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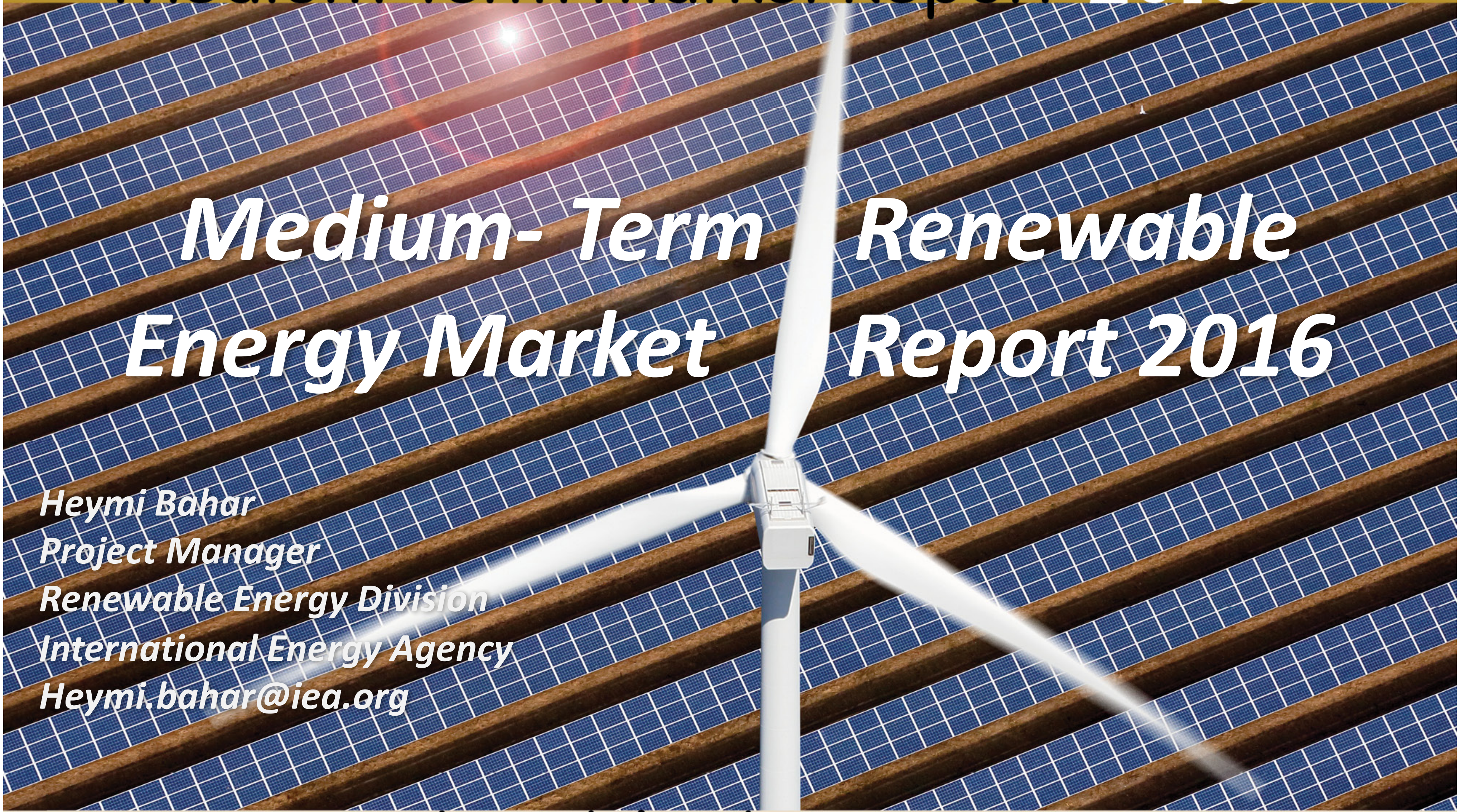
RENEWABLE ENERGY
Medium-Term Market Report 2016



Medium- Term Renewable Energy Market Report 2016

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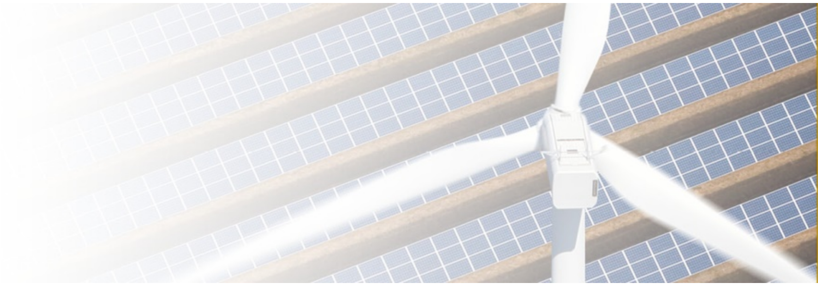
Market Analysis and Forecasts to 2021

Energiforsk, Stockholm, 18 January 2017

Context



- **A year of records for renewable electricity**
  - ***A record amount of new capacity was installed in 2015***
  - ***Total capacity has now overtaken coal***
- **COP21 Paris Agreement gives momentum to renewables**
- **Local air pollution & energy security are also key drivers**
- **Energy investment flows confirm shift to renewables**
- **But policy makers need to heighten their commitments and provide investors more clarity & certainty**

New policies underpin a more bullish forecast for renewables

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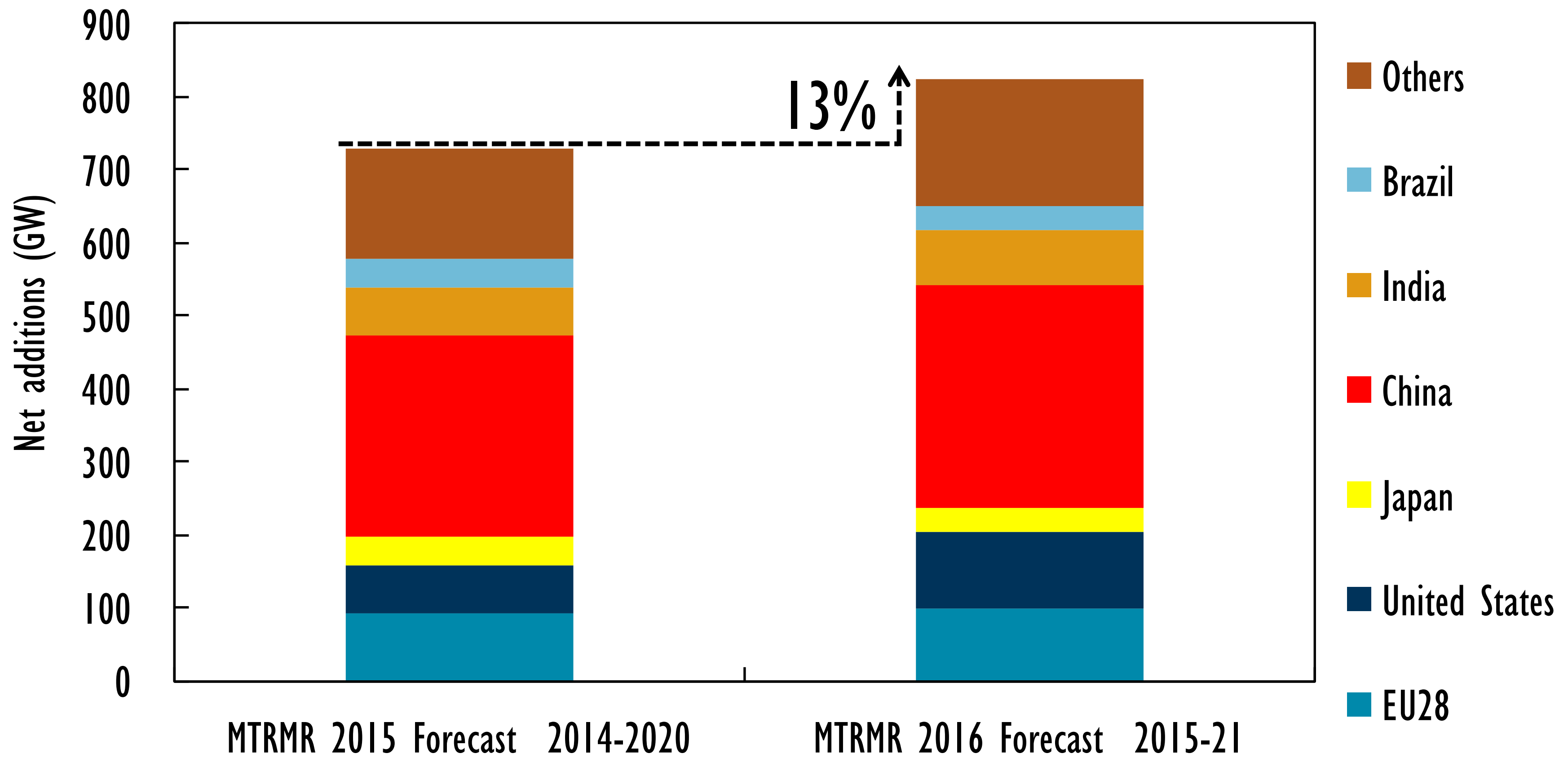
Renewable electricity capacity growth (GW) in *MTRMR's main case*



China remains key growth market for renewable capacity, while the United States surpasses the EU for the first time.

