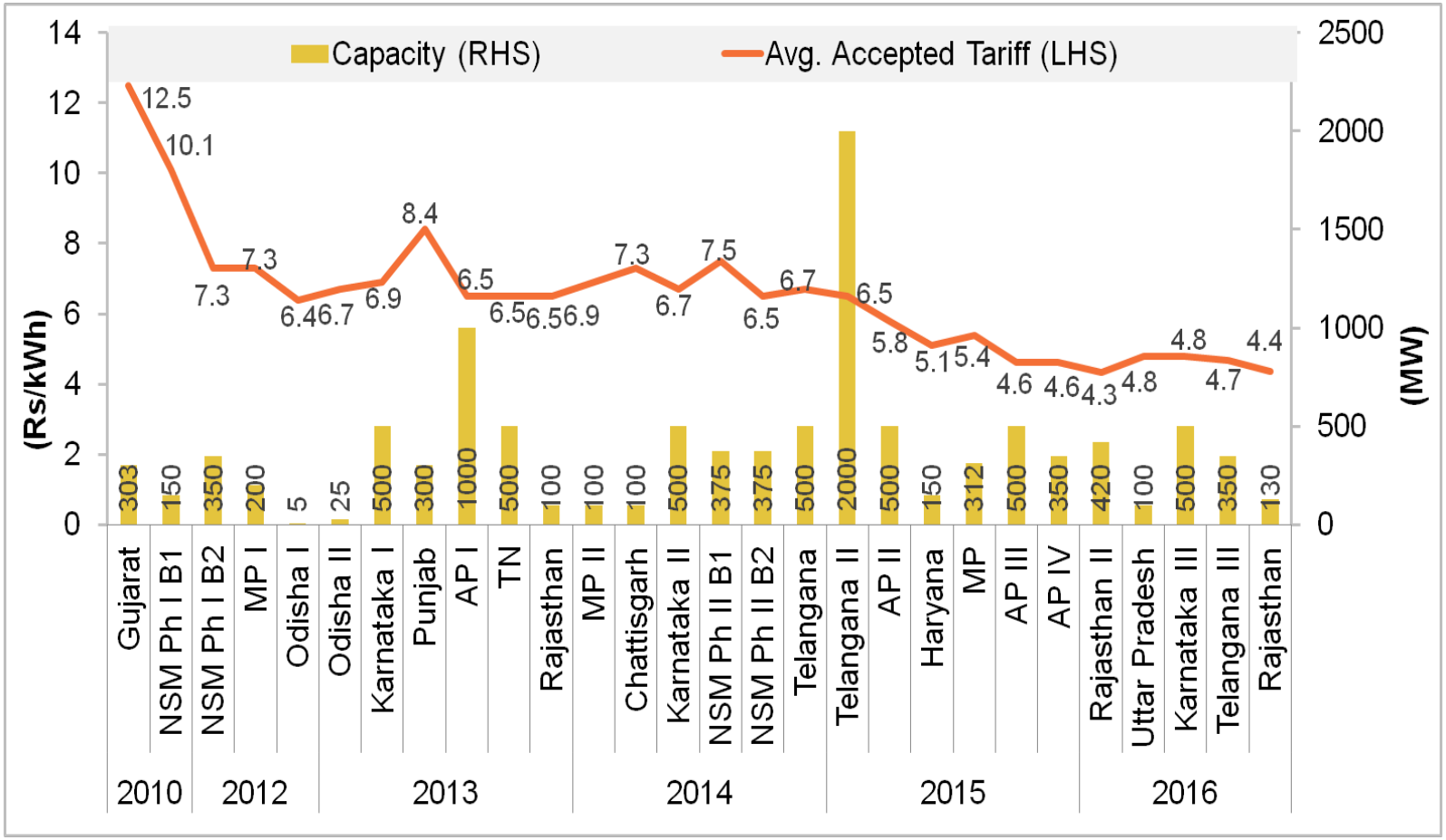
2.2 India

After the 6% yoy decline 2015/16 and an expected further 6% fall in 2016/17 for coal imports, Energy Minister Piyush Goyal stated rather categorically:

> *"Indian companies used to import a lot of thermal coal. We want to completely stop its import over the next 2-3 years. We have already reduced imports by Rs280bn. We will save Rs400bn."*

