

10 June 2015

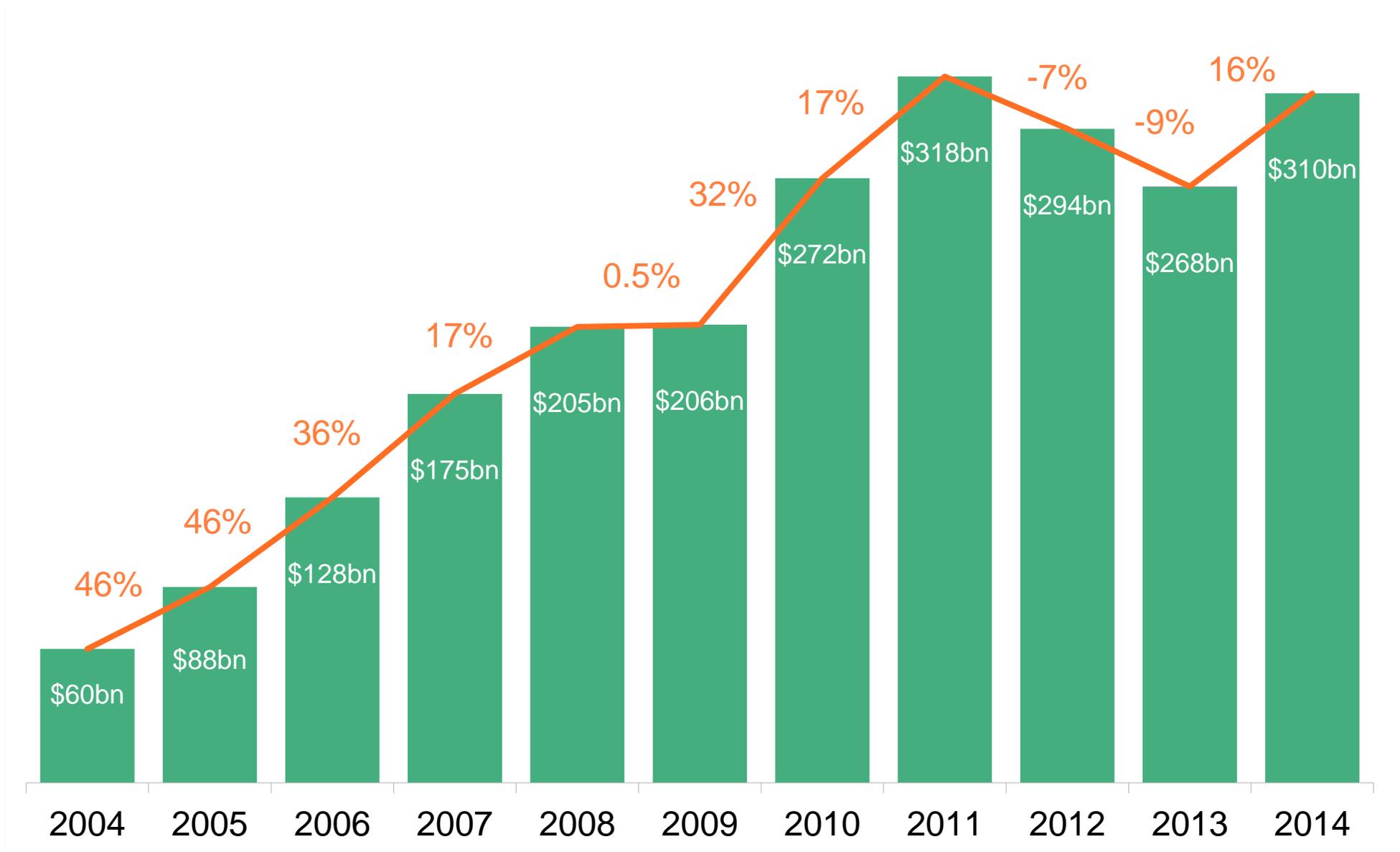
# RENEWABLES AND FOSSIL FUELS COST TRENDS

APERC Annual Conference,  
9 -10 June 2015, Hotel New Otani, Tokyo

Ali Izadi

**Bloomberg**  
NEW ENERGY FINANCE

# NEW INVESTMENT IN CLEAN ENERGY 2004 – 2014 (\$BN)



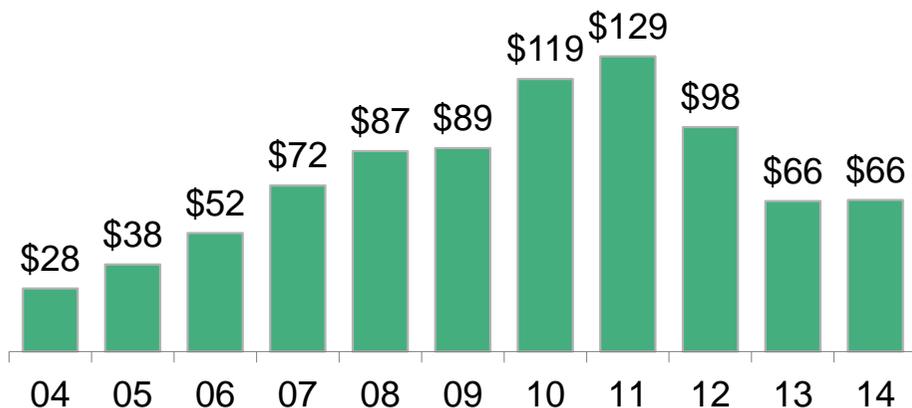
Note: Total values include estimates for undisclosed deals. Includes corporate and government R&D, and spending for digital energy and energy storage projects.

