International Energy Agency
Secure Sustainable Together

World Energy Outlook 2016

京都大学　再生可能エネルギー経済学研究会

2017年2月7日

黒住　淳人

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本日の構成

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1　IEAの新体制と方向性

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- **2005/9 新事務局長就任:「3つの柱」**
  - *新興国にとって門戸をより広く*
  - *根幹的役割であるエネルギー安全保障への取り組み範囲の拡大*

    →変貌する石油状況へのさらなる対応に加え、LNG、電力システム
  - *クリーン・エネルギーおよびエネルギー効率化のハブに*
- **2006/1 組織再編**
  - *部局統合 : Directorate of Sustainability, Technology, and Outlooks*
  - *組織横断的新チーム : Economics and Investment Office (EIO)*
- **各種プロジェクトへの影響？**

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2 World Energy Outlookについて
2-1 体制とスケジュール

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- **WEOチーム**
  - *STO（Directorate of Sustainability, Technology, and Outlooks)のうち、下記2部で構成*
    - *Energy Demand Outlook部*
    - *Energy Supply Outlook部*
- **スケジュール**
  - *6月　特定テーマにおける特別報告（2011,12天然ガス、13気候変動、14投資、15気候変動、16大気汚染）*
  - *（夏までに予測数字がほぼ固まる）*
  - *11月　本報告*

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2 World Energy Outlookについて
2-2 基本構成ほか

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- **基本シナリオ**
  - *Current Policies Scenario (CPS:現行政策シナリオ)*
  - *New Policies Scenario (NPS:新政策シナリオ)＝中心シナリオ*
  - *450 Scenario/2℃ Scenario (450/2℃シナリオ)*
- **詳細分析分野**
  - *エネルギー全般を扱う唯一の国際機関として網羅的に分析しつつ、毎回ひとつの燃料および地域を特に詳細に分析*
    - *直近のWEO-2016の詳細分析対象燃料は再生可能エネルギー*

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3-1　ローンチ資料より
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The global energy context today

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- **Key points of orientation:**
  - *Middle East share in global oil production in 2016 at highest level for 40 years*
  - *Transformation in gas markets deepening with a 30% rise in LNG*
  - *Additions of renewable capacity in the power sector higher in 2015 than coal, gas, oil & nuclear combined*
  - *Energy sector in the spotlight as the Paris Agreement enters into force*
  - *Billions remain without basic energy services*
- **There is no single story about the future of global energy; policies will determine where we go from here**

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A new ‘fuel’ in pole position

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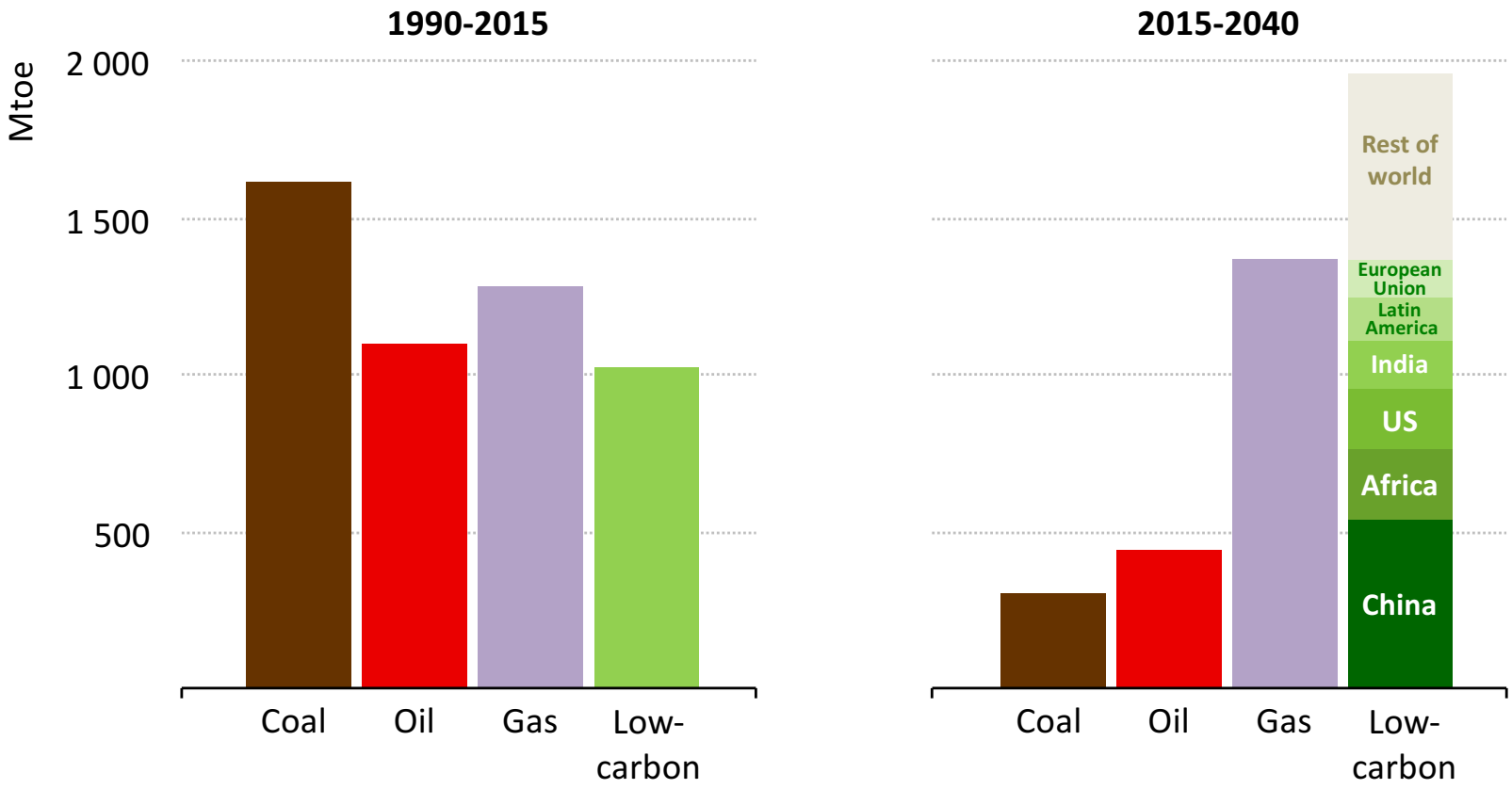
Change in total primary energy demand in the New Policies Scenario



Low-carbon fuels & technologies, mostly renewables, supply nearly half of the increase in energy demand to 2040

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Greater policy support boosts prospects for solar PV & wind

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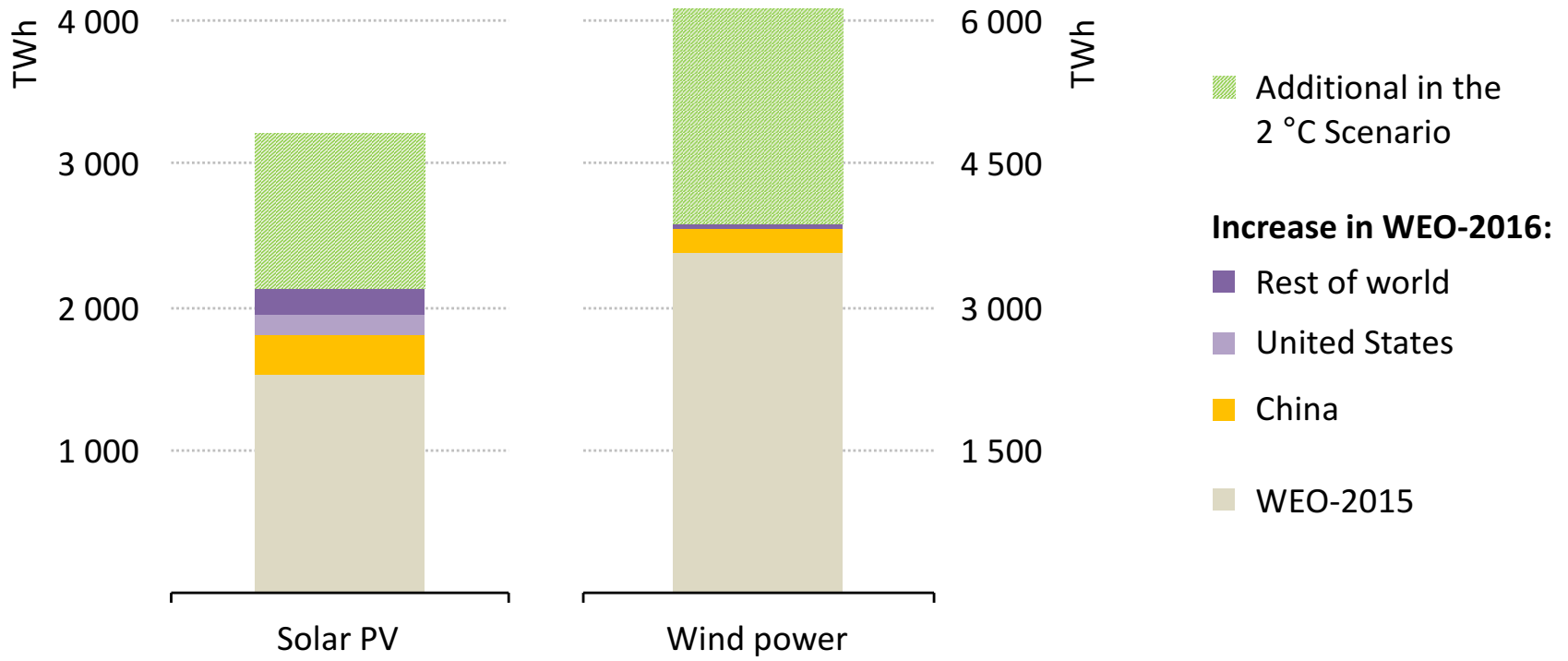
Solar PV & wind generation in the New Policies Scenario, 2040



Stronger policies on solar PV & wind help renewables make up 37% of electricity generation in 2040 in our main scenario – & nearly 60% in the 2 °C Scenario

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The next frontiers for renewables are heat & transport