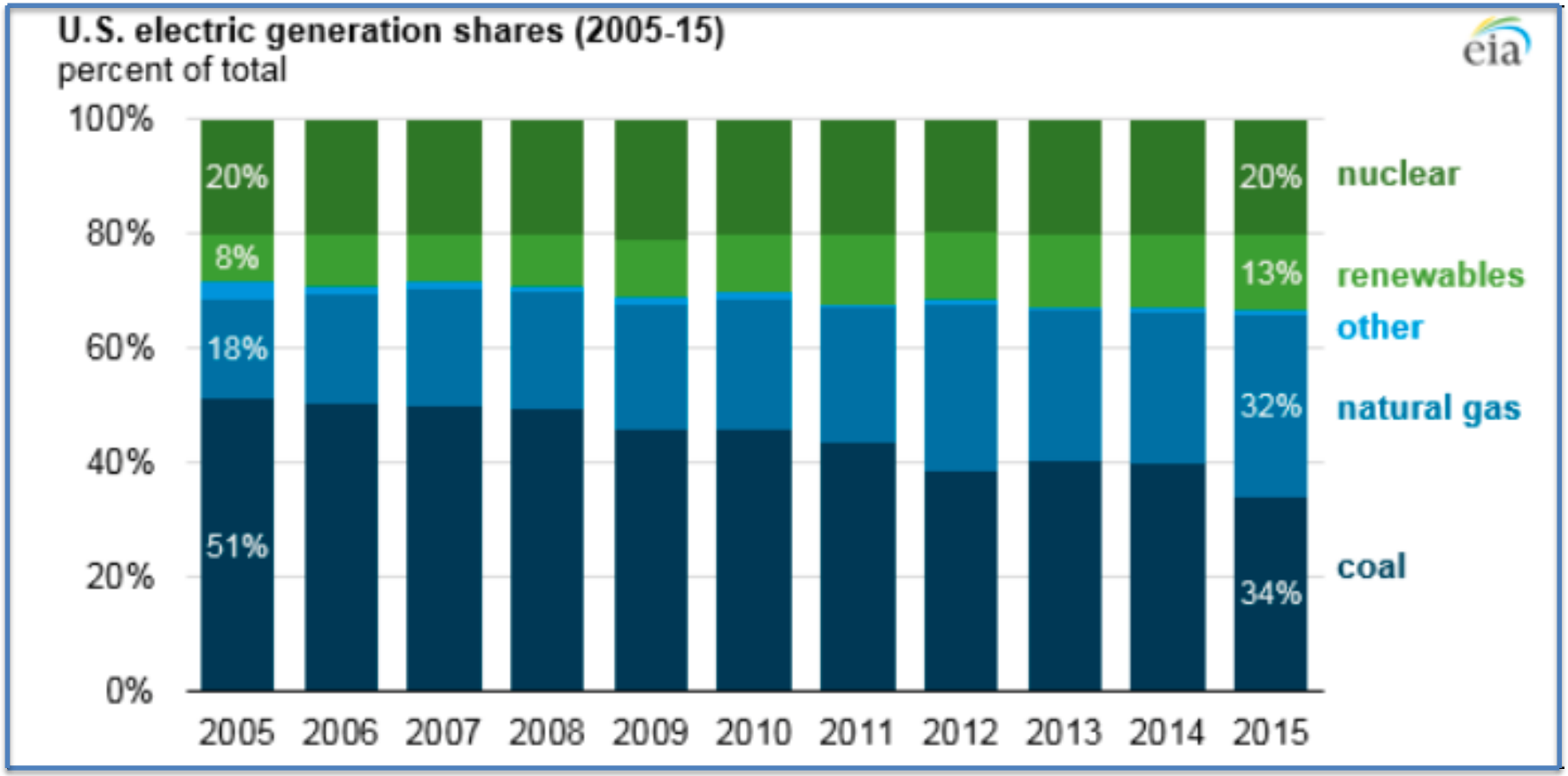
http://www.businesstoday.in/current/policy/govt-considering-thermal-coal-import-in-two-three-years/story/231166.html

2.2 India – Solar Tariffs Are Falling Rapidly



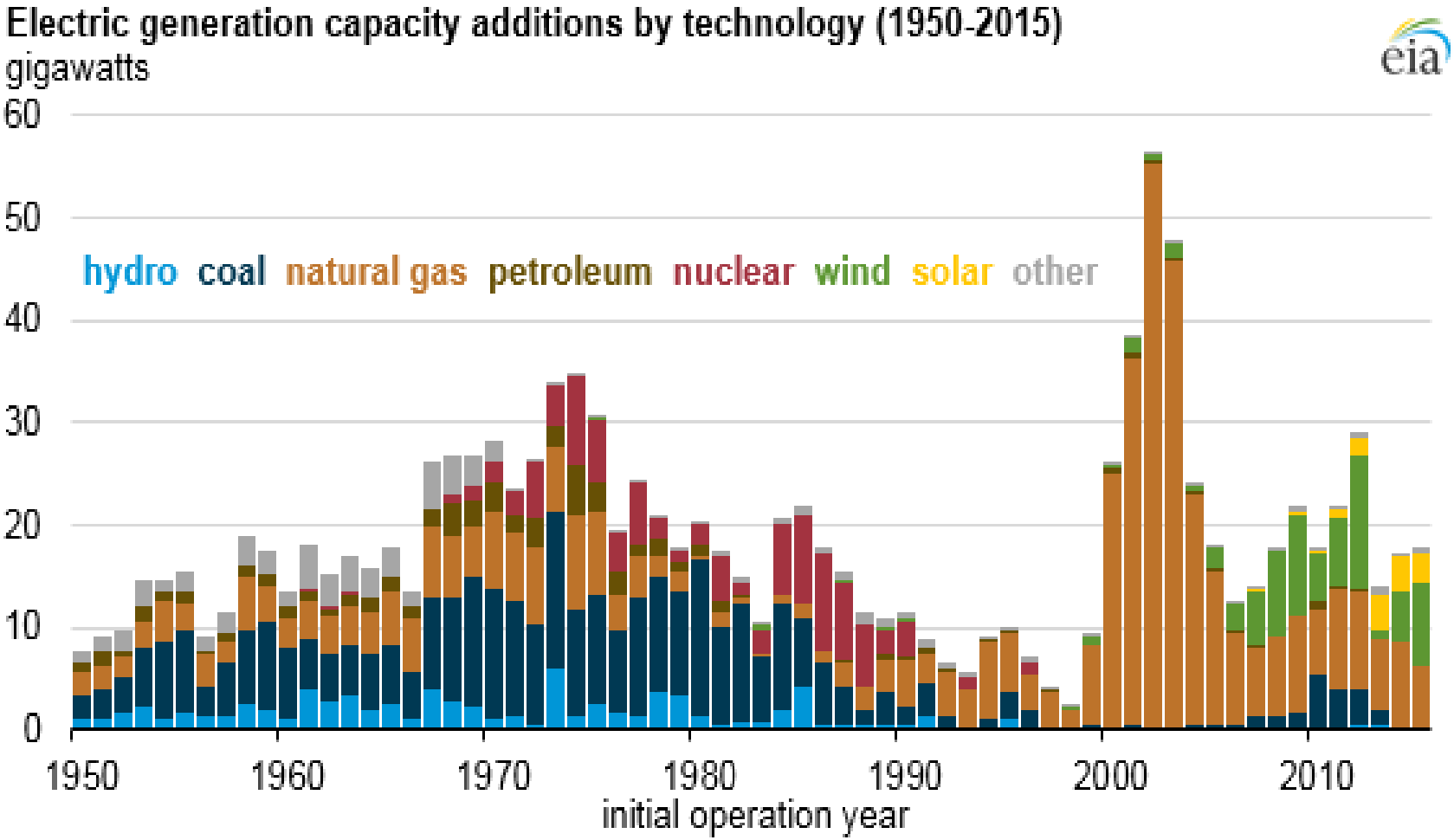
Feb 2017: A new low utility solar of Rs3.59/kWh (US$53/MWh) was set: 16% lower than one year earlier. This is down from Rs12/kWh in 2010.