Source: Bloomberg New Energy Finance

# CLEAN ENERGY INVESTMENT BY REGION

## 2004 – 2014 (\$BN)

### Europe



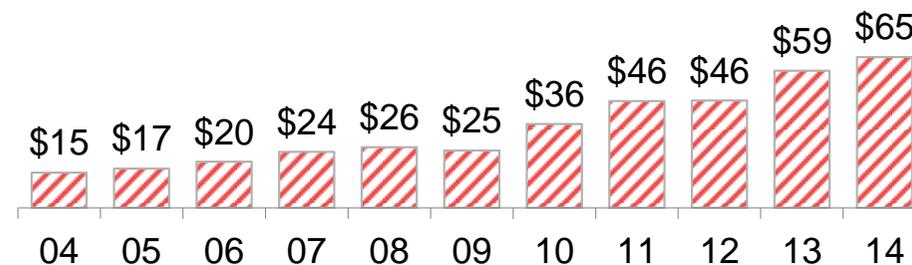
### United States



### China



### Asia ex-China



Source: Bloomberg New Energy Finance

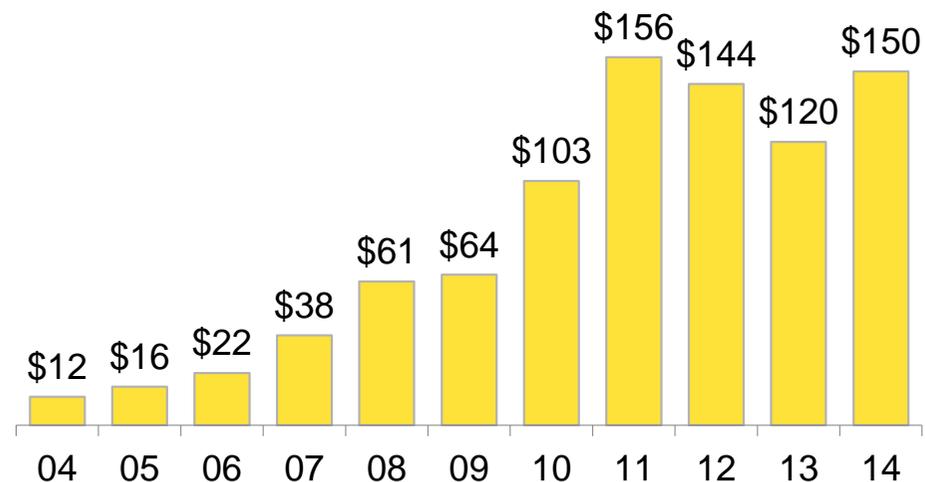
# CLEAN ENERGY INVESTMENT BY SECTOR

## 2004 – 2014 (\$BN)

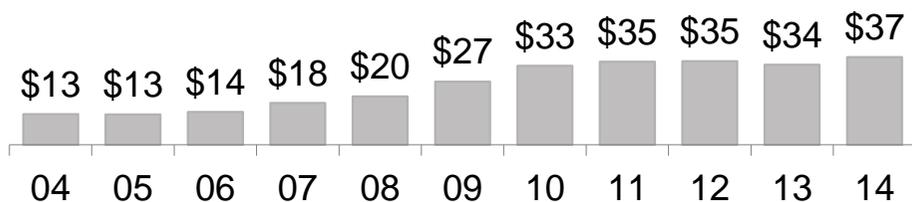
### Wind



### Solar



### Energy Smart Technologies (EST)

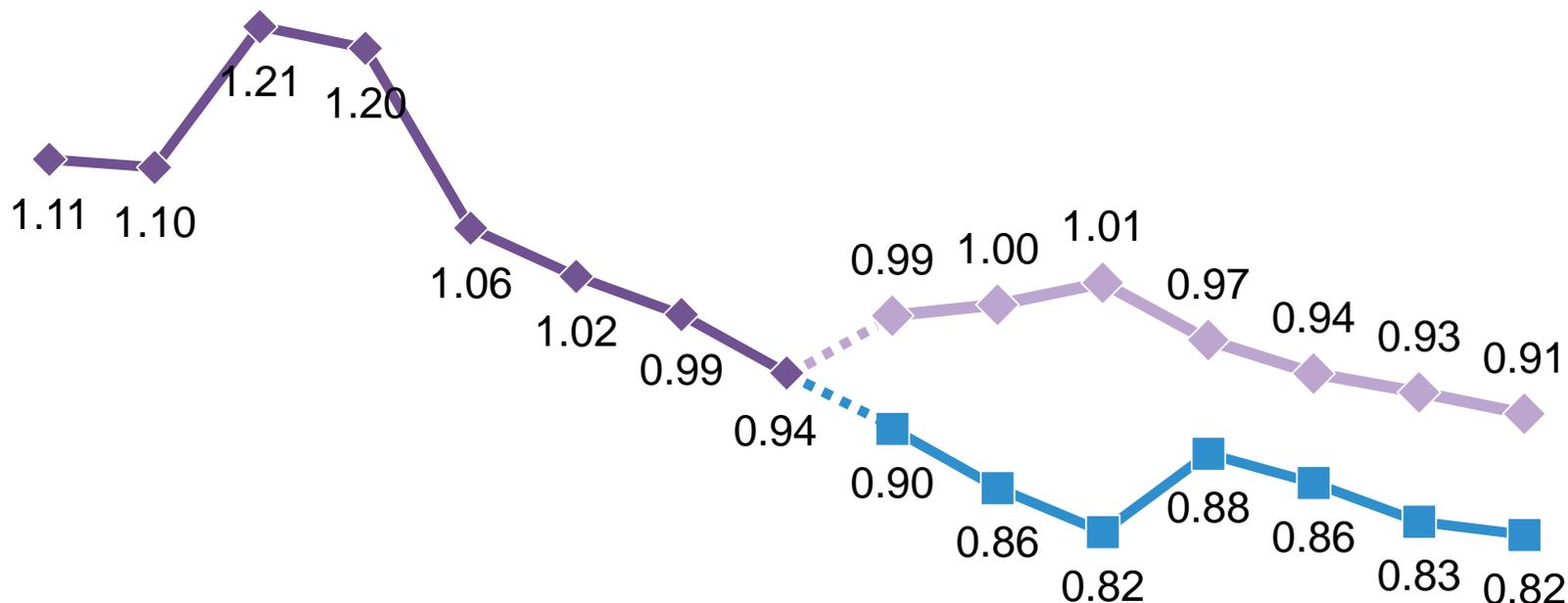


### Biofuels



Source: Bloomberg New Energy Finance

# WIND TURBINE PRICE INDEX MEAN PRICE BY DATE OF DELIVERY H1 2008 – H1 2015 (€M/MW)



H1	H2	H1												
2008		2009		2010		2011		2012		2013		2014		2015

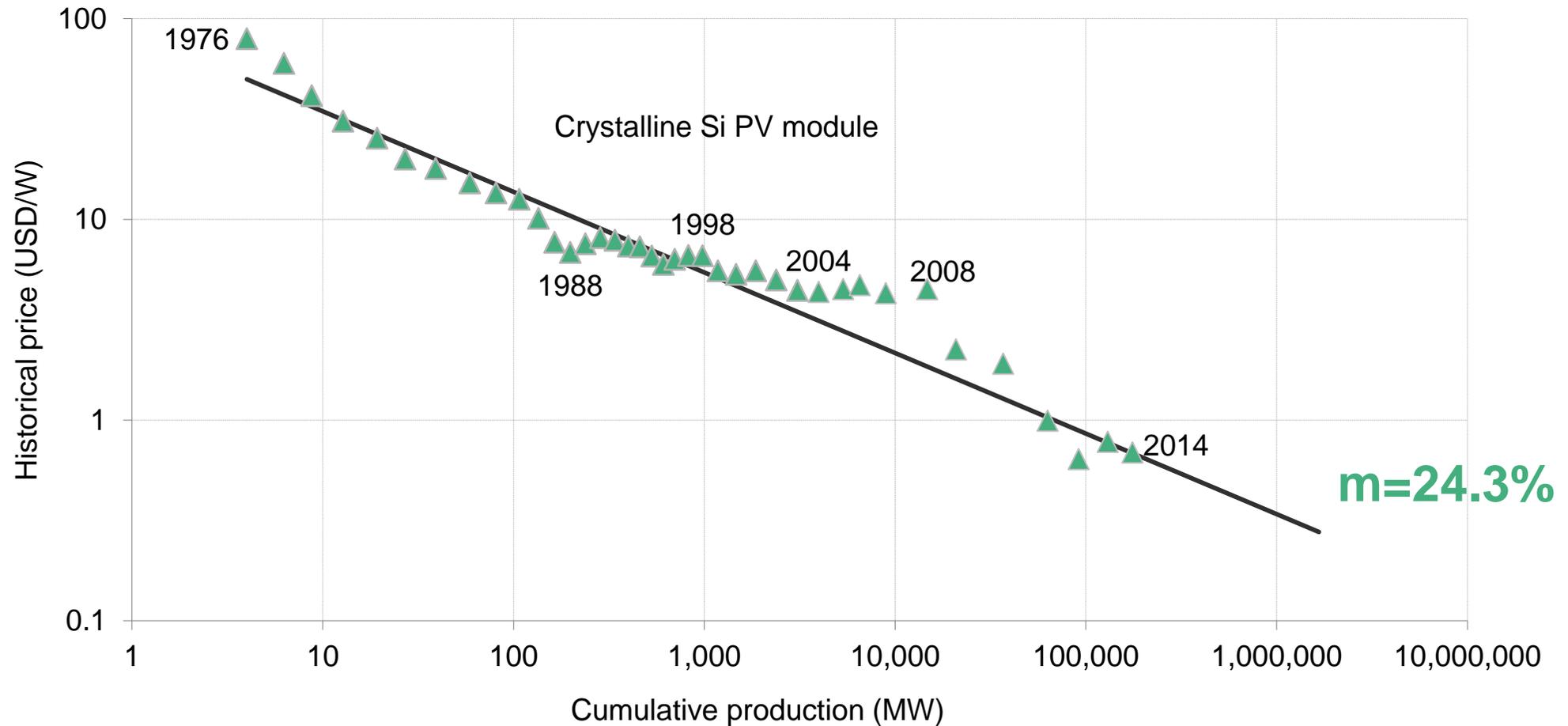
◆ WTPI

■ <95m rotor diameter

◆ >95m rotor diameter

Source: Bloomberg New Energy Finance Note: Contract prices include turbine plus towers and transport to site, and they exclude VAT. Turbine contracts signed for delivery in China are excluded from this Index.

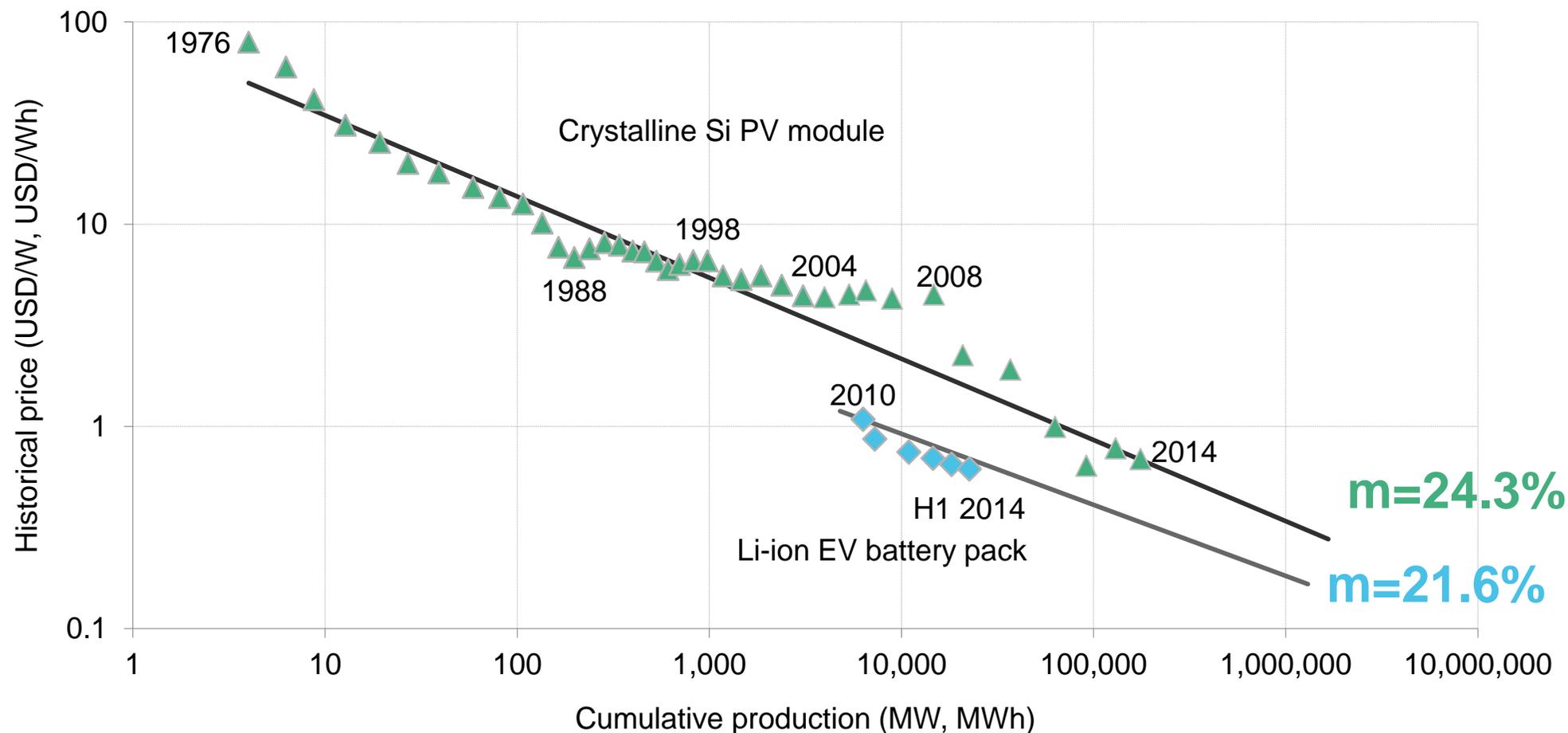
**Solar PV module experience curve: 24% cost reduction for every doubling of capacity**



Note: Prices are in real (2014) USD.