Renewables to remain fastest growing source of electricity generation

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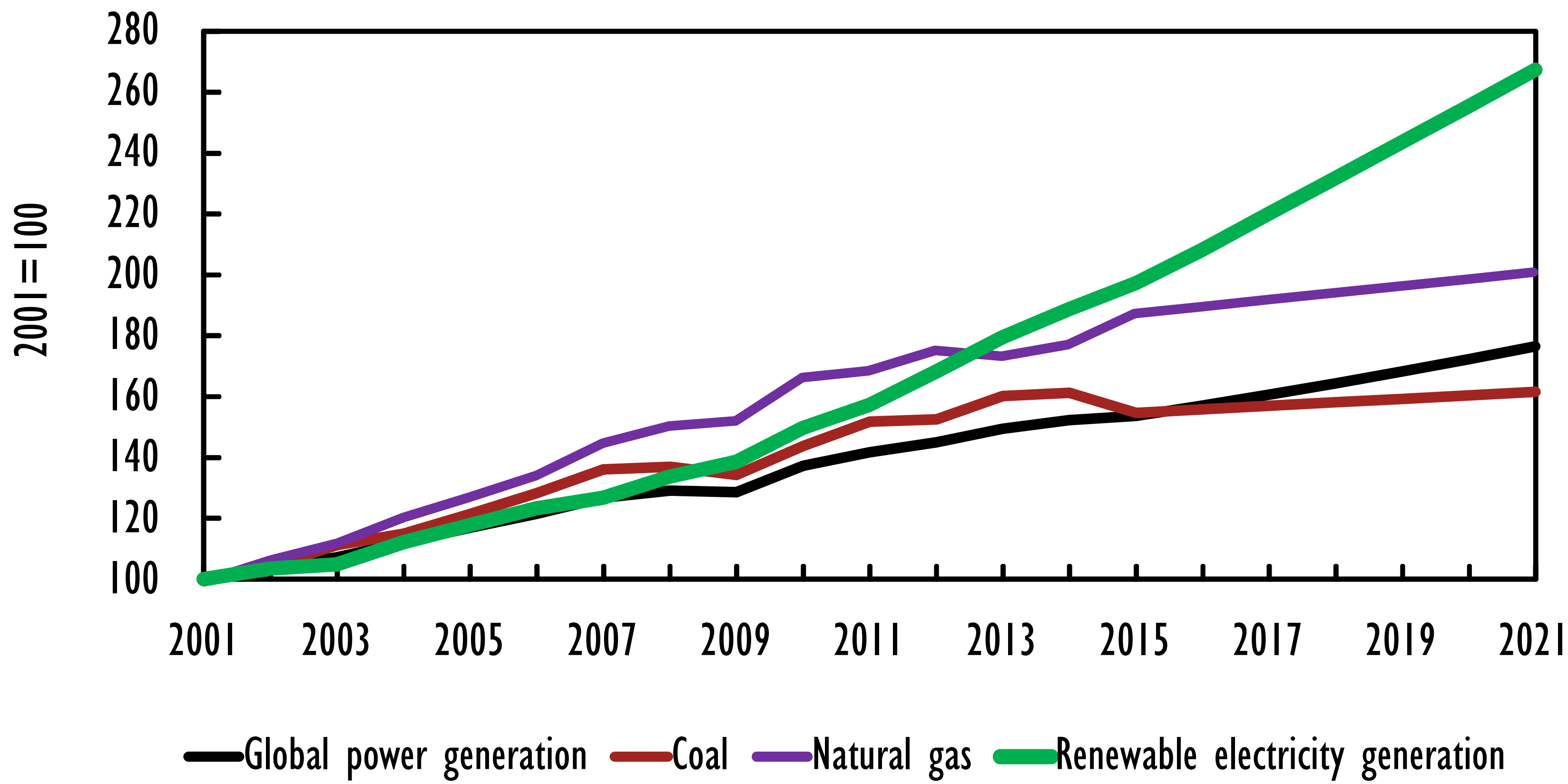
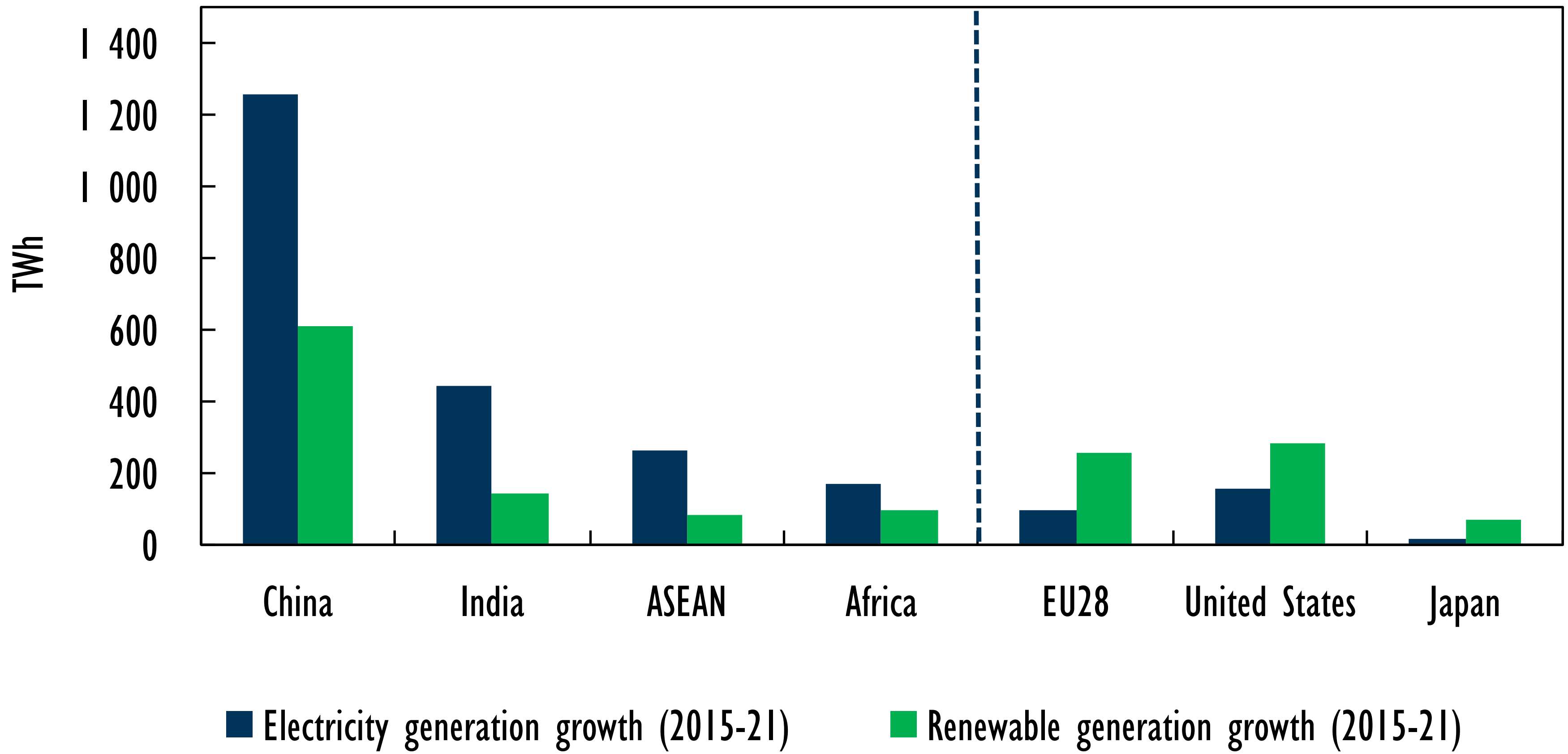
Indexed electricity generation by fuel (2001-21)