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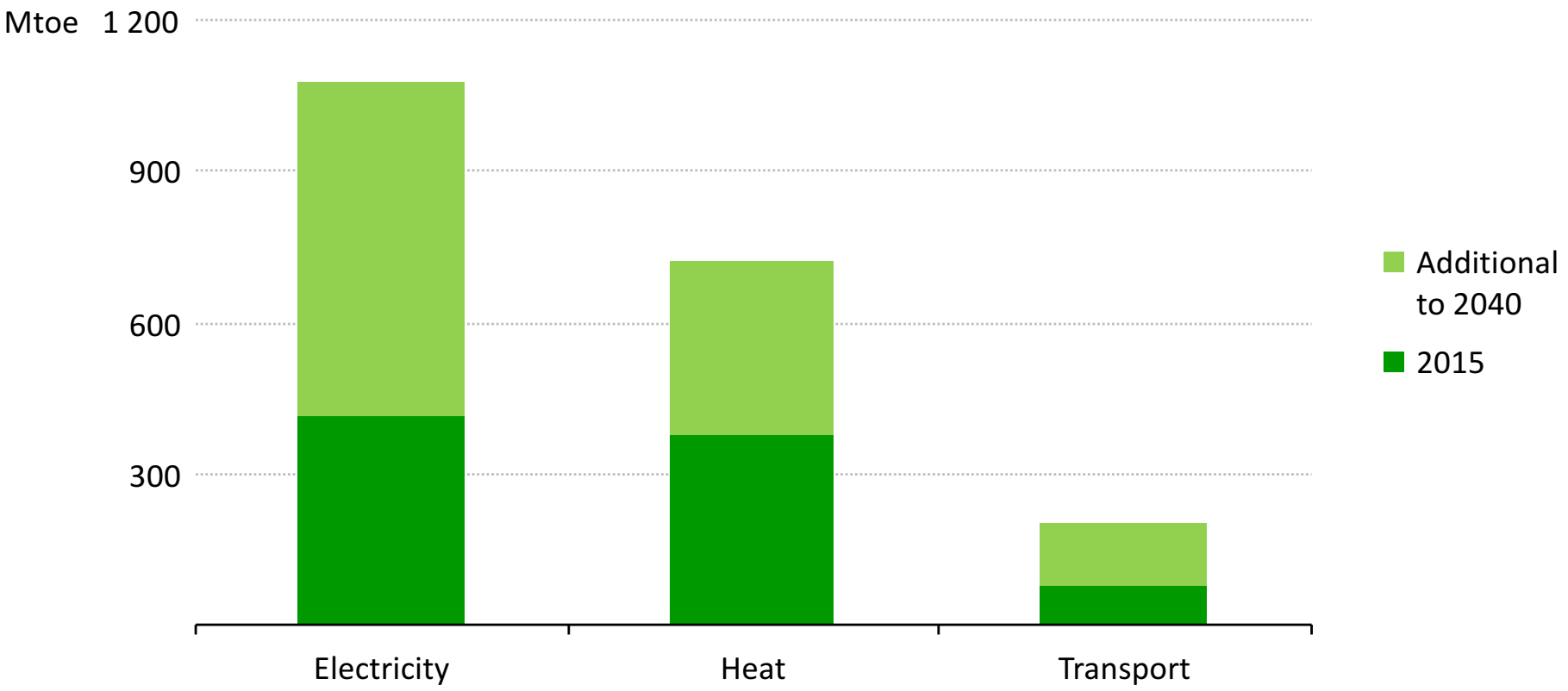
Renewable energy use by sector in the New Policies Scenario



Today renewables in electricity & heat use are nearly at par; by 2040, the largest untapped potential lies in heat & transport

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A suite of tools to address energy security

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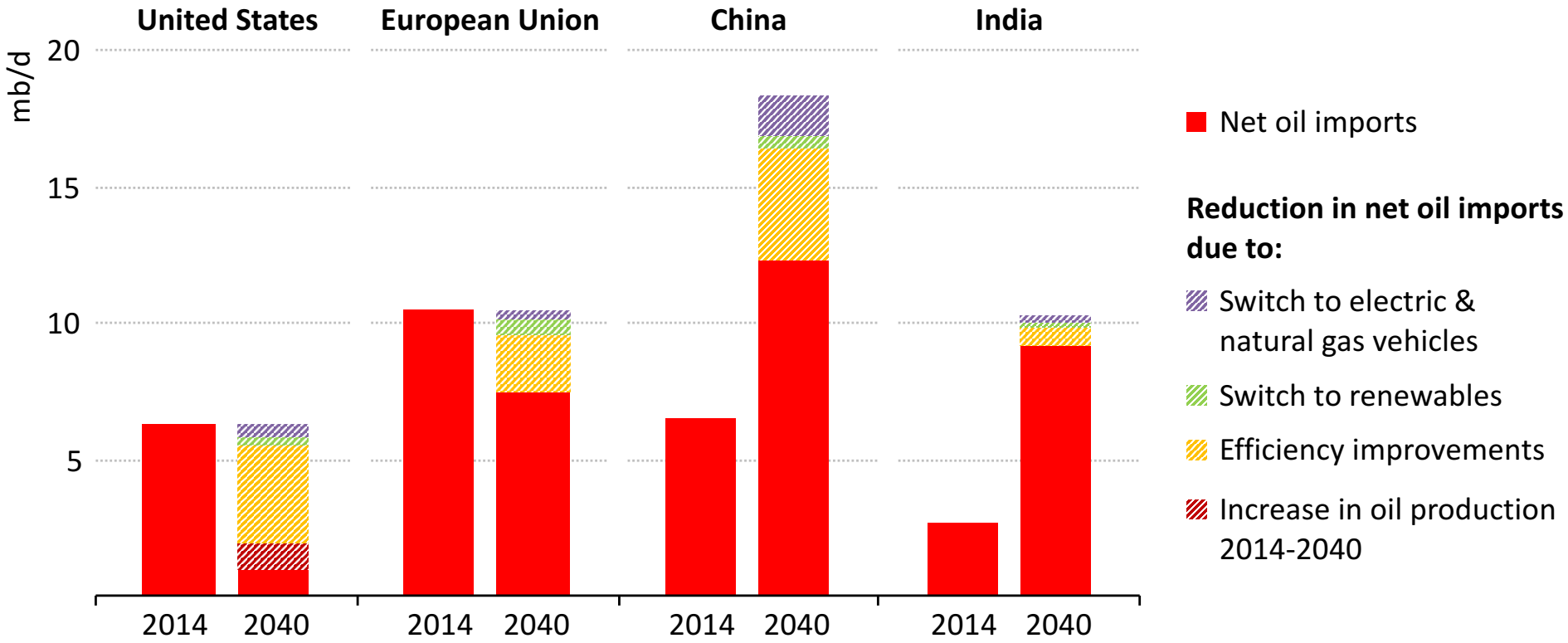
Net oil imports in the New Policies Scenario



The energy transition provides instruments to address traditional energy security concerns, while shifting attention to electricity supply

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Entering a period of greater oil market volatility

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- Approvals of new conventional crude oil projects in 2015-2016 have fallen to the lowest level since the 1950s
- If approvals remains low in 2017, an unprecedented effort will be needed to avoid a supply-demand gap in a few years' time
- US tight oil provides a potential lifeline, but cannot be relied upon to cover a major shortfall in the 'baseload' of oil supply
- Without a pick-up in investment, or a rapid slowdown in demand growth, the stage is set for the next boom-and-bust cycle for oil

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No peak yet in sight, but a slowdown in growth for oil demand

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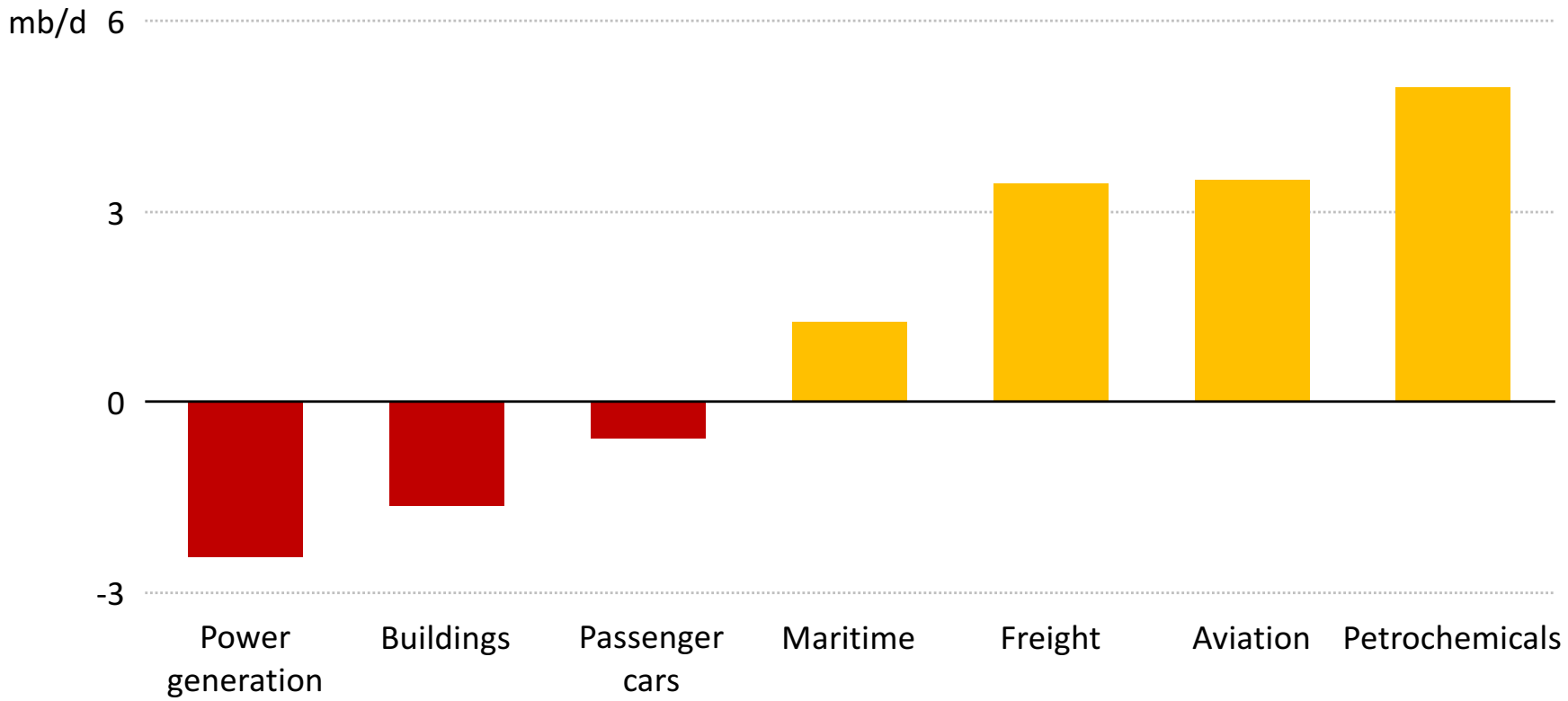
Change in oil demand by sector in the New Policies Scenario, 2015-2040



The global car fleet doubles, but efficiency gains, biofuels & electric cars reduce oil demand for passenger cars; growth elsewhere pushes total demand higher

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A wave of LNG spurs a second natural gas revolution