Source: Bloomberg New Energy Finance, Maycock, Battery University, MIT

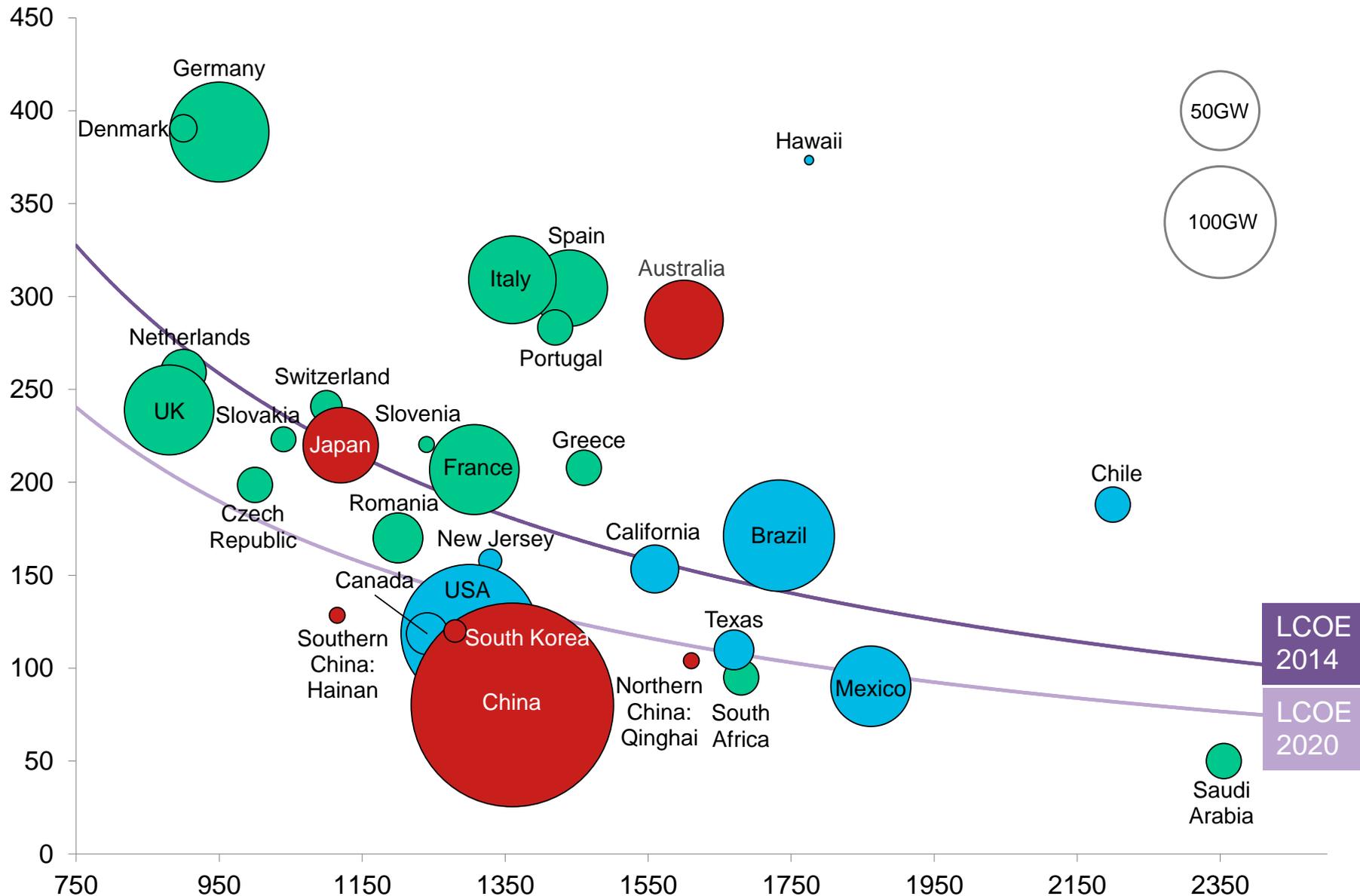
# LITHIUM-ION EV BATTERY EXPERIENCE CURVE COMPARED WITH SOLAR PV EXPERIENCE CURVE



Note: Prices are in real (2014) USD.

Source: Bloomberg New Energy Finance, Maycock, Battery University, MIT

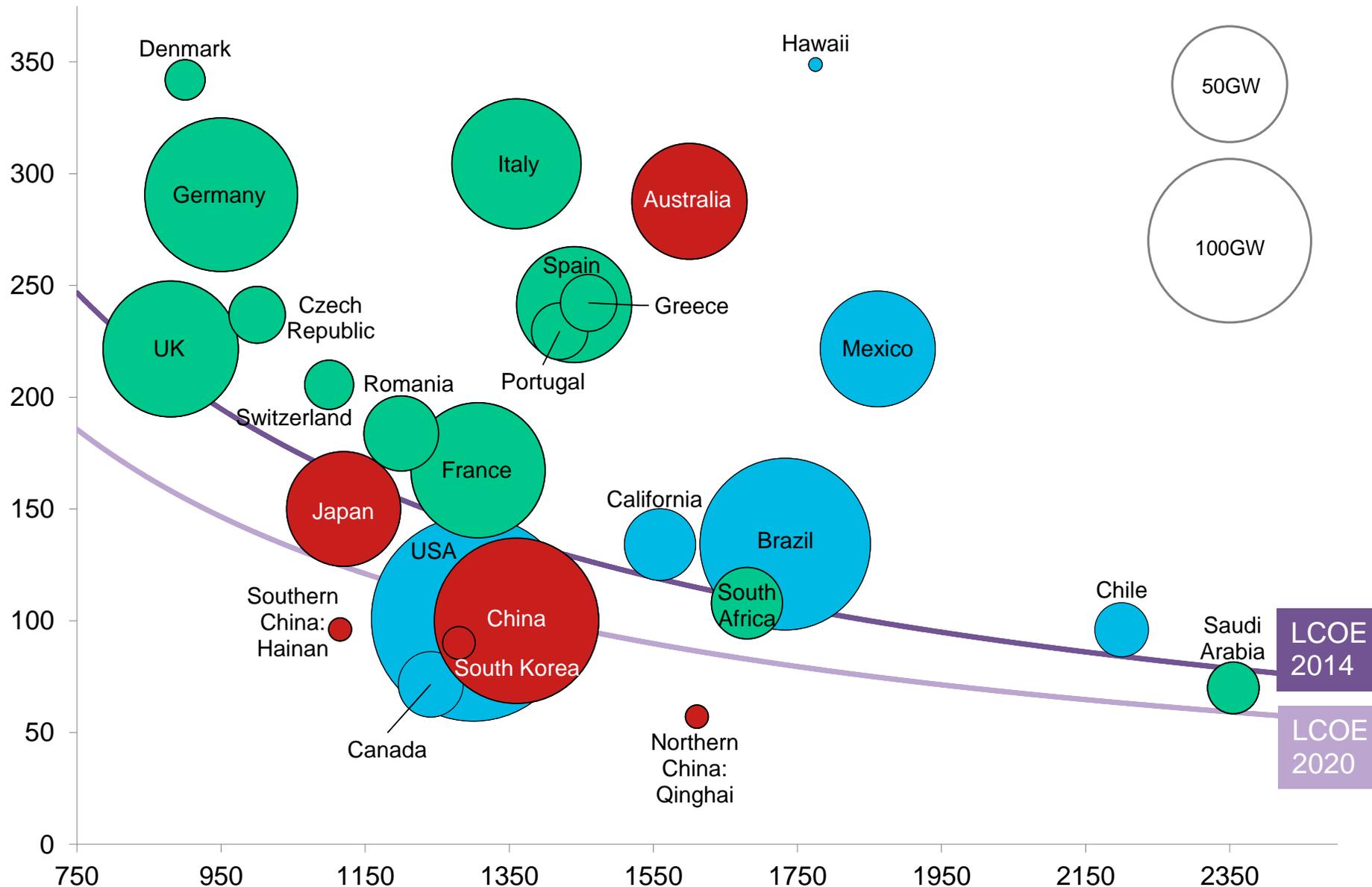
# AVERAGE RESIDENTIAL ELECTRICITY PRICE (USD/MWH) AGAINST AVERAGE ANNUAL OUTPUT PER WATT INSTALLED (KWH/KW/YEAR)



Note: Bubble size represents approximate total residential rooftop PV market potential