2.3 US Electricity Transformation



EIA YTD Nov'2016: estimates coal share @ 30% for 2016
http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_es1b

2.3 US Electricity Transformation



http://www.eia.gov/todayinenergy/detail.cfm?id=25432&src=email

2.4 Japan

Japan's thermal power demand outlook: down 40% by 2030

1. ***Energy efficiency*** *– 11.5% decline in electricity demand from FY2010-FY2015 despite 0.6% pa GDP growth (a 3.0% pa electricity productivity gain)*

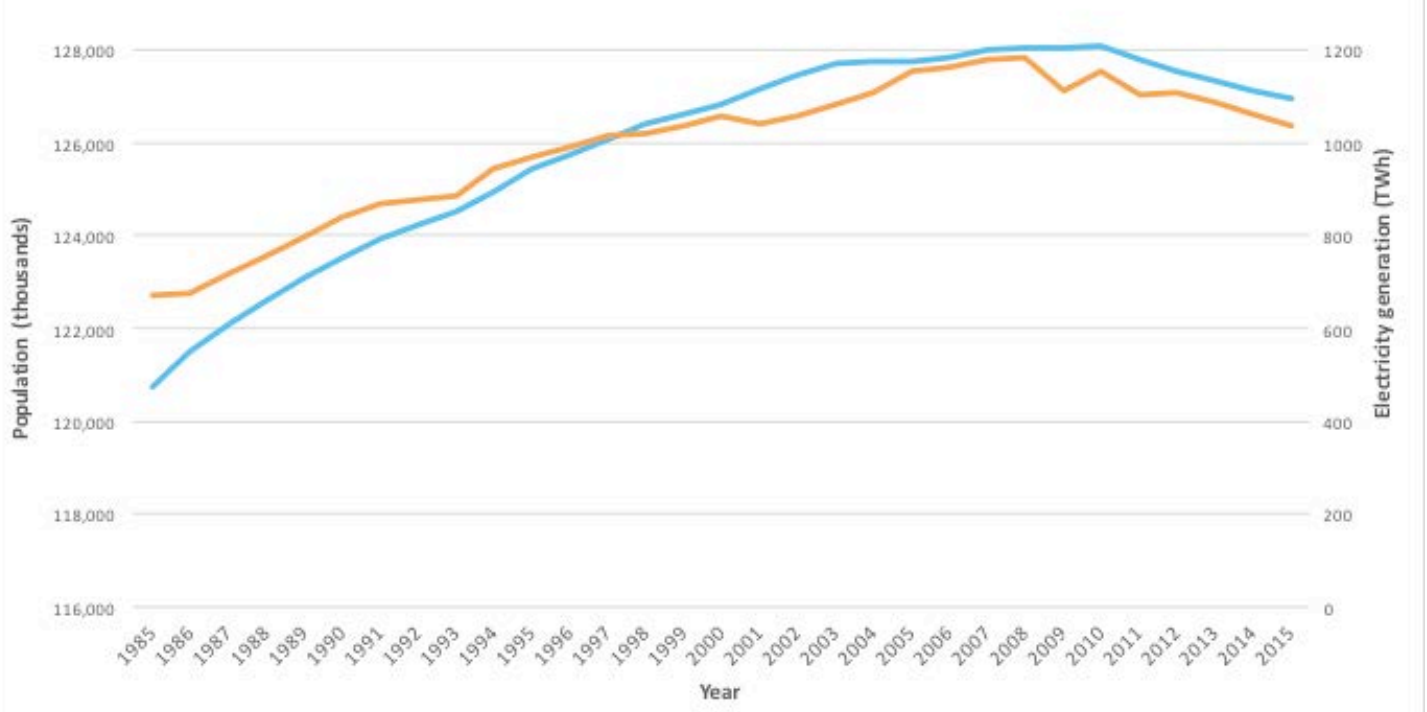
2. ***Nuclear restart*** *– The key question is the rate of restarts for 40GW of nuclear capacity – US$50bn of idle assets. Just 3 unit restarts to-date.*