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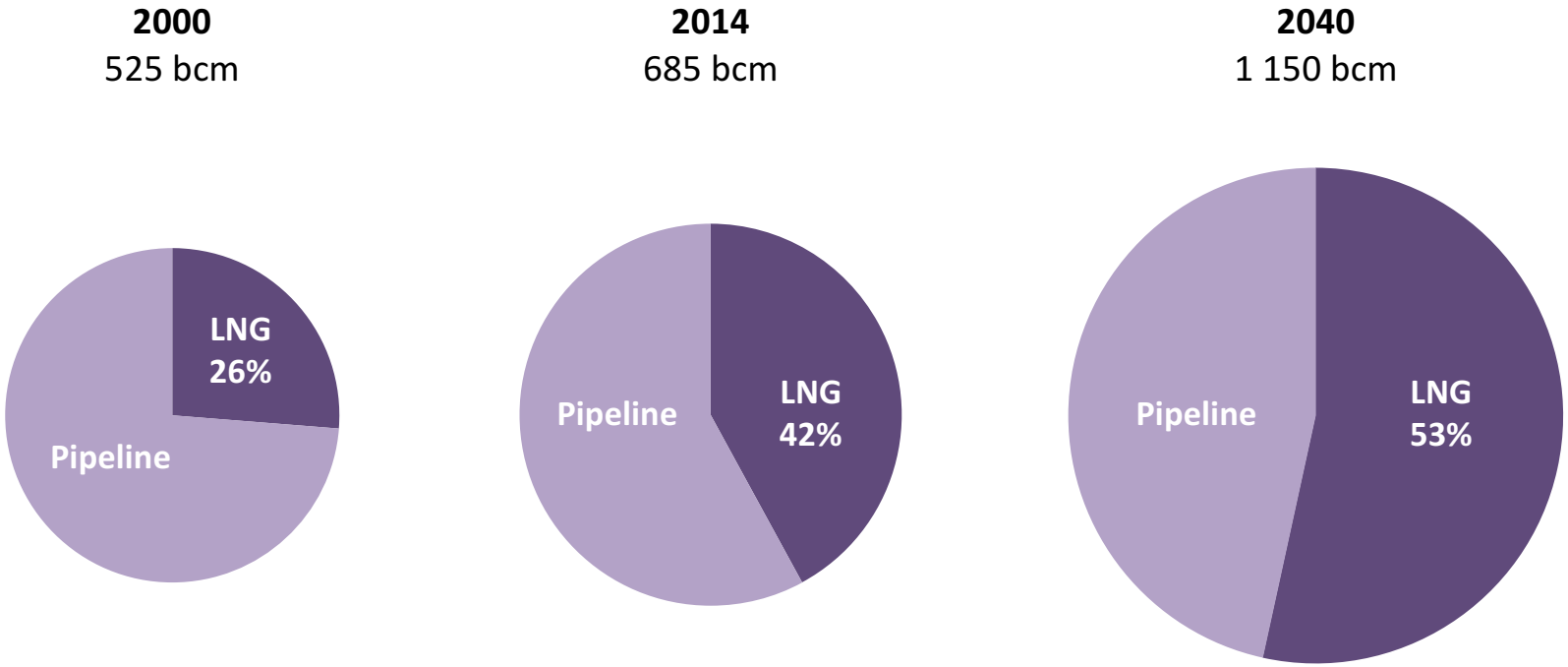
Share of LNG in global long-distance gas trade in the New Policies Scenario



Contractual terms & pricing arrangements are all being tested as new LNG from Australia, the US & others collides into an already well-supplied market

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Coal: a rock in a hard place

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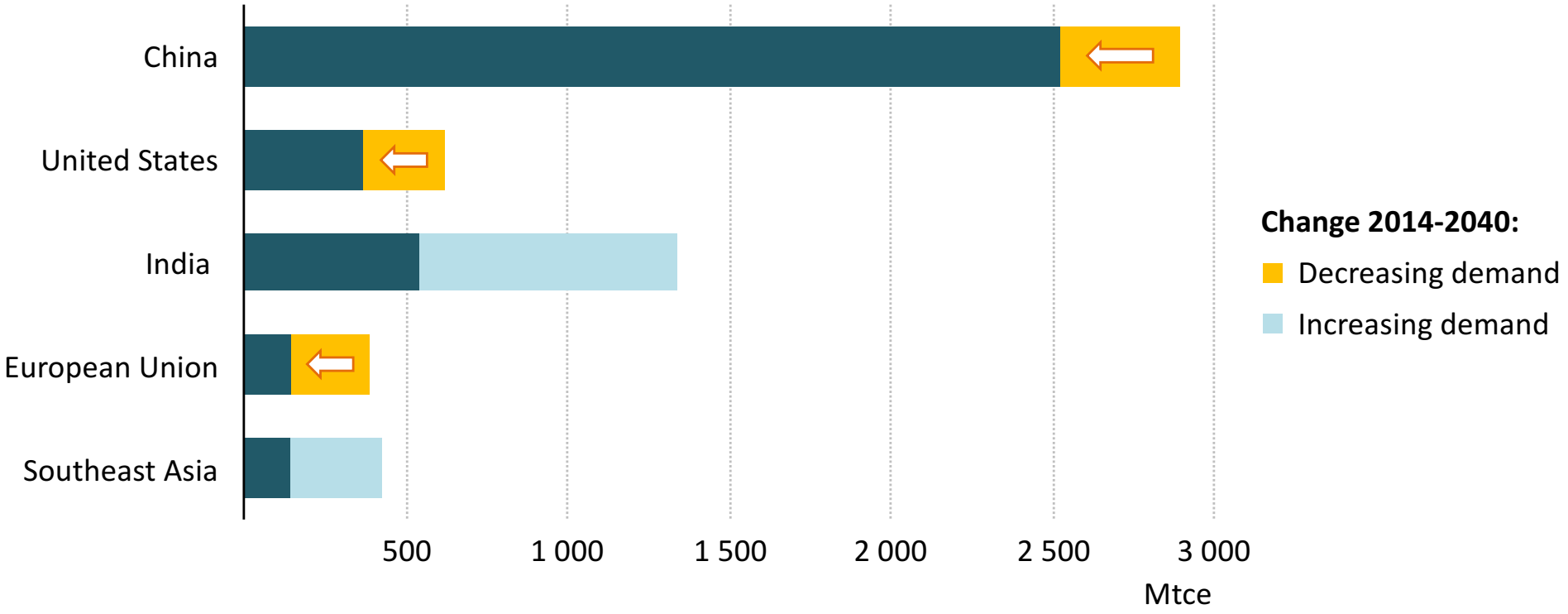
Coal demand in key regions in the New Policies Scenario



The peak in Chinese demand is an inflexion point for coal; held back by concerns over air pollution & carbon emissions, global coal use is overtaken by gas in the 2030s

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Still a long way from a pathway to energy sector decarbonisation

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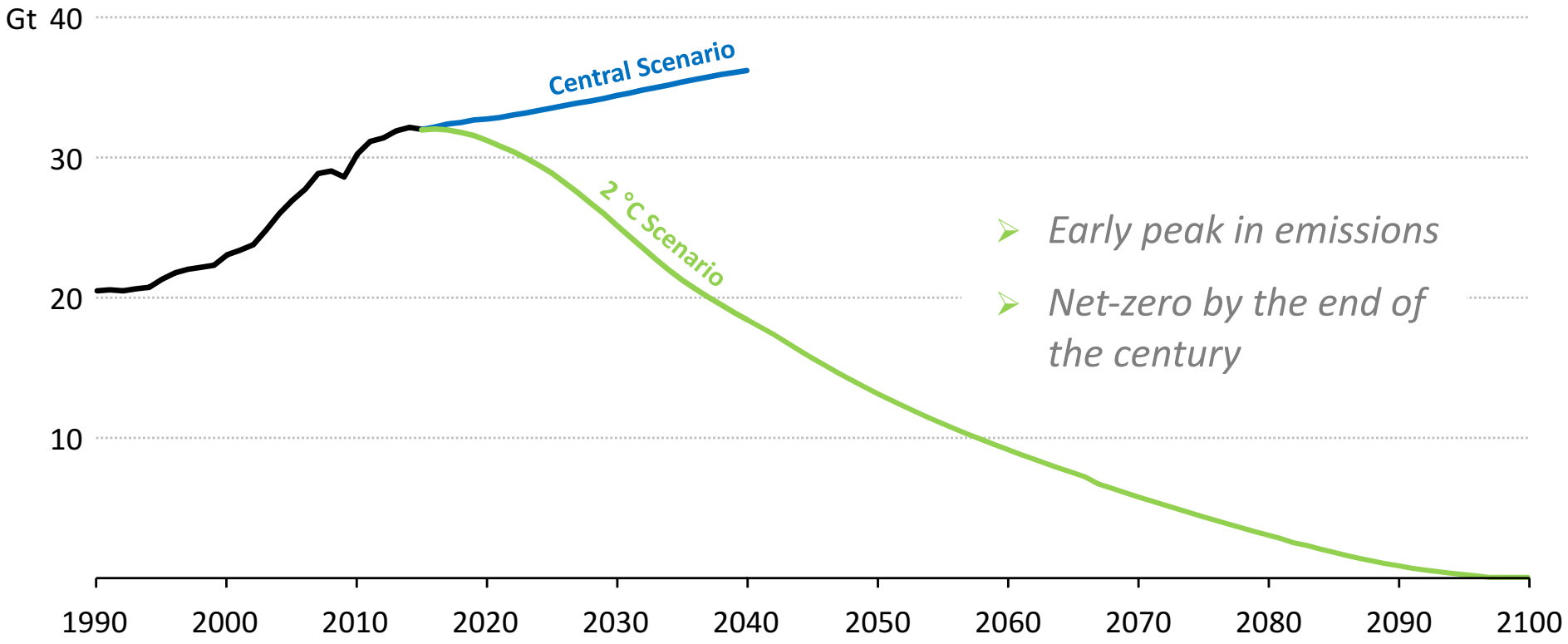
Energy-sector CO_2 emissions in the New Policies Scenario



Current pledges fall short of limiting the temperature increase to below 2 °C; raising ambition to 1.5 °C is uncharted territory

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Conclusions

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- Energy security remains a major concern; potential vulnerabilities are growing, so too is the range of tools available to address them
- New oil market dynamics & subdued upstream investment are ushering in a period of greater market volatility
- A wave of LNG is the catalyst for a second natural gas revolution, with far-reaching implications for gas pricing & contracts
- The next chapter in the rise of renewables requires policies to push their role in heat & transport & changes in power market design
- The Paris Agreement is a framework; its impact on energy depends on how its goals are translated into real government policy actions

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Renewable energy has a role to play in all sectors