Generation from renewables to rise by almost two-fifths over 2015-2021, pushing their share of total electricity generation from 23% to 28%

A two-speed world for renewable electricity

Electricity and renewable generation growth by country/region



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

The increase in generation from renewables in 2015-2021 represents 60% of the global increase in electricity output, but prospects vary across regionally

Wind and solar PV compensate for slower hydropower growth

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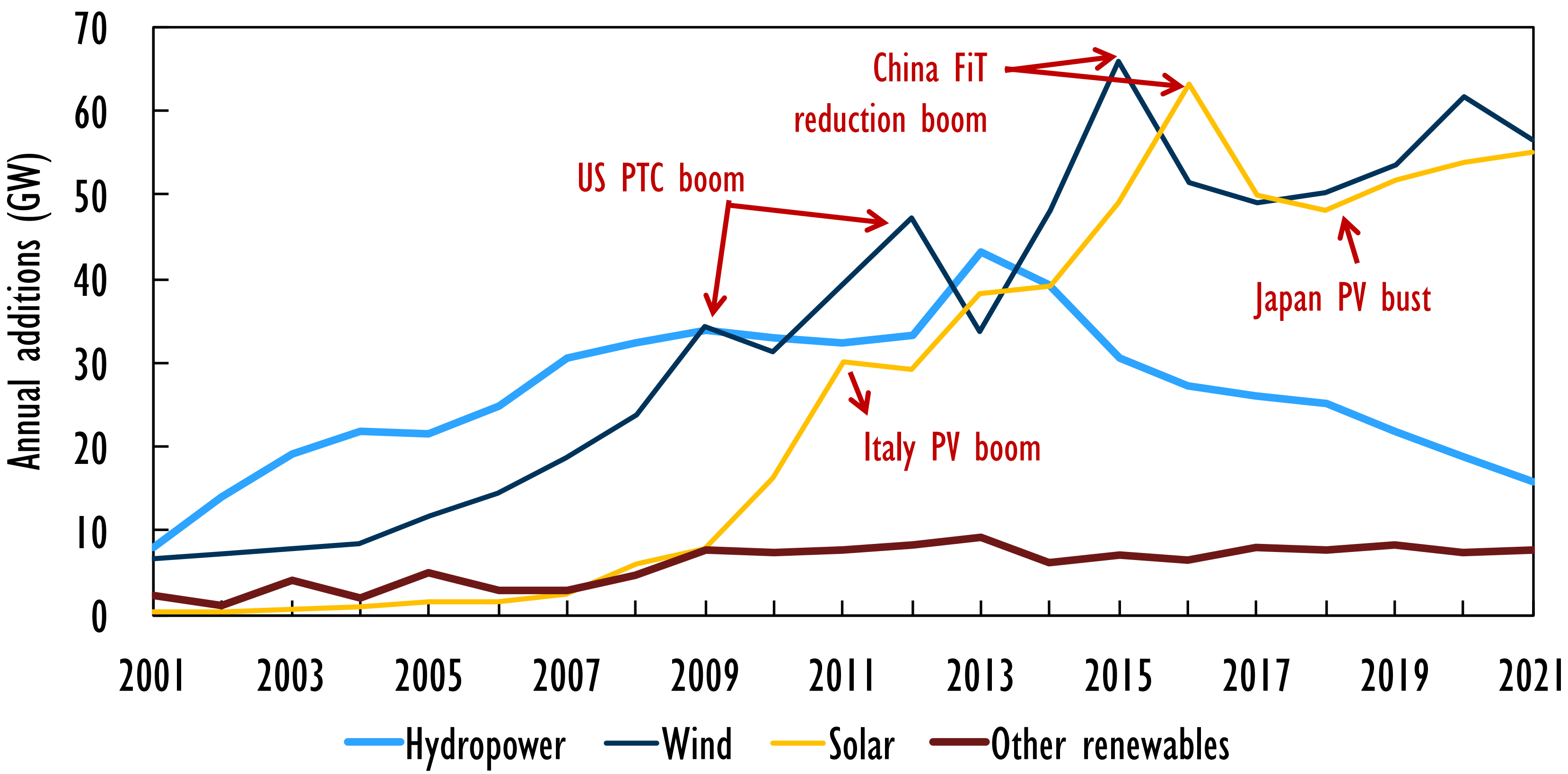
Renewable electricity capacity additions by technology (2001-21)



Predicting policy-driven boom and bust cycles remains a challenge, which is expected to continue over the medium-term.

Renewable costs reductions to remain an important driver for future growth

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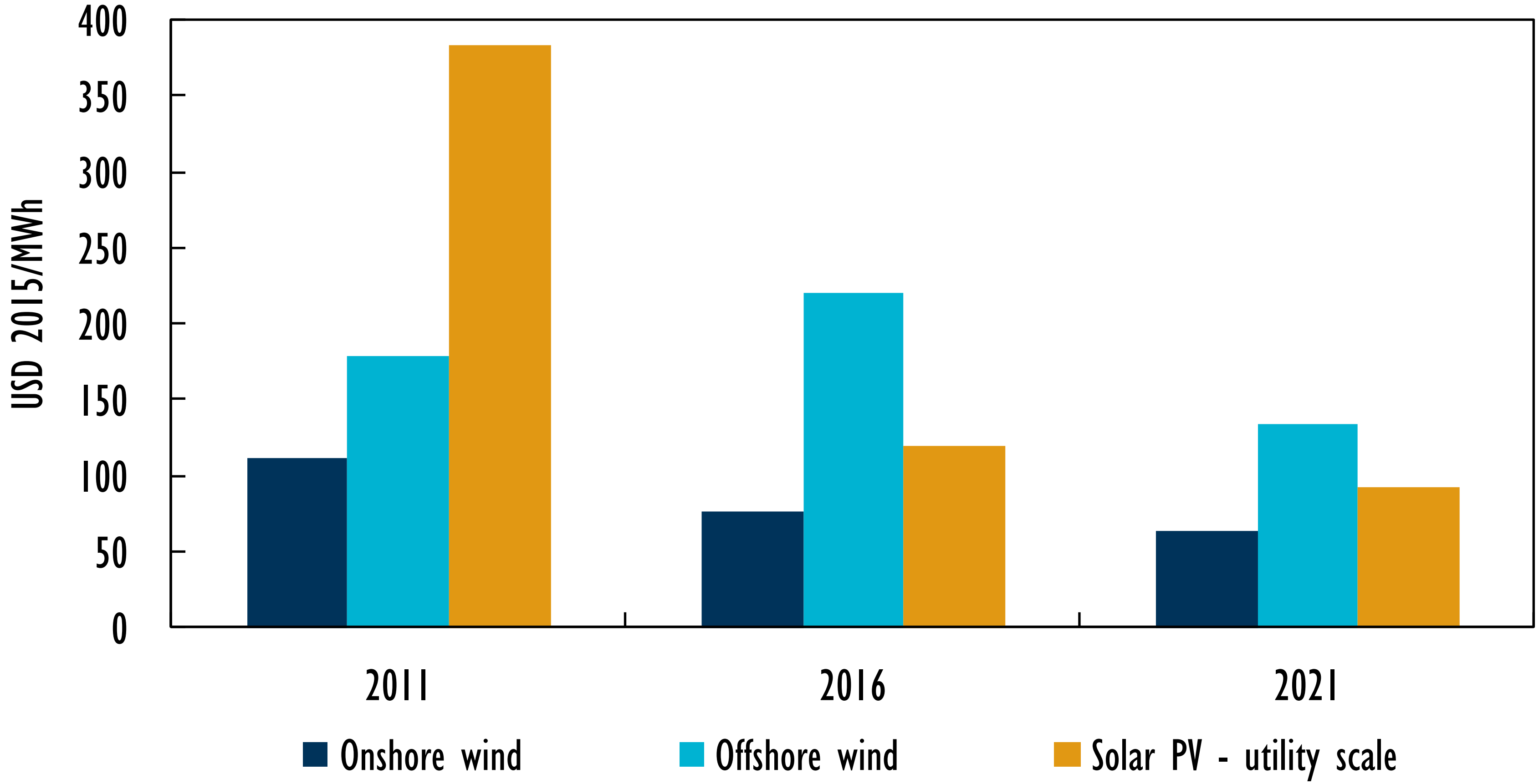
Weighted average generation costs for solar PV and wind