Source: Bloomberg New Energy Finance

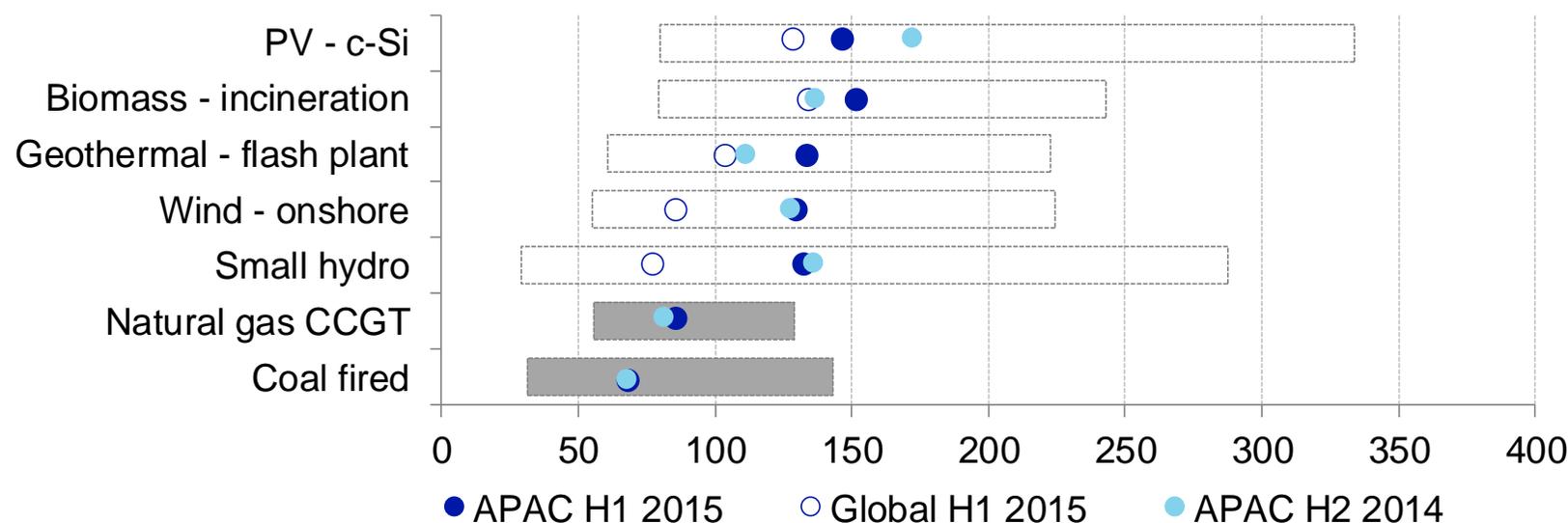
# AVERAGE COMMERCIAL ELECTRICITY PRICE (USD/MWH) AGAINST AVERAGE ANNUAL OUTPUT PER WATT INSTALLED (KWH/KW/YEAR)



Note: Bubble size represents approximate total commercial rooftop PV market potential

Source: Bloomberg New Energy Finance

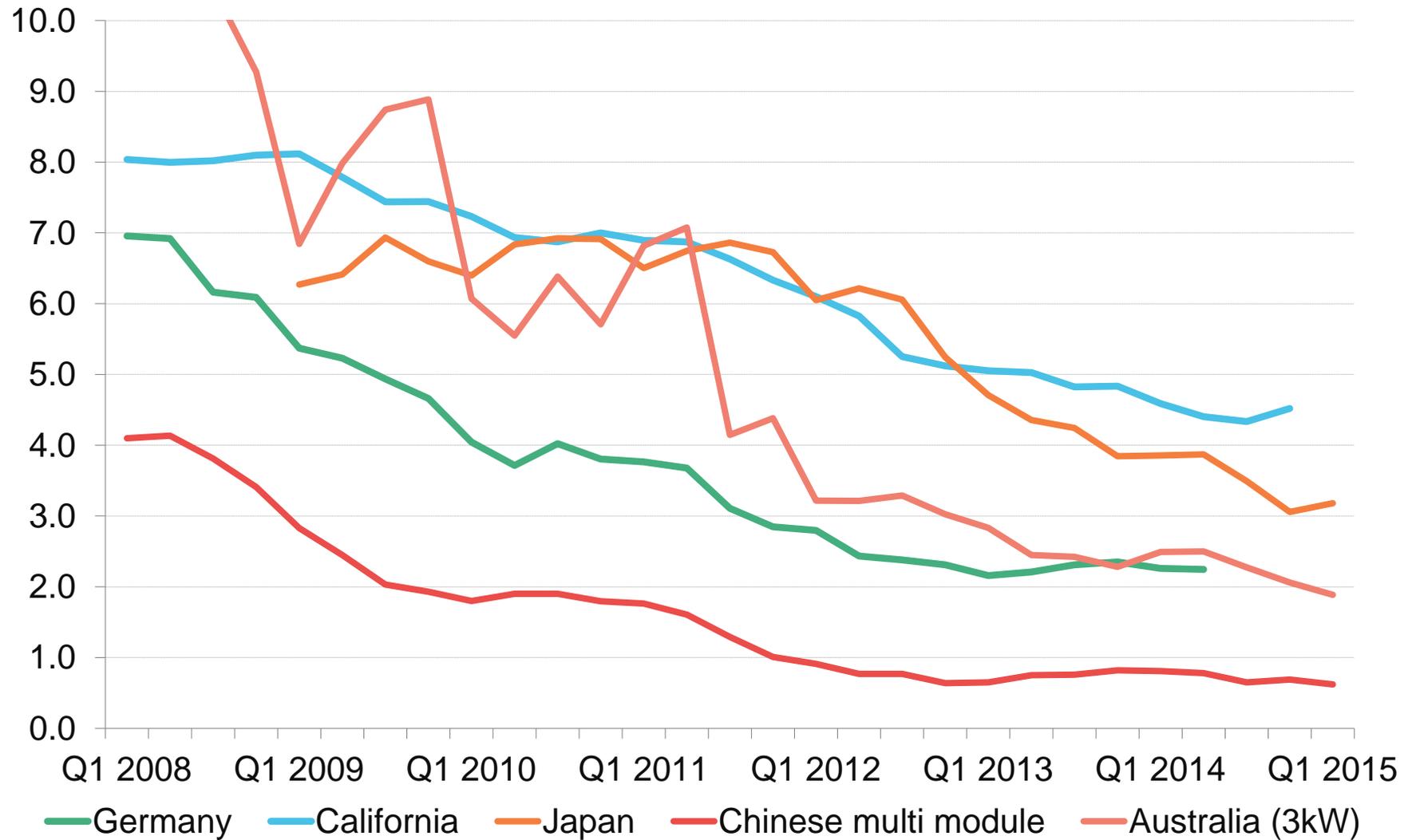
# H1 2015 LEVELISED COST OF ELECTRICITY (\$/MWH) – GLOBAL AND APAC



The cost of electricity generated from renewable energy sources in APAC remains noticeably higher than the global average. However, the gap between renewable and fossil-fuel LCOEs in Asia continues to decrease. Onshore wind power is more competitive than gas power in China and India due to deteriorating gas power economics. The cost of PV continues to fall. In China, the average PV LCOE is now in parity with gas LCOE at \$100/MWh. Other countries will follow suit, with Japan having the biggest medium-term potential in PV LCOE reduction given lower financing costs.

- Coal-fired electricity remains the cheapest among all energy sources under review due to the increasing use of more efficient supercritical technologies mandated by policy and slumping coal prices. Indonesia, China and India manage the lowest coal LCOEs at below \$40/MWh
- The average cost of gas power has increased across Asia as gas prices are rising under many countries' gas pricing reforms. In China, gas LCOEs are pushed up to \$100/MWh by lower capacity factors in addition to rising gas prices
- In contrast, the cost of PV continues to fall thanks to further reductions on equipment cost and improved capacity factors. The region's average PV LCOE currently stands at \$150/MWh. As lower cost Chinese solar modules gain larger market shares in current high cost regions such as Japan and Southeast Asia, APAC's average PV LCOE could fall to as low as \$120/MWh in the medium term

