GLOBAL RENEWABLE ENERGY MARKET OUTLOOK 2013

FACT PACK

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HEAD OF ECONOMICS AND COMMODITIES

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Bloomberg NEW ENERGY FINANCE

INTRODUCTION

- This year's Global Renewable Energy Market Outlook updates our previous long term projections of the clean energy markets published in November 2011 (Exec Summary: bnef.com/WhitePapers/download/53).
- The analysis uses the same analytical framework - BNEF's Global Energy and Emissions Model (GE²M) – but is updated in a number of ways.
- This year three scenarios have been created to show a range of possible future outcomes for the clean energy market - New Normal, Barrier Busting and Traditional Territory. These scenarios create three different views of how the world's energy system will evolve based on assumptions around technology costs, economic prosperity, policy ambitions and investment in grid infrastructure.
- The analysis has been updated to include the latest trends and forecasts in fuel prices, GDP, population, technology costs and energy and environmental policies – in particular, projections of world coal prices and future clean energy costs have both come down since our last analysis.
- The future demand for rooftop PV has been analysed in considerably more detail using consumer adoption principles. This takes into account local demographics, solar radiation levels and patterns in consumer investment decisions. This is done across 84 separate economic regions.
- Technology costs are now differentiated in more detail by country, taking into account local prices for land, labour and equipment prices. In particular the Chinese market has been analysed in more detail using a China-specific technology adoption model.
- Grid constraints are more comprehensively taken into account by adjusting the return on investment for certain types of distributed technologies.

THREE FUTURE SCENARIOS

TRADITIONAL TERRITORY

- World economy remains subdued: real GDP CAGR 2.2%
- Cheap fossil fuels – shale gas expands rapidly lowering international gas and coal prices.
- Moderate environmental concerns largely appeased by more use of gas.
- Main energy investments goes into trusted technologies of gas and coal and nuclear.
- Supportive policies for new energy technologies weaken.
- Grid investments focus on maintaining existing centralised infrastructure

NEW NORMAL

- Economic hangover continues: real GDP CAGR 2.7%.
- Rising demand for energy from developing countries outstrips supply – prices of fossil fuels rise.
- Environmental concerns remain at current levels – no major breakthroughs but carbon prices from current policies rise in the EU and Australia.
- Current clean energy policies expected to run course to 2020 then mostly taken over by carbon prices in key countries.
- Steady investment in grid to accommodate moderate new distributed technologies.

BARRIER BUSTING

- World economic growth recovers to trend of past 20 years: real GDP CAGR 3.6%.
- Demand puts pressure on fossil prices. Fossil fuels and carbon prices remain expensive.
- Environmental concerns heightened - stronger policy coordination; carbon priced in China and US.
- Unit costs of generation technologies are the same as in NN scenario.
- Strong investment in grid technologies and progress in storage technologies.
- Breakthrough in second generation biofuel technology.

The emphasis in the scenarios is to explore the effects of technical and economic barriers to renewables, rather than other drivers such as policy decisions.

NEW NORMAL: CUMULATIVE INSTALLED POWER GENERATION CAPACITY

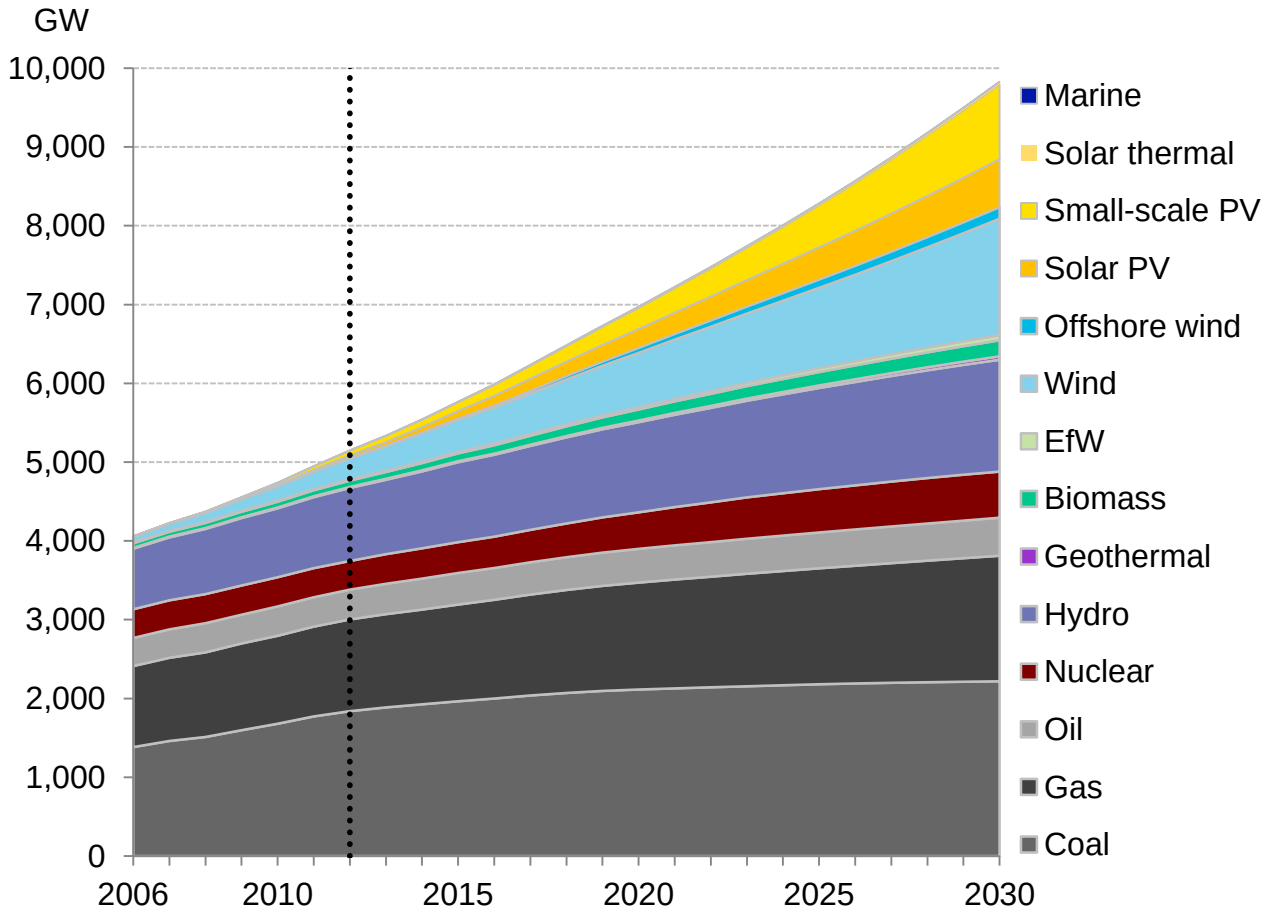
By 2030 renewables will account for 50% of installed power generation capacity

In the NN scenario by 2030 renewables (including hydro) will account for 48% of total power generation capacity installed around the world, up from 28% in 2012.

Wind and solar continue to dominate. Wind (on and offshore) rises from 5% in 2012 to 17% of installed capacity by 2030, overtaking large-hydro. Starting from a lower base, solar PV capacity grows from 2% in 2012 16% by 2030.

Less variable renewables such as marine, geothermal and solar thermal make a lesser contribution due to their higher costs.

Fossil-fuel generation capacity grows slightly in absolute terms in all scenarios, but its relative contribution falls from 67% in 2012 to 40-45% by 2030. Nuclear's share remains steady at around 6%.



Note: EfW is energy from waste Small-scale PV includes commercial and residential scale rooftop PV.

