

# Lecture 1: Introduction to key themes

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# Outline of the course

**Overall objective – understand how senior management use economic models to make investment decisions**

- 1. Introduction to key themes in the global energy market**
2. Introduction to financial modelling as a management tool
  1. Understanding some key concepts
3. Starting two models for an oil and a gas field – revenues and prices
4. Inputting the costs – capital expenditure
5. Operating costs and paying the government
6. A power plant – a buyer and seller of energy
7. Calculating a discounted cashflow
  1. Why is it important
  2. How is it used to make decisions
8. Testing the investment decisions: running some numbers under different assumptions
9. Answering your questions



# Assessment

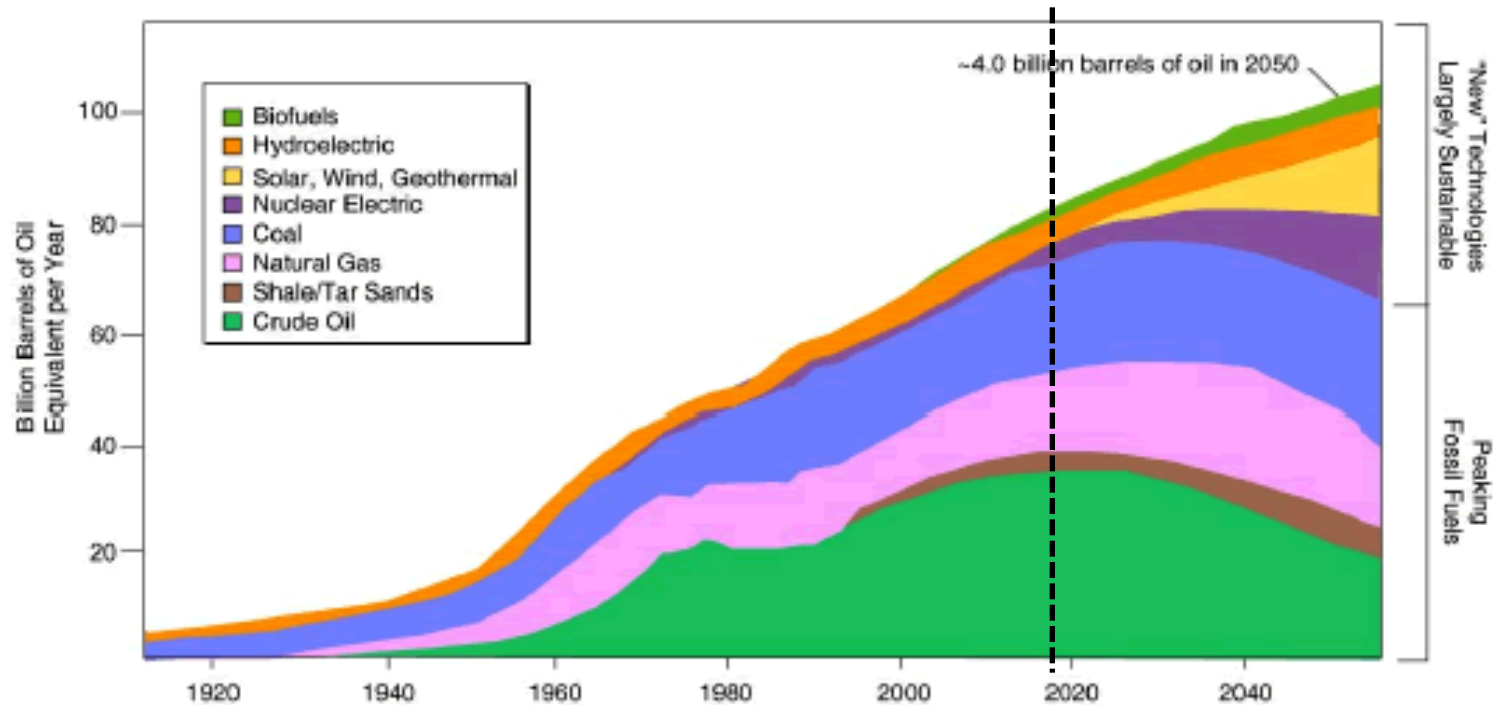
## **Overall objective – demonstrate understanding of cashflow models and output**

1. Create a simple cashflow model, given set assumptions
2. Generate NPV and other results
3. Provide an analysis of simple scenarios
4. Write up results in short review (one page)



# World Energy Consumption – A Long-Term View

World Energy Demand—Long-Term Energy Sources



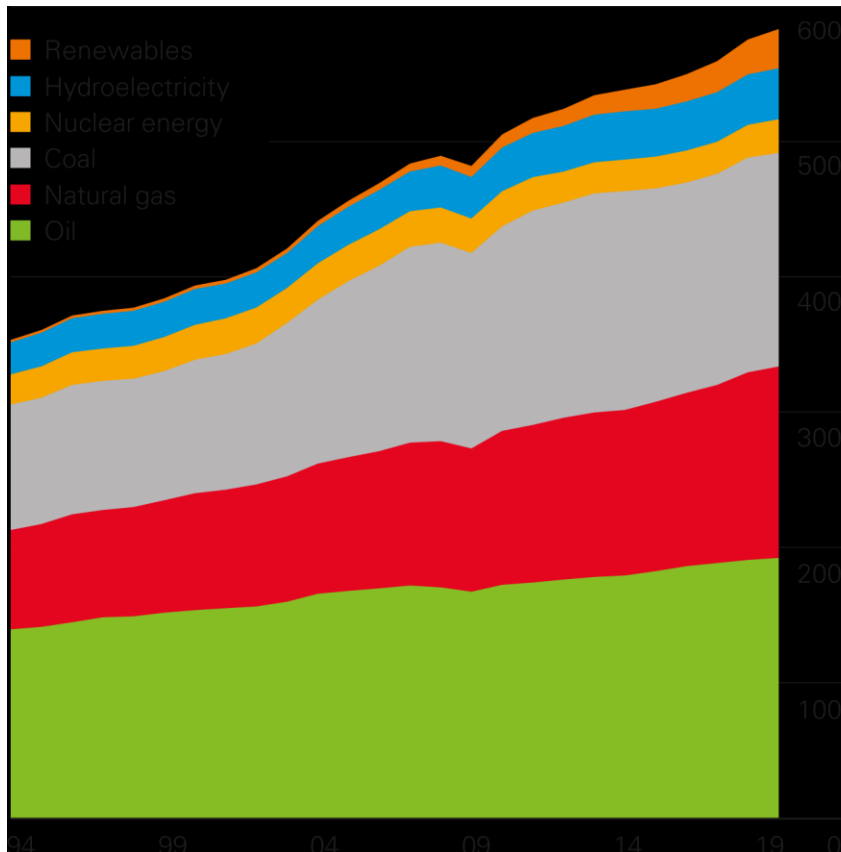
Sources: Lynn Orr, *Changing the World's Energy Systems*, Stanford University Global Climate & Energy Project (after John Edwards, American Association of Petroleum Geologists); SRI Consulting.

- The future looks very different with fossil fuel demand peaking
- Renewables and other new technologies will take a much larger share
- The key question is how fast this energy transition can technically and economically take place?

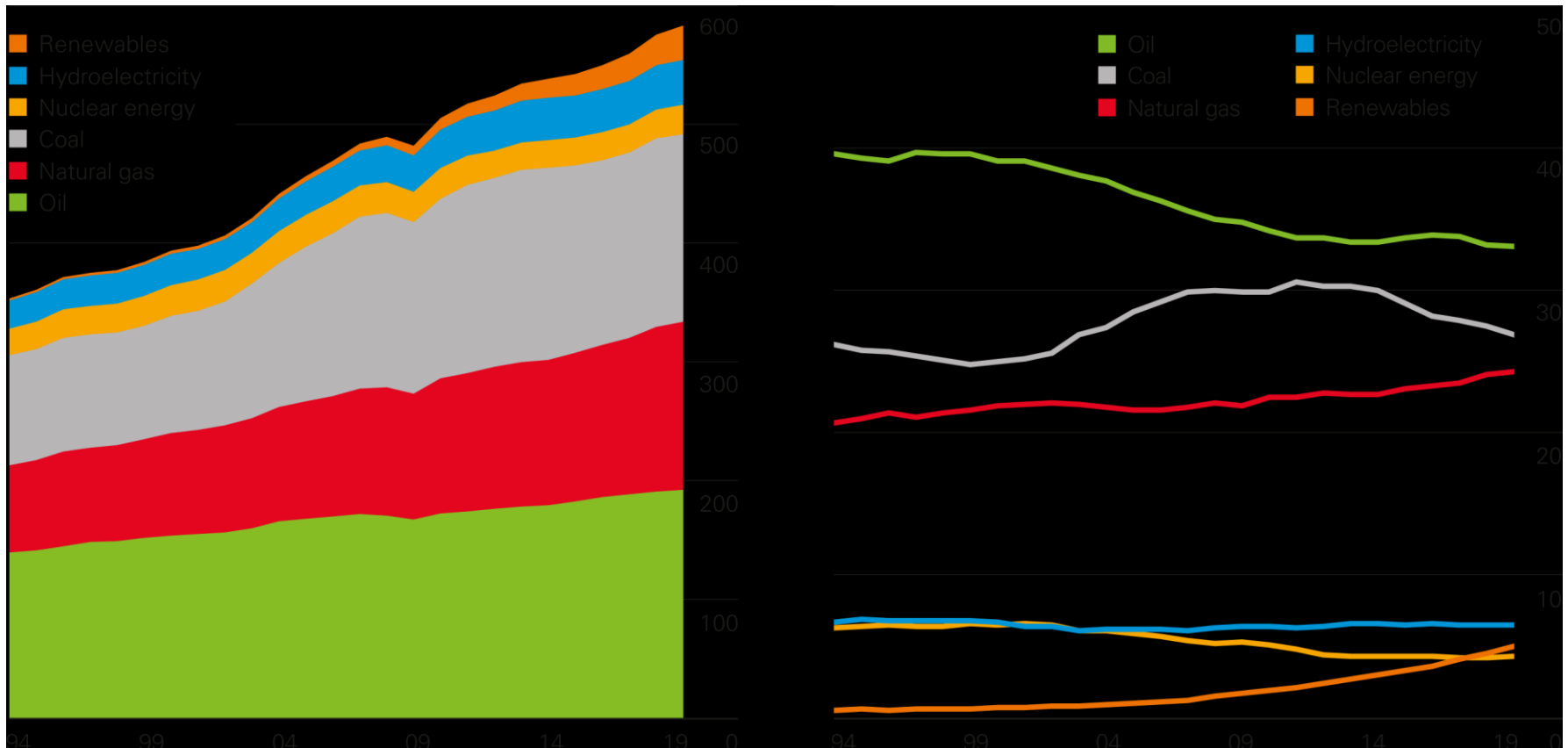


# Primary energy consumption since 1990 (mmtoe)

World Consumption (Exajoules)