# PUBLIC BENCHMARKS OF RESIDENTIAL PV SYSTEM CAPEX, \$/W(DC)

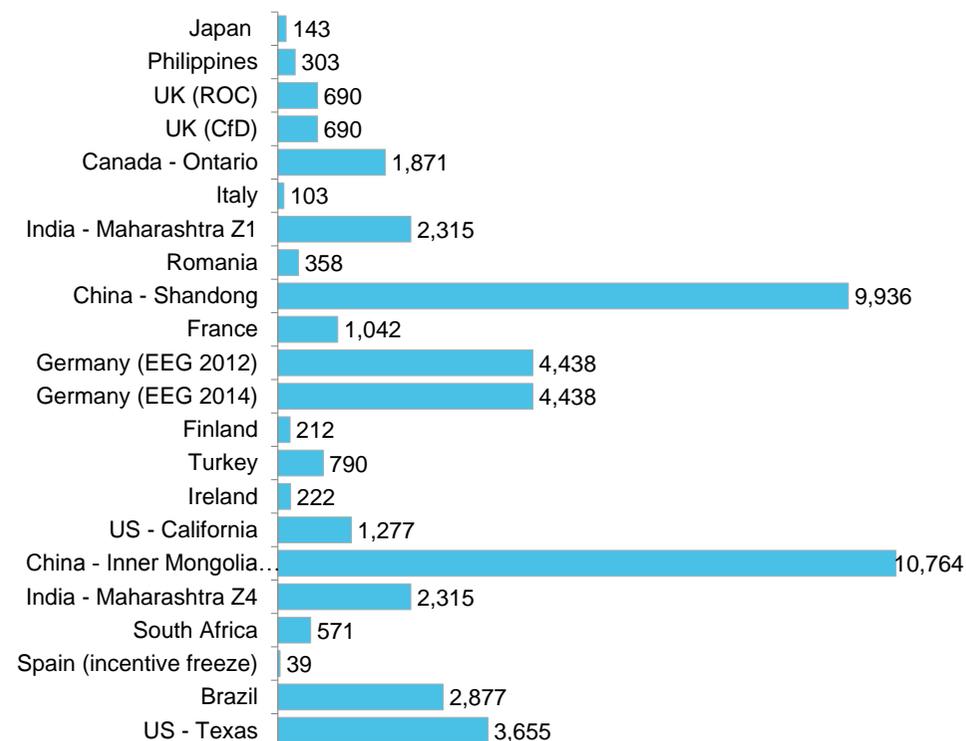
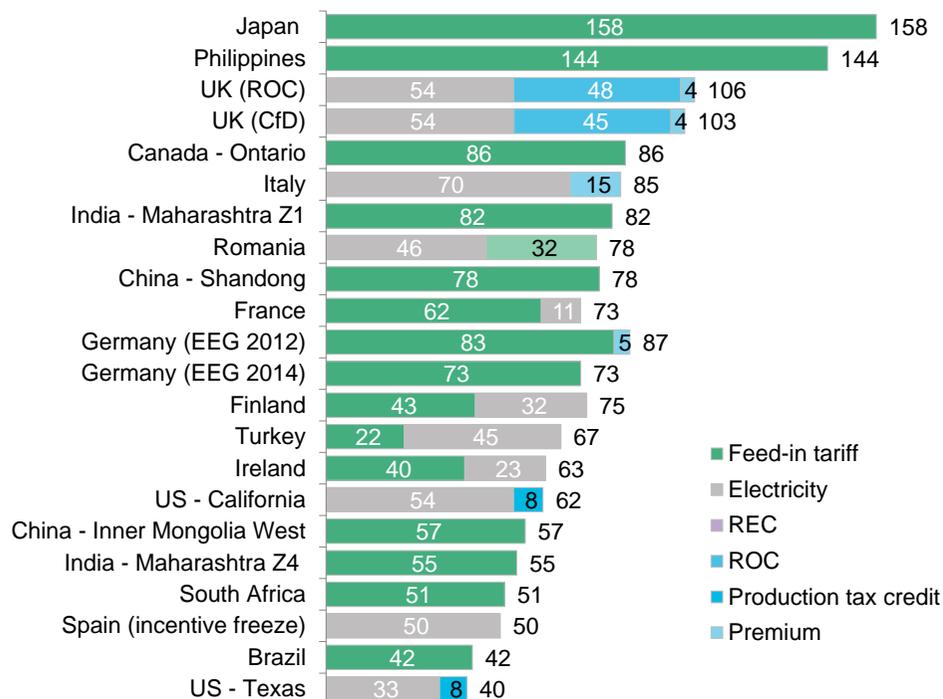


Source: Bloomberg New Energy Finance, Solarchoice, METI, BSW-Solar, California Solar Initiative

# LEVELISED SUPPORT MECHANISMS FOR ONSHORE WIND BY MARKET VS NEW BUILD 2014

## LEVELISED SUPPORT MECHANISMS (EUR/MWH)

## 2014 NEW BUILD (MW)



# WTI CRUDE OIL PRICES, 2000–14 (\$2014 / BARREL)



Note: WTI crude oil prices adjusted to inflation

Source: Bloomberg New Energy Finance,  
World Bank



Abdalla El-Badri, Secretary General,  
OPEC

“If you don’t invest in oil  
and gas, you will see  
more than \$200”

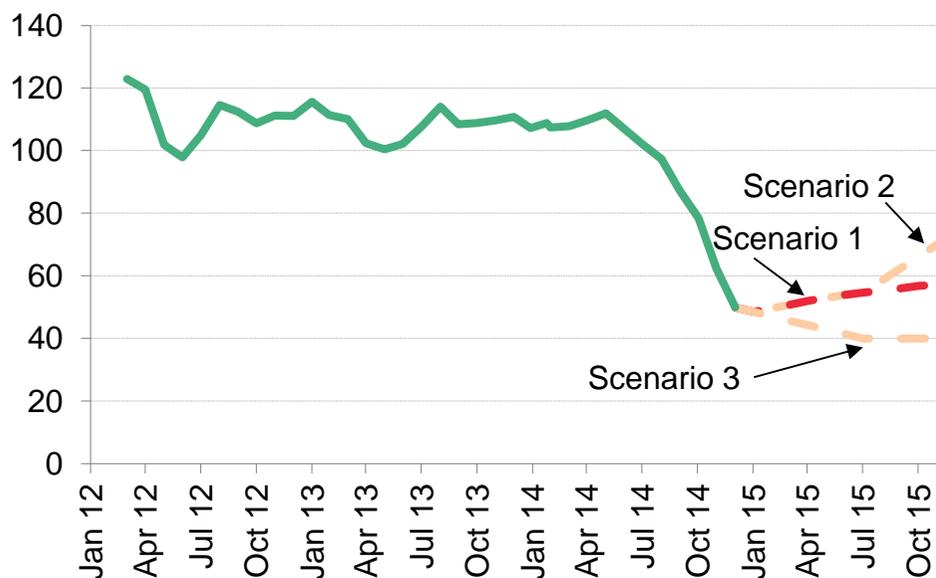


Bob Dudley CEO, BP

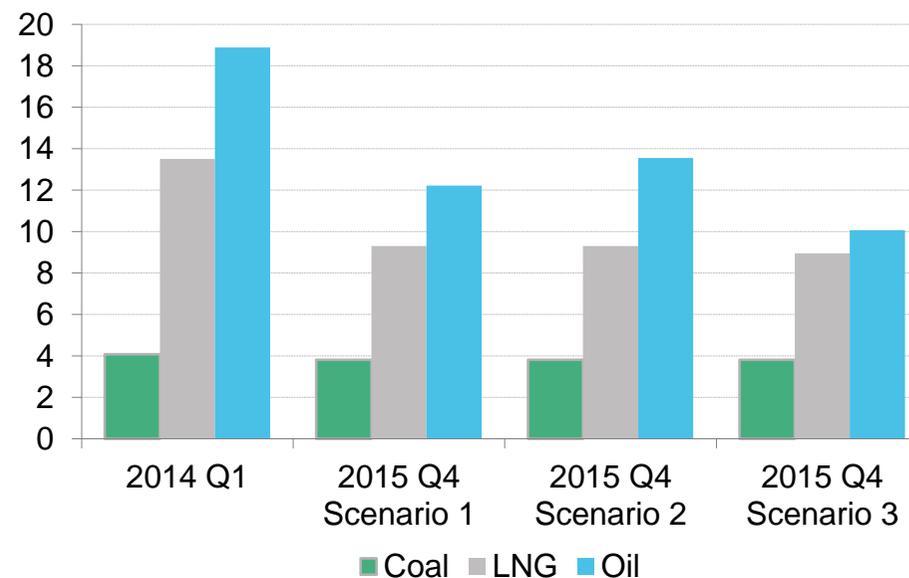
You won’t see \$100 oil  
again “for a long time”

# ANY IMPACT FROM LOW CRUDE PRICES? PRIMARILY INDIRECTLY VIA LOWER GAS PRICES

## BRENT CRUDE, HISTORICAL AND THREE SCENARIOS (US\$/BBL)



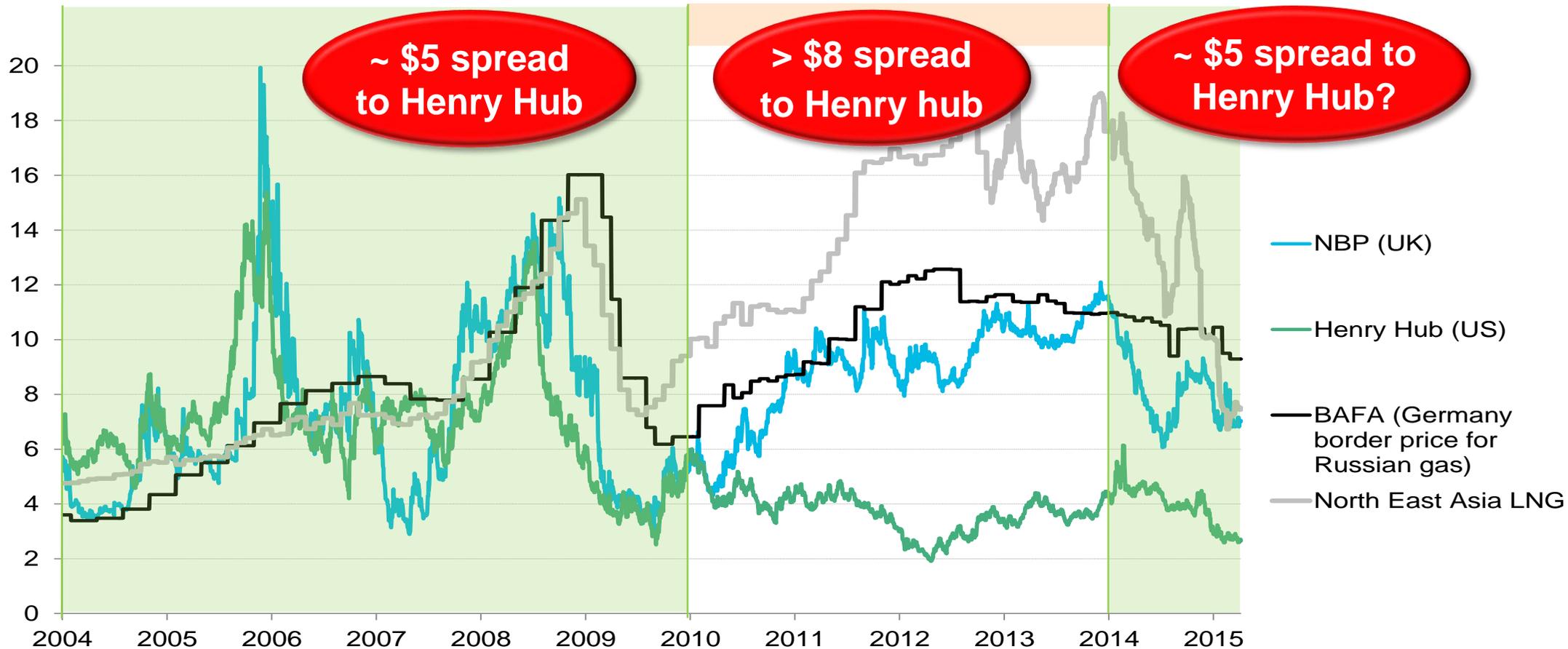
## FUEL COSTS FOR ELECTRICITY GENERATION IN JAPAN (JPY/kWh)



Source: Bloomberg New Energy Finance.