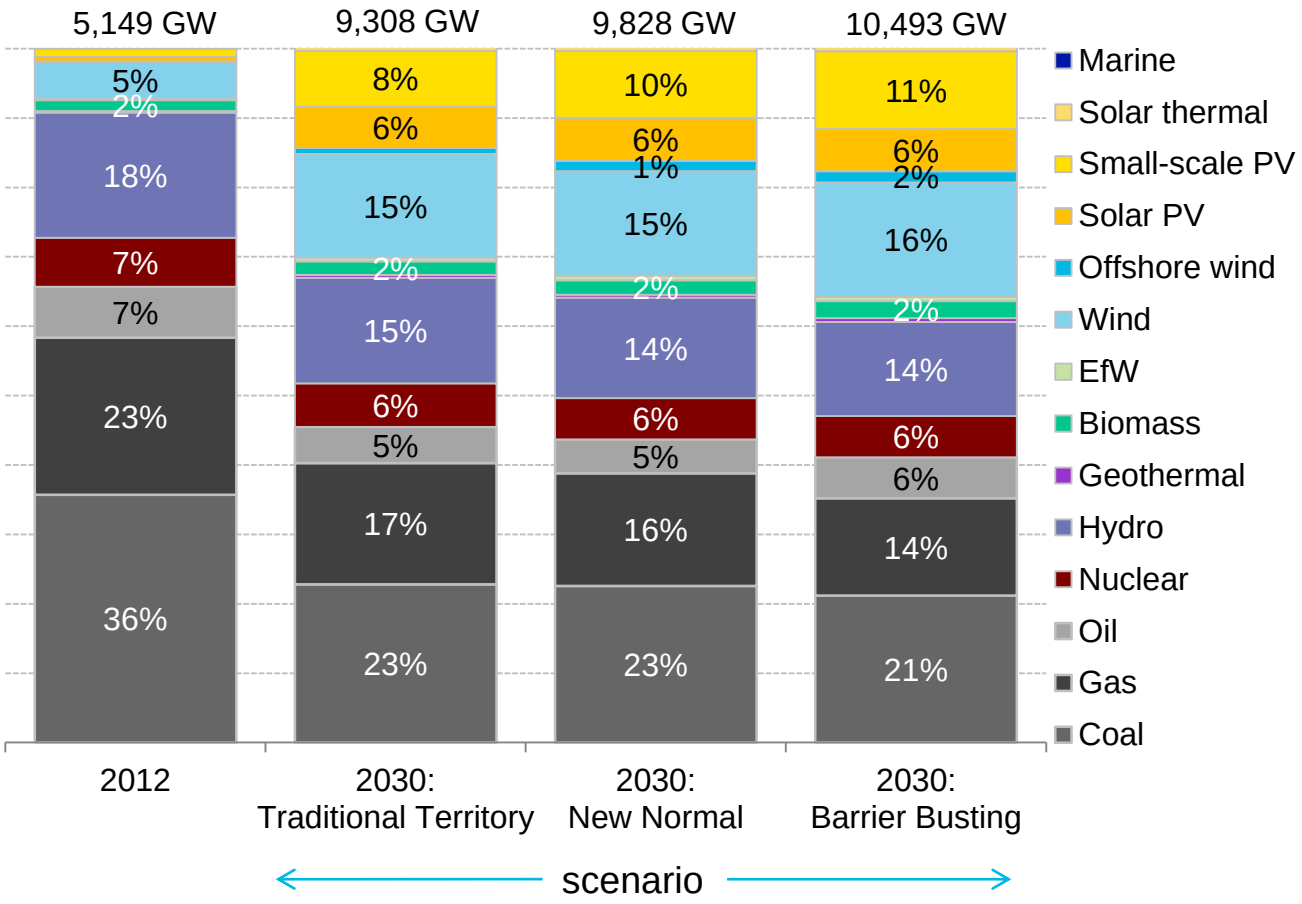
Source: Bloomberg New Energy Finance

CUMULATIVE INSTALLED GENERATION CAPACITY, 2030

The share of "new renewables" of installed power capacity varies between 33% and 39% in 2030 across the TT and BB scenarios

In the BB scenario the share of renewables, including hydro, in power generation capacity rises to 53% from 50% in the NN scenario – a relative increase of 5%. The share of "new" renewables (ie excluding hydro) increases to 39% from 36% in the NN scenario – a relative increase of 10%.

In the TT scenario the share of renewables, including hydro, in power generation capacity reduces to 48% from 50% in the NN scenario – a relative contraction of 4%. The share of "new" renewables (ie excluding hydro) reduces to 33% – a decline of 8%.



Note: Small-scale PV includes commercial and residential scale rooftop PV.

Source: Bloomberg New Energy Finance

ADDITIONS TO POWER GENERATION CAPACITY 2013 TO 2030 (NEW NORMAL)

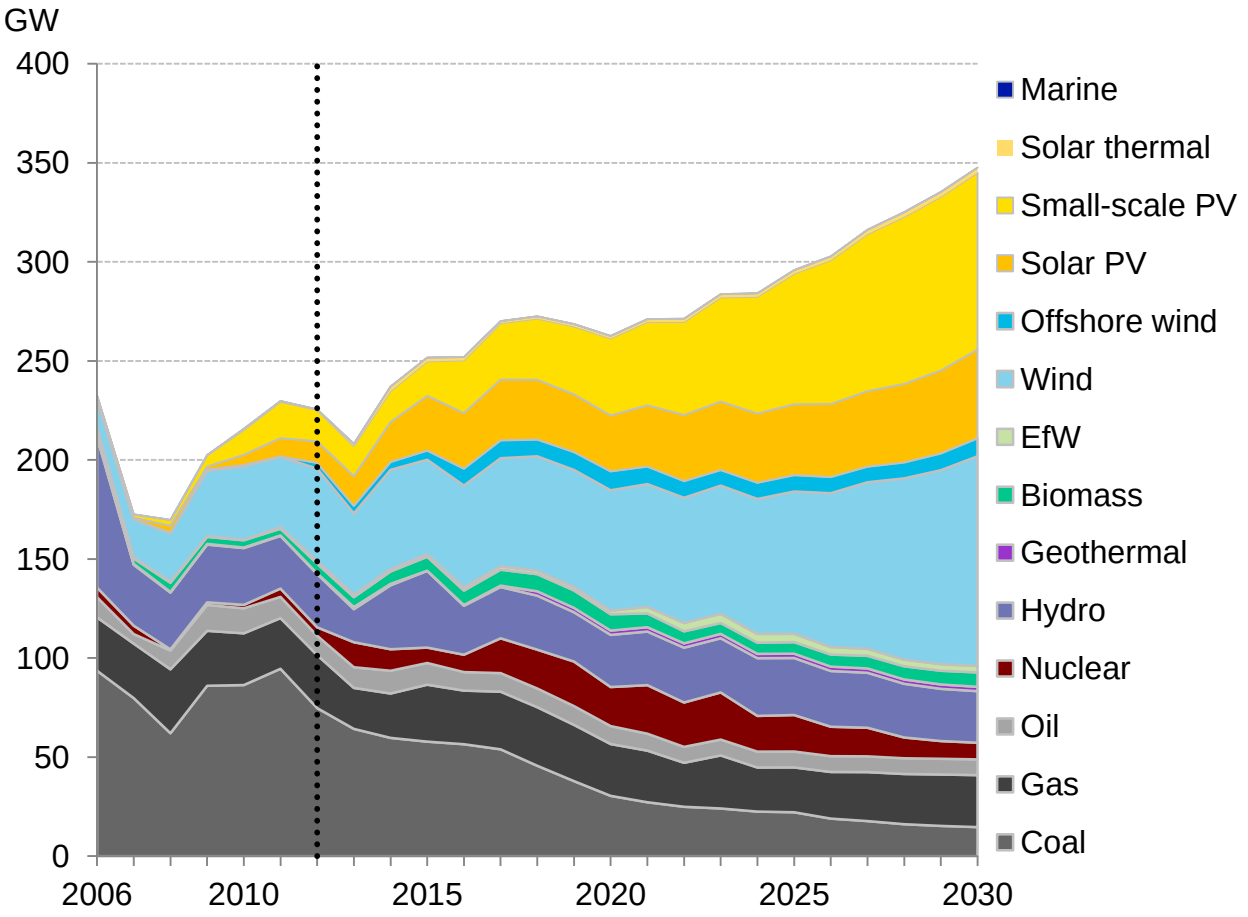
Renewables will account for 70% of the new power generation capacity added to 2030

Globally 70% of the new power generation capacity added between 2012 and 2030 will be from renewable technologies - the IEA's New Policies scenario projects 57% of new power capacity to 2030 will be in the form of renewable technologies.

Solar PV and wind will comprise the largest share of new power capacity added to 2030, accounting for 30% and 27% respectively.

As the cost of wind and solar falls and carbon prices and other environmental controls, increase the cost of fossil fuels in certain countries, new coal and gas capacity become less attractive, comprising only 25% of capacity additions to 2030.

Nuclear also sees something of a renaissance but this is limited to 5-6% of total new capacity added to 2030.



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Source: Bloomberg New Energy Finance

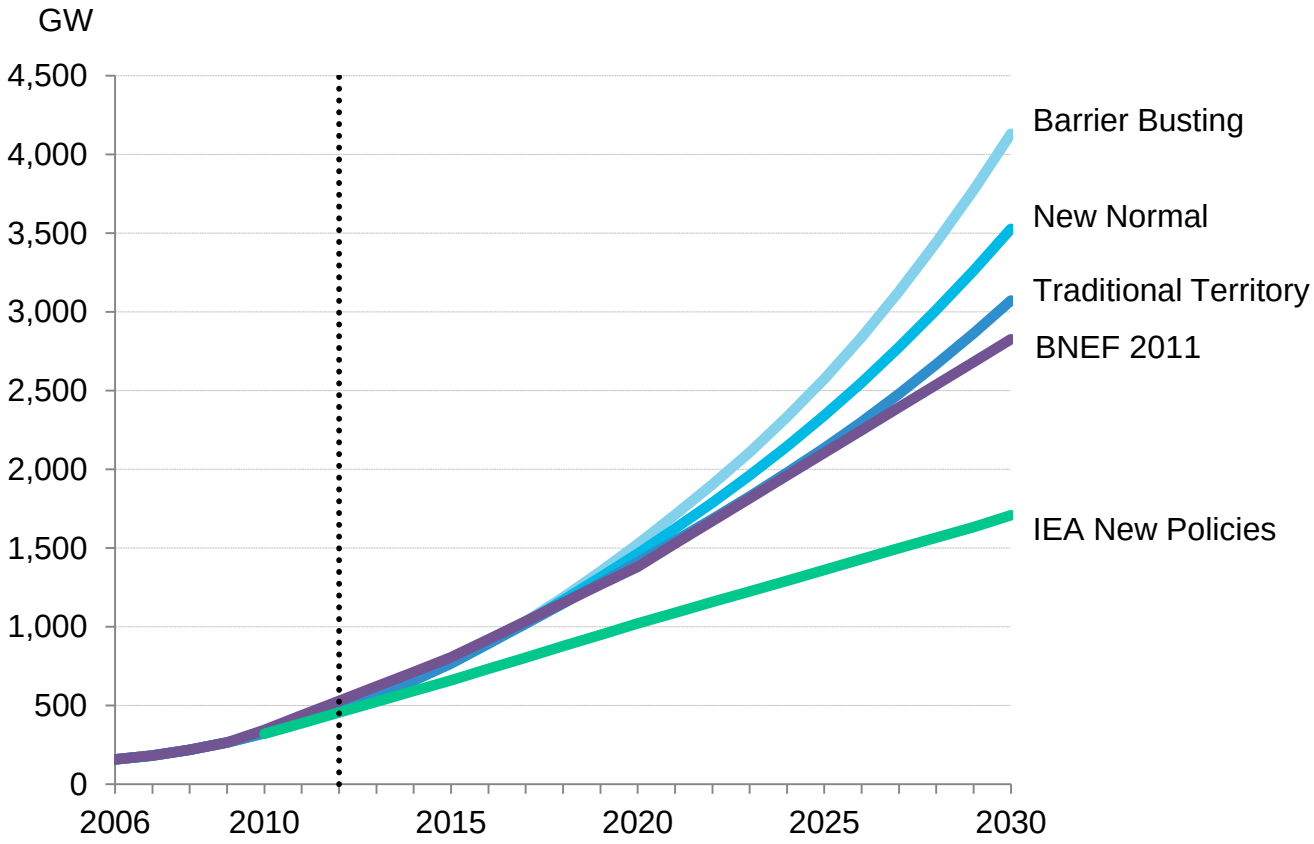
TOTAL RENEWABLE POWER GENERATION CAPACITY - SCENARIO COMPARISON

Our 2013 forecasts for renewable power generation capacity are higher than our 2011 forecast and higher than the IEA's last projection

We expect cumulative RE capacity to reach 3,500GW in 2030 under our New Normal scenario, up 25% from our 2011 estimate of 2,800GW.