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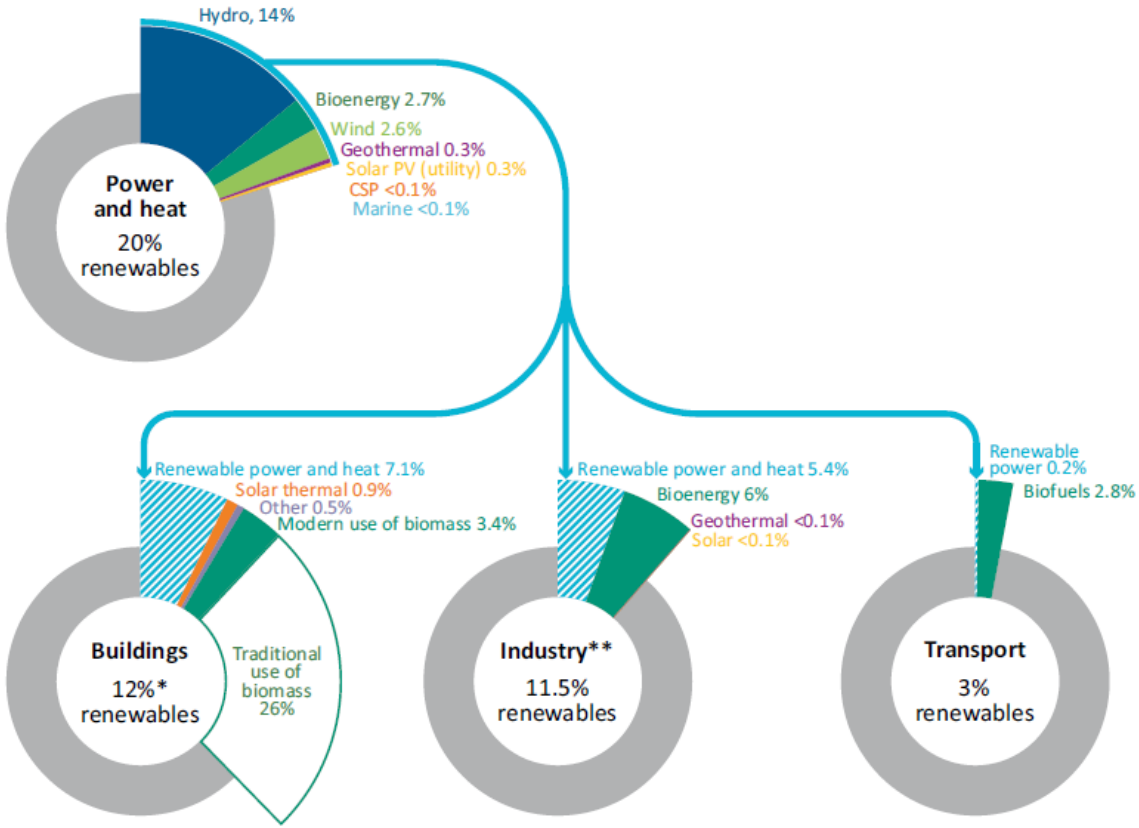
World share of renewable energy by sector & type, 2014



Power is leading the transition to renewable energy; other sectors lag behind

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Energy efficiency leads the way to lower emissions

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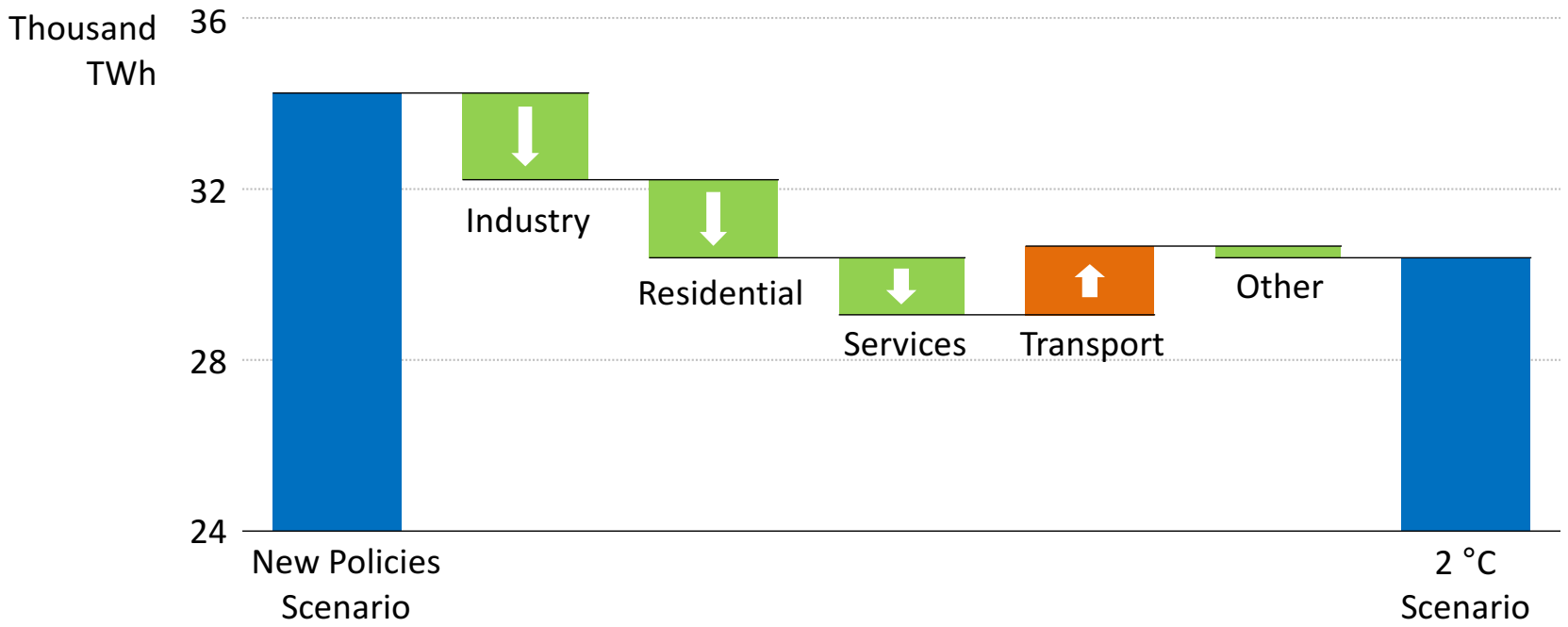
Change in global electricity demand in 2040 in the 2 °C Scenario relative to the New Policies Scenario



Transport is the only sector that sees higher global power demand in the 2 °C Scenario relative to our main scenario

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Policy sets the course for the power mix

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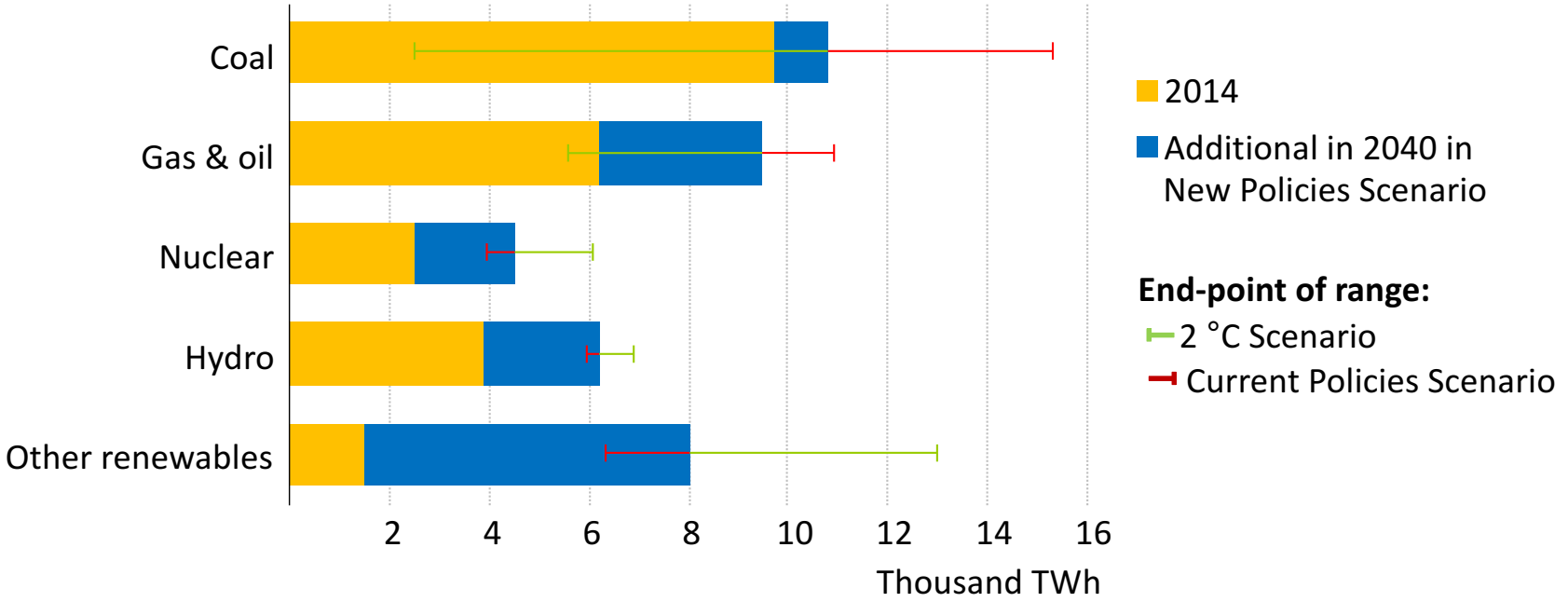
Global electricity generation by fuel & scenario



Coal-fired generation sees the greatest variation across scenarios

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A wide range of emissions pathways

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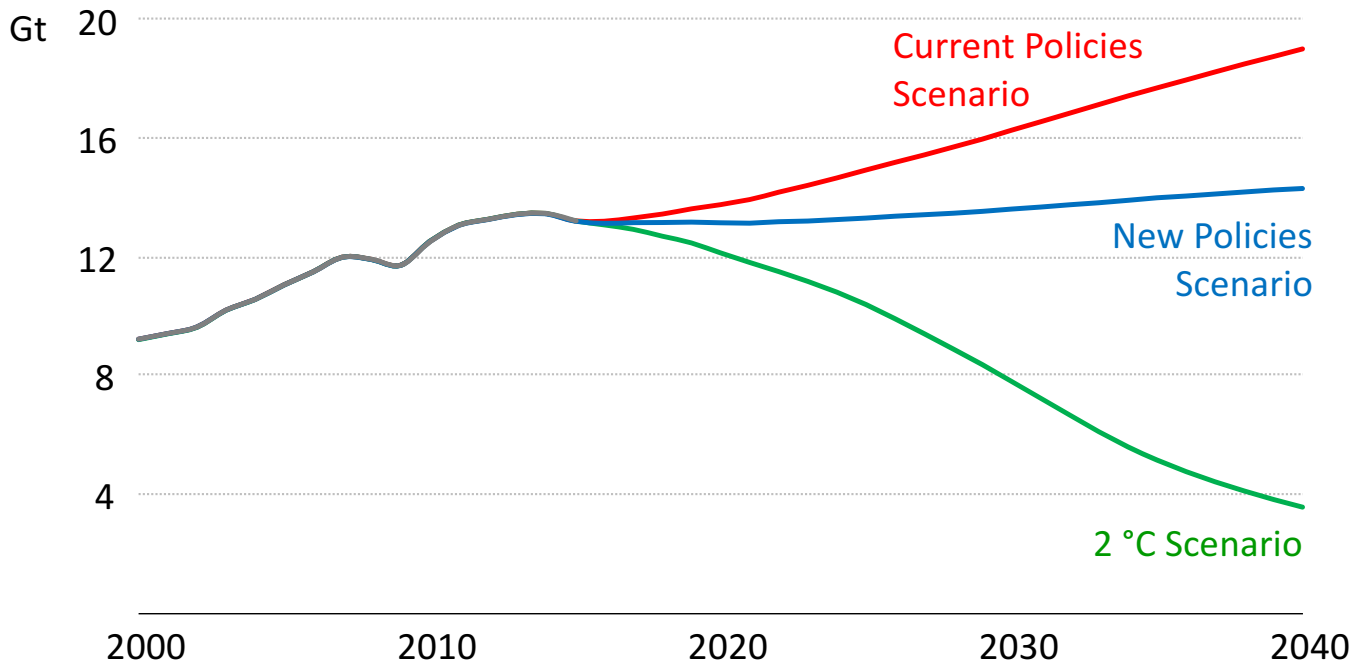
Global CO_2 emissions from fossil-fuel combustion in the power sector by scenario