Utility-scale solar PV generation costs to fall by another quarter and onshore wind by 15% over 2015-21, largest absolute cost reduction expected from offshore wind

Policy transition from government-set tariffs to policy-driven auctions/tenders

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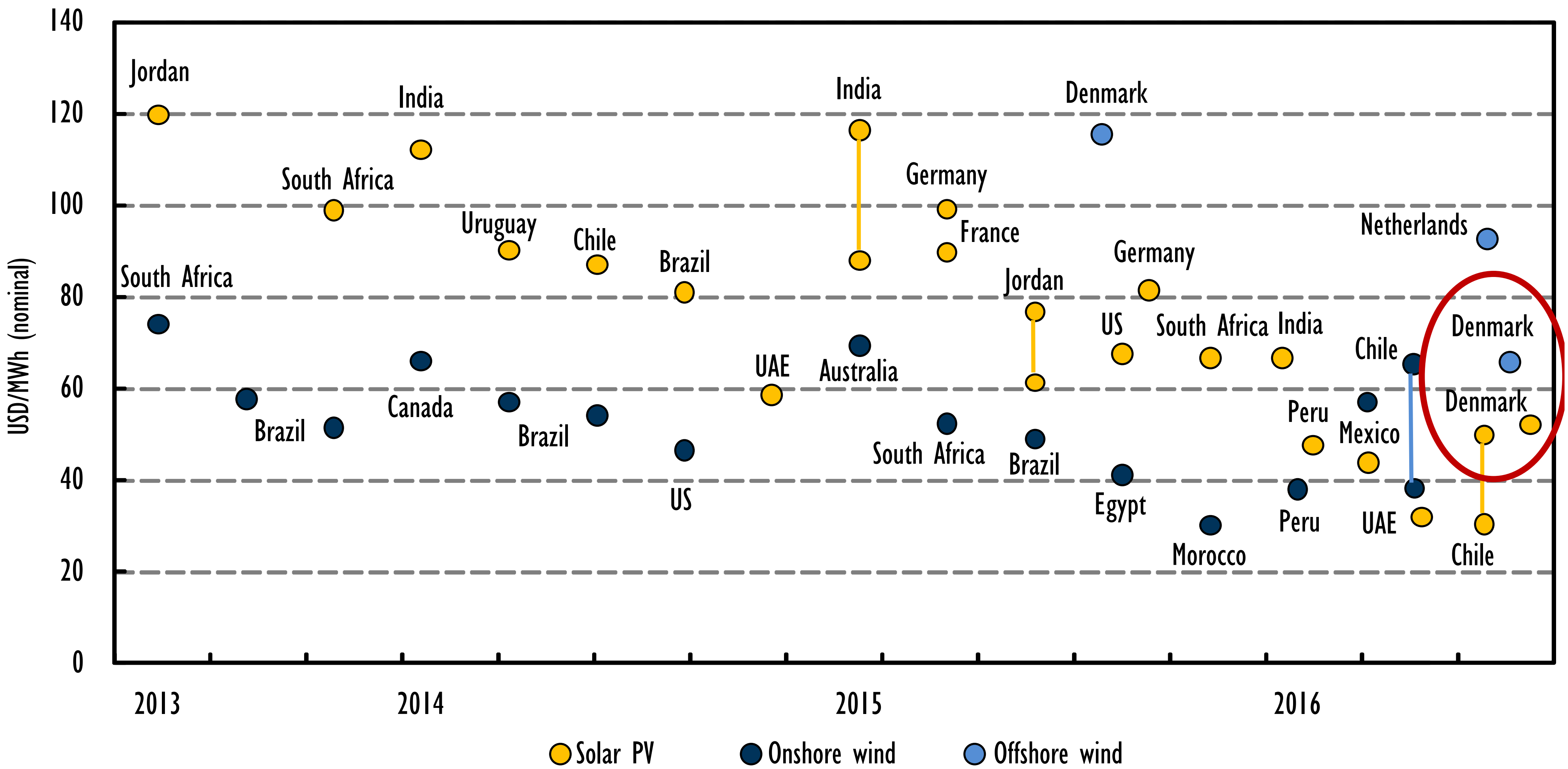
Recent announced long-term contract prices for new renewable power to be commissioned over 2016-2019



Best results occur where price competition, long-term contracts and good resource availability are combined