3. ***Solar surge*** *– Japan installed ~10GW pa in FY2014, FY2015 and FY2016; part of a 80GW pipeline of approved projects. 10GW of offshore wind by 2030.*

4. ***LNG vs coal vs oil*** *– relative price moves: Japanese LNG pricing has halved in US$ terms over 2014-16. Japan signed 1000Bcf/year of new US LNG supply contracts due online by 2020. IEEFA forecasts a 40% decline in thermal power generation by 2030, => falling utilisation rates and stranded assets.*

2.4 Japan

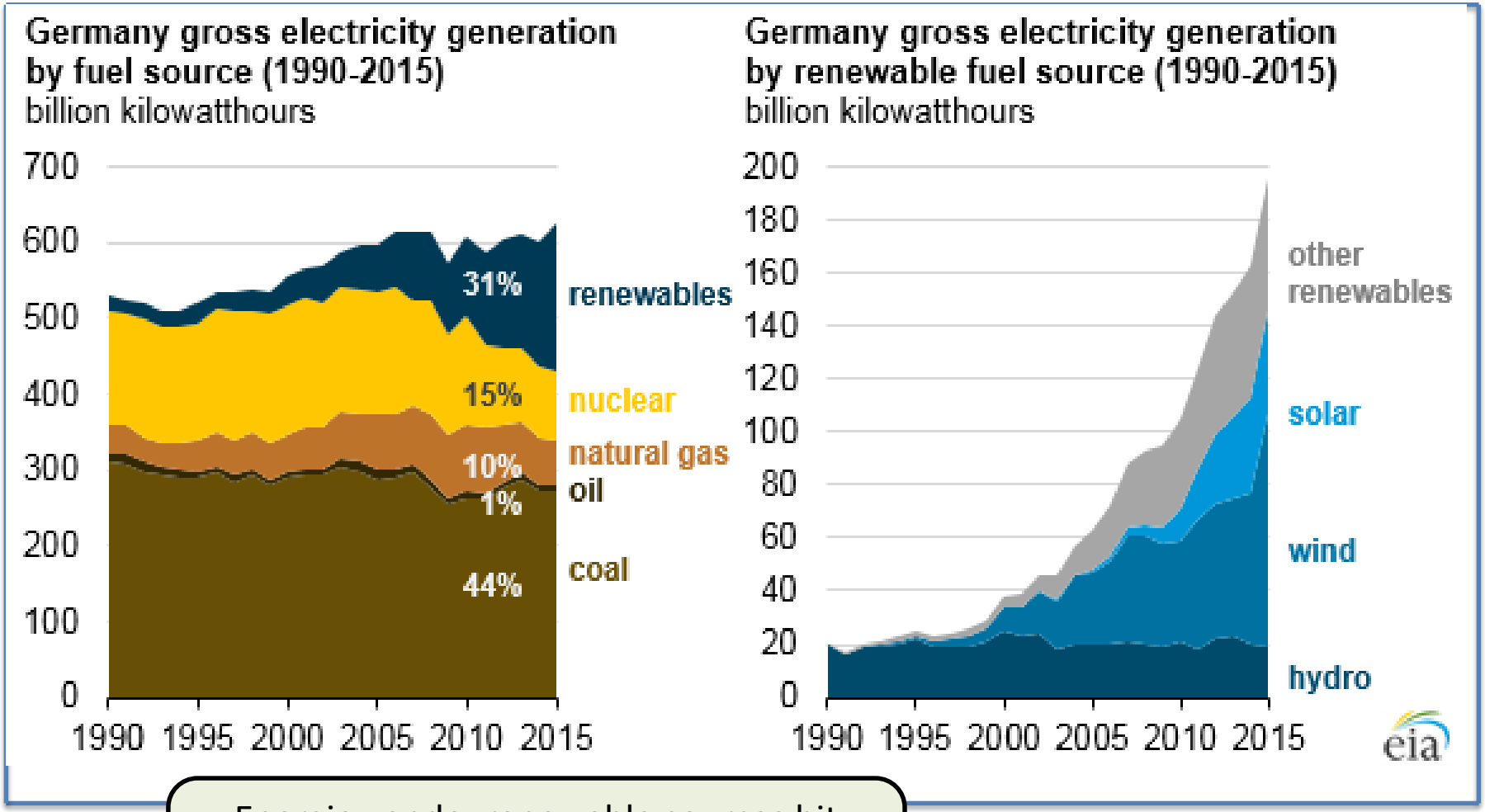
Japan's Historical Population and Electricity Generation



	FY2010	FY2011	FY2012	FY2013	FY2014	FY2015	2011-2015 Average
Electricity Generation (TWh) - IEA	1,140	1,074	1,056	1,059	1,035	1,009	
Change in electricity generation		-5.8%	-1.7%	0.3%	-2.2%	-2.6%	-2.4%
GDP Growth (%) - World Bank		-0.5%	1.7%	1.4%	0.0%	0.5%	0.6%
Electricity Productivity (p.a.)		**5.4%**	**3.4%**	**1.1%**	**2.2%**	**3.0%**	**3.0%**