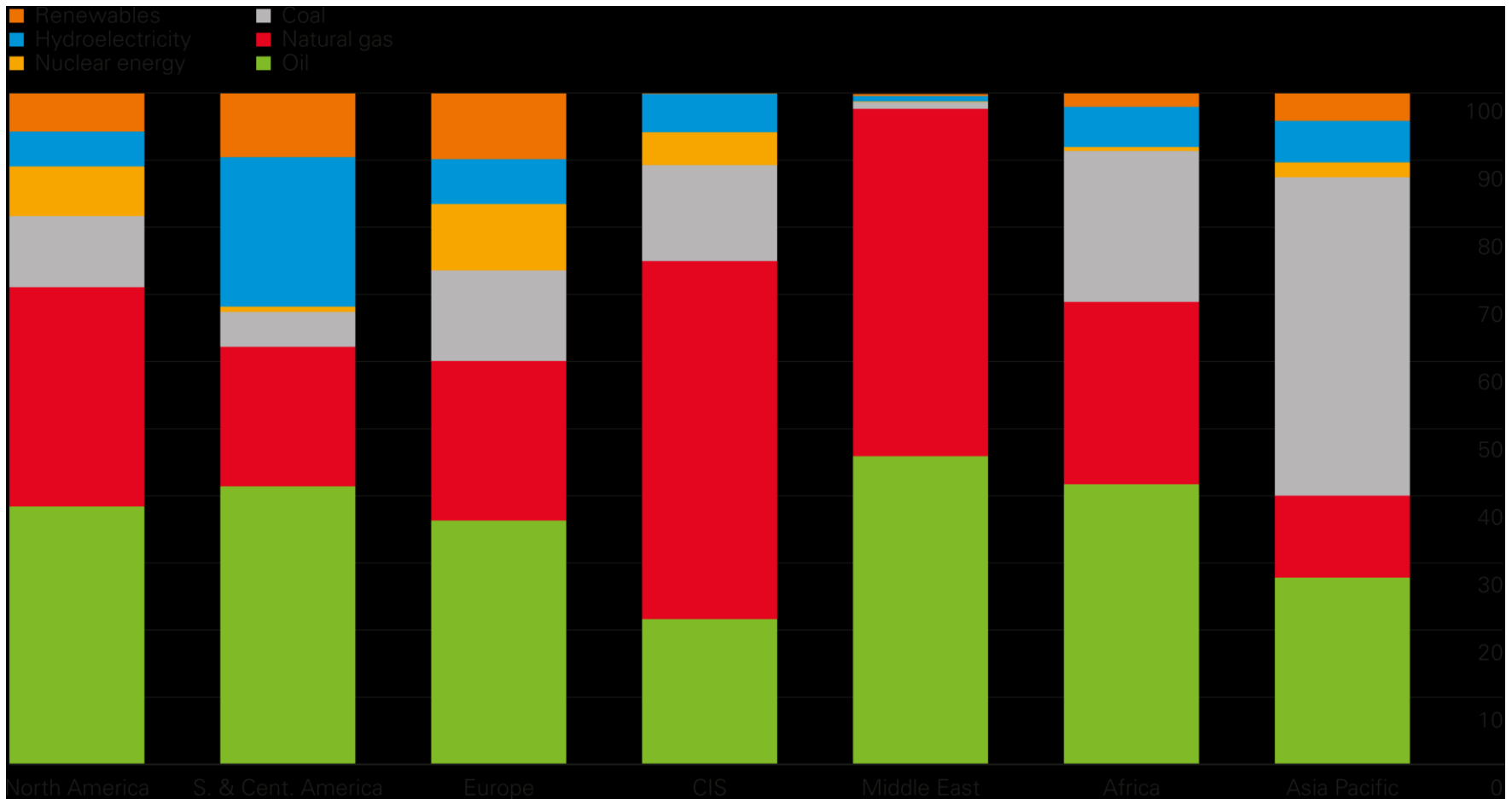
Share by Fuel (%)



- Overall energy demand has been growing by around 1% per annum
- The key primary fuels have been hydrocarbons, which account for 80%+ of total energy consumption
- Renewables are growing fast but from a very low base



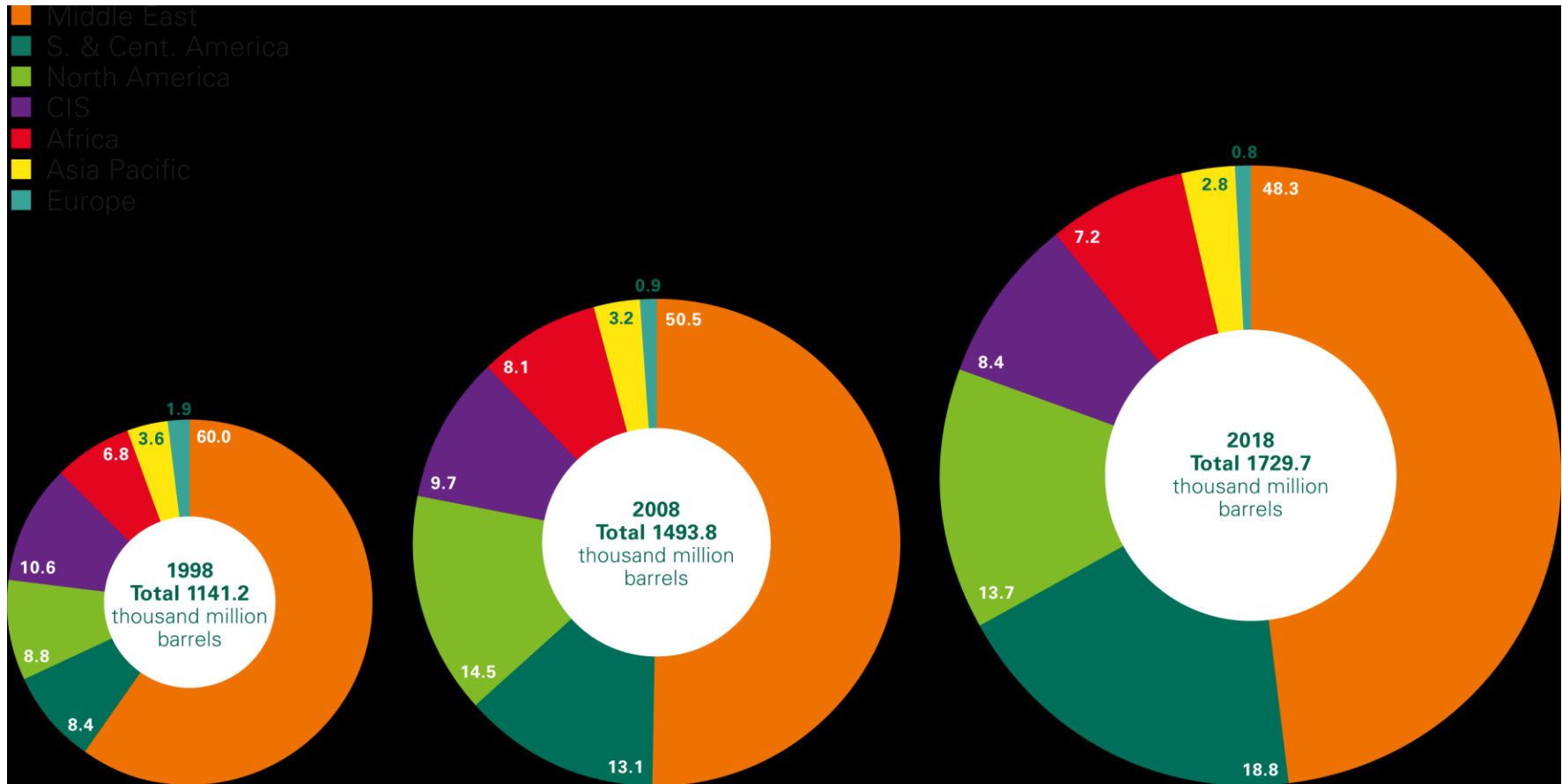
# Primary energy regional consumption by fuel (2019, %)



- Fuel split is very different by region, and is generally driven by indigenous supply
- Countries are reluctant to be over-committed to imports