This change in forecast is driven by a number of factors including:

- Faster declines in unit costs of clean energy technologies
- Greater take up these technologies in regions that have higher overall installation costs, but where it is still cost effective to develop the asset (eg Middle East)
- Lower coal prices – this increases the price of carbon in regions with high gas prices and firm climate policies, eg Europe



Note: Renewable energy includes wind, solar, biomass, energy from waste, geothermal.

Source: Bloomberg New Energy Finance

CUMULATIVE ADDITIONAL POWER GENERATION CAPACITY 2013 – 2030

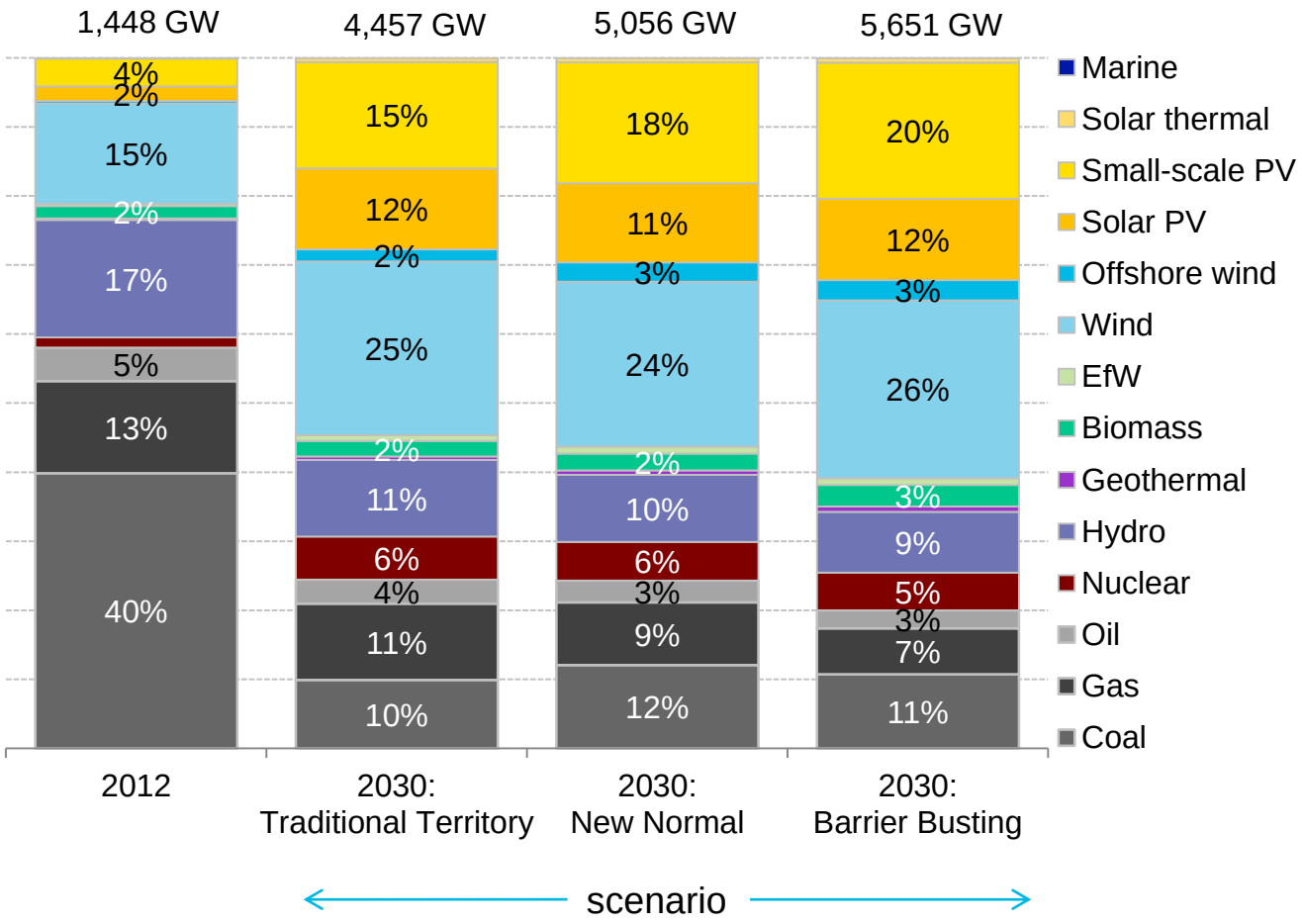
The share of "new renewables" in capacity additions to the power sector to 2030 varies between 58% and 66% across the TT and BB scenarios

The share of renewables, including hydro, in new capacity additions in the power sector up to 2030 increases to 75% in the BB scenario (from 70% in the NN scenario).

Excluding hydro, the share of renewables in new capacity additions up to 2030, increases to 66% (from 60% in the NN scenario).

Under the TT scenario the share of renewables in new capacity additions to falls, but not by much, to 69% including hydro, or 58% excluding hydro.

The share of build between the three scenarios does not change significantly.



Note: EfW is energy from waste Small-scale PV includes commercial and residential scale rooftop PV.

Source: Bloomberg New Energy Finance

POWER GENERATION OUTPUT, 2013-2030

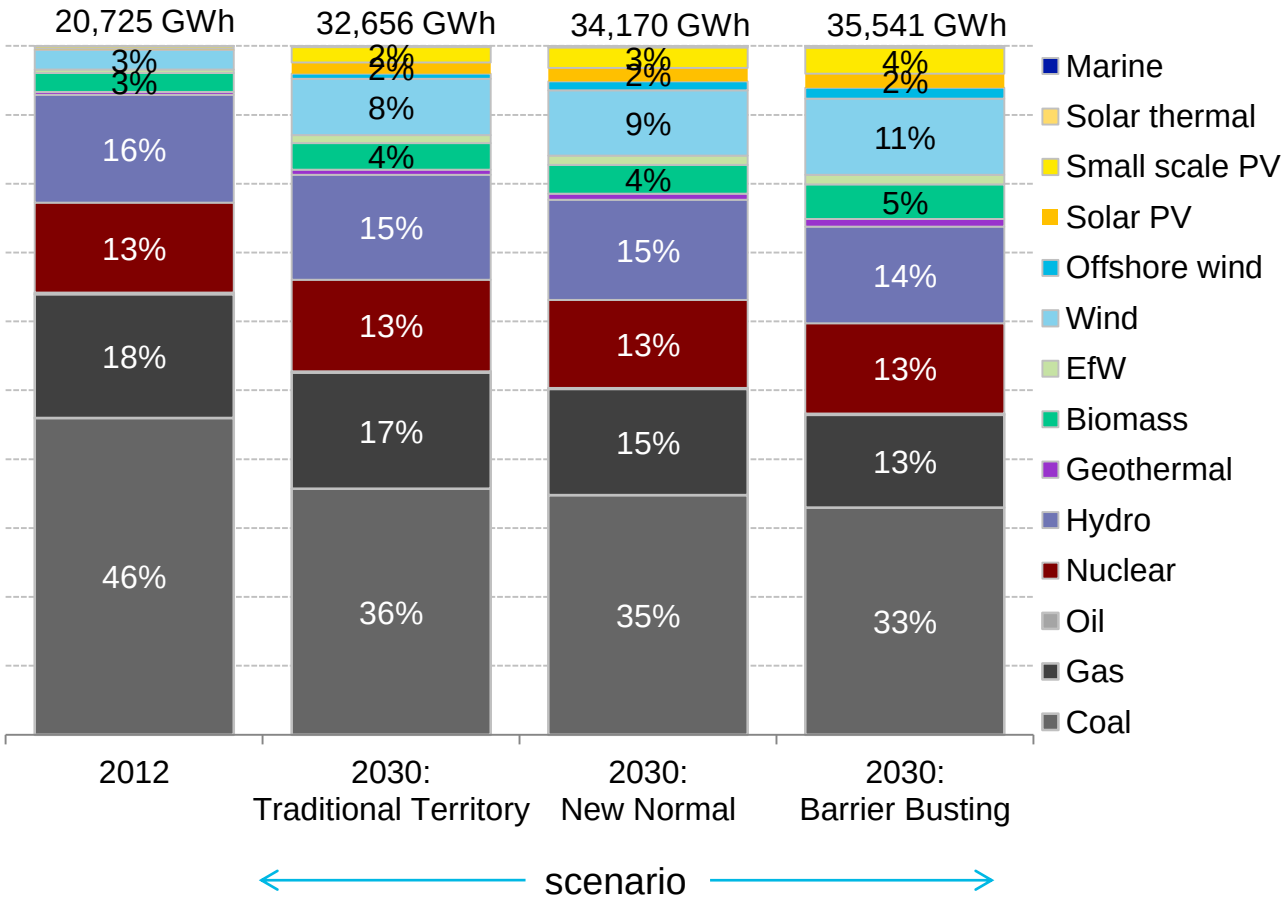
Large hydro will continue to generate the most power of the clean technologies to 2030

Generation from renewable sources will increase from 22% in 2012 up to 37% in 2030 under our Barrier Busting scenario. This is lower than installed capacity because renewables (excluding large hydro) have lower load factors than traditional thermal technologies.