Note: Petroleum and coal tax is included in the calculation for the three fuels. Thermal efficiency is assumed at oil 38.4%, coal 40.5%, LNG 44.1%, which are the 10 utilities' average in FY2013. Forex assumed at US\$1=JPY118 in Q4 2015.

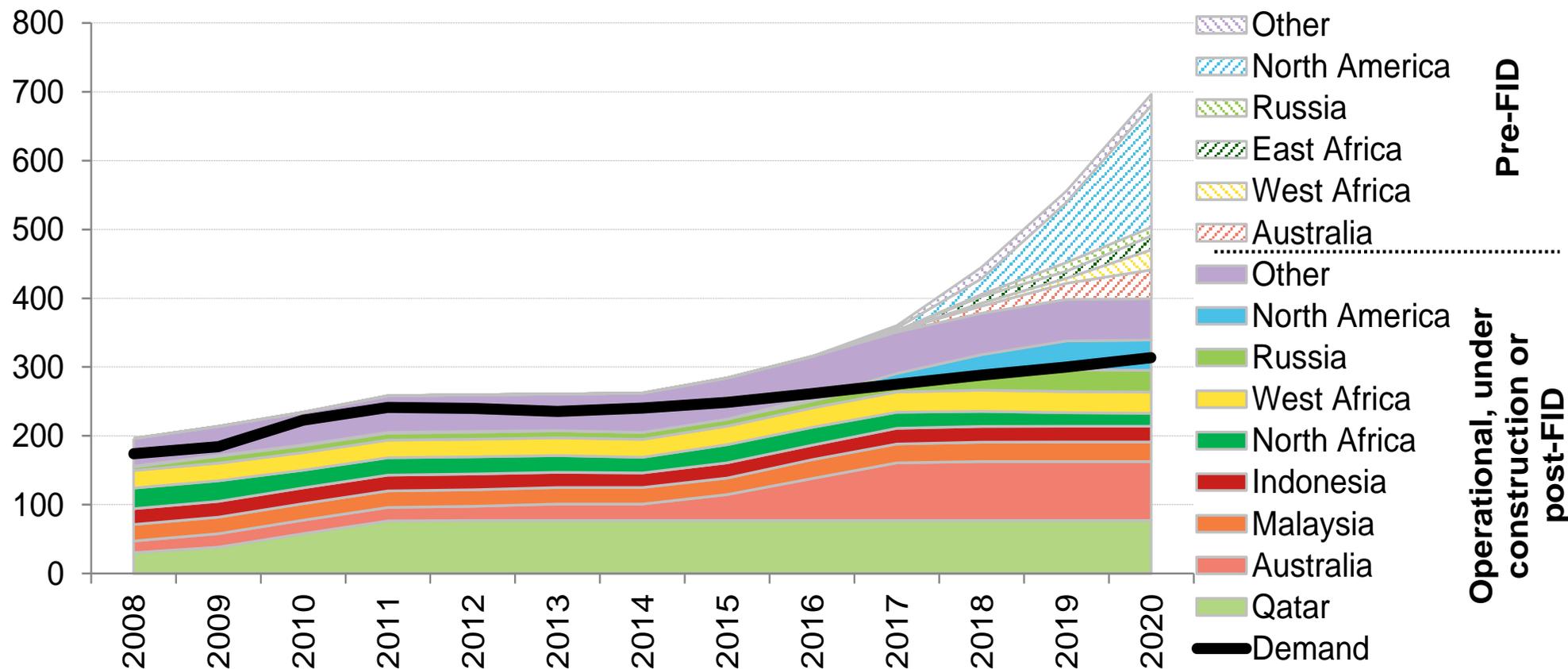
# GAS PRICES: HENRY HUB, NBP, BAFA, AND NE LNG, 2004-2015 (US\$/MM BTU)



Note: Japan-Korea Marker is based on broker assessments of the spot price of un-contracted LNG cargoes delivered into the Northeast Asia market.

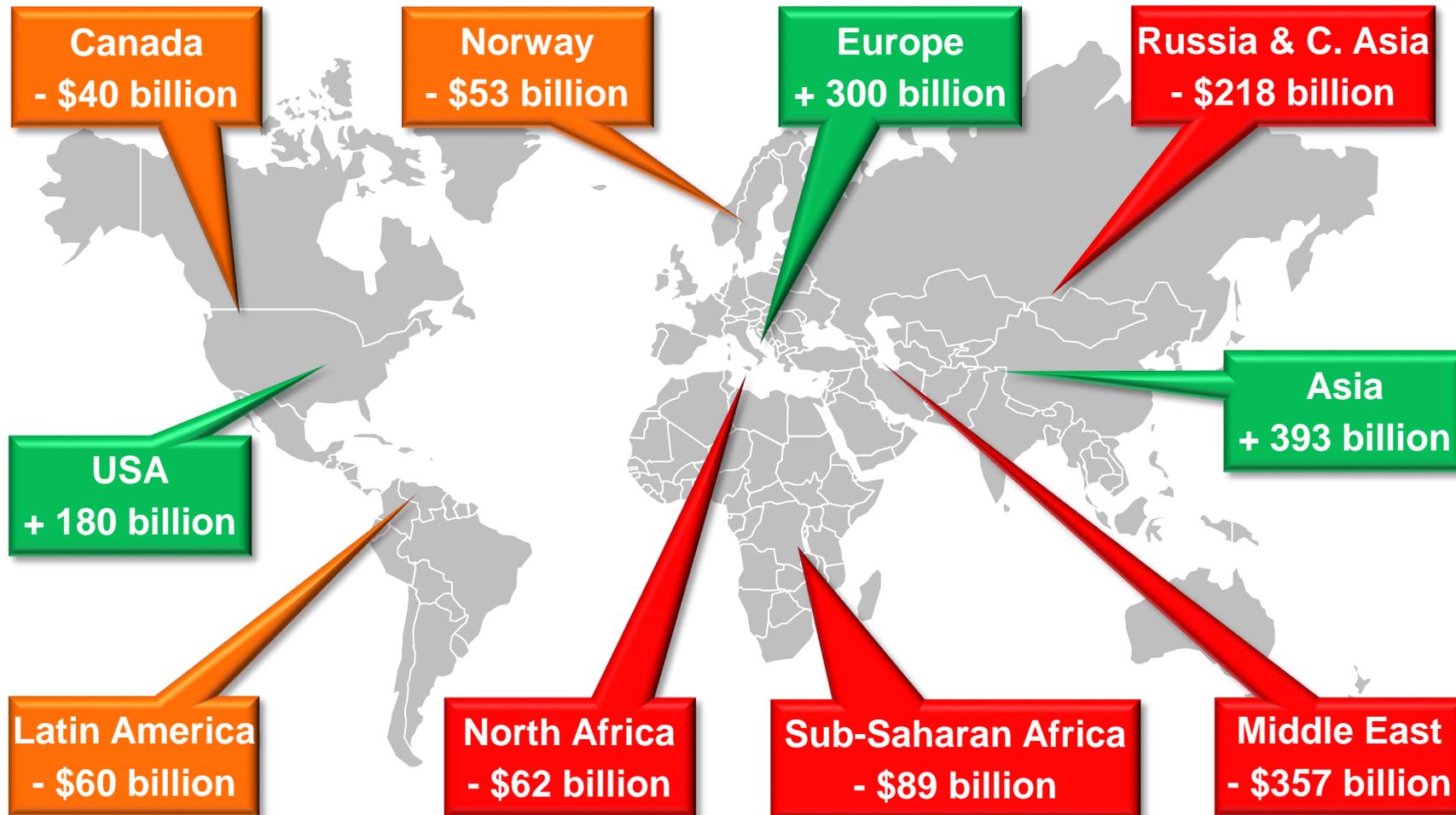
Source: Bloomberg New Energy Finance, ICAP, Platts