Source: World Bank, BP Statistical Review of World Energy, IEA Japan Report

2.5 German Electricity Transformation



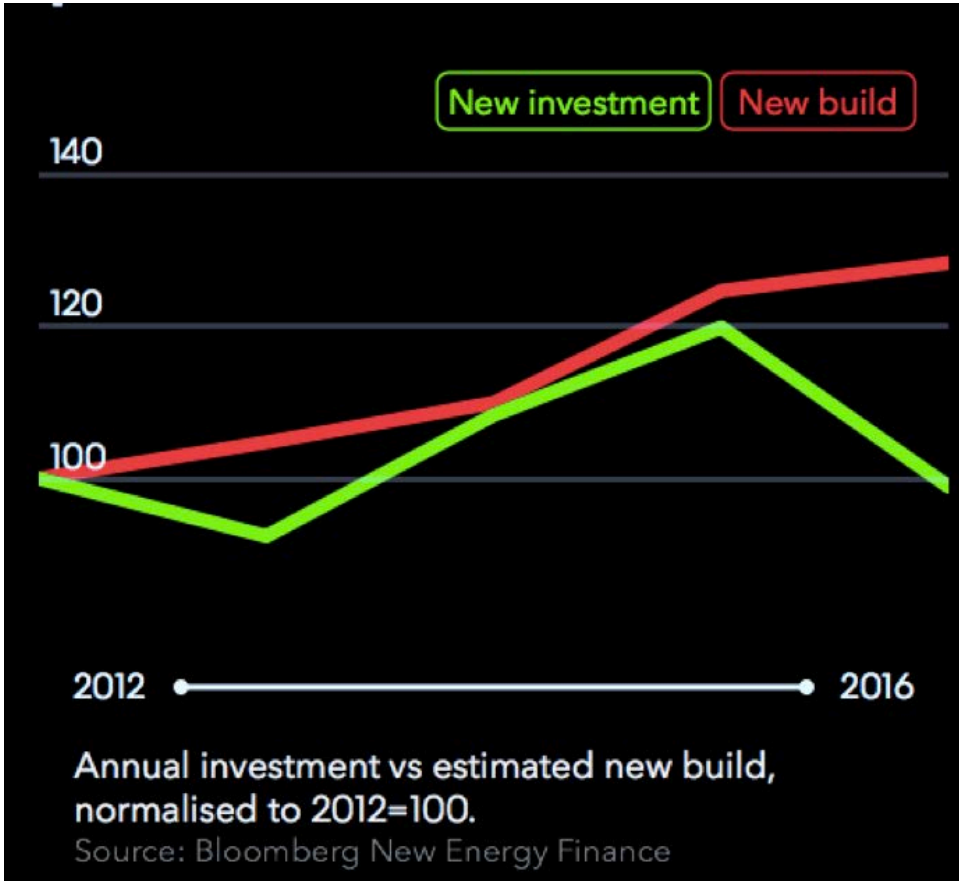
Energiewende: renewable sources hit 34.8% share in YTD Nov'2016 to increase to 40-45% by 2025 and to >80% by 2050

3 Thermal Coal Export Price Volatility

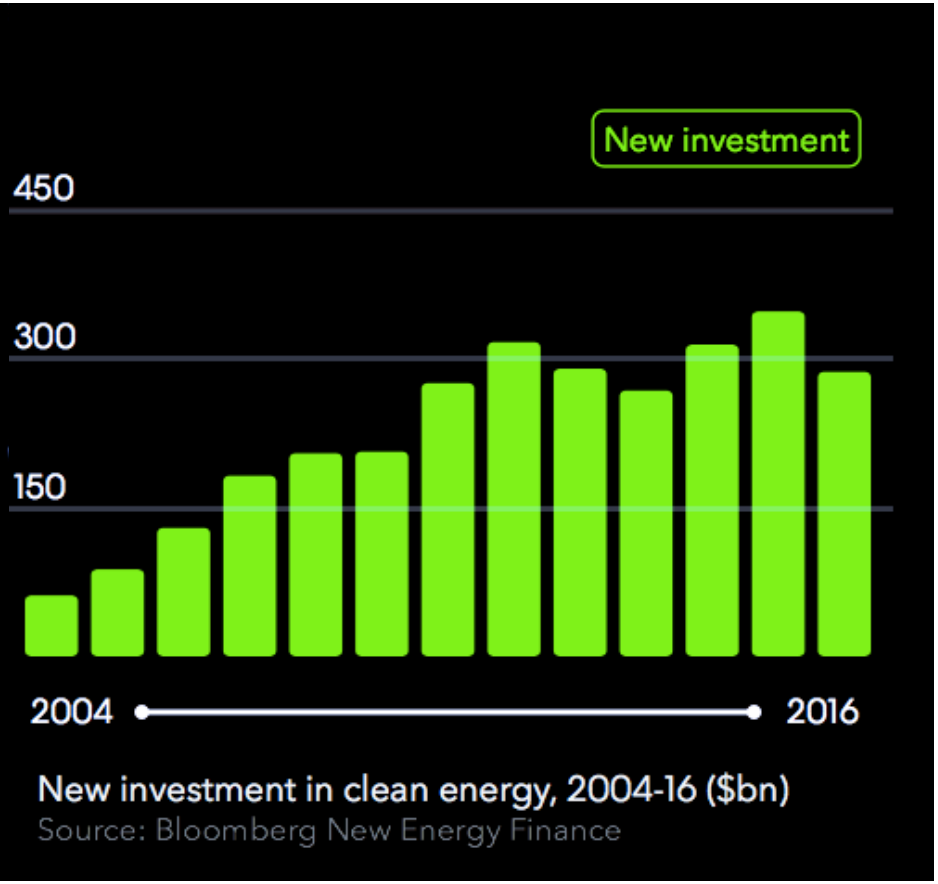
Description: Coal, Australian thermal coal, 12000- btu/pound, less than 1% sulfur, 14% ash, FOB Newcastle/Port Kembla, US Dollars per Metric Ton

http://www.indexmundi.com/commodities/?commodity=coal-australian&months=60
https://www.barchart.com/futures/quotes/LQ*0/all-futures