By 2030 wind accounts for 12% of generation and solar PV 6%. Large-hydro remains the dominant form of clean energy production to 2030.

Gas-fired generation remains steady at 17-18% under our Traditional Territory scenario, but falls to 13% in our high gas price Barrier Busting scenario.

Coal-fired electricity generation falls in all scenarios as it becomes displaced by generation from new wind and solar plants with lower running costs.



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Source: Bloomberg New Energy Finance

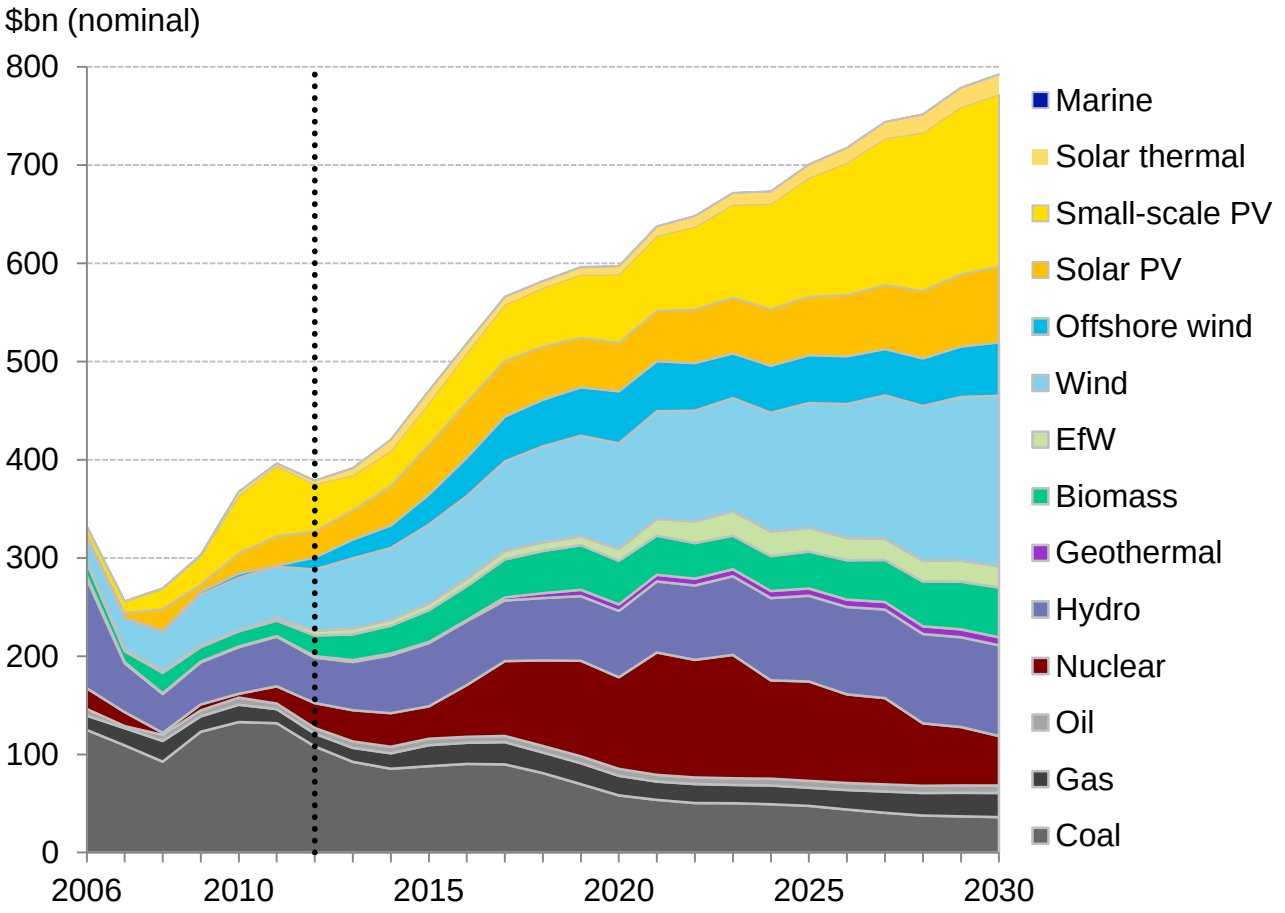
POWER GENERATION CAPACITY ASSET FINANCE (NEW NORMAL)

73% of total investment in power generation to 2030 will be directed to renewables

Under our NN scenario, investment in power generation assets will reach $790bn a year by 2030 and $11 trillion cumulatively from 2013.

Around $8.2 trillion or 73% of total asset finance to 2030 will be spent on renewable energy including large hydro.

Capital intensive renewable energy technologies such as offshore wind and solar thermal are more visible here as each MW installed has higher cost. The high capital costs of nuclear facilities also raise the share of financing required by the nuclear sector.



Note:

1. All $bn figures are nominal assuming a 2% annual rate of inflation
2. EfW is energy from waste Small-scale PV includes commercial and residential scale rooftop PV.

Source: Bloomberg New Energy Finance

CUMULATIVE POWER GENERATION CAPACITY ASSET FINANCE 2013 TO 2030

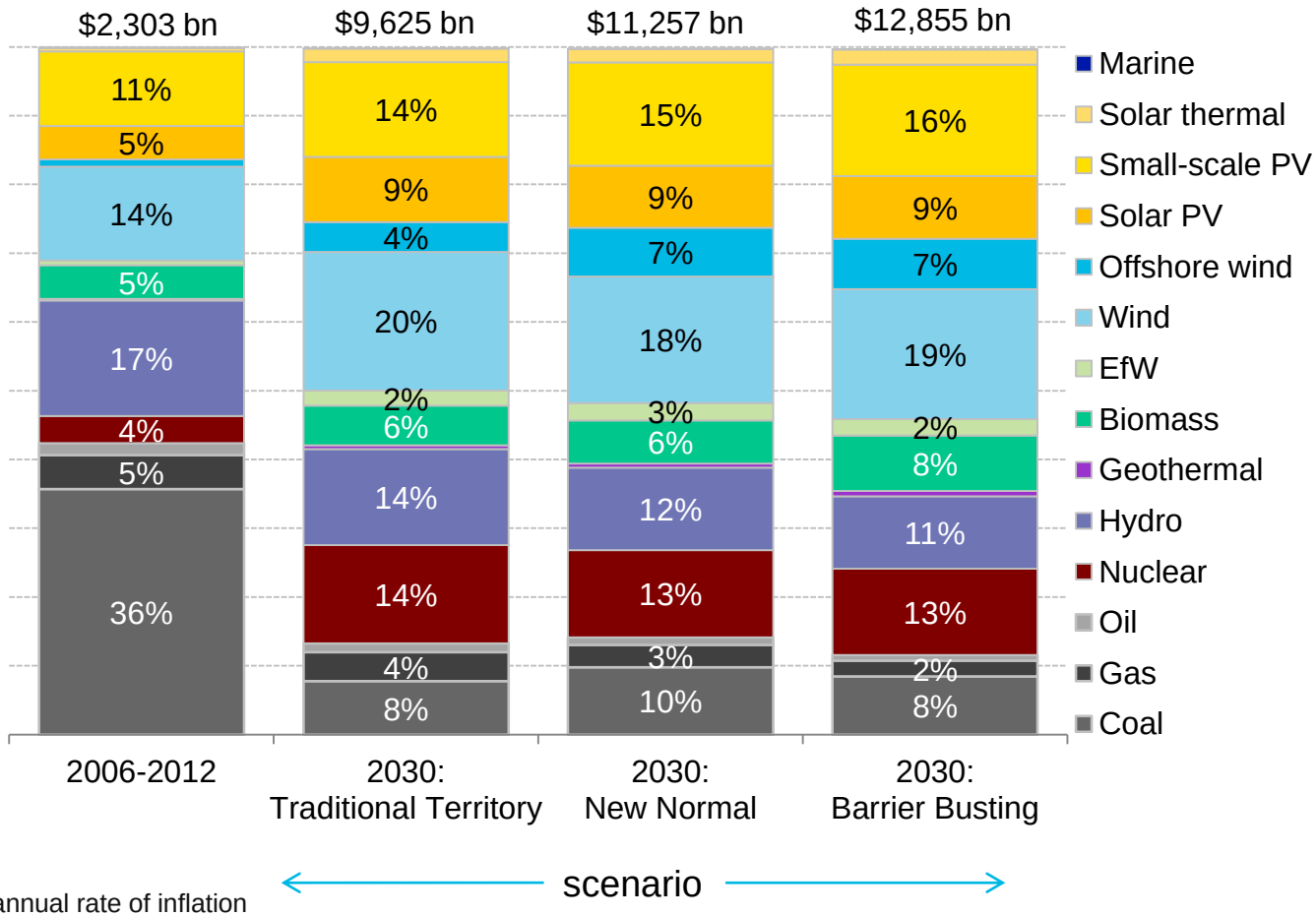
Power generation assets will need over $11 trillion of capital to 2030. Half of this will be spent on wind and solar

Under the NN scenario, annual investment in renewable energy power assets will rise to $454bn in 2030, with solar PV and wind energy attracting the majority of investment.

Solar PV will attract between 23% and 25% of asset finance worth over $3.2 trillion in our Barrier Busting scenario. Just under two thirds of this is directed to roof-top deployment.

Wind energy investment grows in all scenarios attracting between $2.3 trillion to 2030 under our Traditional Territory scenario and $3.3 trillionin our Barrier Busting scenario. Just over a quarter of which is offshore wind under BB and NN.

Investment in geothermal, marine, ands solar thermal remain small in comparison.



Note:
1. All $bn figures are nominal assuming a 2% annual rate of inflation
2. EfW is energy from waste Small-scale PV includes commercial and residential scale rooftop PV.