# The growth in oil reserves and the regional split



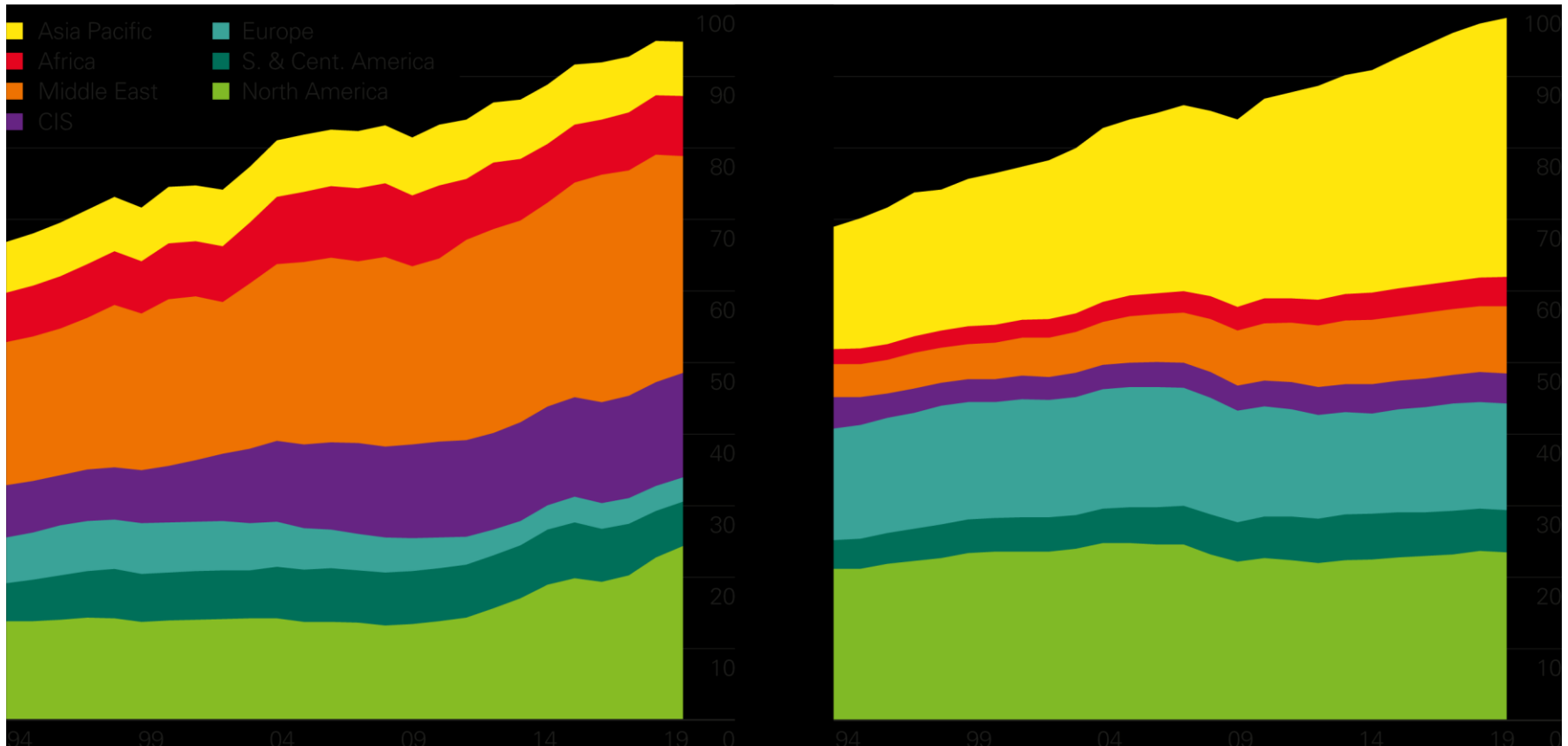
- Oil is not running out – proved reserves are up by 50% since 1995
- Middle East continues to dominate, but other regions are growing – the Americas in particular



# The growth in oil production and regional split

*Production*

*Consumption*

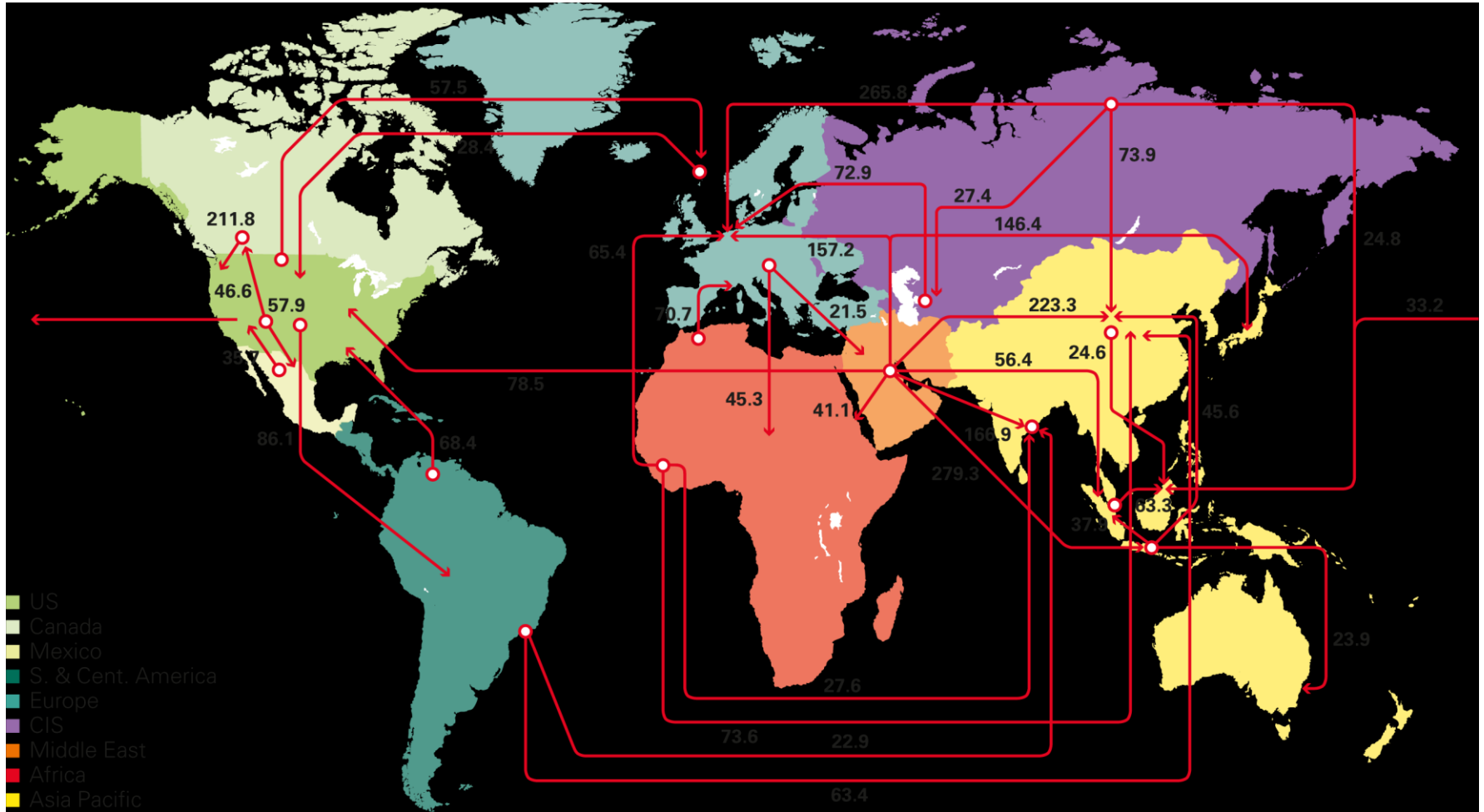


- Middle East dominates supply but US has been rising fast due to shale oil
- CIS also a major producer and exporter, mainly thanks to Russia
- Overall demand has continued to rise by 1mmbpd per annum, but is the peak in sight?





# Oil is a global commodity

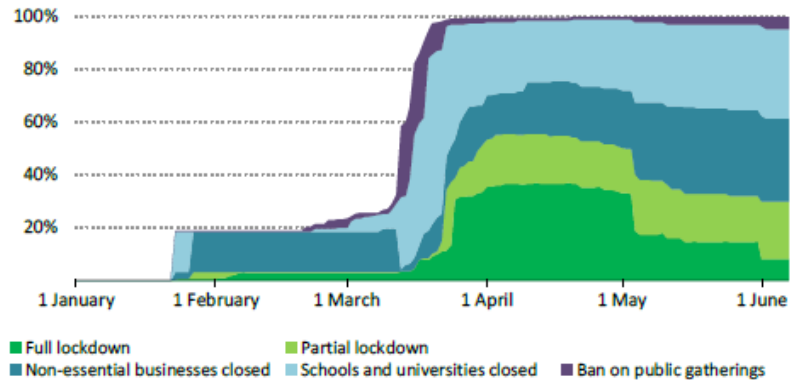


- Oil is traded in multiple directions across the globe
- Much of the trade originates from the Middle East and flows West and East
- Prices are set relative to a set of global benchmarks



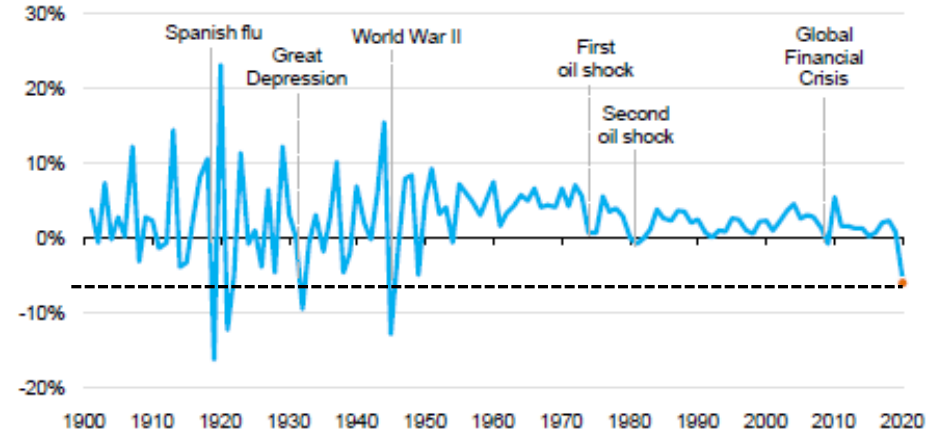
# Economic impact of COVID 19 the worst since World War 2

**Figure 1.1** ▶ Share of global population under containment measures, 2020



*Measures to contain the spread of the pandemic started at the end of January. In mid-May, around one-third of the global population remained under full or partial lockdown.*