Non-hydro renewables to represent majority of capacity growth

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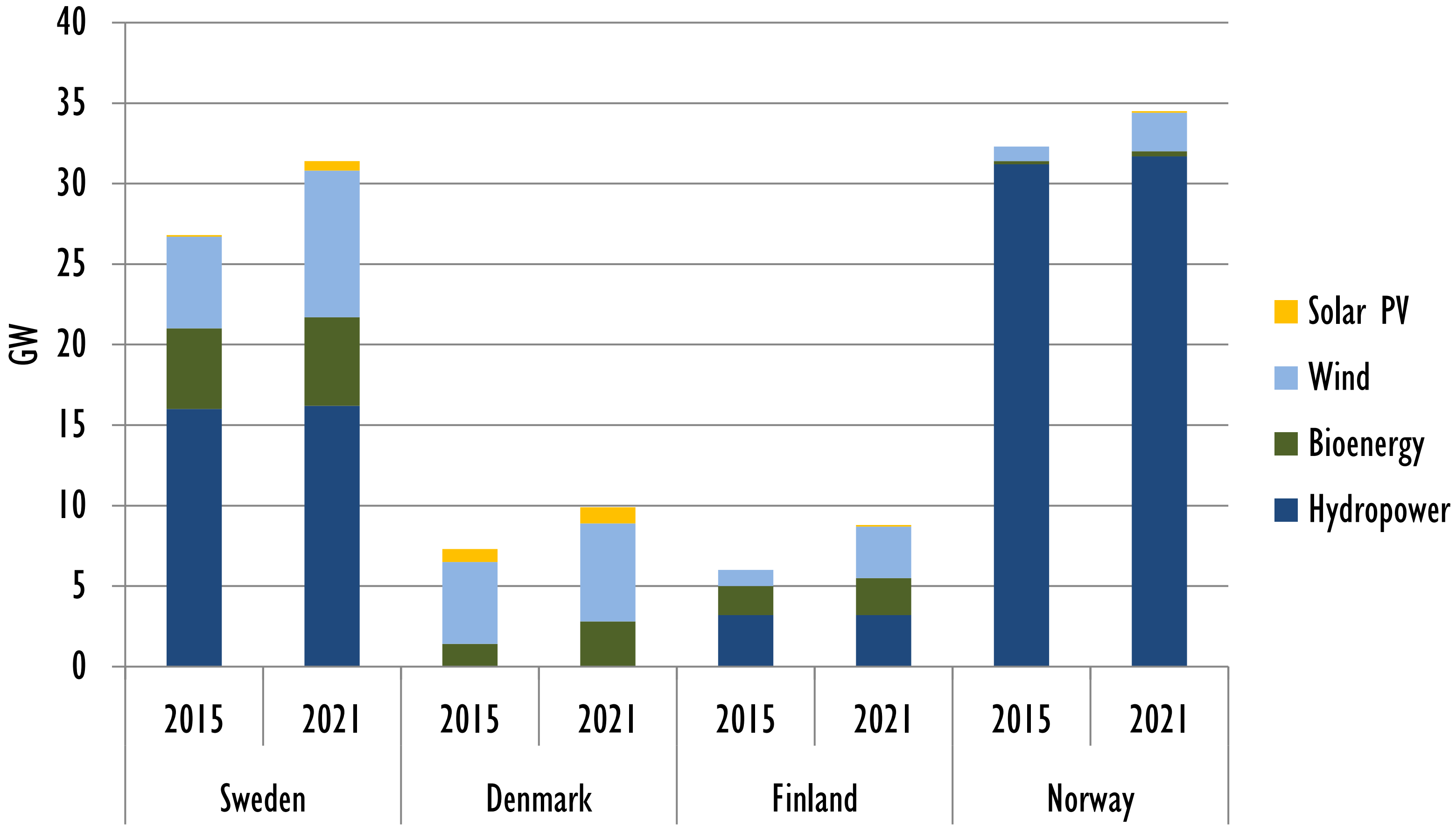
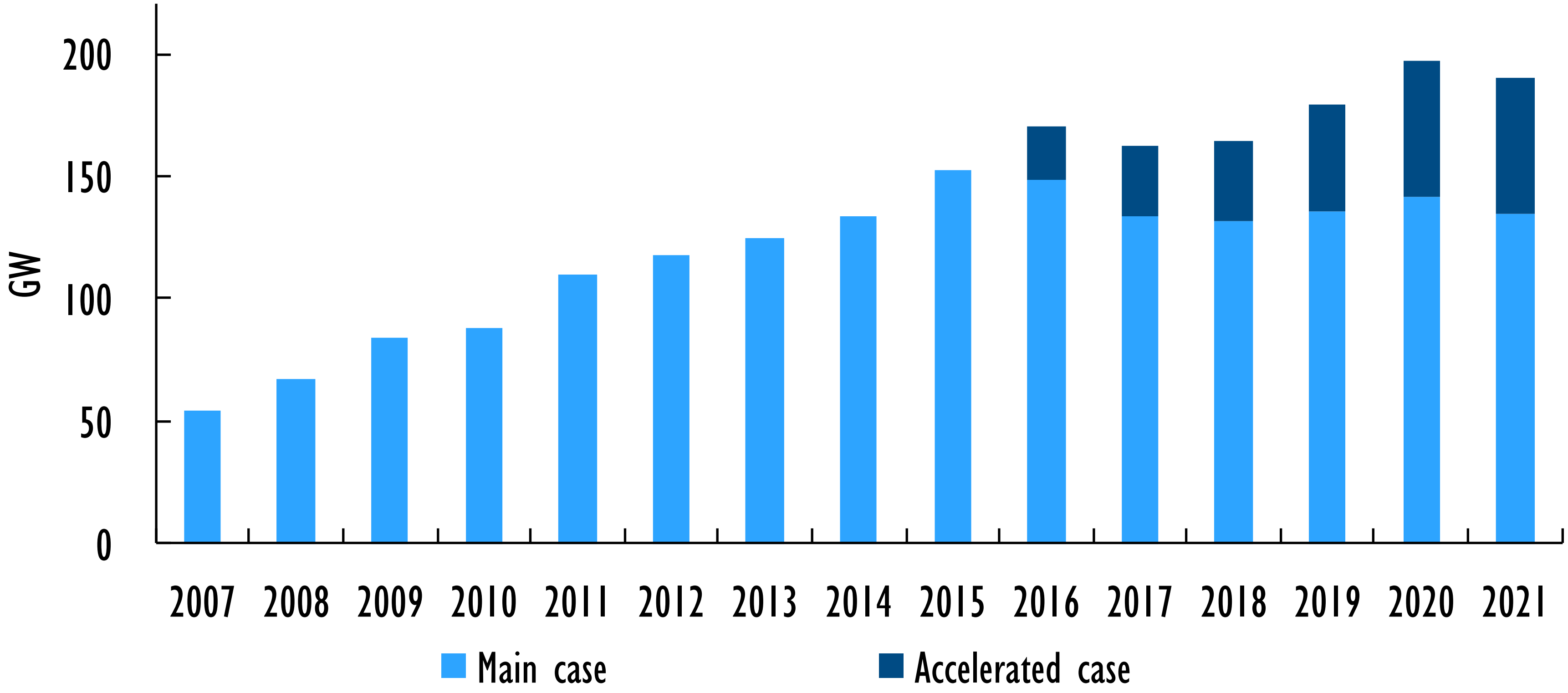
Cumulative renewable capacity by selected Nordic countries (GW)



Share of renewables in electricity generation to grow significantly in all Nordic countries ranging from 50% to over 99%

More ambitious policies could further enhance the outlook in line 2°C target

Renewable electricity capacity additions in Accelerated Case vs. Main Case



Renewables are in line with NDC pledges by 2030 but reducing policy uncertainty and overcoming financing & grid integration challenges remain key to achieve 2°C target

Renewables to dominate electricity growth, but less progress in heat and transport

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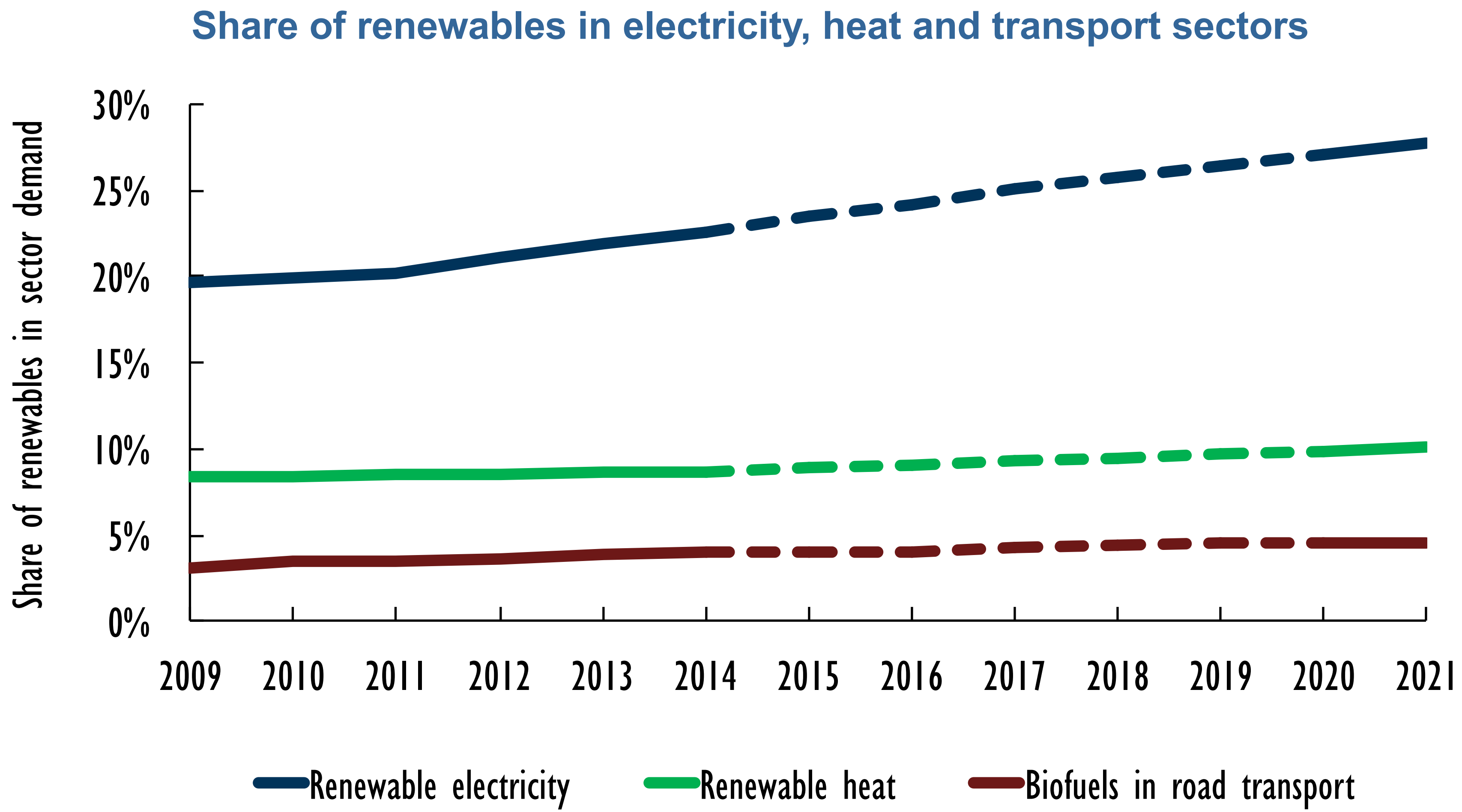

The share of renewables rises in all sectors, despite persistent challenges in heat & transport; interactions between energy efficiency & renewables become critical

Infrastructure and technology factors are key considerations to increase renewable heat uptake

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Renewable heat share and information on district heating, co-generation and industrial sectors, selected countries (2014)

Country	District heating (toe per capita)	RES in district heating (%)	Co-generation in total electricity generation (%)	RES & renewable waste in co-generation (%)	Share of pulp & paper and food & tobacco in Industry FEC (%)	RES heat share 2014 (%)
Sweden	124	77	10	75	38	68.1
Finland	271	48	34	56	59	51.9
Germany	47	22	12	13	18	12.2
Poland	73	2	16	11	23	13.9
Netherlands	40	2	35	3	18	5.2
United Kingdom	39	2	6	7	17	4.5
EU28	**38**	**26**	**12**	**18**	**22**	**17.7**

Source: European Commission, Notes: RES = renewable energy sources, FEC = final energy consumption.