Our main scenario almost breaks the link between rising power demand & related CO_2 emissions, but the two are completely decoupled in a 2 °C Scenario

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Low carbon technologies need to build on recent momentum

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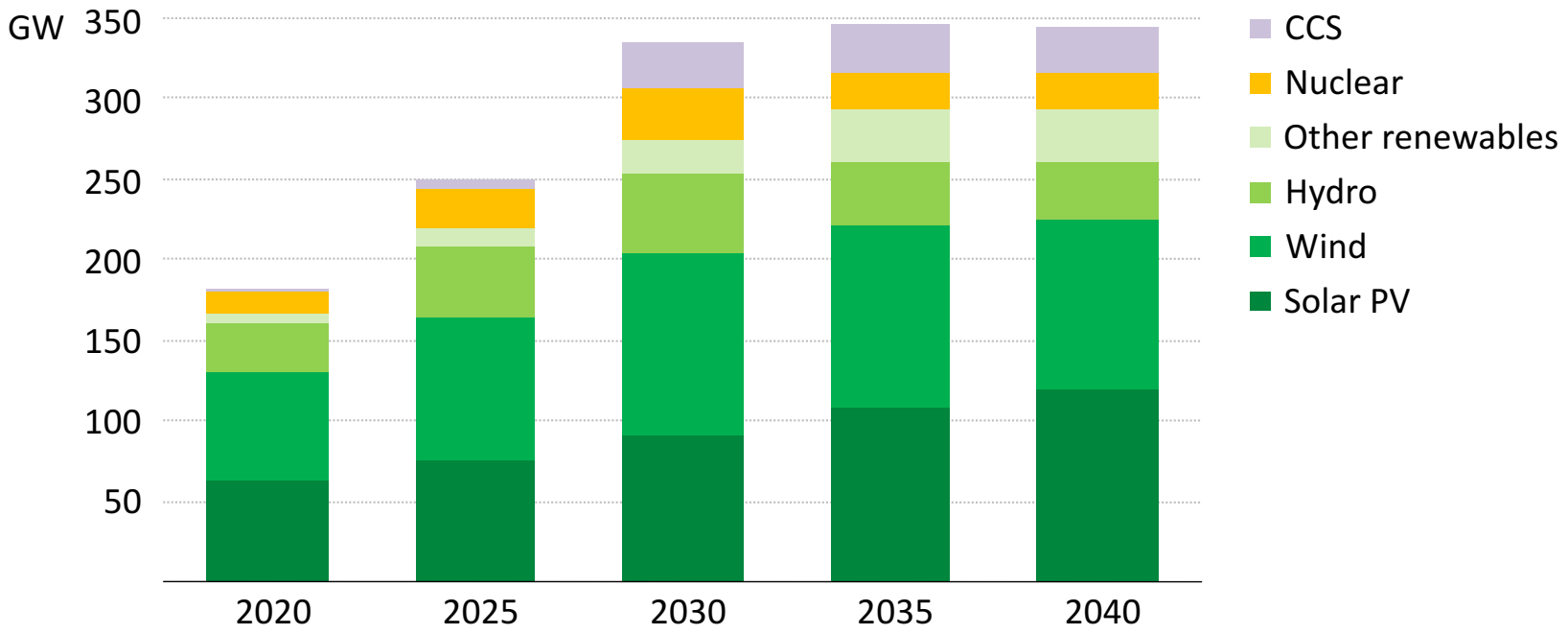
Global annual capacity additions of low-carbon technologies in the 2 °C Scenario



Annual capacity additions of low-carbon technologies need to exceed 300 GW per year by the 2030s

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Renewables take centre stage to meet tomorrow's electricity demands

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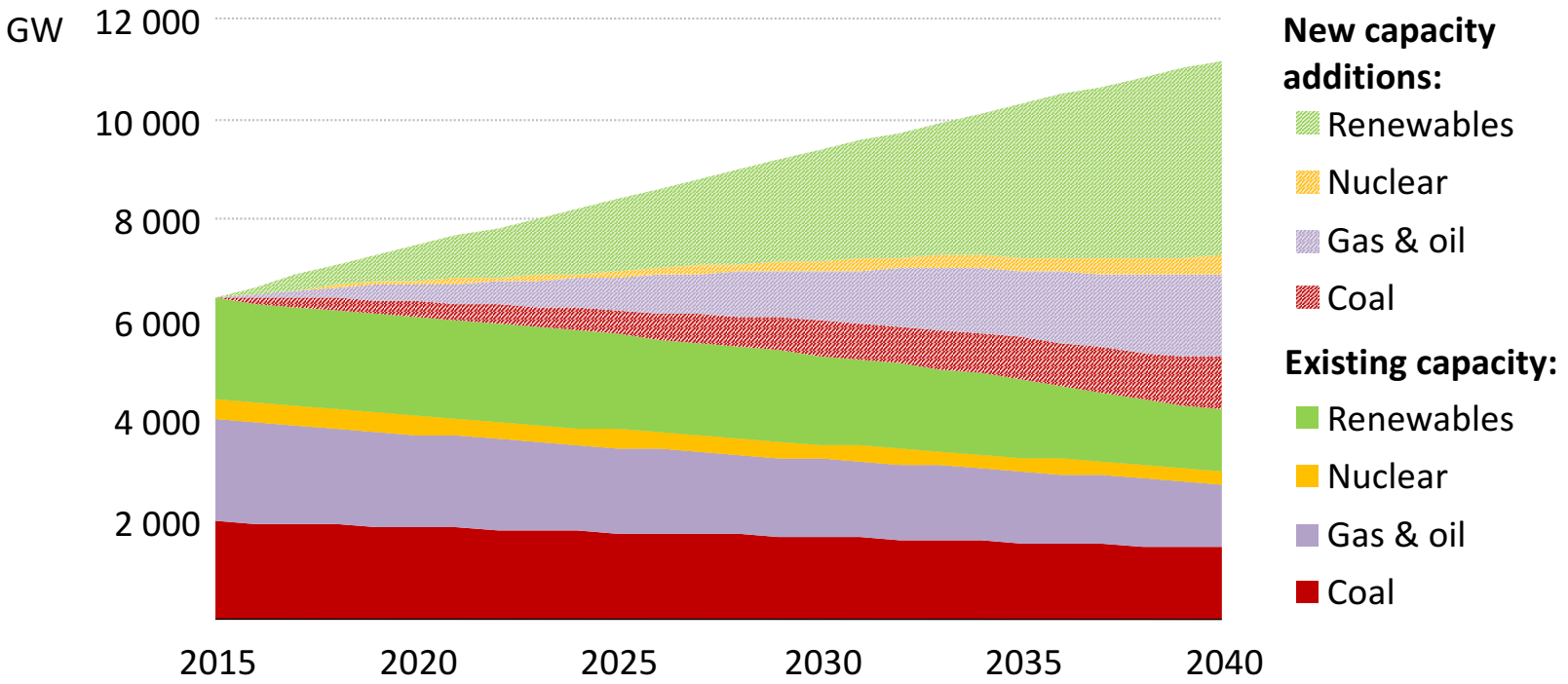
Global installed generation capacity in the New Policies Scenario



Renewables account for almost two-thirds of the overall growth in installed generation capacity to 2040

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Renewables & networks attract most investment in power

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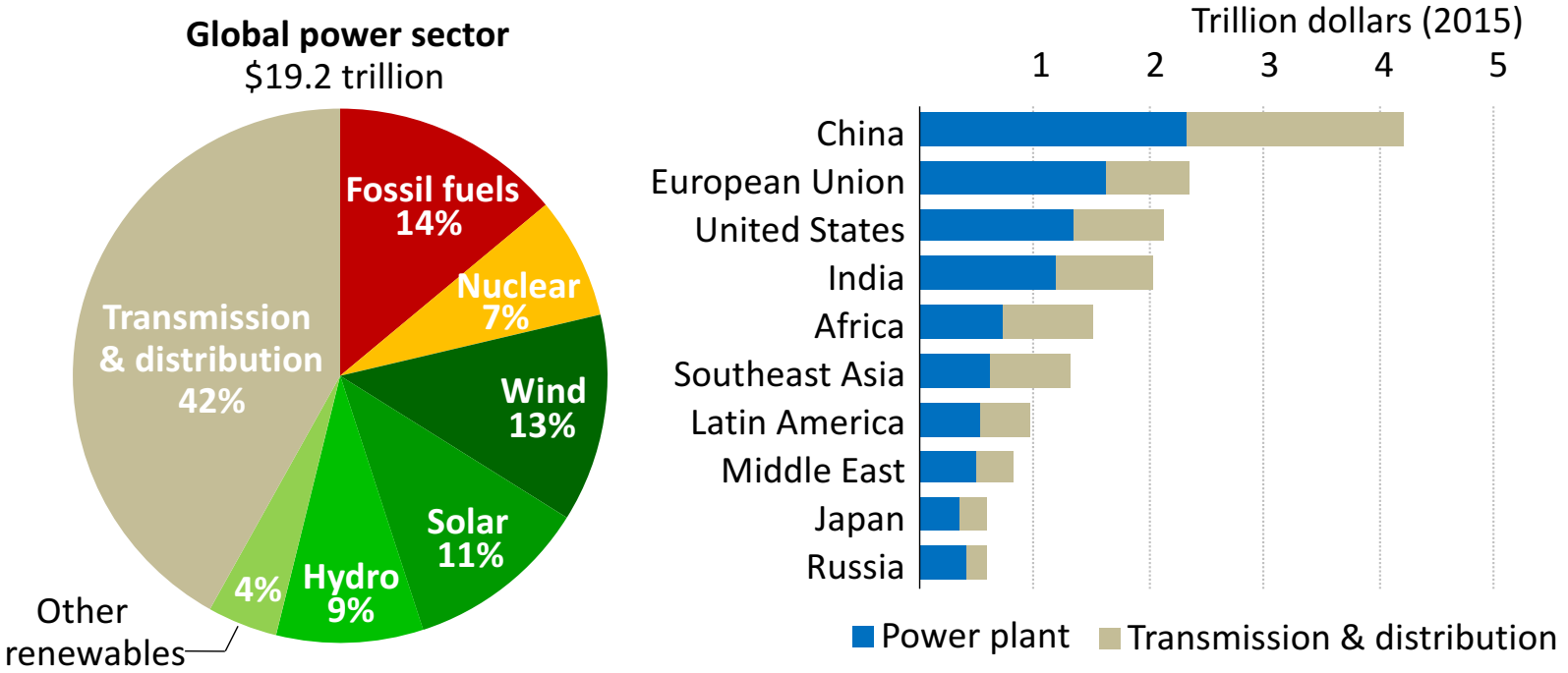
Cumulative power sector investment in the New Policies Scenario, 2016-2040