# LNG EXPORT CAPACITY BY COUNTRY/REGION (MMTPA)



Source: Bloomberg New Energy Finance

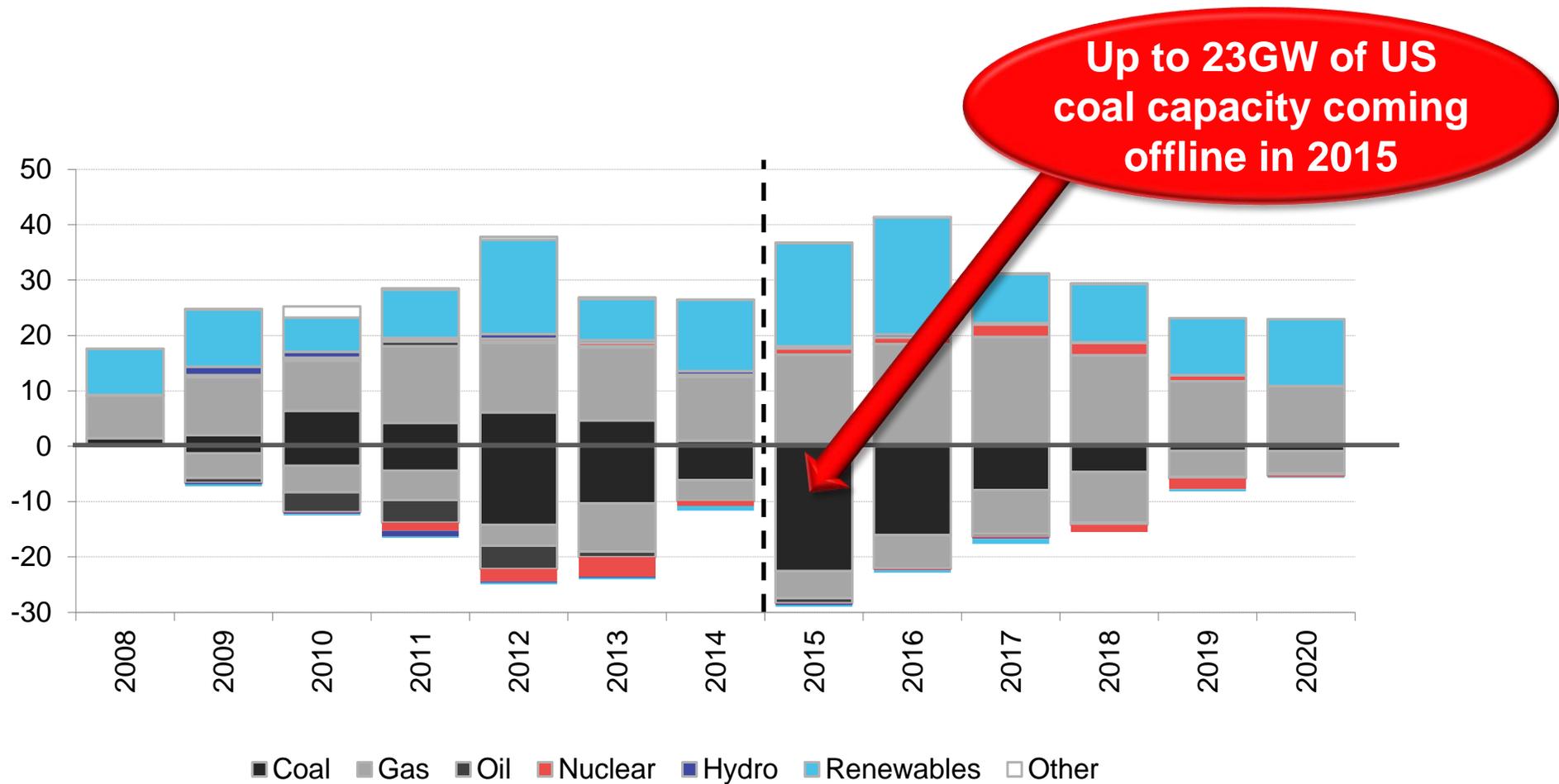
# IMPACT OF LOWER OIL AND GAS PRICES (\$BN/YR)



Note: Calculation based on \$5 drop in natural gas price and \$50 drop in oil price; based on import/export volumes 2011-2013, excluding impact of changes in volumes since then

Source: Bloomberg New Energy Finance; CIA Fact Book; IEA; EIA; World Bank; IMF

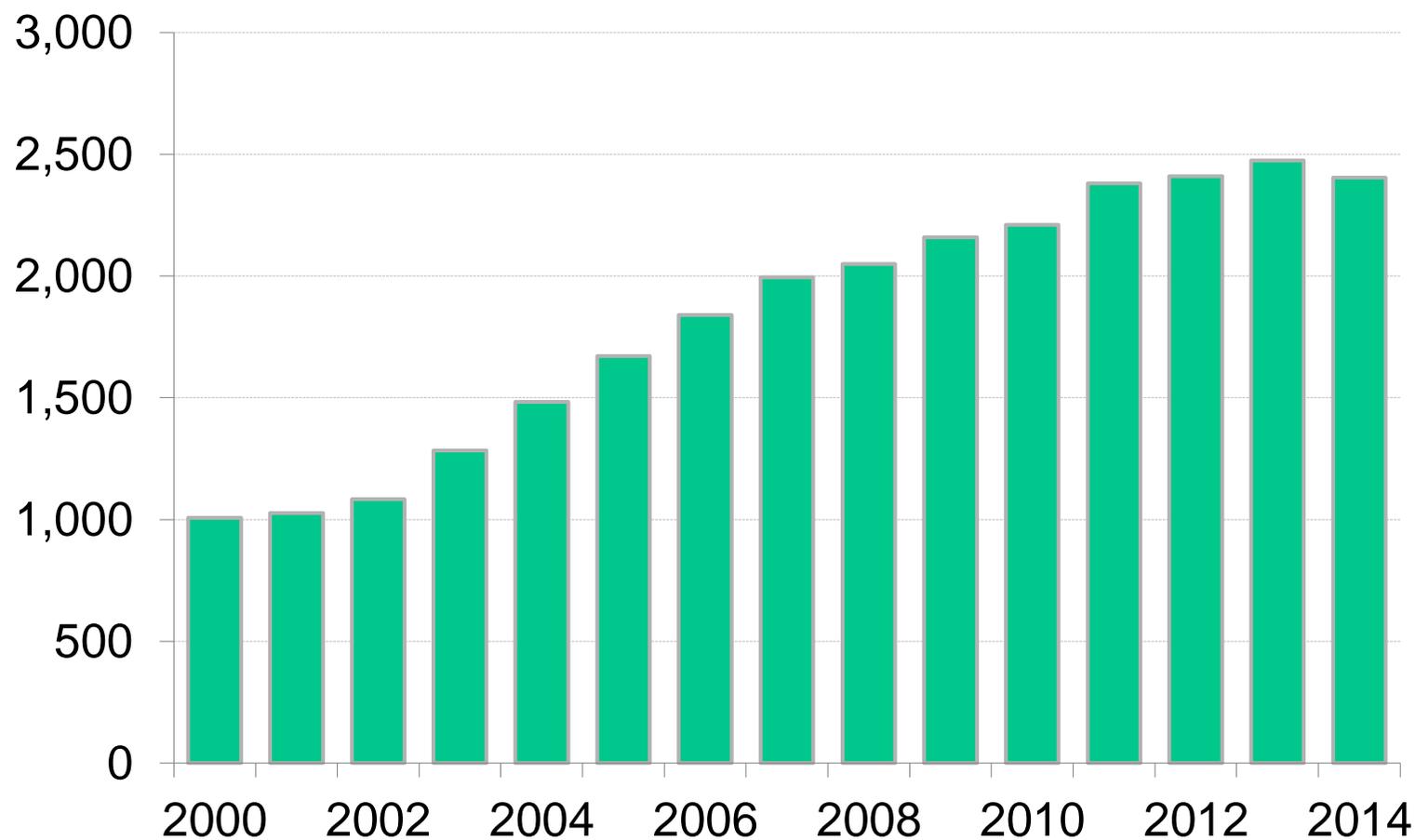
# US CAPACITY BUILD, 2008–20 (GW)



Notes: Bloomberg New Energy Finance base case build forecasts; historical build from EIA Form 860