Source: Bloomberg New Energy Finance

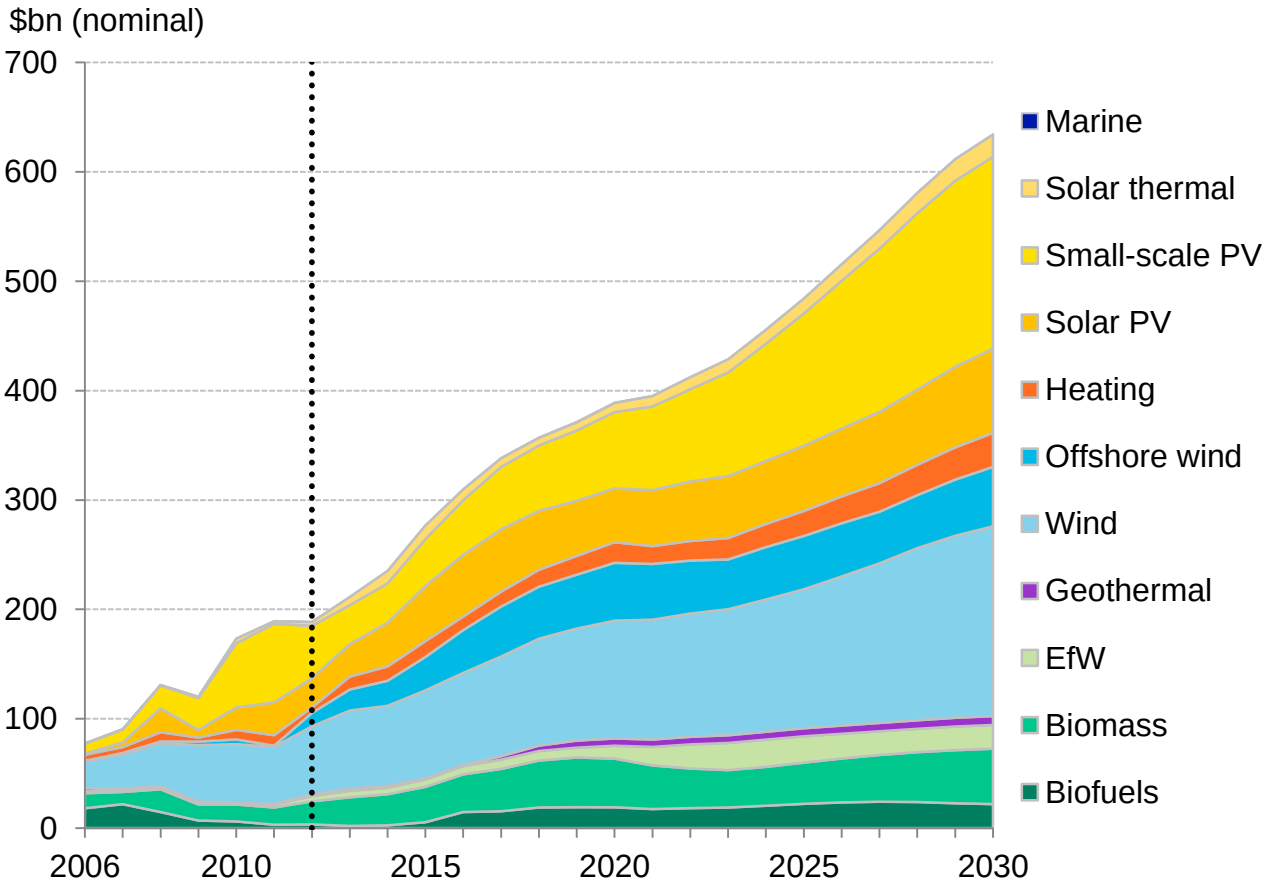
ANNUAL CLEAN ENERGY INVESTMENT TO 2030 – NEW NORMAL

Total investment in clean energy assets, including power, biofuels and heat, will reach $630bn by 2030 (nominal)

Annual investment in all clean energy assets will increase from $189bn in 2012 to $630bn in 2030.

Cumulatively this will require some $7.6trillion of finance over the period 2013 to 2030.

90% of this capital will be needed in the power sector, with the remaining 10% distributed broadly equally between biofuels and renewable heating.



Note:

1. All $bn figures are nominal assuming a 2% annual rate of inflation
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Source: Bloomberg New Energy Finance

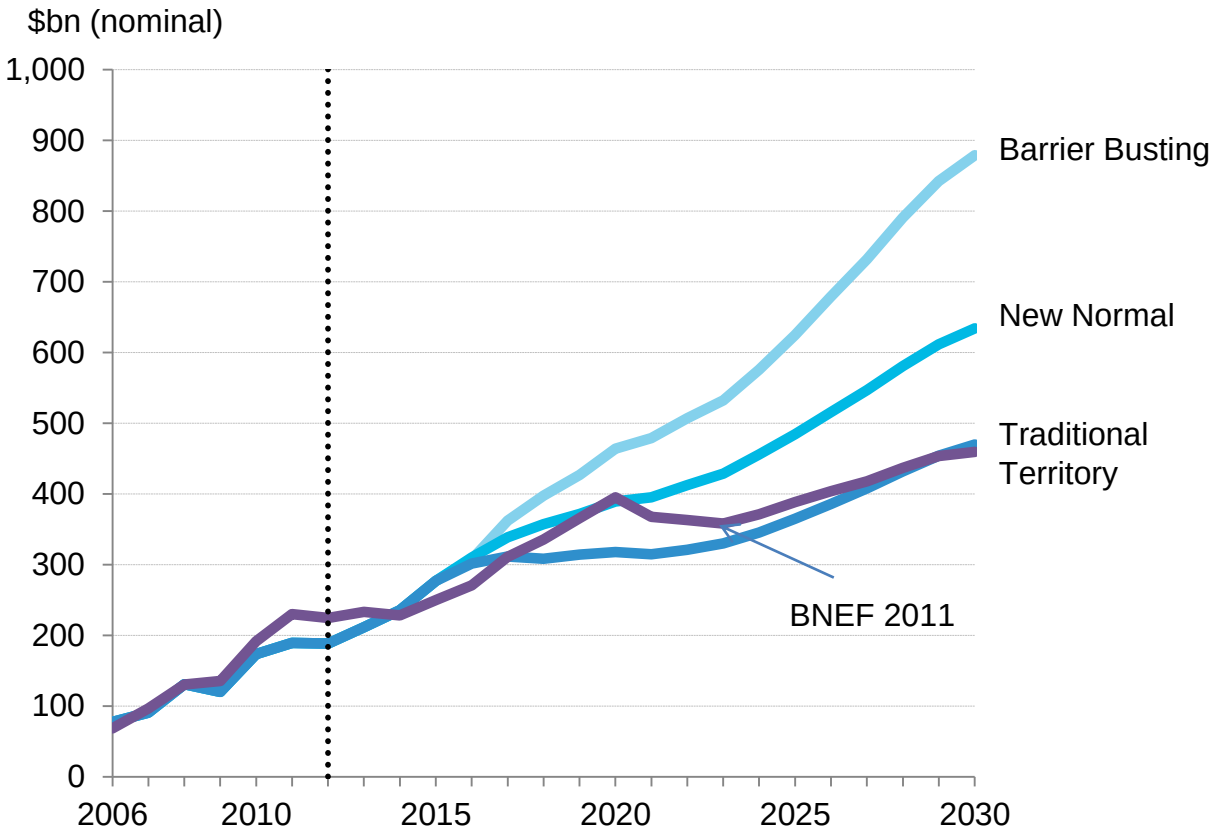
RENEWABLE ENERGY CAPITAL REQUIREMENTS

Renewable energy investment could vary between $470bn and $880bn in 2030

Cumulative requirement for capital from 2012 to 2030 is up 18% at $7.6tr. This is equivalent to a compound annual growth rate of 6.7% in nominal terms.

The Barrier Busting scenario sees investment in clean energy assets grow to $880bn by 2030 ($9.3 trillion cumulatively). This would require an additional $2 trillion invested in supporting infrastructure such as long distance transmission systems, smart grids, storage and demand response.

Weaker climate policies and a more subdued economic outlook sees only $470bn invested in our Traditional Territory scenario in 2030 with an annual compound growth rate of 4.8% nominal.



Note: Renewable energy includes wind, solar, biomass, energy from waste, geothermal. biofuels, heat.