Two-and-a-half times as much is invested in renewable technologies than that of fossil-fuel plants

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Renewables look to re-balance the scales in power

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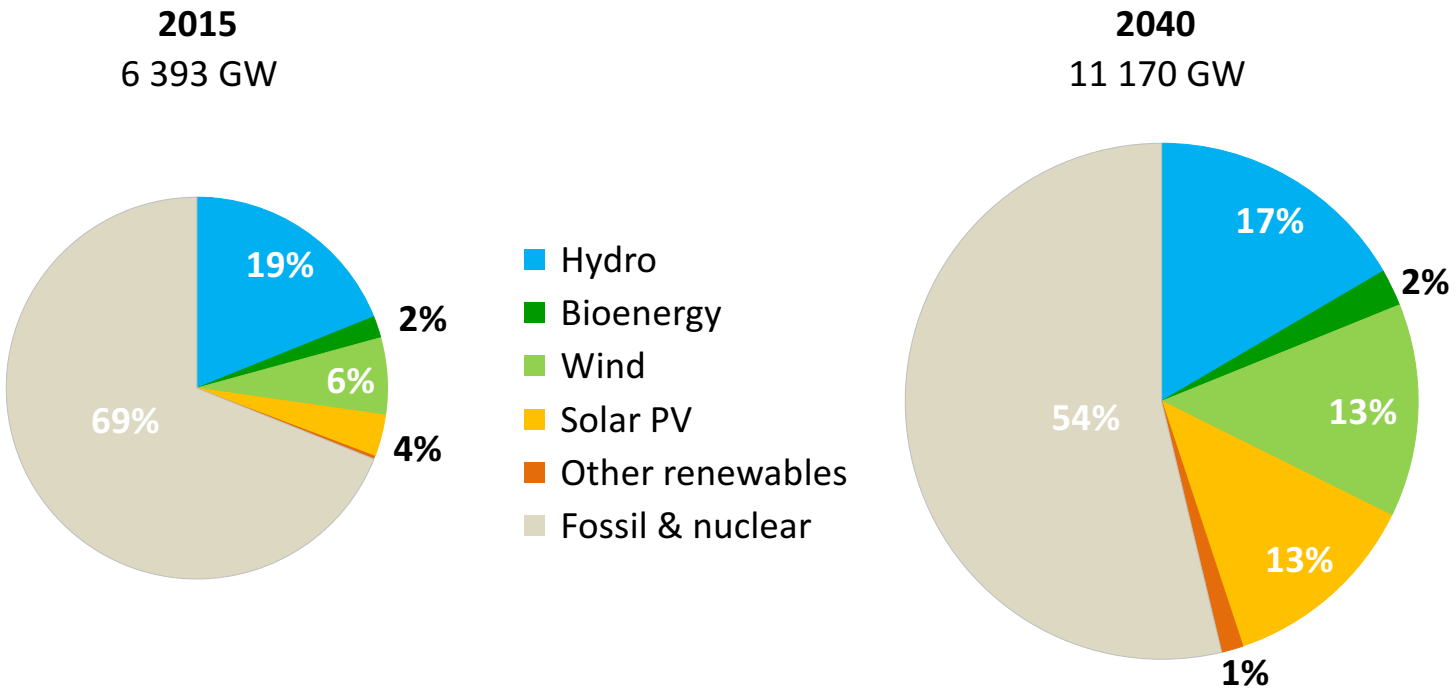
World power generation capacity by type in the New Policies Scenario



Renewables account for nearly half of total installed capacity by 2040, up from 31% today

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Further cost reductions for wind & solar PV

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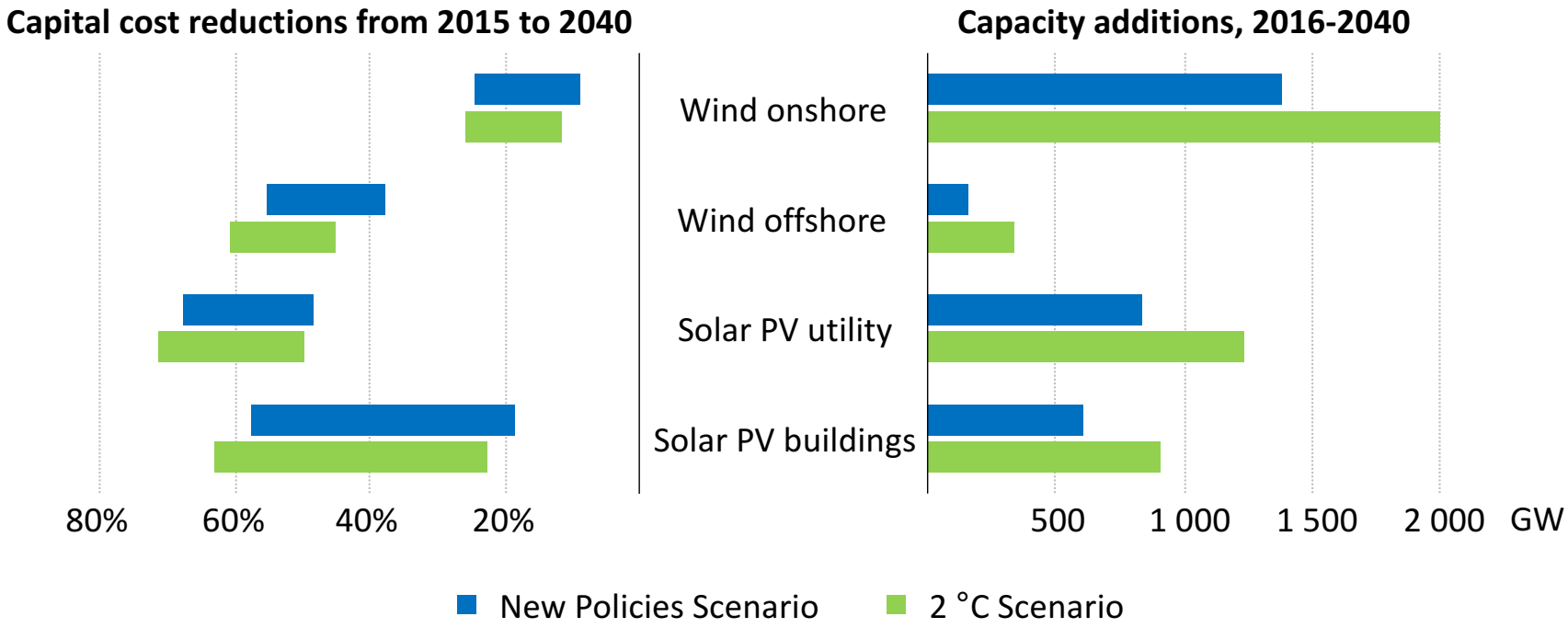
Global wind & solar PV capacity additions & capital cost reductions across regions by scenario to 2040



The cost to build wind projects is projected to fall by 10-60% by 2040, while solar PV capital costs decline by 20-70%

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Sunny outlook for the competitiveness of renewables

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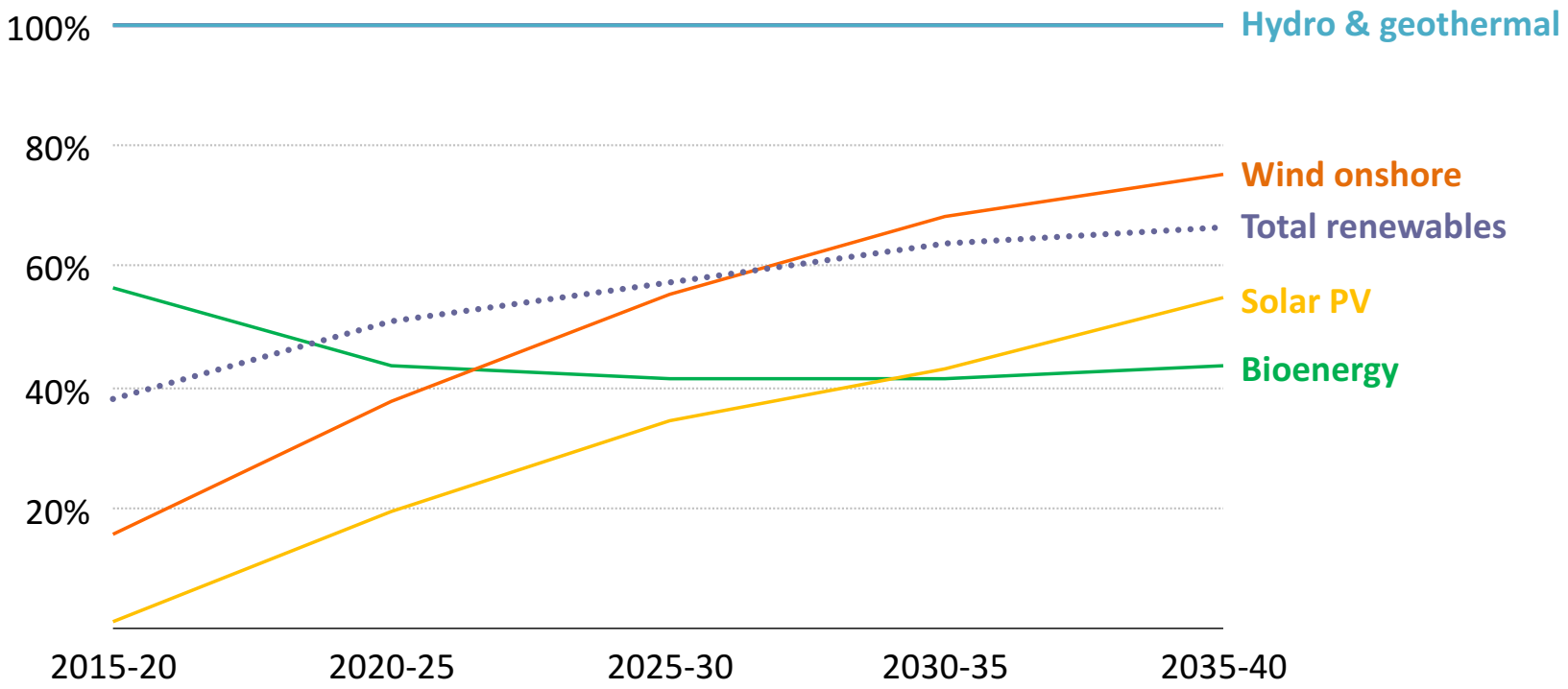
Share of generation from new renewable energy projects that do not require subsidies by technology in the New Policies Scenario