4 Renewable Energy

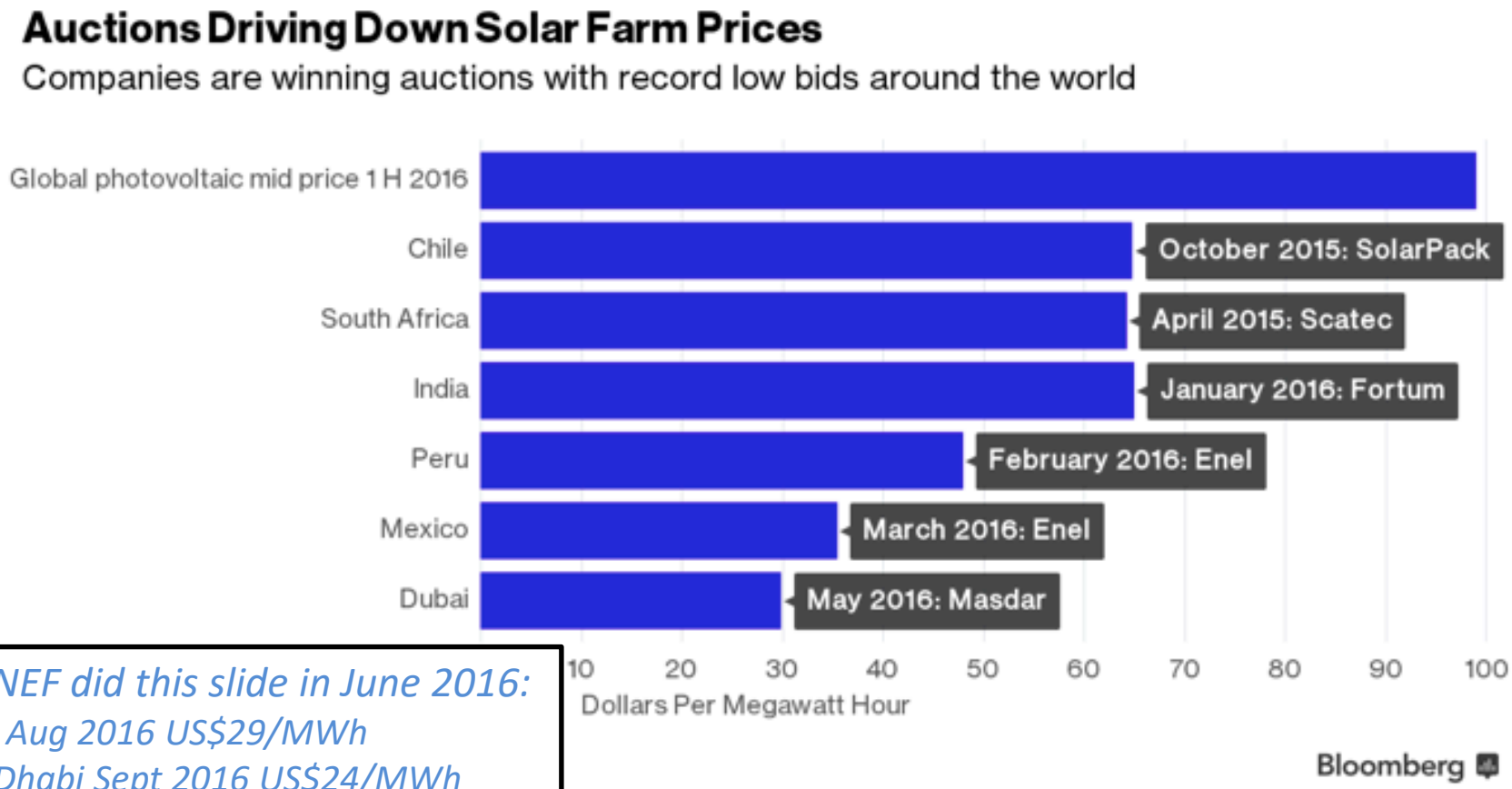


Annual investment vs estimated new build, normalised to 2012=100.
Source: Bloomberg New Energy Finance



New investment in clean energy, 2004-16 ($bn)
Source: Bloomberg New Energy Finance