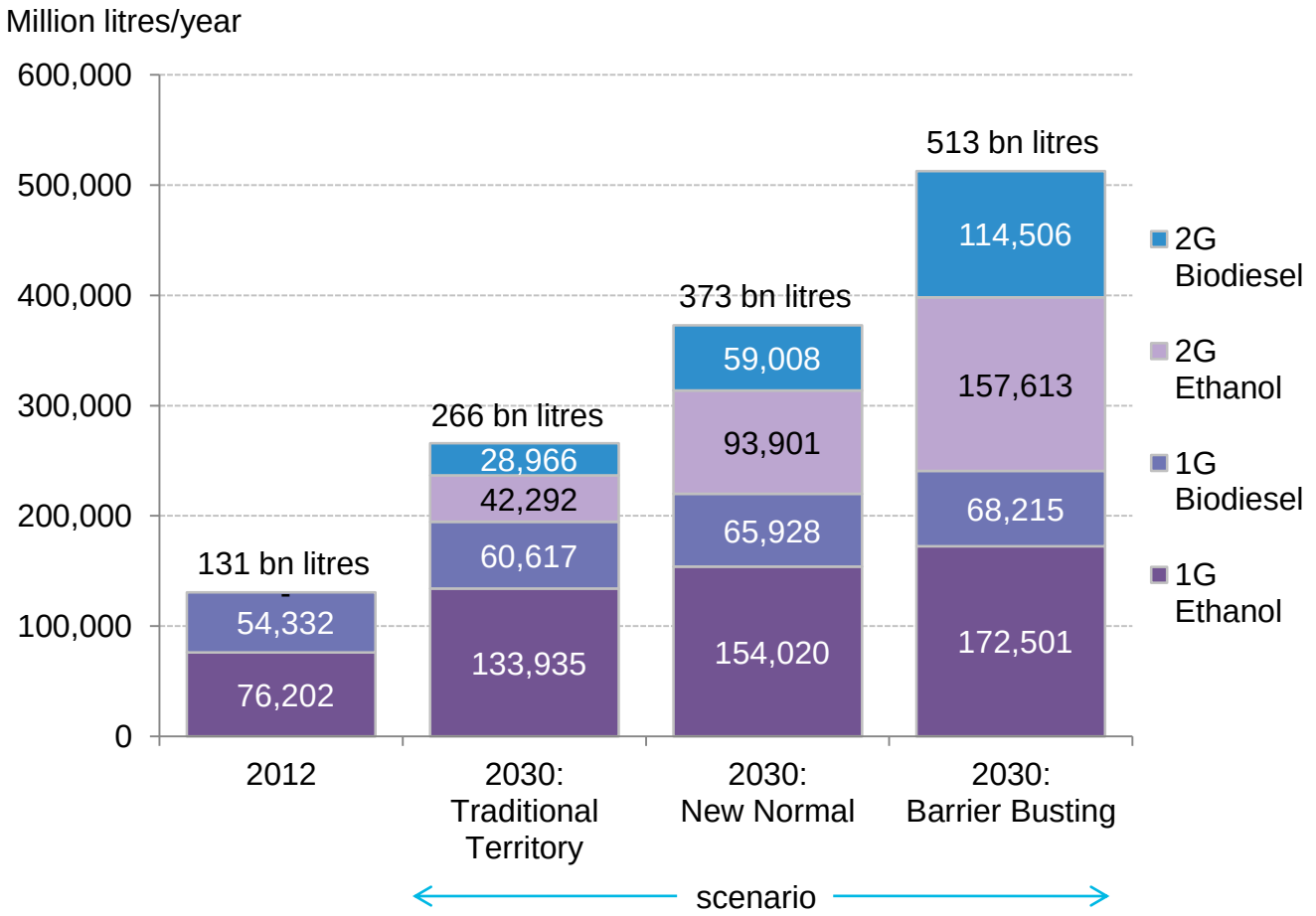
Source: Bloomberg New Energy Finance

ANNUAL BIOFUEL CONSUMPTION, 2013-2030

Global biofuel production to increase by 200% to 373bnL in 2030

Global biofuel production increases by around 200% to 2030 in our New Normal scenario from 120bn litres to 370bn litres in 2030.

The most rapid growth is in second generation biodiesel and ethanol which make up 41% of global consumption in our New Normal and 53% in our Barrier Busting scenario to 2030.



Source: Bloomberg New Energy Finance

TOTAL PRIMARY ENERGY DEMAND

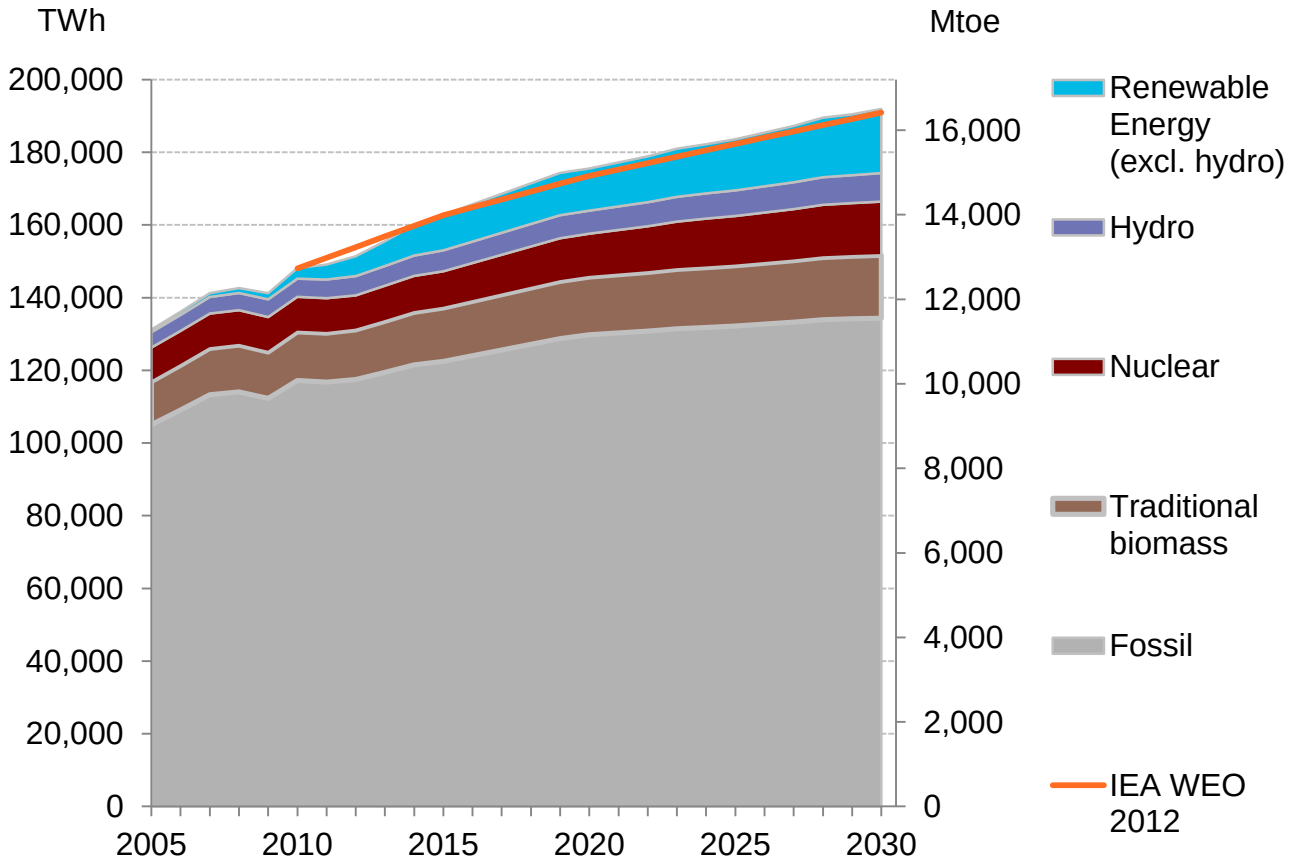
Renewable energy rises to 28% of TPED by 2030 up from 21% in 2012

In the NN scenario renewable energy (including large hydro and traditional biomass) increases its share of world primary energy demand by a third from 21% in 2012 to 28% by 2030.

The share of fossil fuels is expected to reduce from 78% in 2012 to 72% under the NN scenario. In the BB scenario the share of renewable energy (including large hydro and traditional biomass) in world primary energy demand increases to 30% .

In the TT scenario renewable energy (including large-hydro and traditional biomass) accounts for only 26% of world primary energy demand.

New renewable technologies of wind, solar, bio-energy, geothermal and marine is expected to increase from 3% in 2012 to as much as 10% under the BB scenario.



Source: Bloomberg New Energy Finance

APPENDIX

METHODOLOGY AND ASSUMPTIONS

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METHODOLOGY

- The analysis uses BNEF's Global Energy and Emissions Model (GE²M) – a partial equilibrium model of the world energy system. The model is based on detailed country and sector analyses incorporating real world constraints as well as modelled outputs..
- The model is structured around three time periods:
  - Short term (to c.2016) in which build forecasts are based on known development pipelines as determined by BNEF sector experts around the world;
  - Medium term (to c.2020) in which build rates for clean energy technologies are strongly determined by policy goals and BNEF's judgment of these goals being met or exceeded;
  - Long term (to 2030) in which build rates are modelled economically based on an investment decision framework.
- The investment decision analysis determines the demand for energy (based on economic, demographic and technological trends), and which technologies will be built to meet that need. The model builds more of the cheaper technologies, where costs are those seen by project developers and determined on an "levelised cost" basis.
- In the power system, the costs of maintaining / upgrading the network and ensuring reliability of supply demand are borne by the tax payer or electricity user – they are not attributed to individual projects or technologies. This means that renewable technologies do not bear the costs of managing intermittency.
- The levelised costs of power technologies are projected to 2030 using BNEF analysis of technology experience curves and assumptions on future fuel prices and resource curves (for renewable technologies).
- Policy goals are varied in the three scenarios, but in all three scenarios it is assumed that no technology specific support mechanisms are in place post 2020. In countries or regions with climate policies