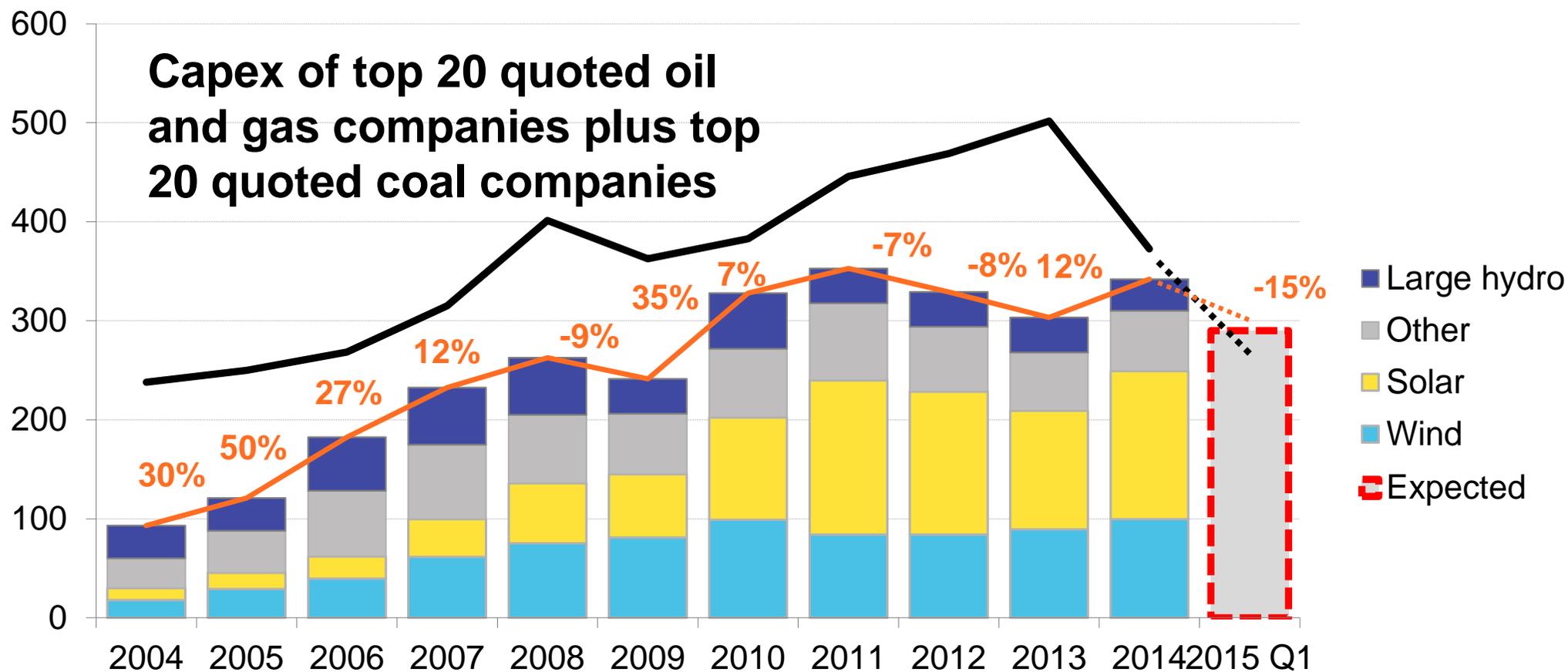
Source: Bloomberg New Energy Finance

# CHINA COAL CONSUMPTION, 2000-14 (MILLION TONS)



Source: Bloomberg New Energy Finance, Chinese Government

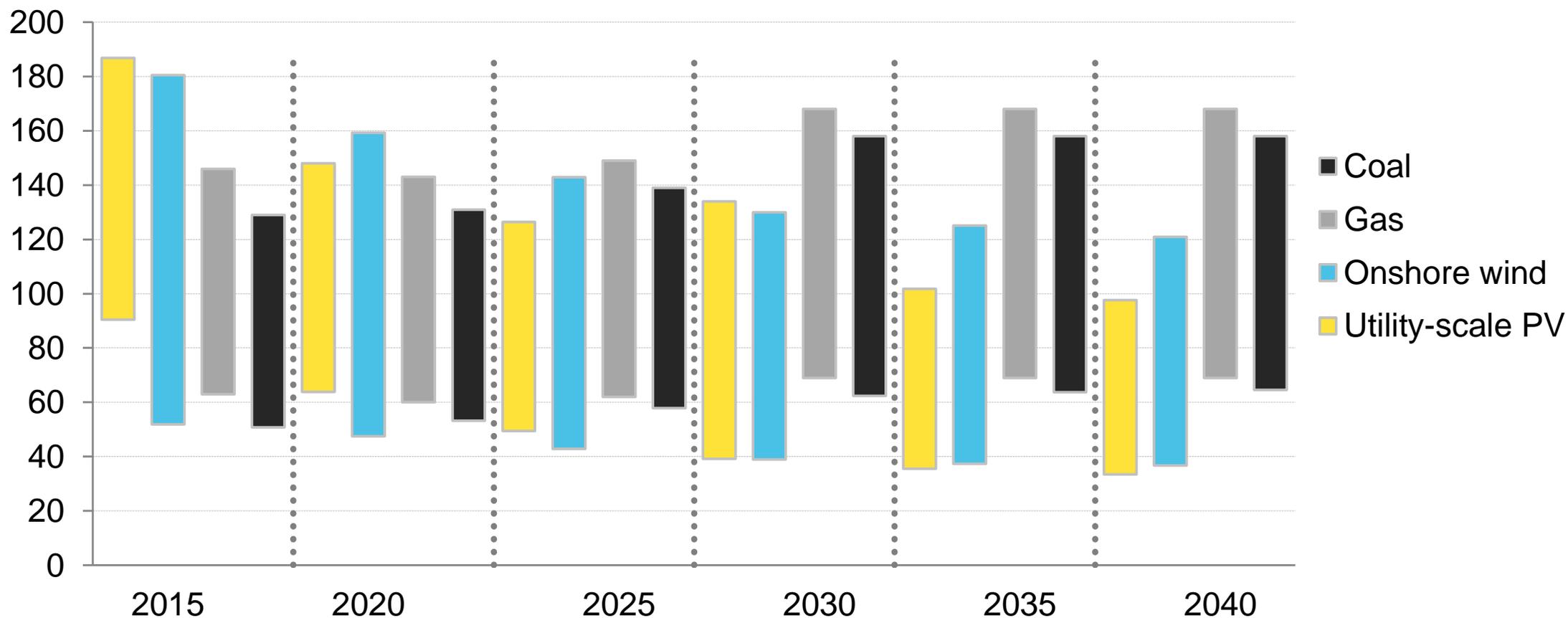
# CLEAN VS FOSSIL ENERGY INVESTMENT (\$BN)



Note: Nominal values. Renewable energy includes large hydro, investment made at financial close. Fossil fuel is gross investment on coal, gas and oil capacity. We assume capacity retirement of 3.3%/yr for coal, 4%/yr for gas and 2.5%/yr for coal in all countries where fossil capacity is net positive. We assume retiring capacity is replaced in countries where fossil fuel capacity additions are net positive and not where additions are zero or negative. We count fossil fuel investment in the year when capacity was commissioned (owing to a lower visibility of data). Q1 2015 figures do not include corporate & government R&D, or EST asset finance estimates which are compiled on an annual basis only.

Source: Bloomberg New Energy Finance

# ASIA PACIFIC LEVELISED COST OF ELECTRICITY (\$/MWh NOMINAL)

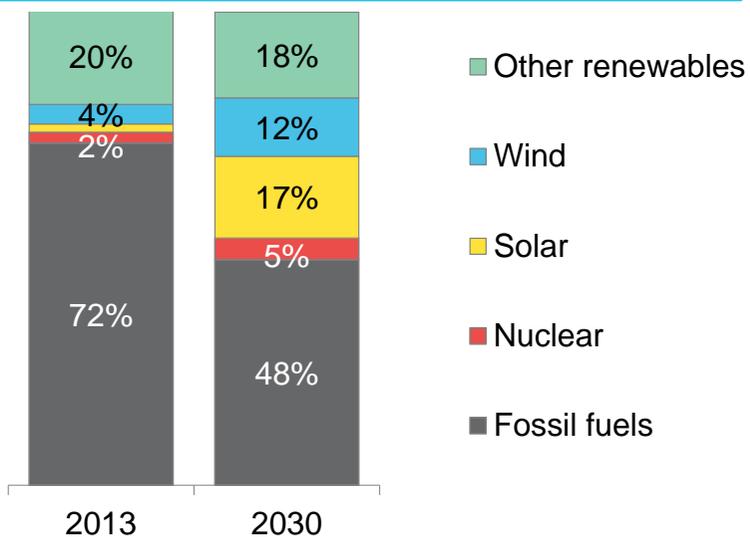


Source: Bloomberg New Energy Finance

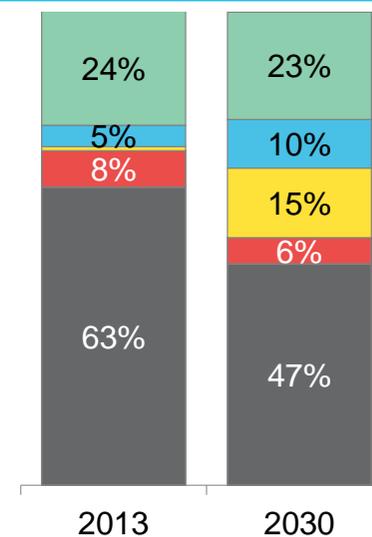
# POWER GENERATION MIX BY REGION

## 2013 AND 2030

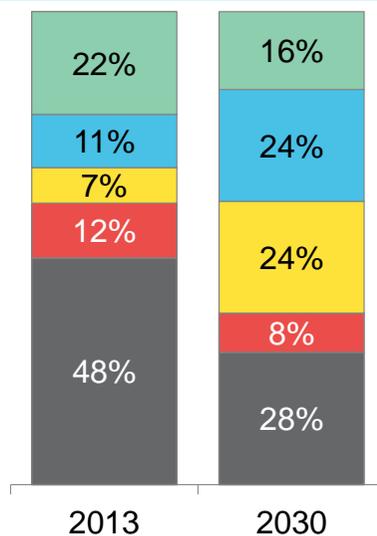
### Asia



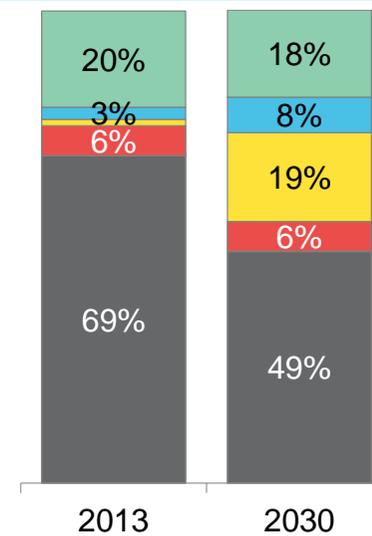
### Americas



### Europe



### Rest of world



Source: Bloomberg New Energy Finance

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