4.1 Solar cost reductions

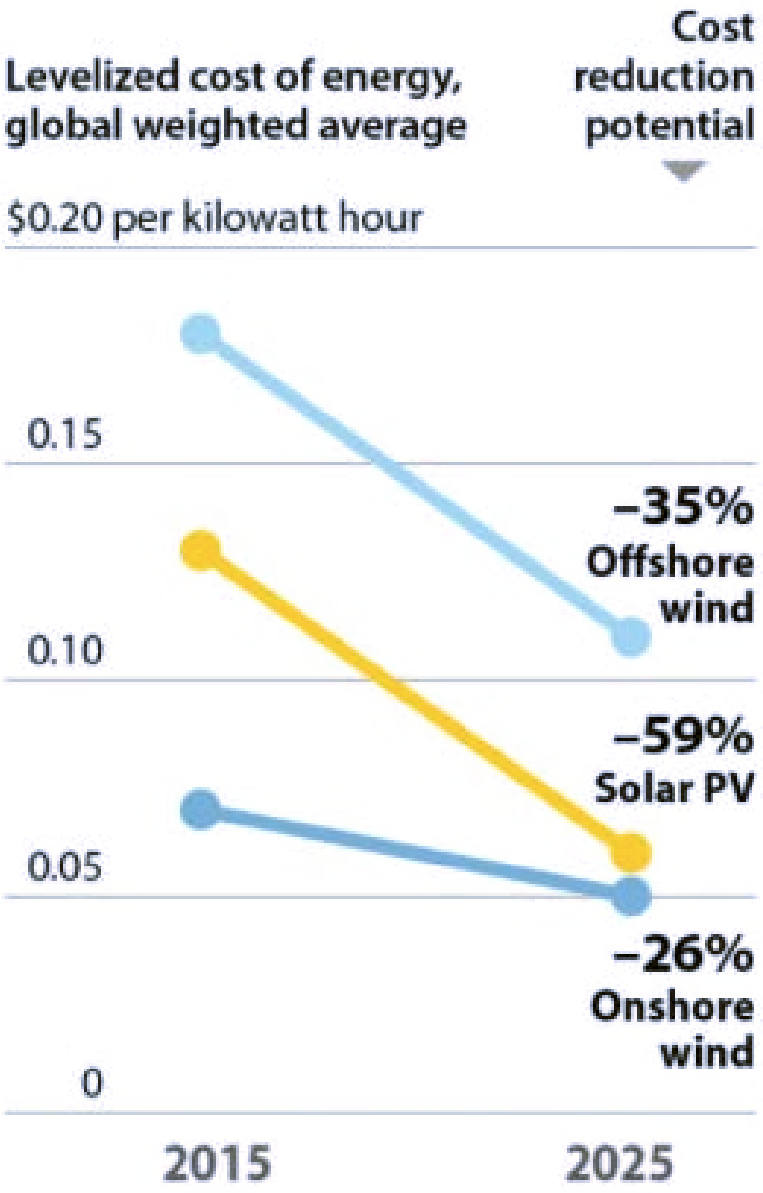


Since BNEF did this slide in June 2016:

- *Chile Aug 2016 US$29/MWh*
- *Abu Dhabi Sept 2016 US$24/MWh*
- *Australia Dec 2016 US$64/MWh*
- *Germany Feb 2017 US$54/MWh*
- *India Feb 2017 US$53/MWh*

http://www.bloomberg.com/news/articles/2016-06-16/solar-s-latest-subsidy-is-squeezing-down-costs-and-companies