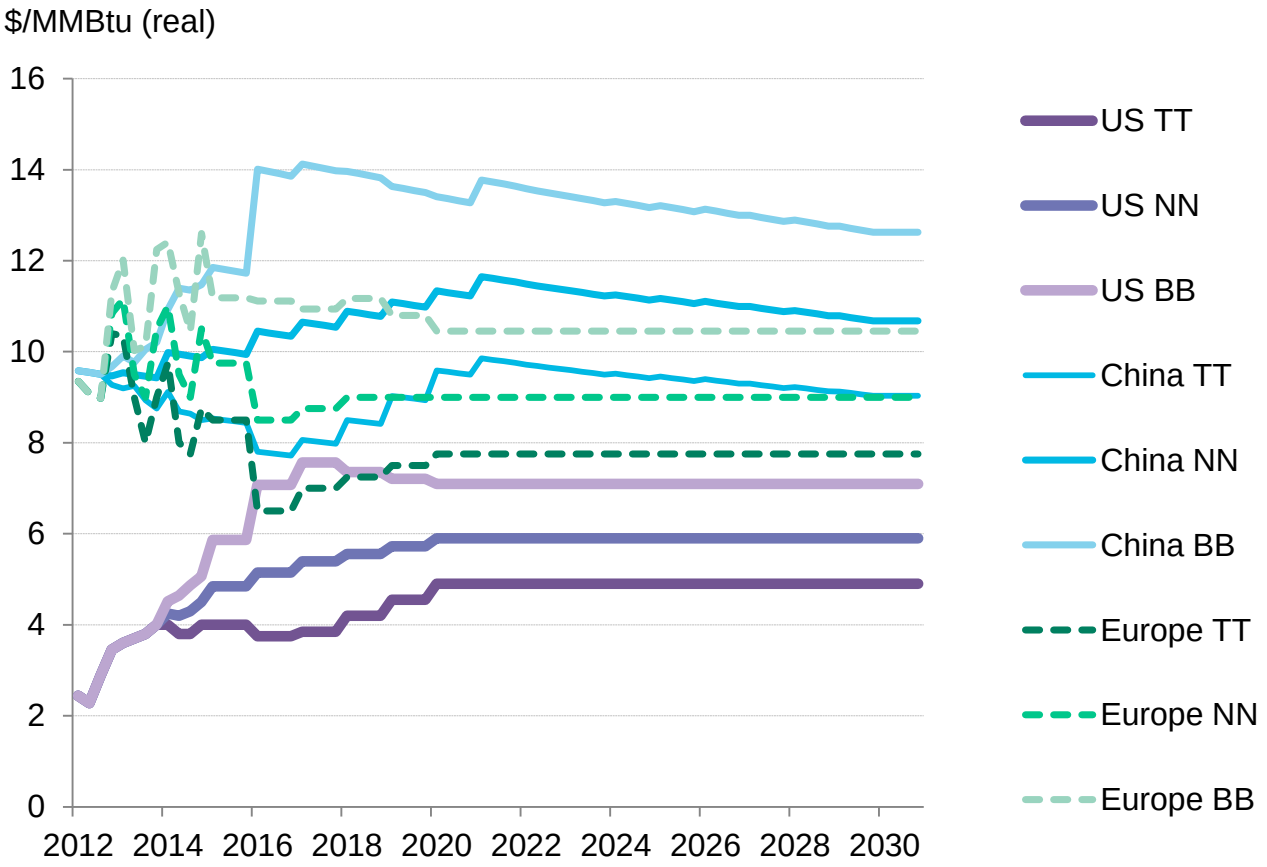
GAS PRICES

Gas prices are assumed to rise in the US to $6/MMBtu by 2030 (NN scenario).

European gas prices remain above US prices and stabilise around $9/MMBtu (NN scenario).

In China gas prices are higher than in Europe being linked to the Asian LNG market. Prices rise up to 2020 but then fall to 2030 towards $11/MMBtu (NN scenario).

Gas price s differ across the three scenarios as a result of differences in economic activity and local demand for gas.



Source: Bloomberg New Energy Finance

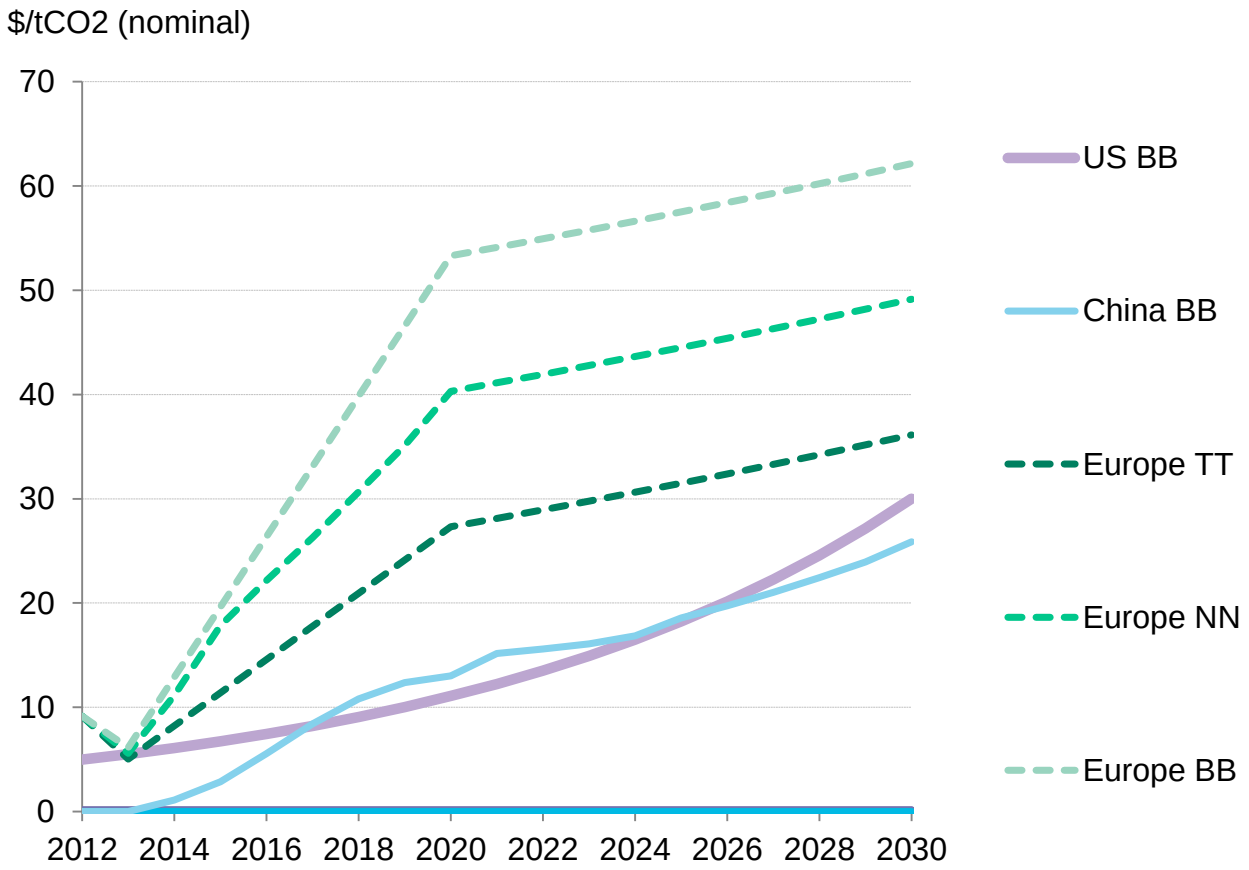
CARBON PRICES

Carbon prices are derived from BNEF's proprietary long-term fundamental analysis of the world's carbon markets.

The NN scenario assumes existing and currently proposed carbon markets in EU, Australia & South Korea continue as planned.

The BB scenario assumes domestic carbon pricing mechanisms are implemented in China and the US. There is no change to the carbon prices for Europe, Australia and S Korea in the NN scenario.

In the TT scenario Australia repeals its carbon price leaving only Europe with a carbon price under the current legislation.



Note: prices in Europe are strongly driven by the cost of fuel switching between coal and gas generation. This is currently > $50/tCO2

Source: Bloomberg New Energy Finance

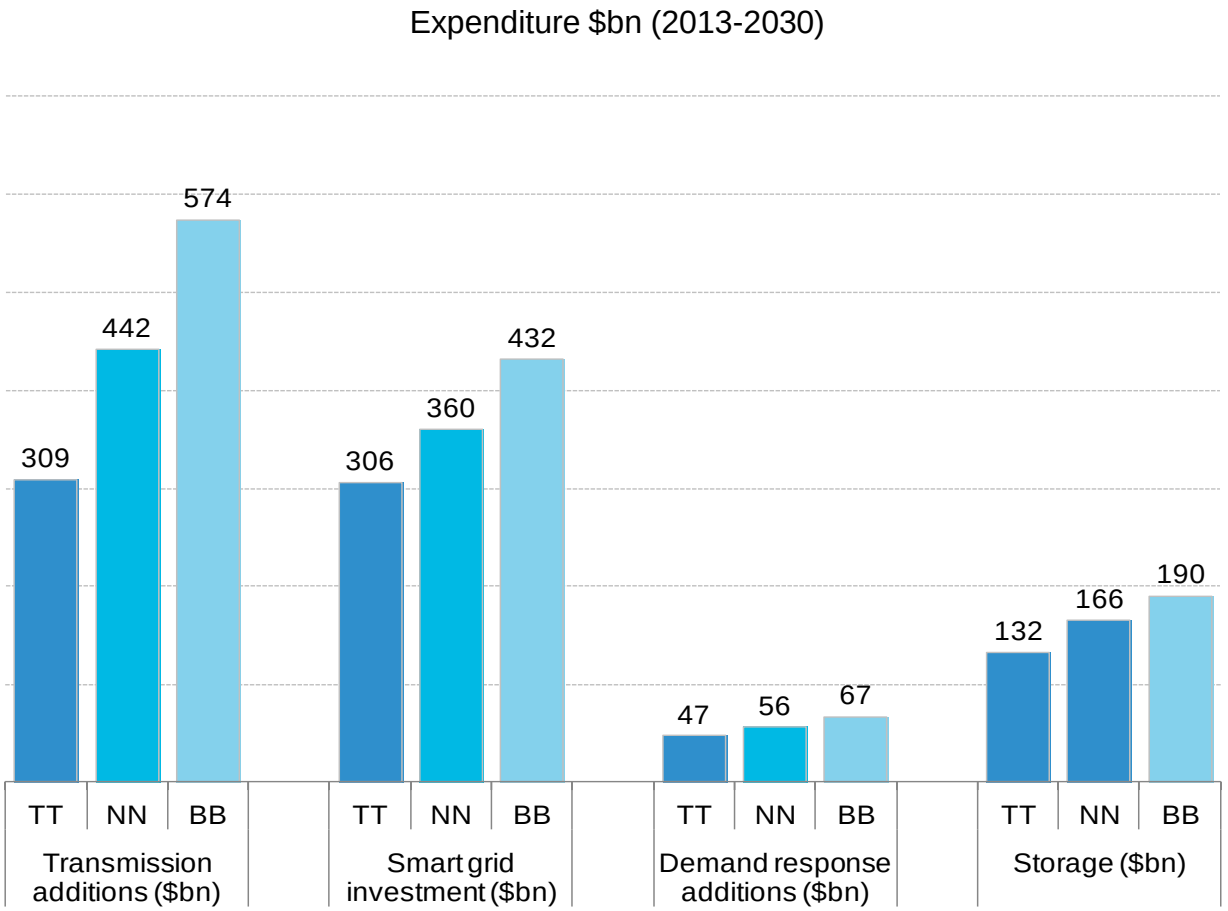
POWER INFRASTRUCTURE IMPROVEMENTS

Power infrastructure expenditure split into: transmission additions, smart grid, demand response and storage.