District heating and co-generation are key to increasing bioenergy's contribution in the heating sector for countries seeking to grow renewable heat deployment.

Renewable heat grows slowly as barriers remain in both buildings and industry

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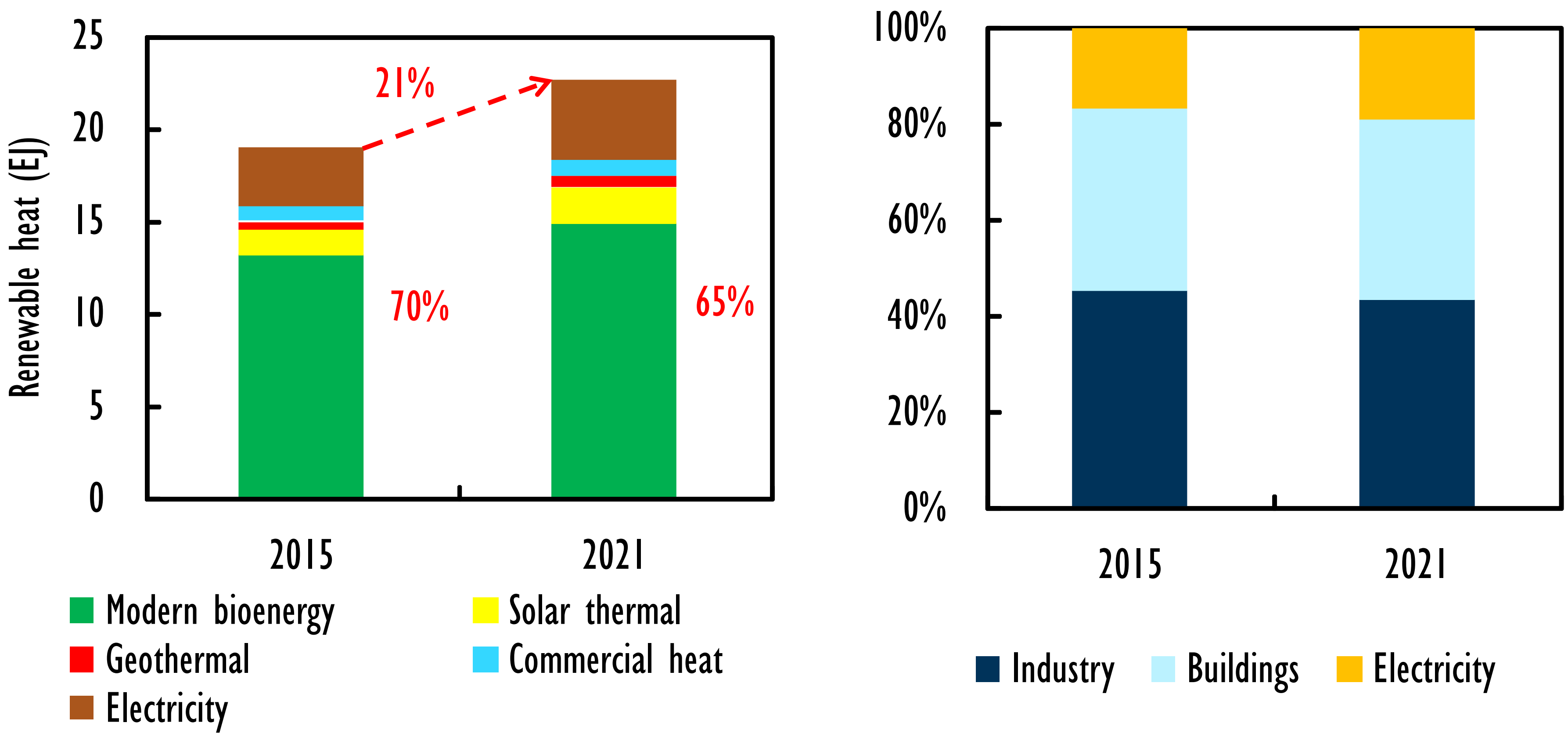
Global final renewable heat consumption by source and sector (2015-21)



Bioenergy to dominate renewable heat consumption over the medium term, with relative consumption in the buildings & industry sectors similar in 2015 and 2021.

Biofuel production shifts to Asia, as EU and US slows

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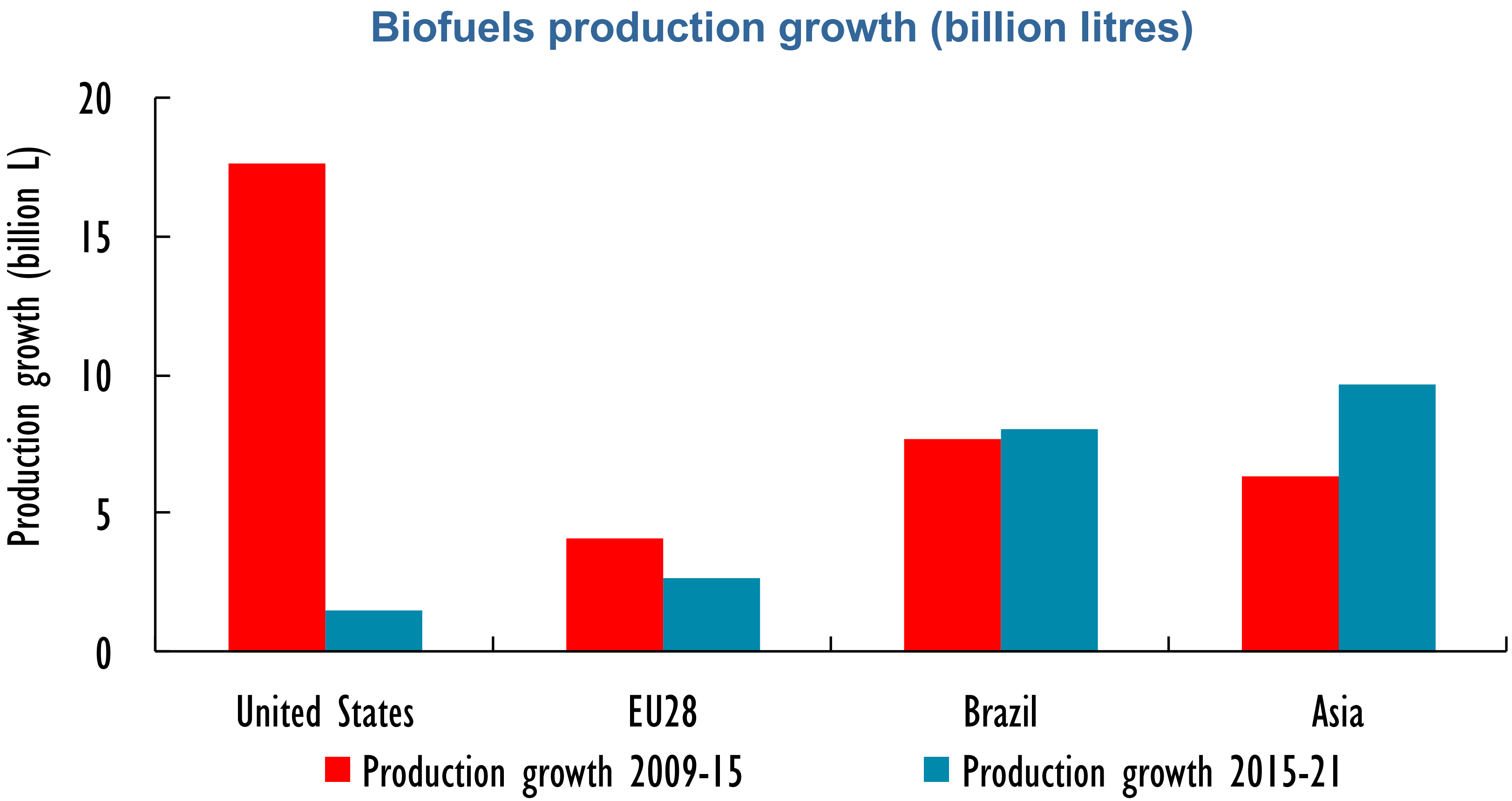