4.3 Global Average RE Cost Reductions

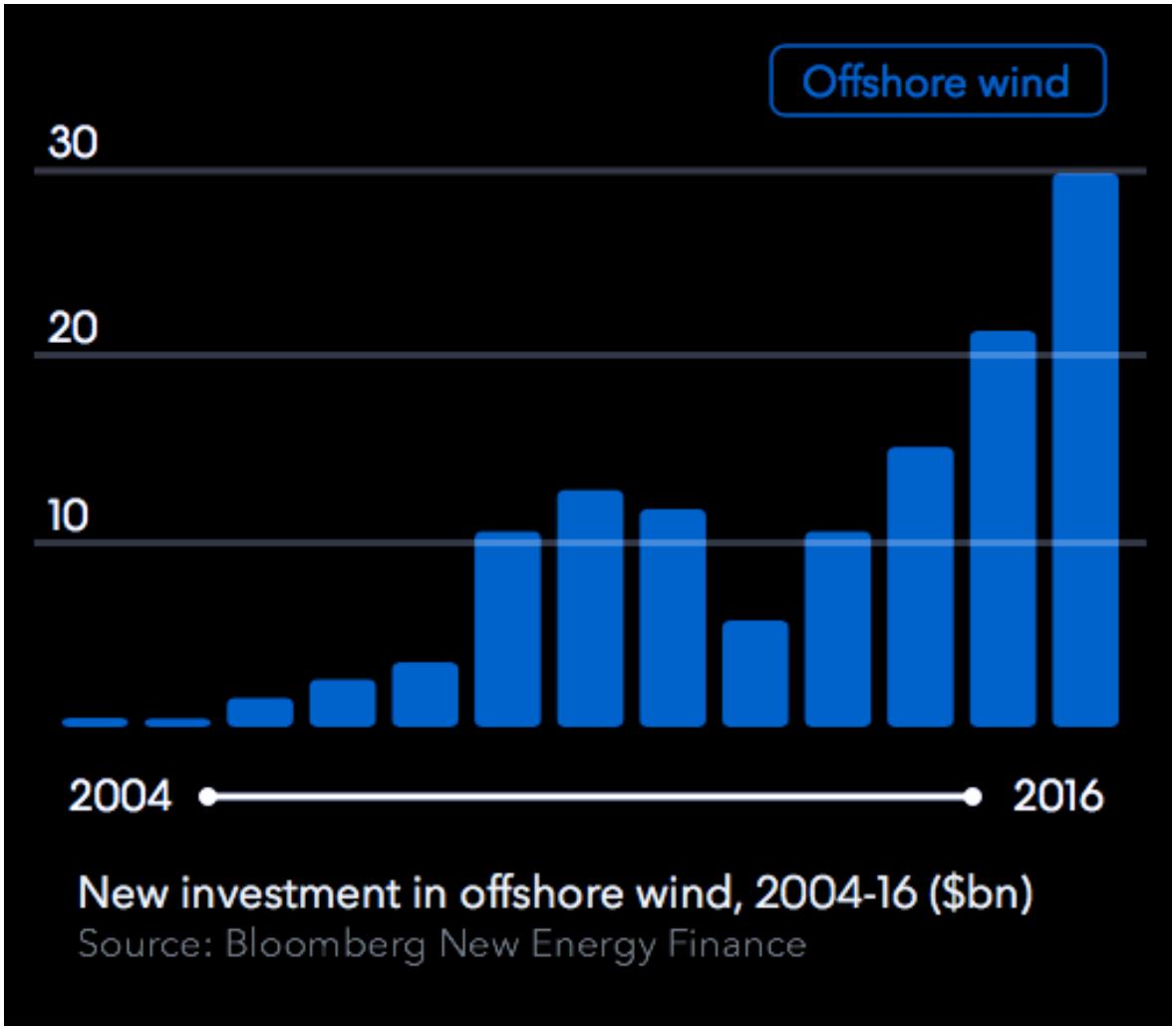


Source: International Renewable Energy Agency, *June 2016*
http://www.bloomberg.com/news/articles/2016-06-15/cost-of-clean-energy-to-keep-nosediving-into-next-decade

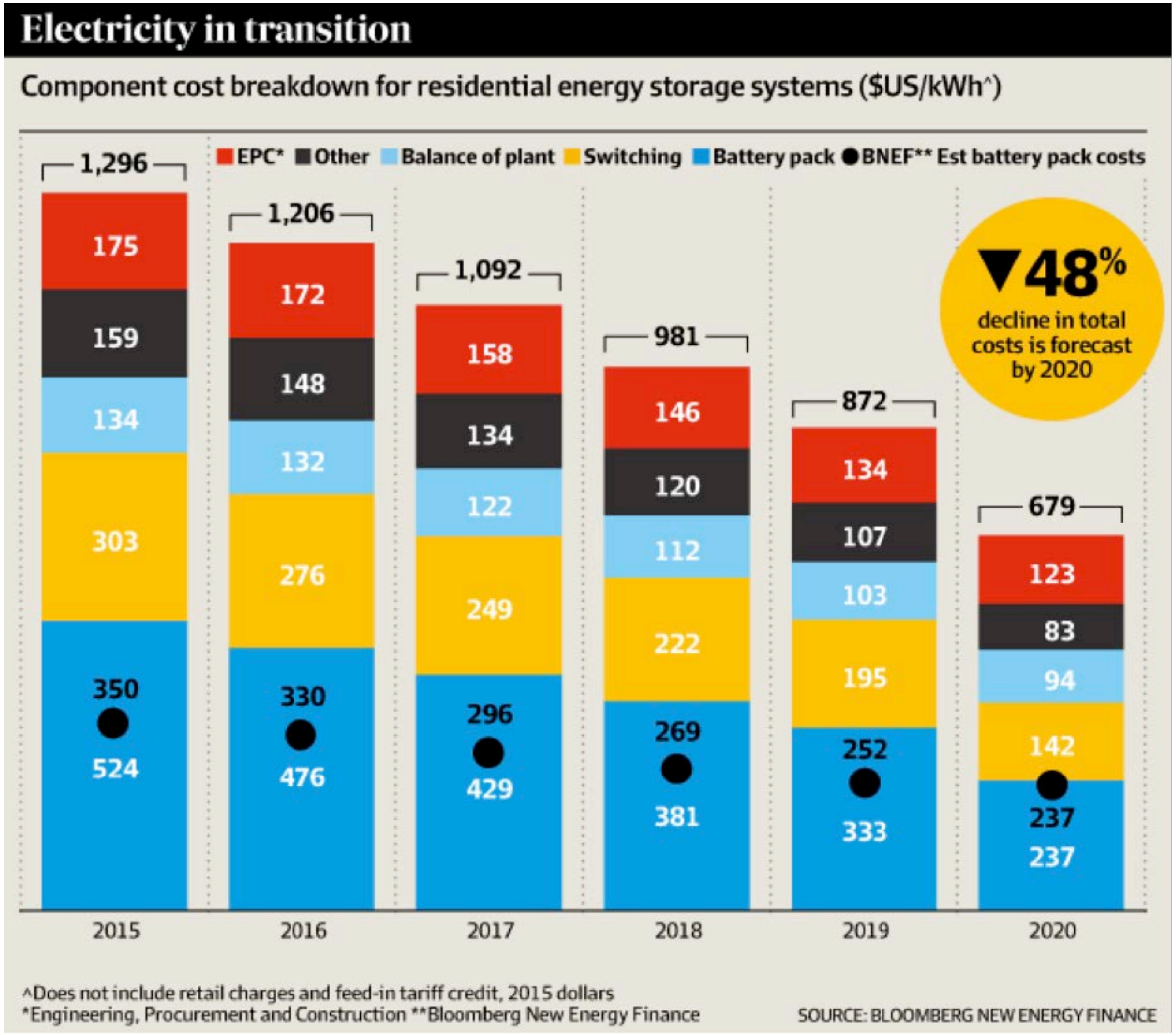
4.4 Offshore Wind – Just Starting

Nov 2016: Vattenfall tendered a record low €50/MWh (US$53) for offshore wind in Denmark. This is half the rate forecast by IRENA for 2025.

A big opportunity for MHI Vestas



4.5 Storage is coming, rapidly



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