Increasing shares of new wind & solar PV projects become competitive over time

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Policy support for renewables spans the globe

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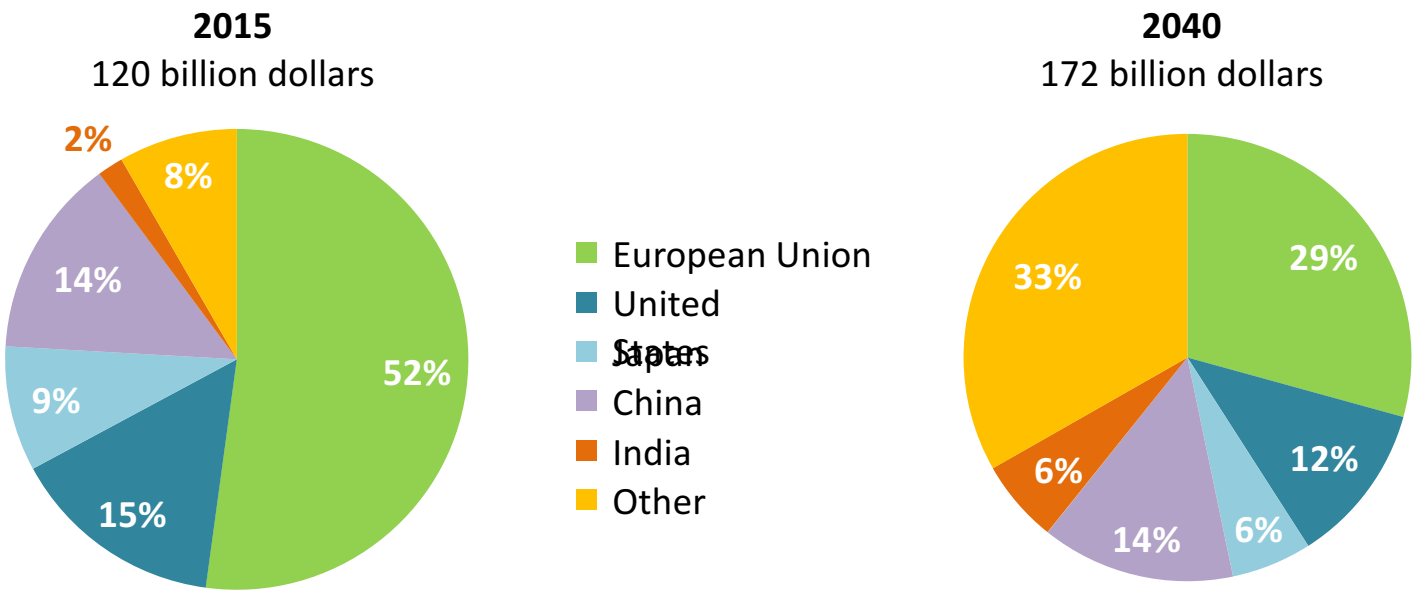
Global subsidies to renewables-based electricity generation in the New Policies Scenario



Support for renewables in power is more evenly spread across the world over time

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Wind & solar PV shares are set to increase substantially

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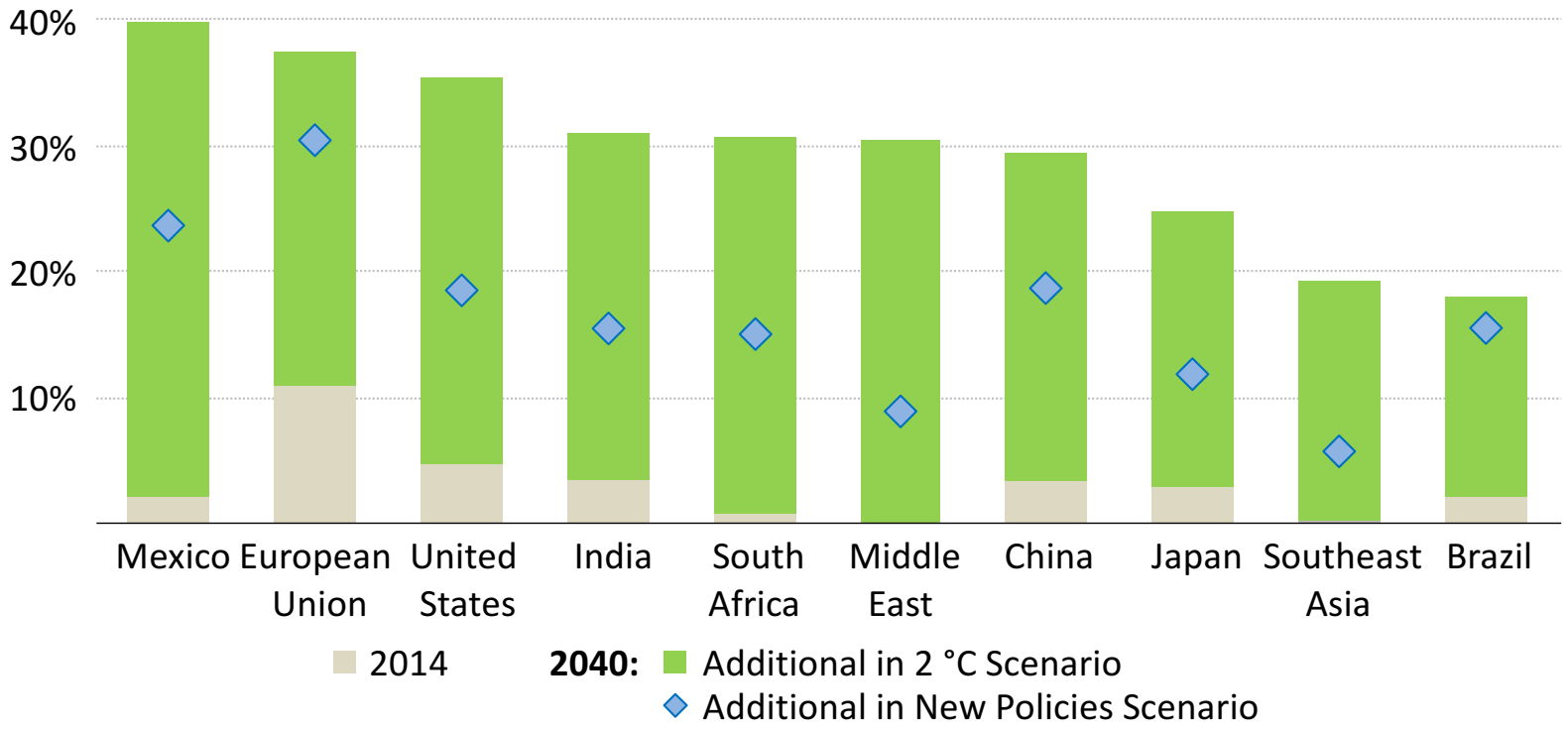
Share of wind & solar PV in total electricity generation by region in the New Policies & 2 °C Scenario



More than one-quarter of global electricity is generated by wind & solar PV by 2040 in the 2 °C Scenario

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Integration measures are key to avoid losing wind & solar generation

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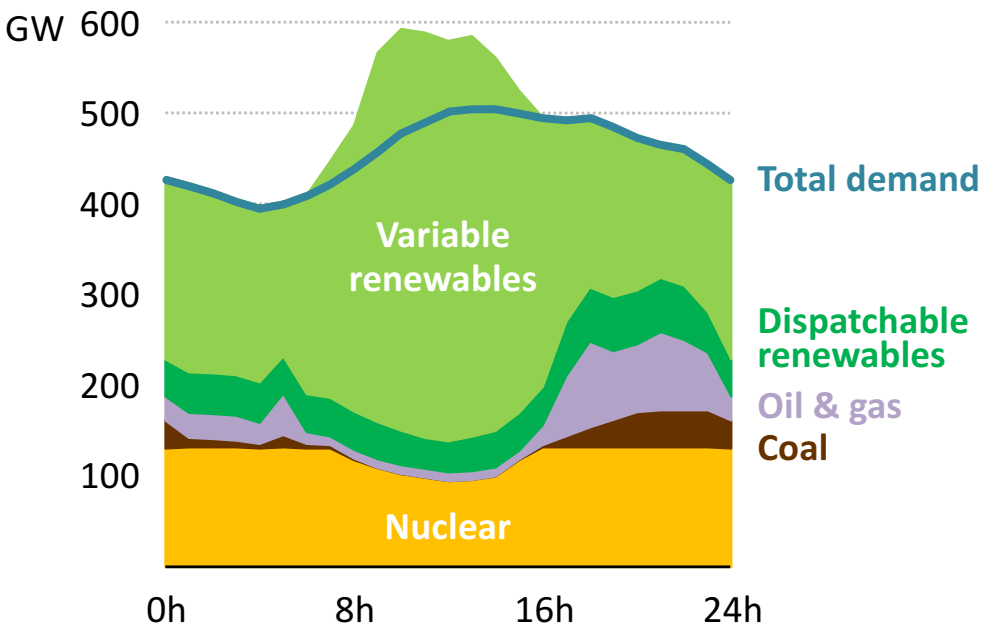
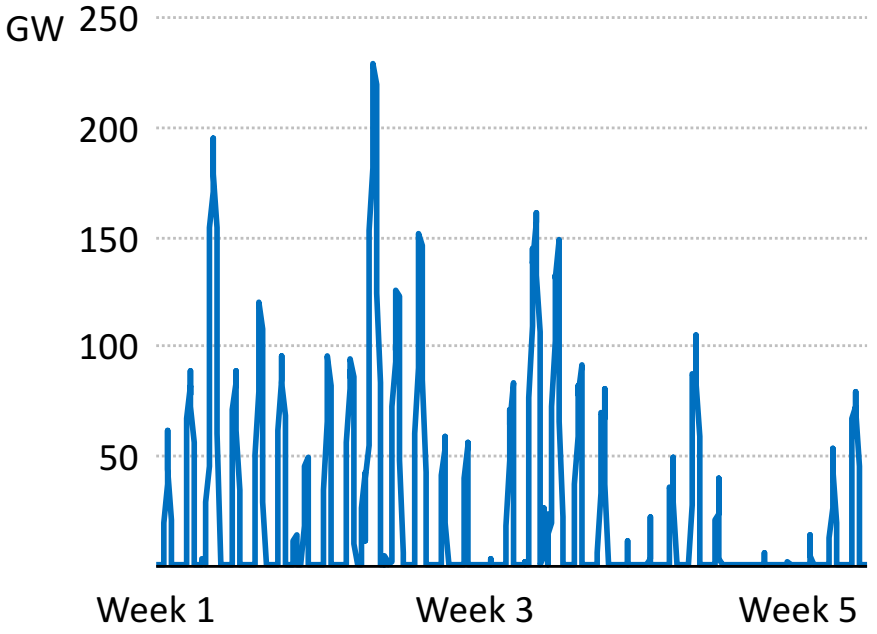
Example of US power demand & supply over one day in the 2 °C scenario, 2040