Structural challenges in the US & policy uncertainty post-2020 in the EU slow growth; Thailand, India & Indonesia have strengthened policies despite low oil prices

Advanced biofuels anticipated to scale up from current production levels

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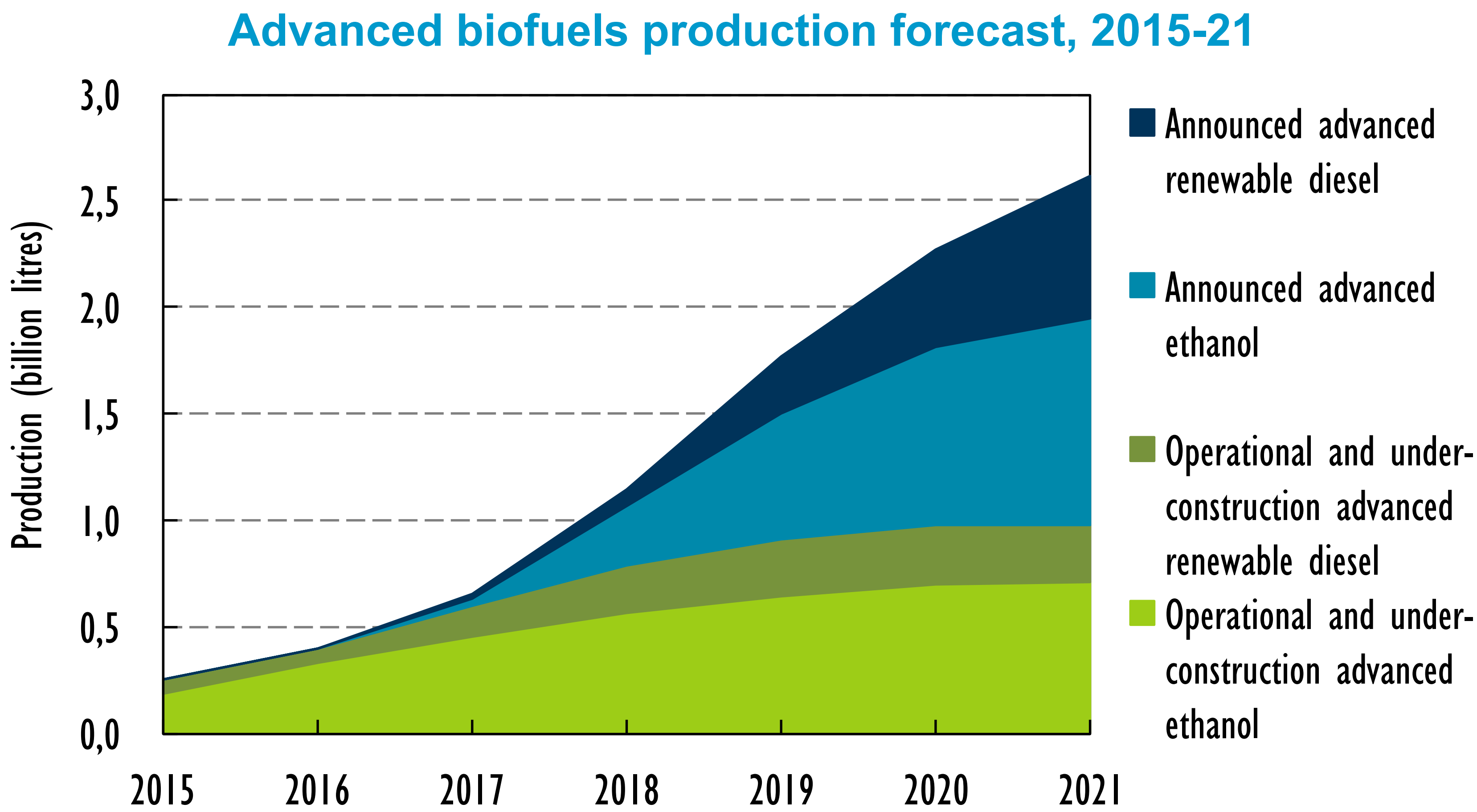
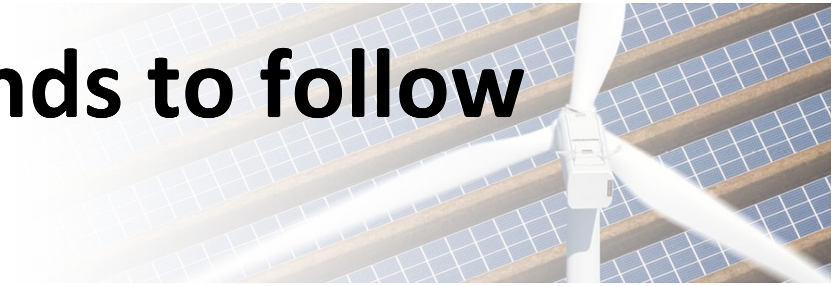


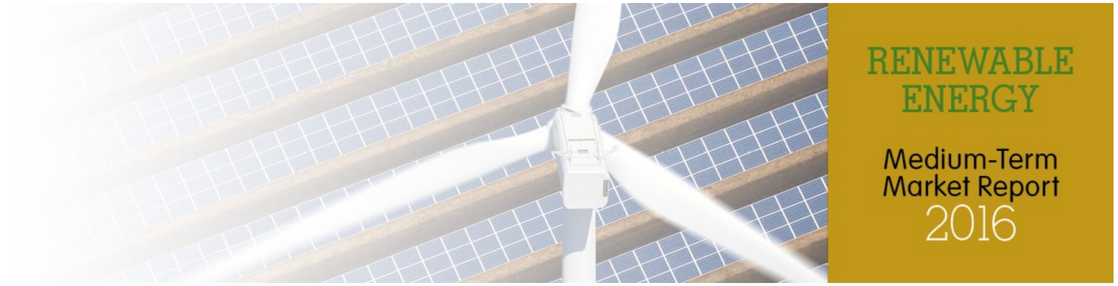
Advanced biofuels are needed in the longer term to sustainably reduce the overall carbon footprint of the transport sector, but the industry is in an early stage of development.

Some important trends to follow for businesses



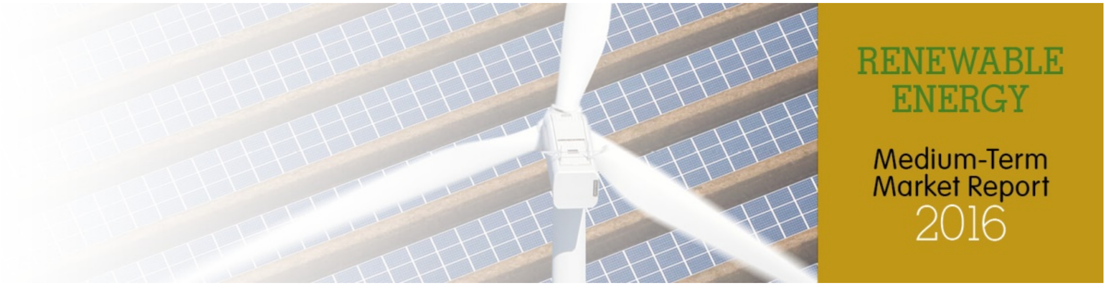
- Distributed solar PV and smart home – new utility business models
- Electrification of transport – infrastructure and IT
- Off-grid electrification in Africa and South East Asia
- Offshore wind cheaper than onshore in Europe
- Market and auction design towards renewable integration
- Advanced biofuels – decarbonisation of aviation and shipping
- Renewable financing industry – diversification of financial products