Expenditure on power infrastructure differs under the three scenarios.

Transmission systems and smart grid schemes account for the majority of expenditure. Demand response requires relatively upfront capital.

Storage systems include pumped hydro and batteries. The cost of battery systems is projected to fall more rapidly in the BB scenario.



Source: Bloomberg New Energy Finance

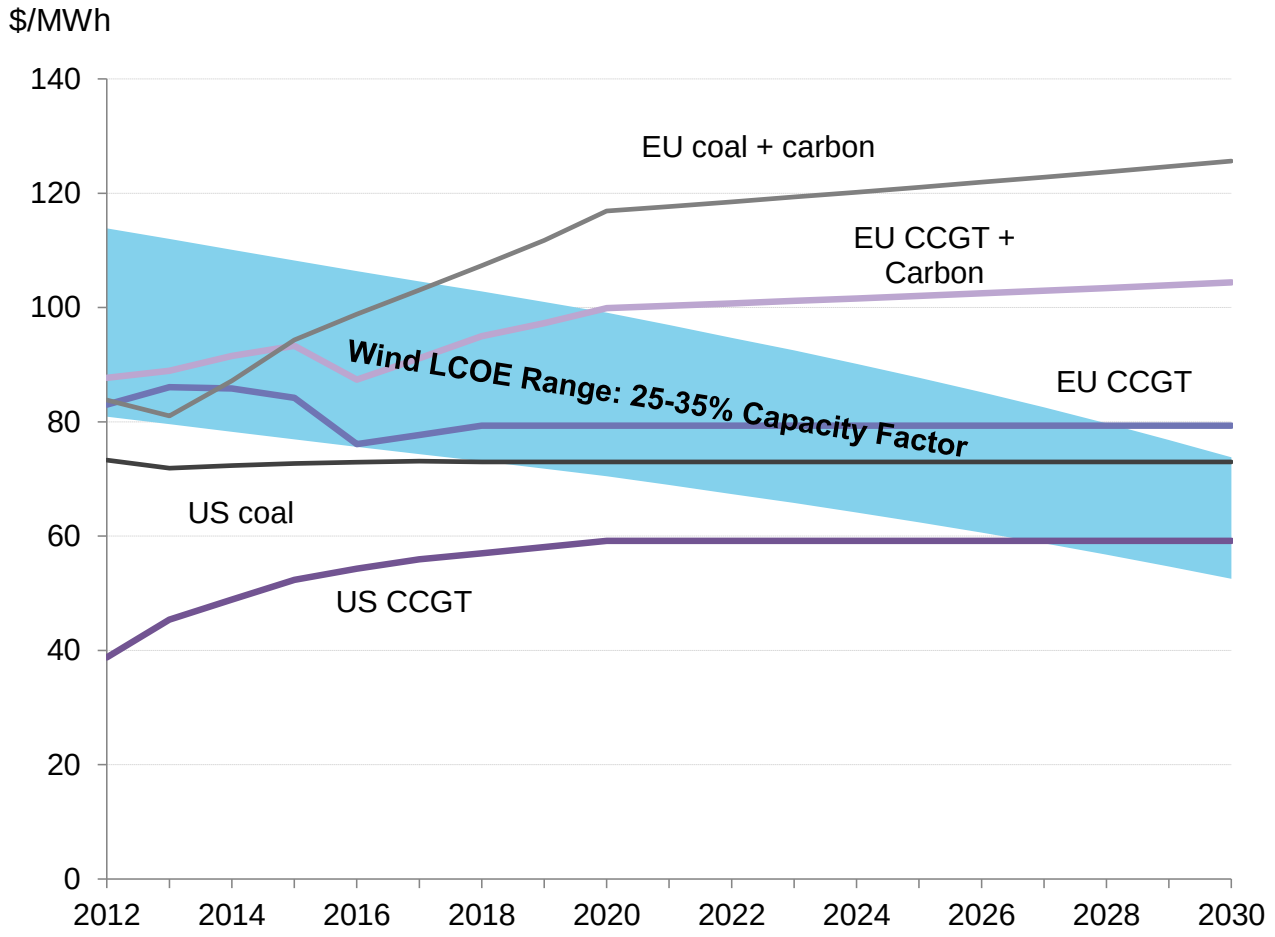
LEVELISED COST OF ENERGY - WIND

The levelised cost of generating power from wind (onshore) falls 35% in real terms between 2012 and 2030 as innovation and economies of scale drive down costs.

In some geographies the LCOE from new build wind energy at high quality sites is already cheaper than new build coal- or gas-fired electricity without subsidy.

Fuel price and carbon risk pushes the cost of new gas- and coal-fired generation higher..

Projected carbon prices in Europe and Australia make it more economical to invest in new wind than gas and coal capacity.



Note: Global average LCOEs calculated from BNEF forecast LCOEs in Europe, China, and US.

Source: Bloomberg New Energy Finance

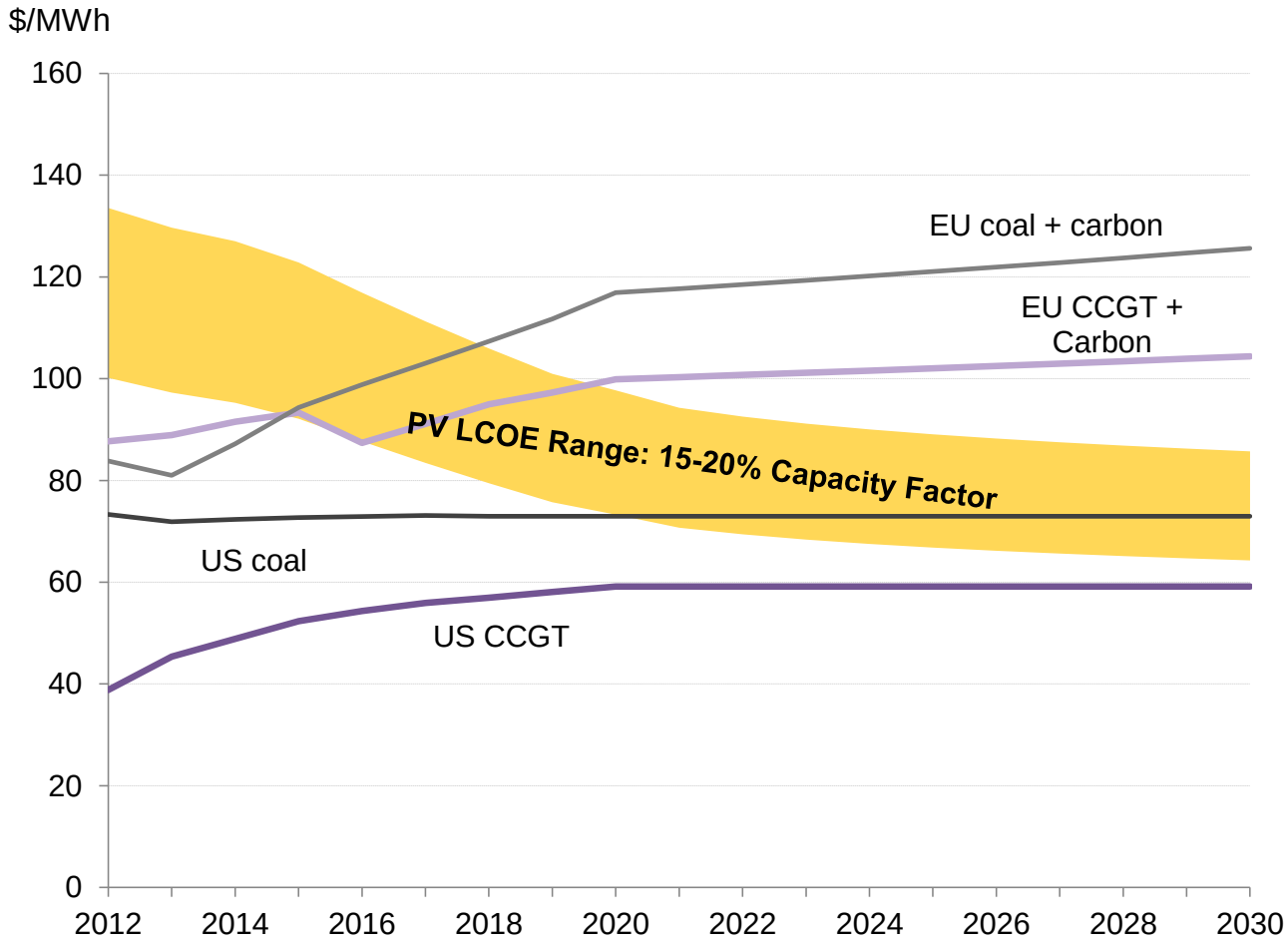
LEVELISED COST OF ENERGY - SOLAR

Utility-scale solar PV is not yet cost competitive with new-build coal- and gas-fired generation in most geographies.

The levelised cost of generating power from solar PV however is expected to fall by 30-40% in real terms between 2012 and 2030.

This cost reduction makes large solar PV arrays competitive in markets with carbon pricing this decade.

By 2020 solar energy from high insolation utility-scale facilities will fall to around $80/MWh – roughly the cost of high quality wind in 2012.



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Source: Bloomberg New Energy Finance

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RODERICK MCKINLEY, ANALYST

MARKETS

Renewable Energy
Carbon Markets
Energy Smart Technologies
Renewable Energy Certificates
Carbon Capture & Storage
Power
Water
Nuclear

SERVICES

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Industry Intelligence: data & analytics
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