Example of excess power supply over one month in the 2 °C scenario, 2040



Rising shares of wind & solar PV shift the attention to electricity security, requiring new tools to balance supply & demand

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Integration measures are key for more use of wind & solar PV

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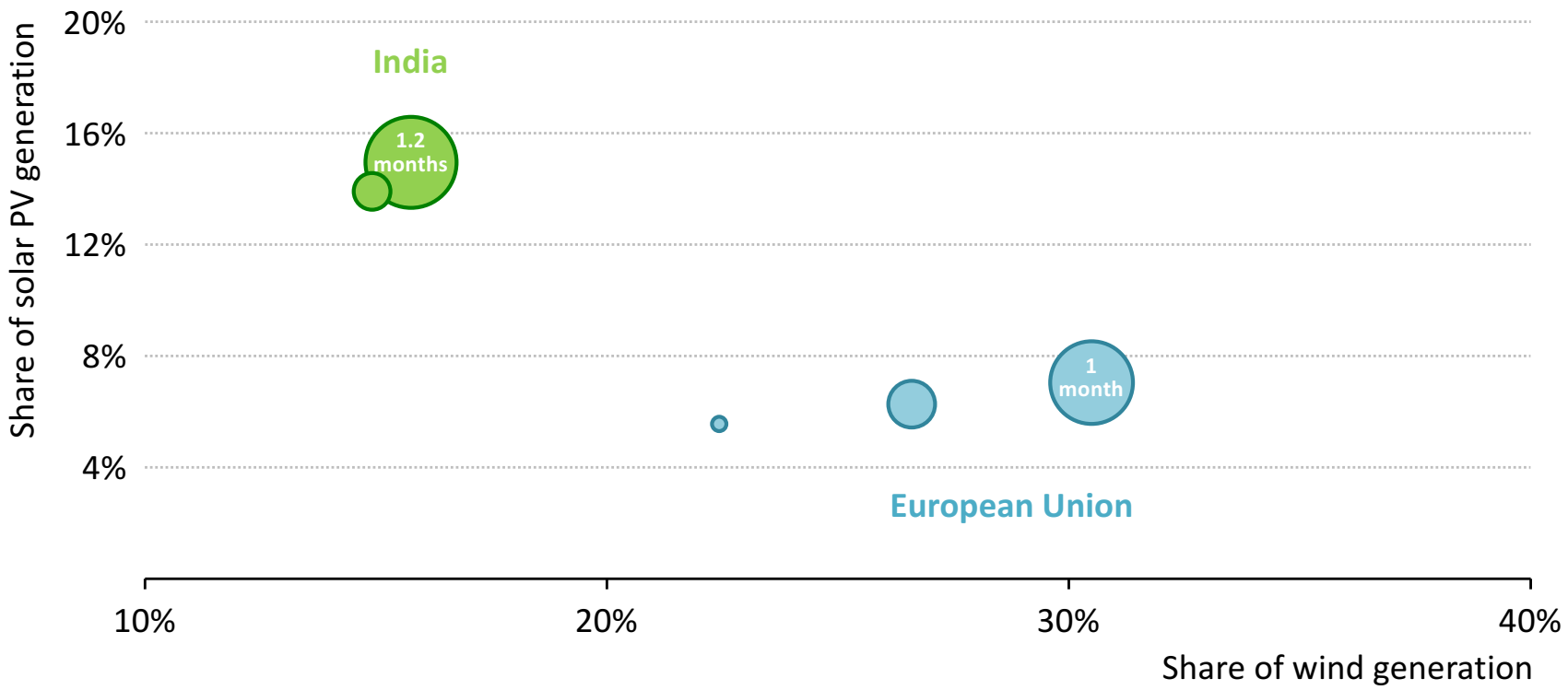
Amount of hours of curtailment per year with system measures



Grid expansion & flexible plants can integrate wind & solar PV to close to 30% share; beyond, demand-side response & storage are needed, requiring market reform

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Most of the demand-side response potential lies in the buildings sector

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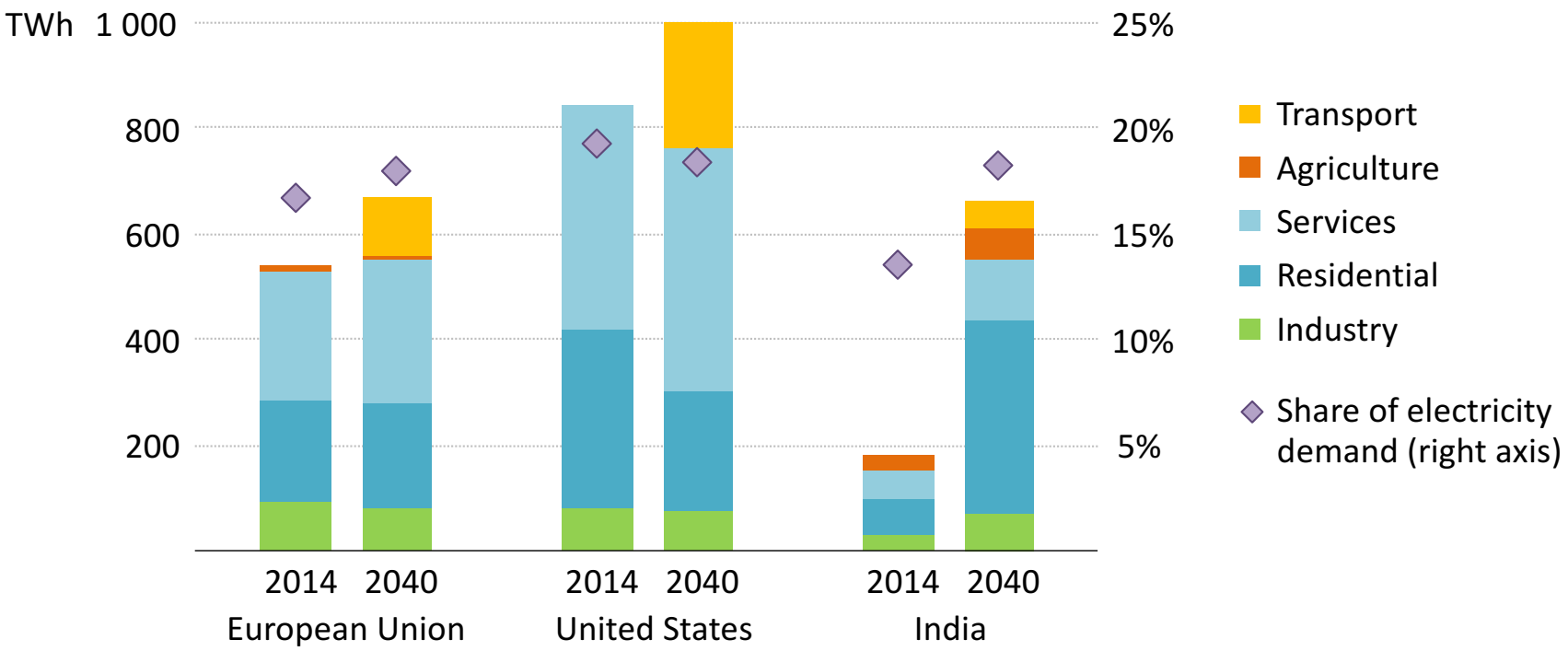
Technical potential of demand-side response by region in the 2 °C scenario



The technical potential for demand-side response is up to 20% of demand, with electric vehicles set to play a larger role through 2040

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Investment needs in power sector to stay on track for 2 °C

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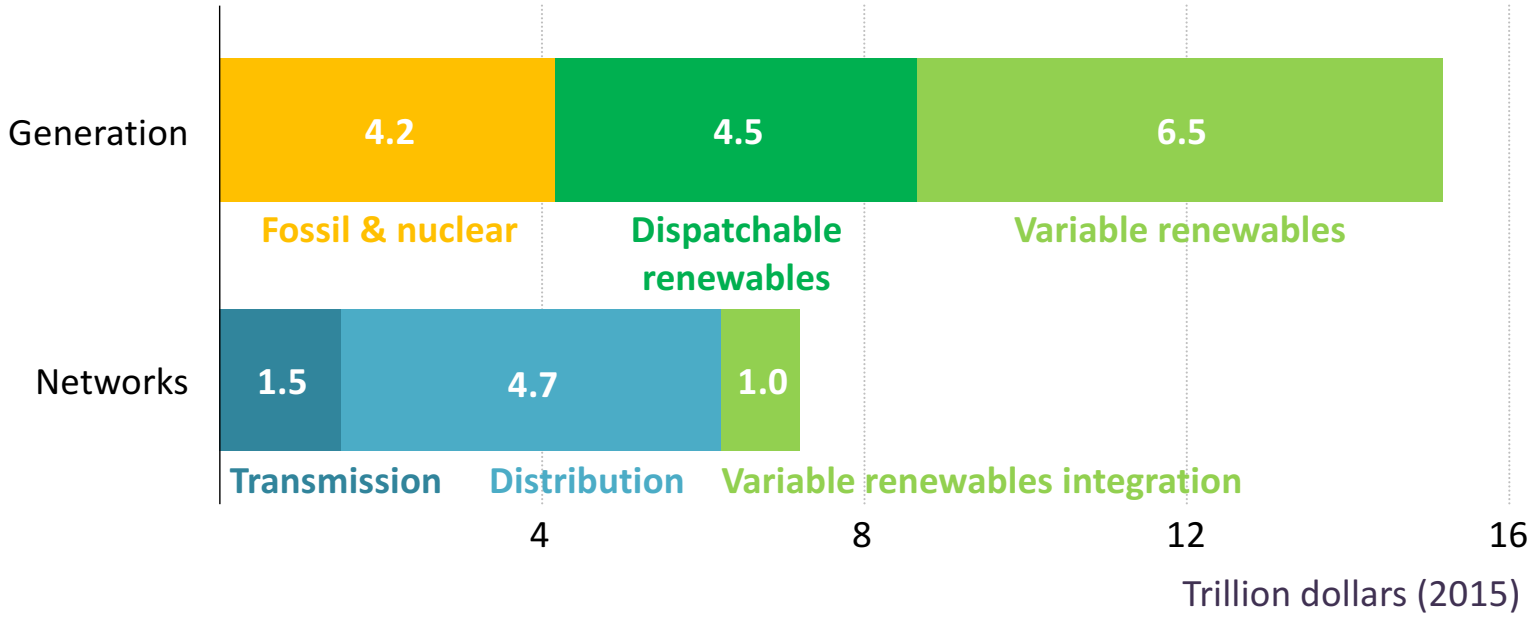
Total global power generation & networks investment in the 2 °C Scenario, 2016-2040



Investments in transmission & distribution grids for integrating variable renewables are a small portion of the total investments in the power sector

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