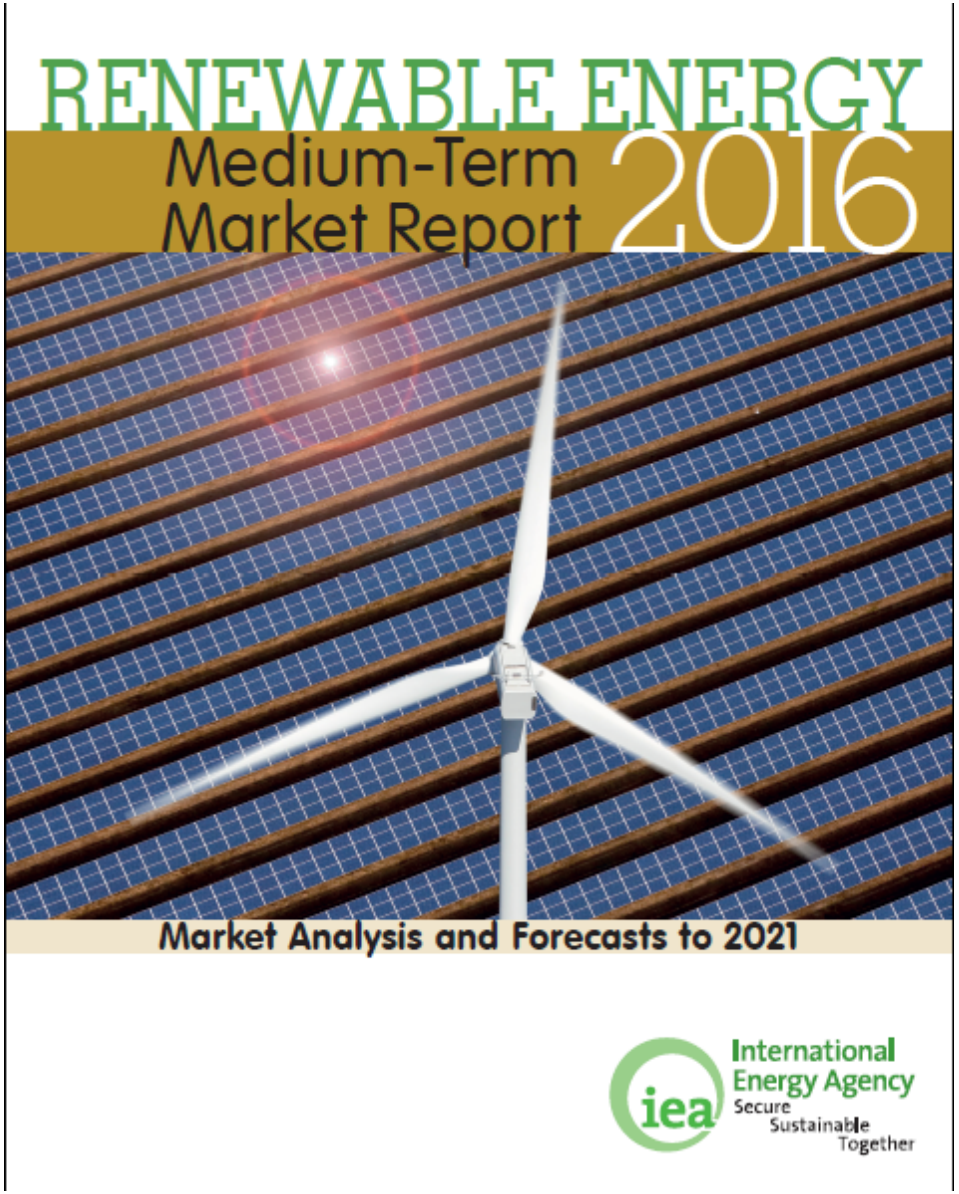
Conclusions



- **Prospects for renewables electricity revised upwards, driven by policy improvements, cost reductions & efforts to improve air quality**
- **The impact of lower fossil fuel prices on renewables varies by sector. Wind (onshore) & solar PV are the only technologies on track for a 2^{o}C scenario**
- **Attracting investment in renewables hinges on appropriate market rules & regulations, particularly in markets with slow electricity demand growth**
- **Progress in renewable growth in the heat and transport sectors remains slow and needs significantly stronger policy efforts.**
- **IEA is working to accelerate energy transition with its analysis on policy & technology and system integration of renewables.**

Thank you. Questions?





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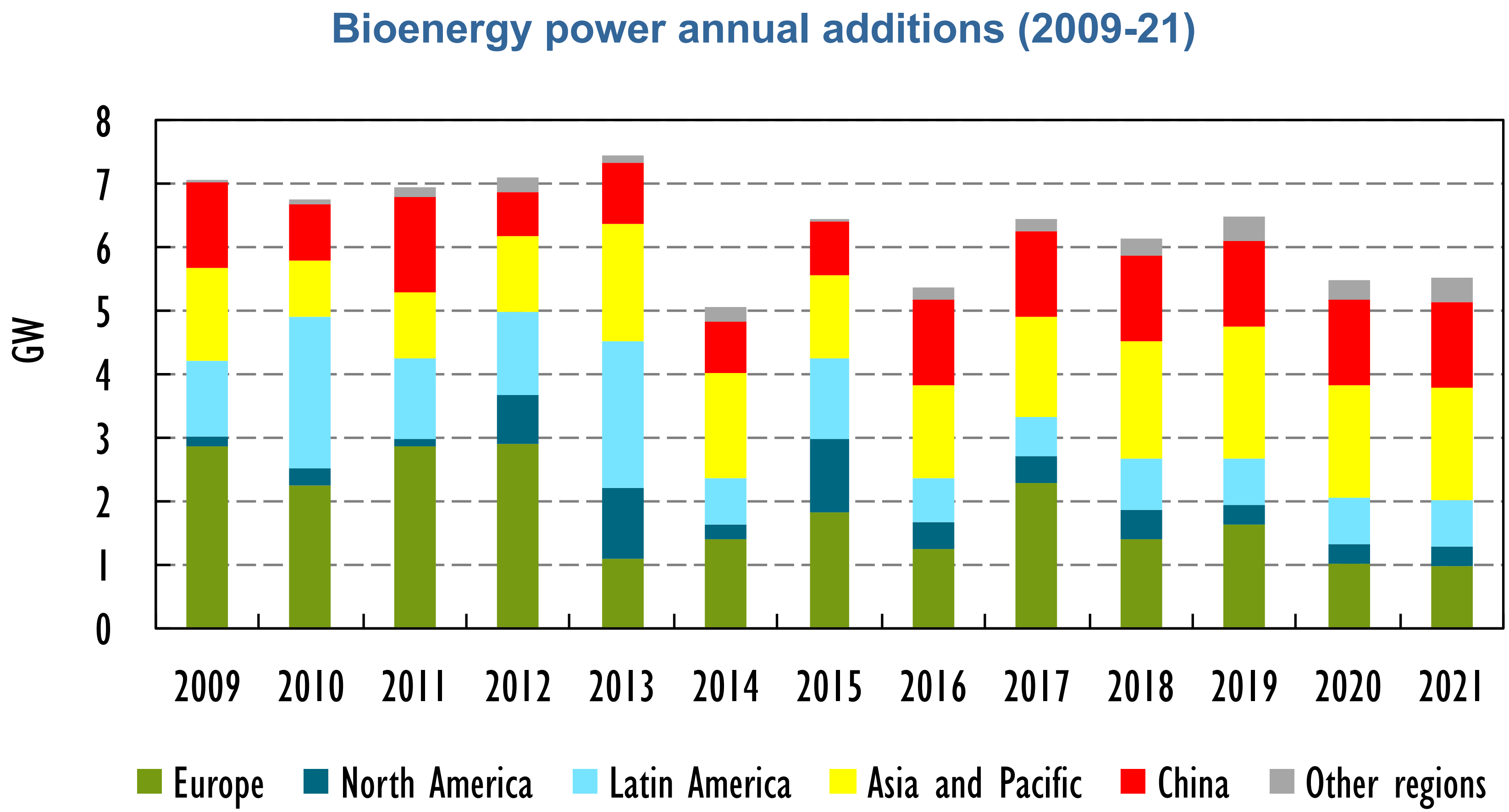
Global bioenergy capacity additions to remain stable



An acceleration of bioenergy deployment over the medium term is not anticipated. While Europe has led deployment historically, Asia is forecast to drive growth moving forward.