**Rate of change in global primary energy demand, 1900-2020**

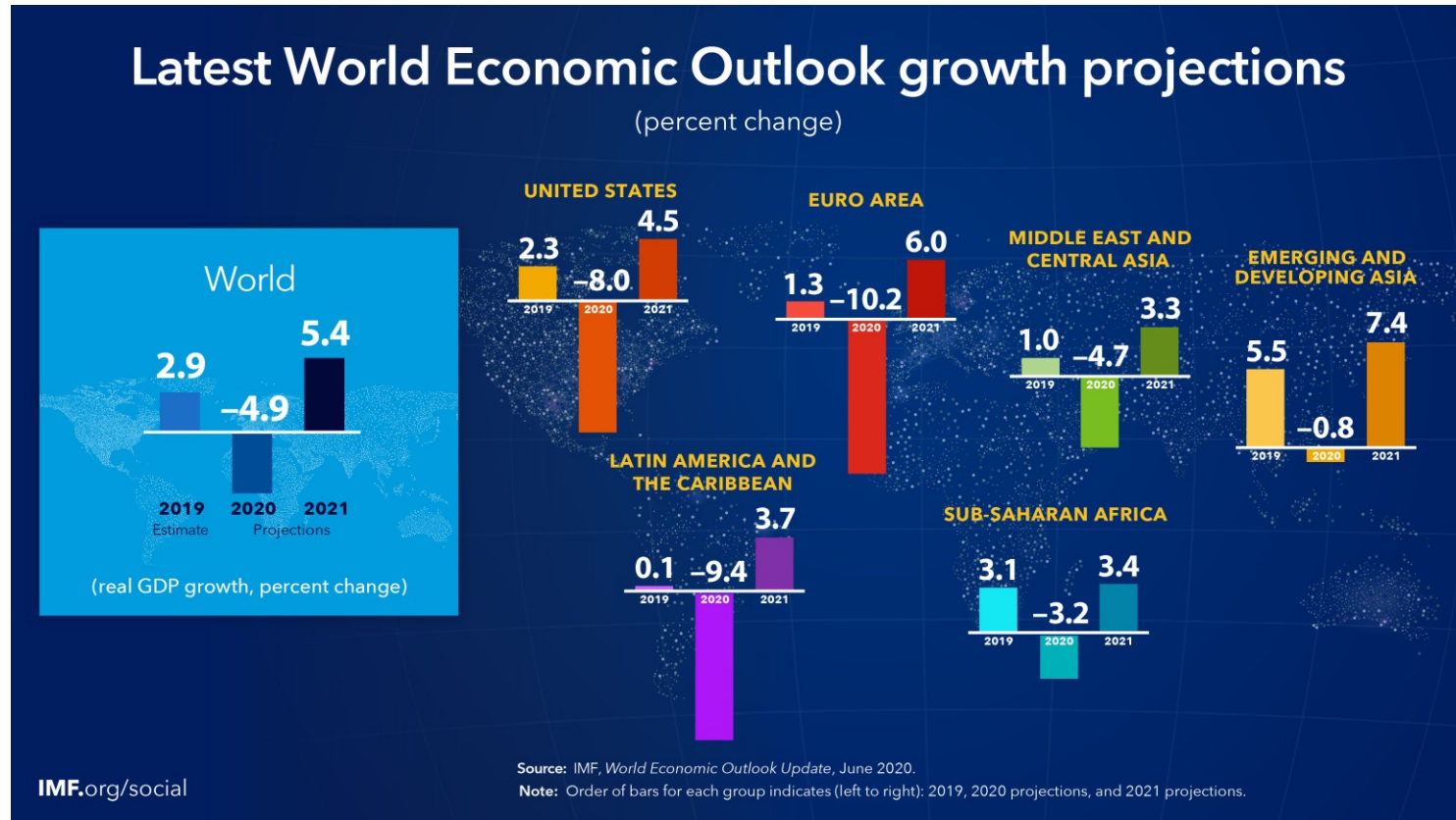


IEA 2020. All rights reserved.

- This market balancing mechanism works in “normal” conditions
- However, a major economic or social shock creates an uncontrollable outcome
- The COVID 19 pandemic is a classic example of this – containment measures dramatically reduced travel and caused a sharp decline in overall energy demand
- This affected all forms of energy consumption, but the most immediate impact was on oil demand



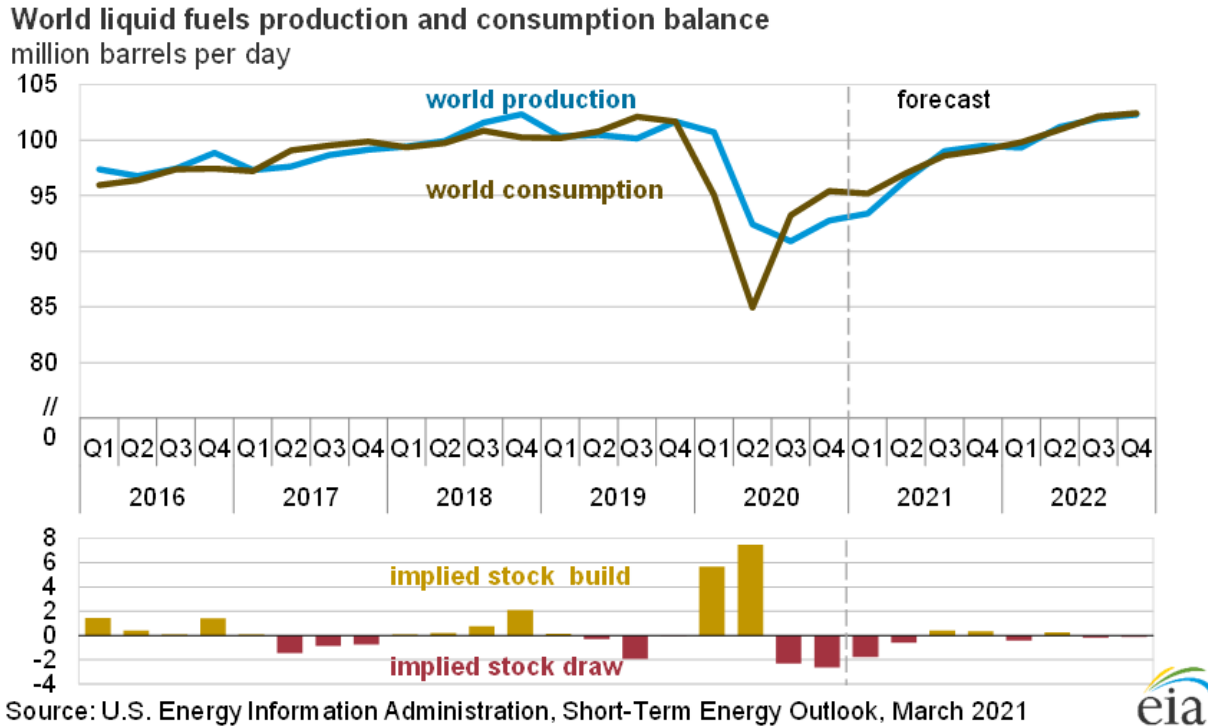
# The outlook for the global economy



- A key question is whether the global economy will recover rapidly or over an extended period
- Initial estimates were quite optimistic, and China does appear to be experiencing something of a V-shaped recovery
- Europe was heading in a similar direction, but the latest lockdown measures and the potential for further waves could change the outlook



# COVID impact on oil demand



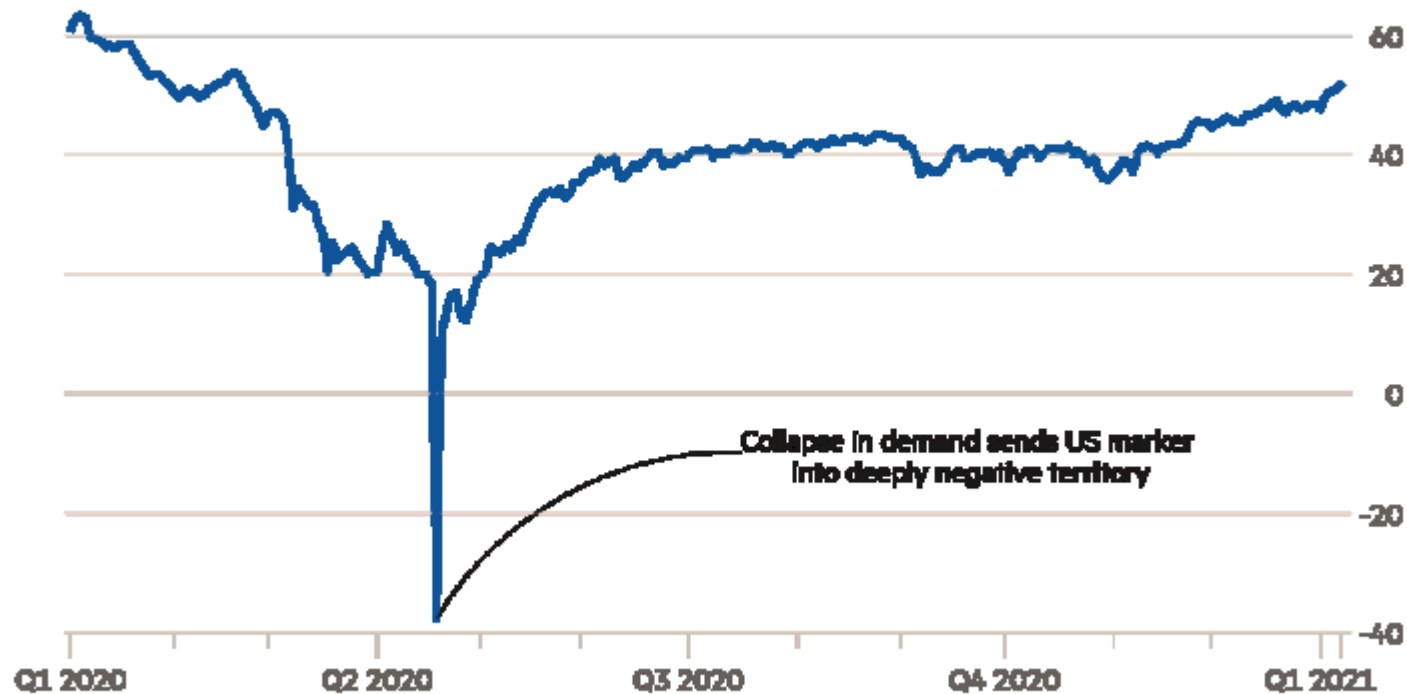
- The impact on transport was immediate, as economies locked-down and people were forced to stay at home
- Oil demand collapsed immediately and the oil price fell from around \$70 to around \$20 per barrel
- There has now been a partial recovery to c.\$40 per barrel, but the outlook remains very unclear



# Recovery in oil price has stalled as demand uncertainty continues

## US oil prices top \$50 after latest Opec+ deal

West Texas Intermediate, \$ per barrel

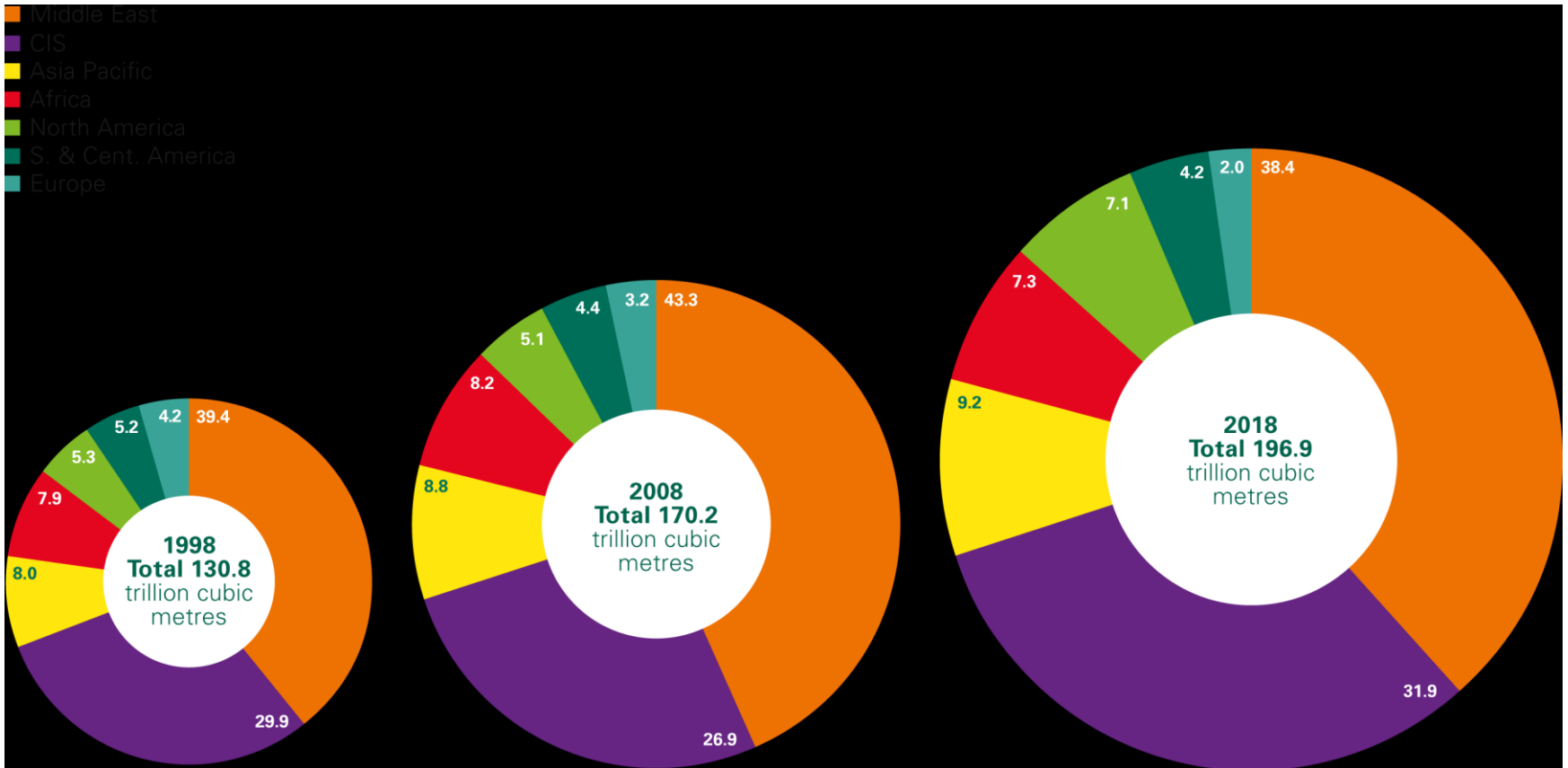


Source: Refinitiv  
© FT

- Concerns over a second wave have led to the oil price recovery ending
- There is confusion over OPEC strategy as many countries are desperate not to reduce production as they need revenues badly



# Gas reserves by region (1998, 2008, 2018)

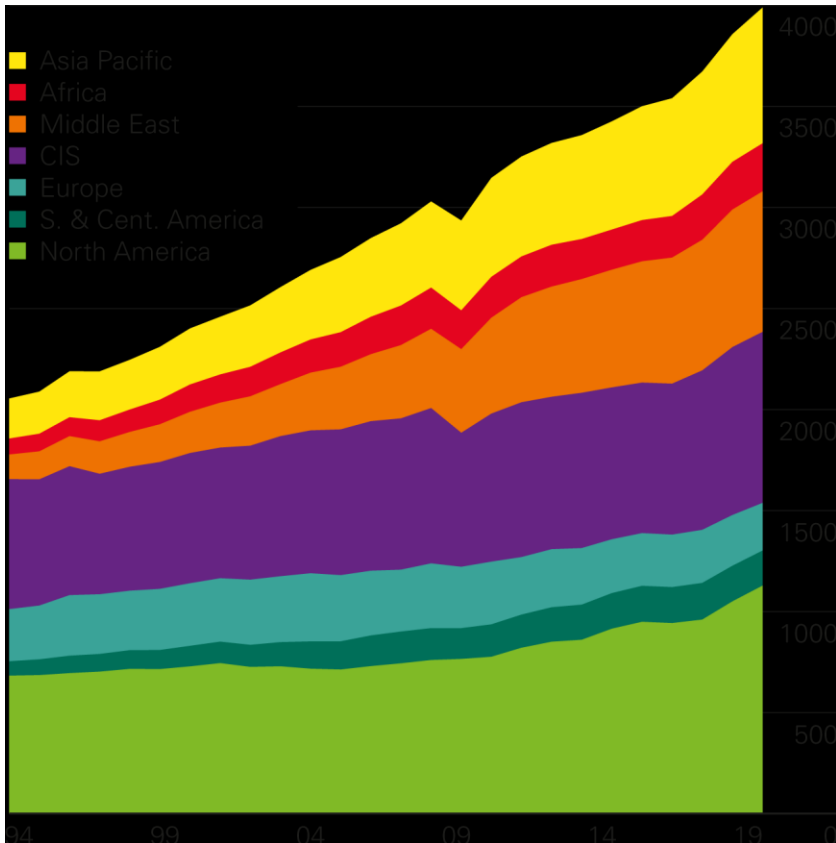


- The Middle East also contains huge amounts of gas, although Russia is the main exporting country
- Gas reserves have grown dramatically as it has increasingly become an important fuel for power generation

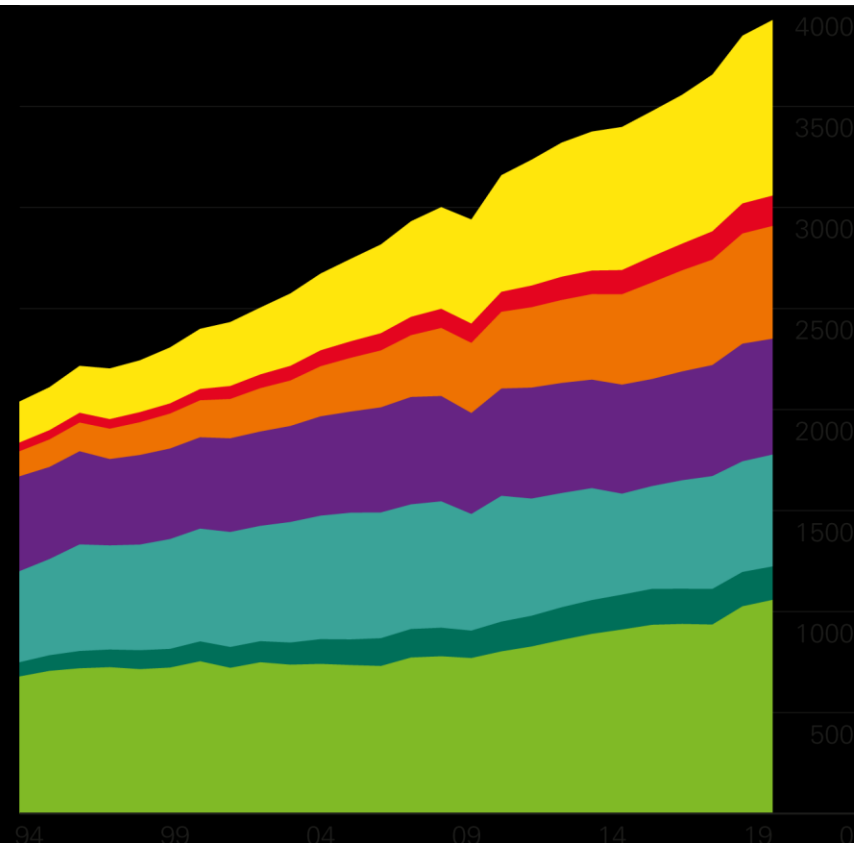


# Gas production and consumption by region (bcm)

*Production*



*Consumption*

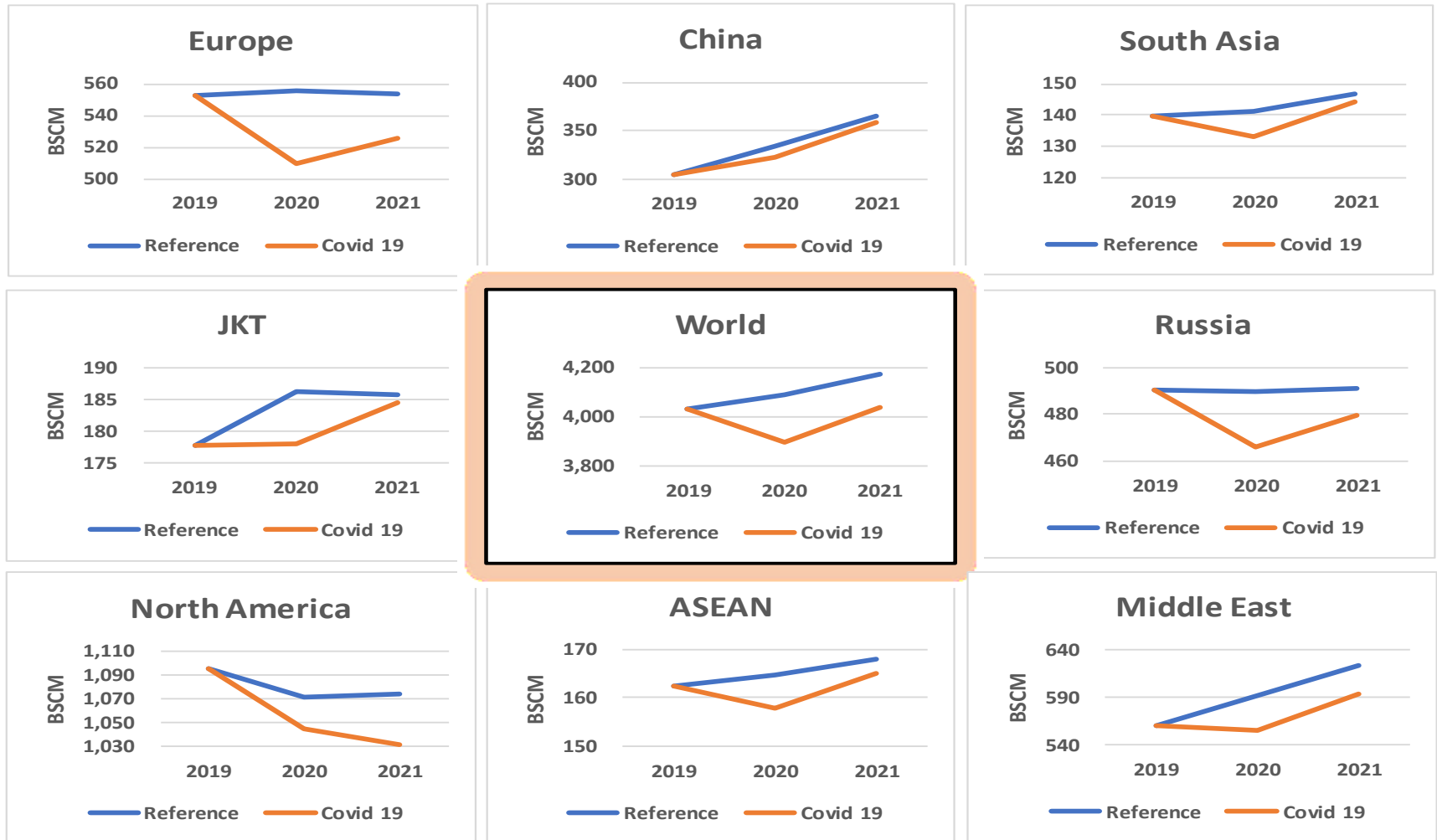


- Europe and North America have traditionally been the largest consumers of gas
- Major infrastructure in both regions facilitates indigenous production and imports
- Asia, the Middle East and Latin America are growing fast, however





# Global consumption declines 3.5% in 2020, bounces back 4% in 2021



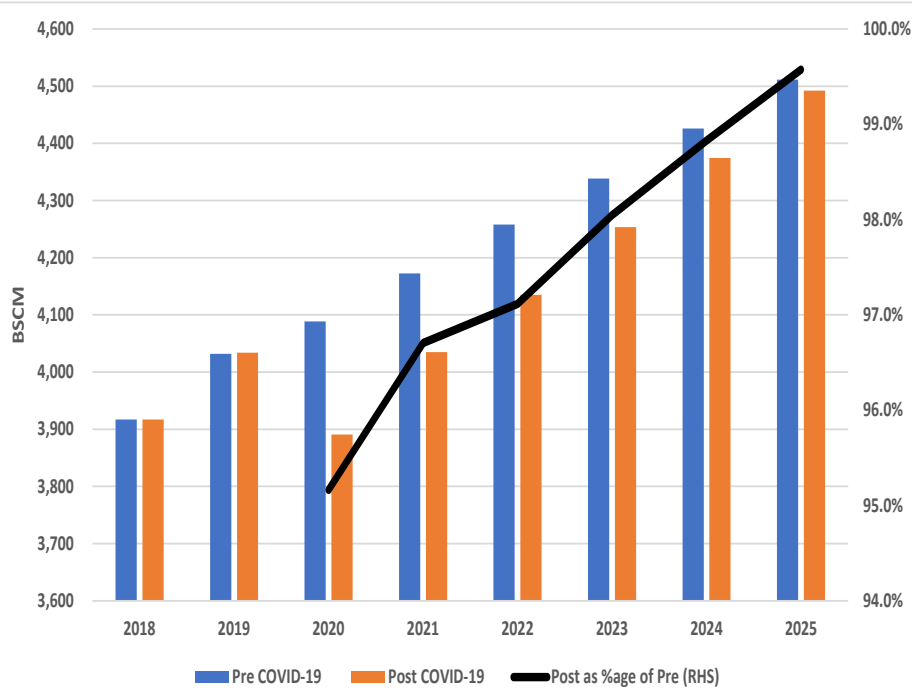
Source: OIES, Nexant WGM



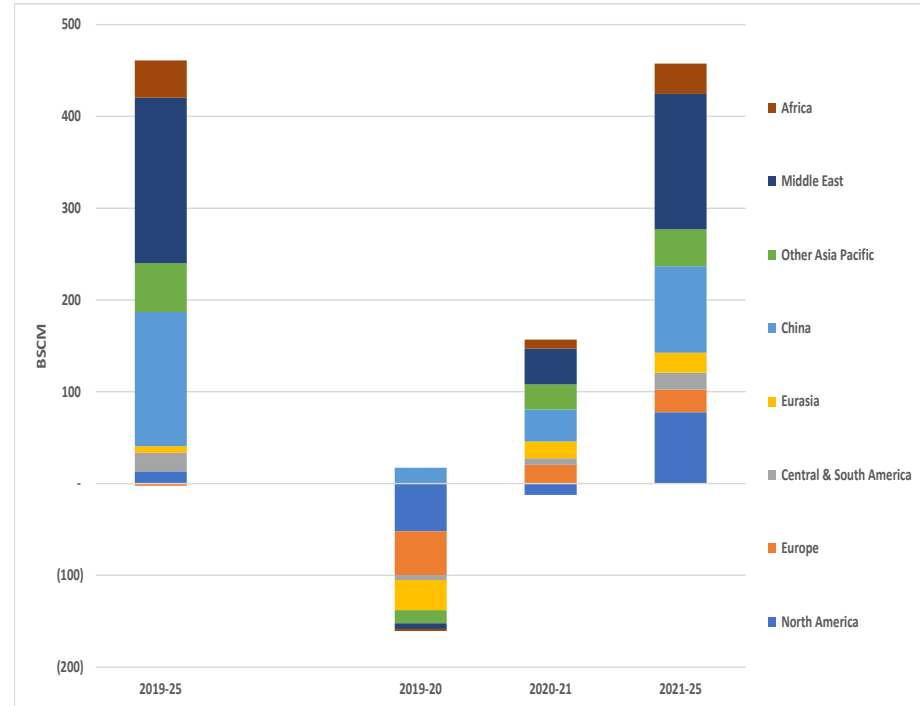


# 5 Year Demand Outlook post COVID

## Pre and Post COVID-19 Demand



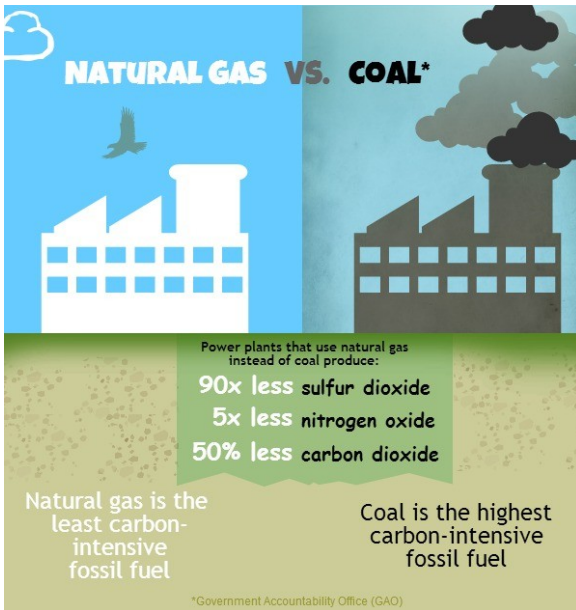
## Regional Breakdown



- 3.5% decline in gas demand on 2020 – return to 2019 levels in 2021
- Demand grows 2.5% a year to 2025 almost reaching the pre-COVID-19 projection
- Largest declines in 2020 in Europe, North America and Russia
- Across the board rebound in 2021 – Europe sluggish growth
- Asia and Middle East lead the growth post 2021

Sources:  
Historic - IEA  
Projections – OIES,  
Nexant WGM

# Key issues for Gas in the longer term

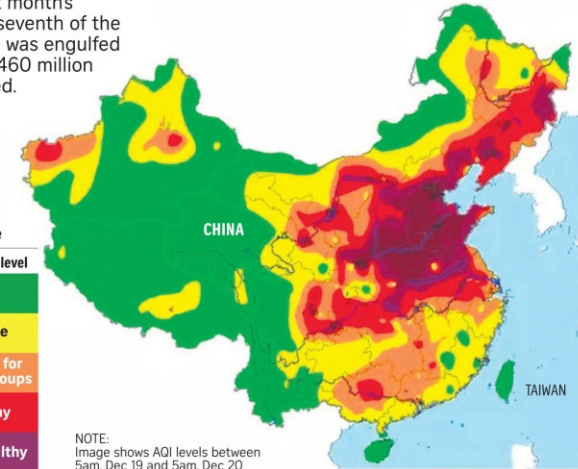


## China's worst air pollution in 2016

At the height of last month's "airpocalypse", one-seventh of the country's land mass was engulfed by smog. A total of 460 million people were affected.

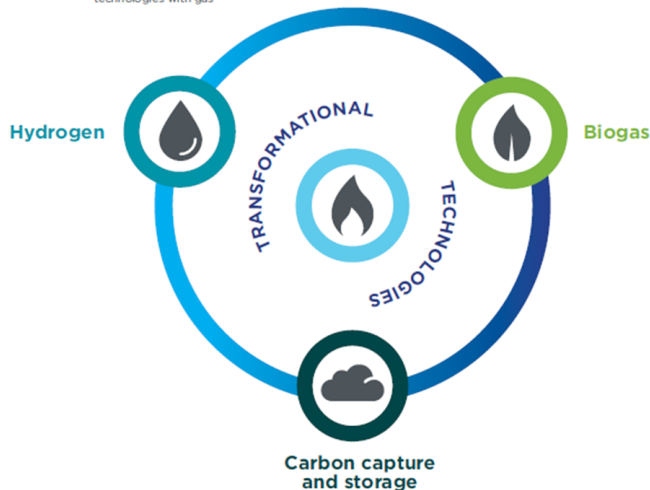
Air Quality Index (AQI) scale

AQI	Air pollution level
0 - 50	Good
51 - 100	Moderate
101 - 150	Unhealthy for sensitive groups
151 - 200	Unhealthy
201 - 300	Very unhealthy
300+	Hazardous



Source: CHINA METEOROLOGICAL ADMINISTRATION STRAITS TIMES GRAPHICS

Figure 4: Integration of low emission transformational technologies with gas

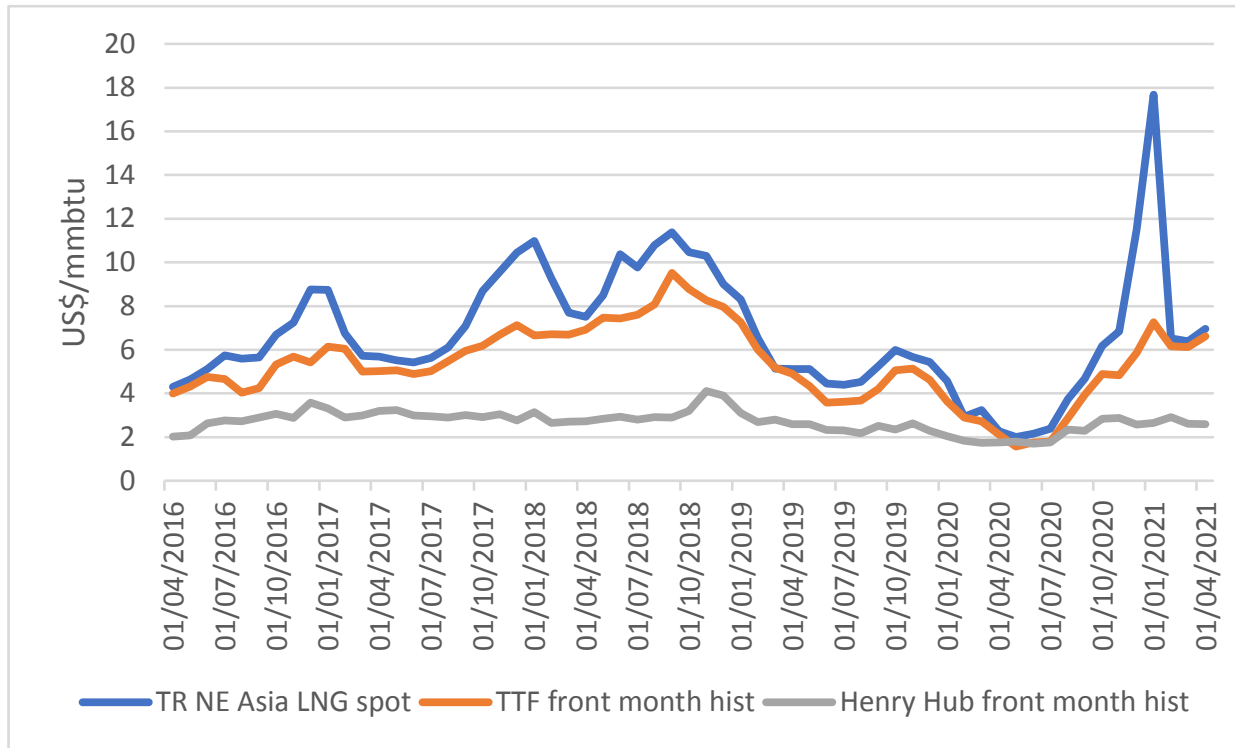


- Gas demand can continue to rise as it displaces coal in the energy mix
- In Asia, air quality is a key issue, and gas can have a major role to play
- In Europe, net zero CO<sub>2</sub> emissions is a major theme – gas is part of the long-term problem unless it finds a pathway to decarbonise



# Gas prices have been in decline for longer

*Gas price in US, Europe and Asia*



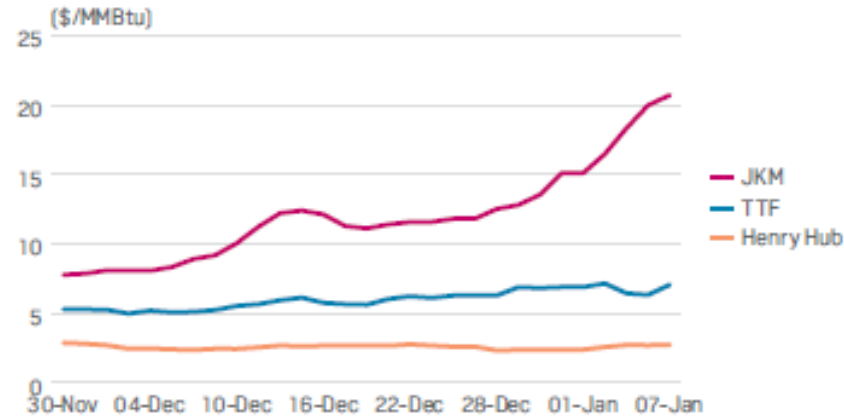
- Gas prices have been in cyclical decline since 2018
- Excess supply has been built due to high prices in the mid-2010s
- Demand has not met expectations and then Covid-19 pandemic caused a decline in consumption
- Winter 2020/21 provided a shock though





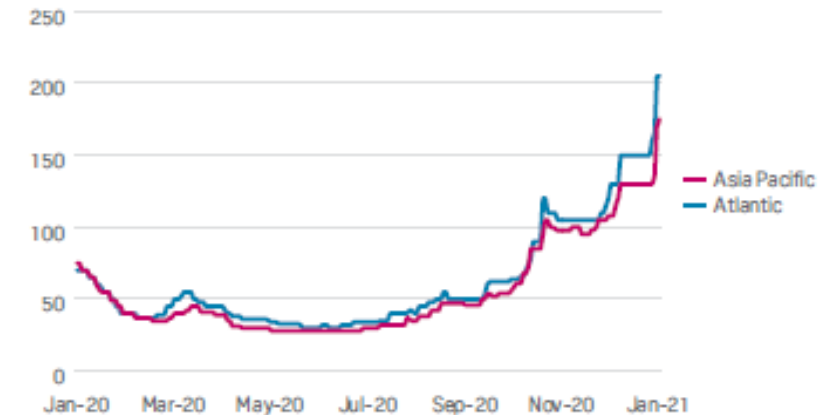
# Perfect storm pushed Asian prices to record levels in winter 2020/21

## NATURAL GAS/LNG



Source: S&P Global Platts

## SHIPPING RATES (\$1000s/DAY)



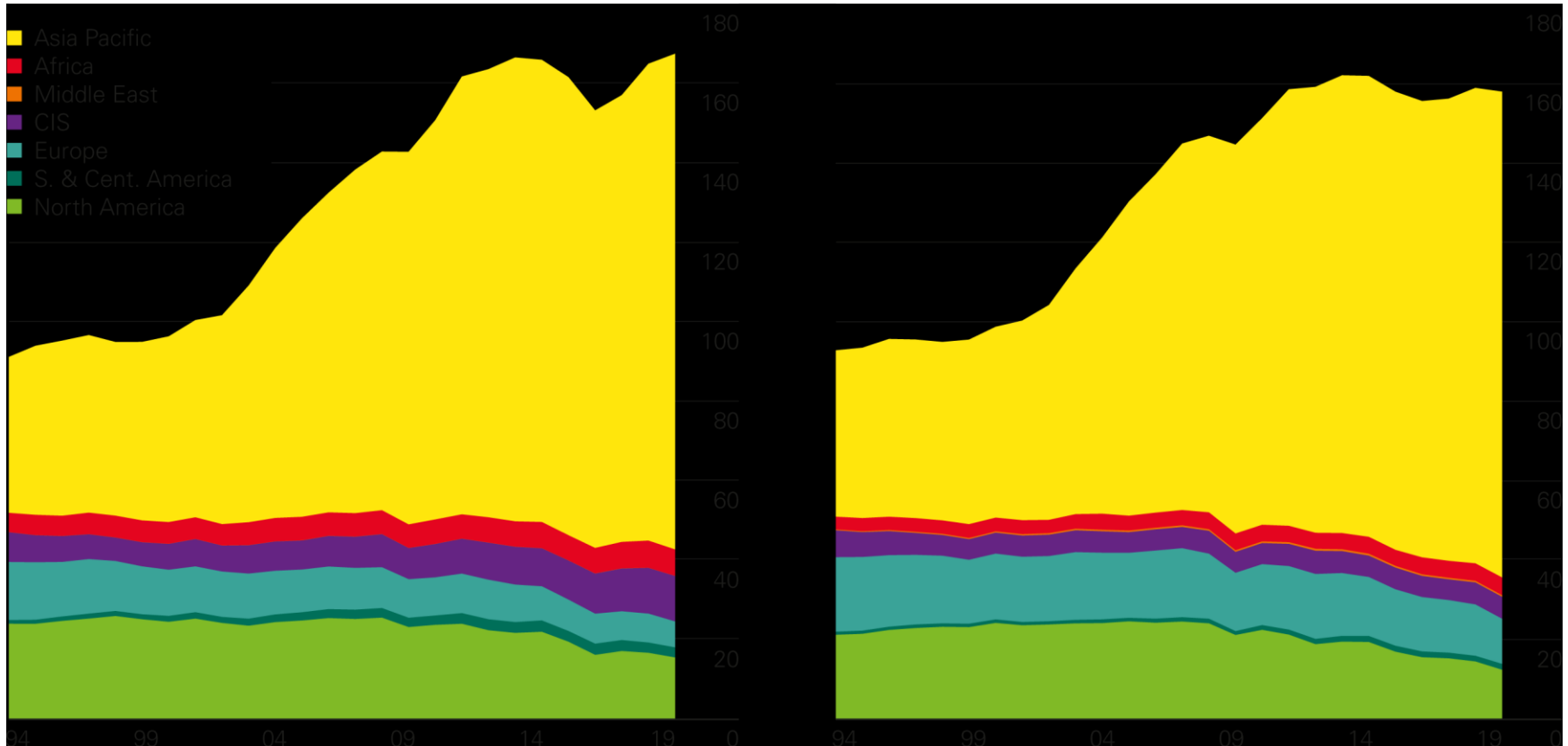
Source: S&P Global Platts

- Record low temperatures in NE Asia boosted power and gas demand
- LNG inventories low, plus lack of availability of prompt cargoes
- Supply disruptions also an issue – pipeline explosion in Nigeria one example
- JKM at record high on Jan 8 at \$21.45/mmbtu (up 158% in 1 month)
- Shortage of LNG tankers also causing a problem
- Increased shipping to Asia, with longer transport times, has reduced effective capacity
- Congestion at Panama Canal also delaying US LNG exports to Asia
- Rate for Atlantic shipping reached \$300,000/day on Jan 8

# Coal production and consumption by region (mt)

*Production*

*Consumption*



- The majority of production and consumption is in Asia, and has grown rapidly
- China and India are the key players, as coal is both countries' major indigenous energy resource
- Decline in North America driven by the arrival of shale gas

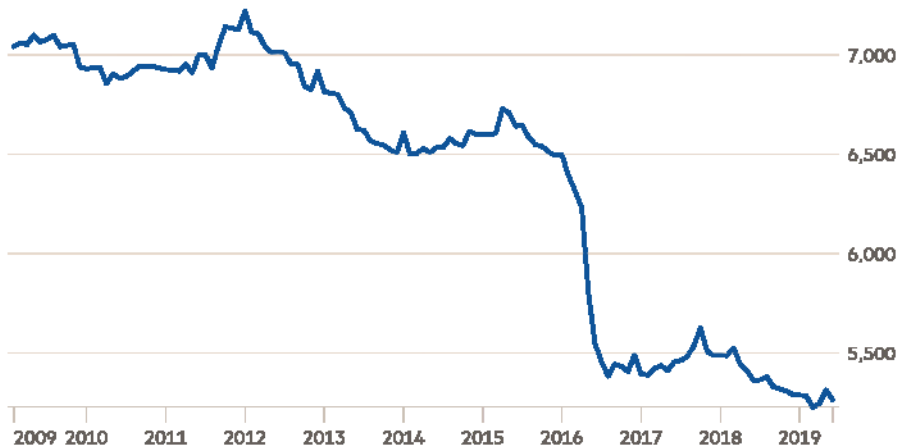


# Decline in coal industry

## *Employment in US coal industry*

### Coal employment declines in top-producing US state

Wyoming payroll jobs in coal mining industry



Source: US Bureau of Labor Statistics

© FT

## *Global coal price (US\$/t)*



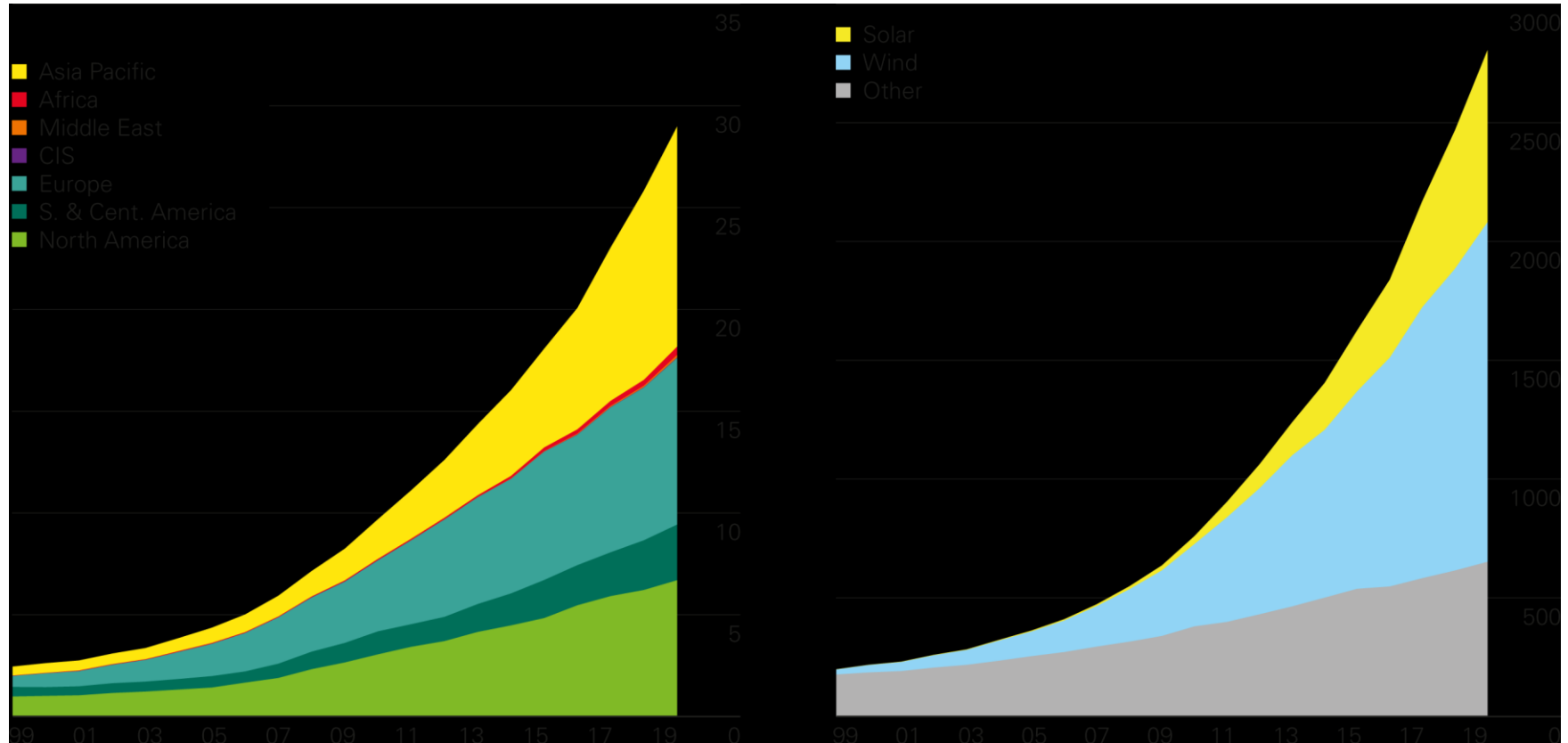
- The coal industry is in long-term decline for environmental and economic reasons
- The US coal industry has collapsed over the past five years
- Cheap gas prices have encouraged a switch from coal, especially in power sector
- Coal is still important in many developing countries, especially in Asia



# Renewable energy consumption by region and source

*Consumption (MMTOE)*

*Source of Renewable Energy*



- Growth in renewable energy has been dramatic – it now accounts for around 9% of the global input to electricity
- Europe has been leading the way, catalysed by policy initiatives in Germany
- Growth in Asia accelerating, as search for indigenous energy continues



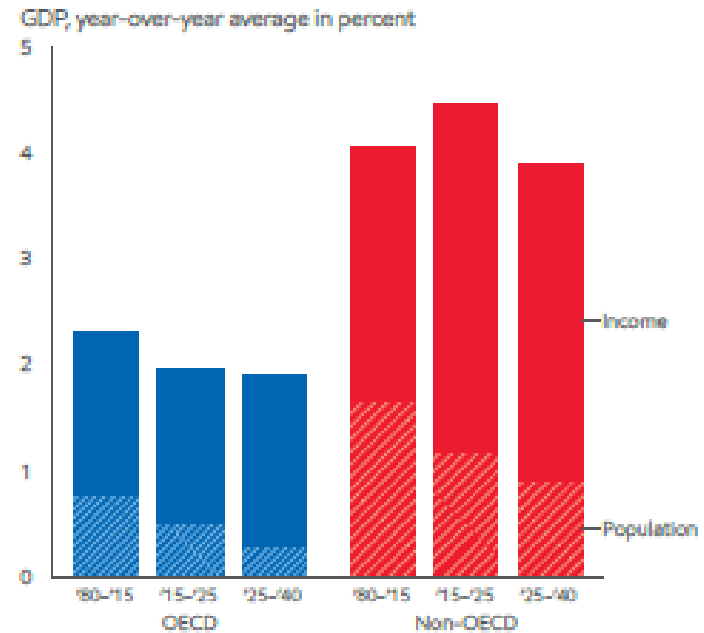
# Key drivers of energy consumption

## World demographics continue to shift



Source: World Bank, EcoinMobil estimates

## Non-OECD leads economic expansion



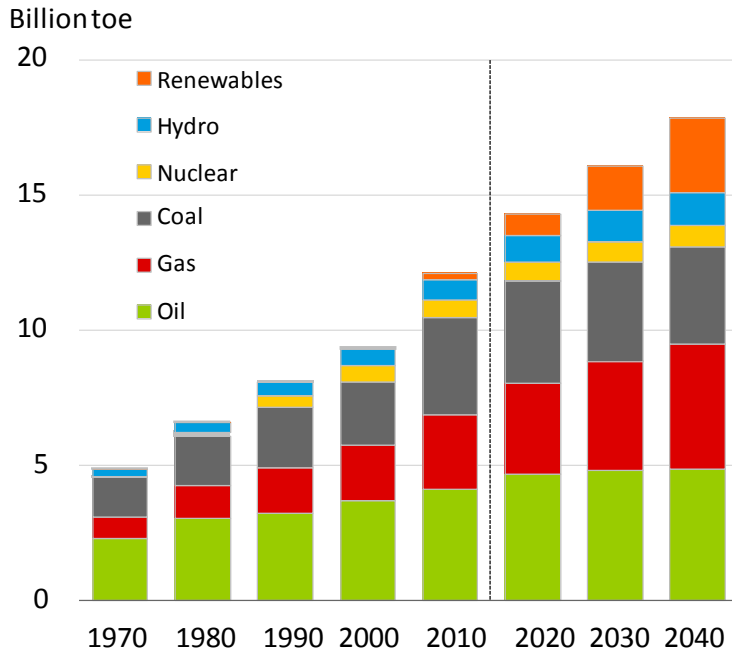
- Global population currently 7.3 billion, expected to reach 9.1 billion by 2040
- Population mainly in non-OECD countries, in many of which the alleviation of energy poverty is a huge issue
- Economic growth is another key driver, leading to increased personal wealth and greater use of energy intensive products
- Again non-OECD countries dominate growth, with their share of global GDP set to rise from 35% to 50% by 2040



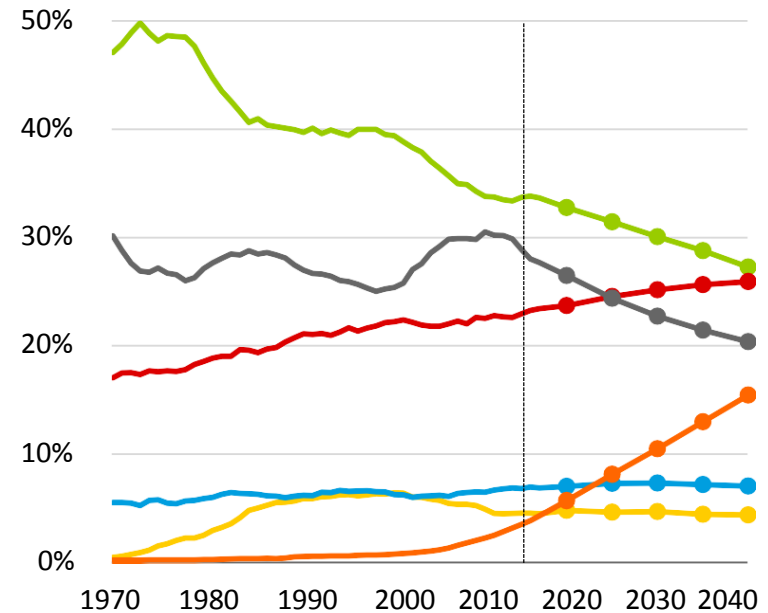


# The shifting global energy economy

Primary energy consumption by fuel



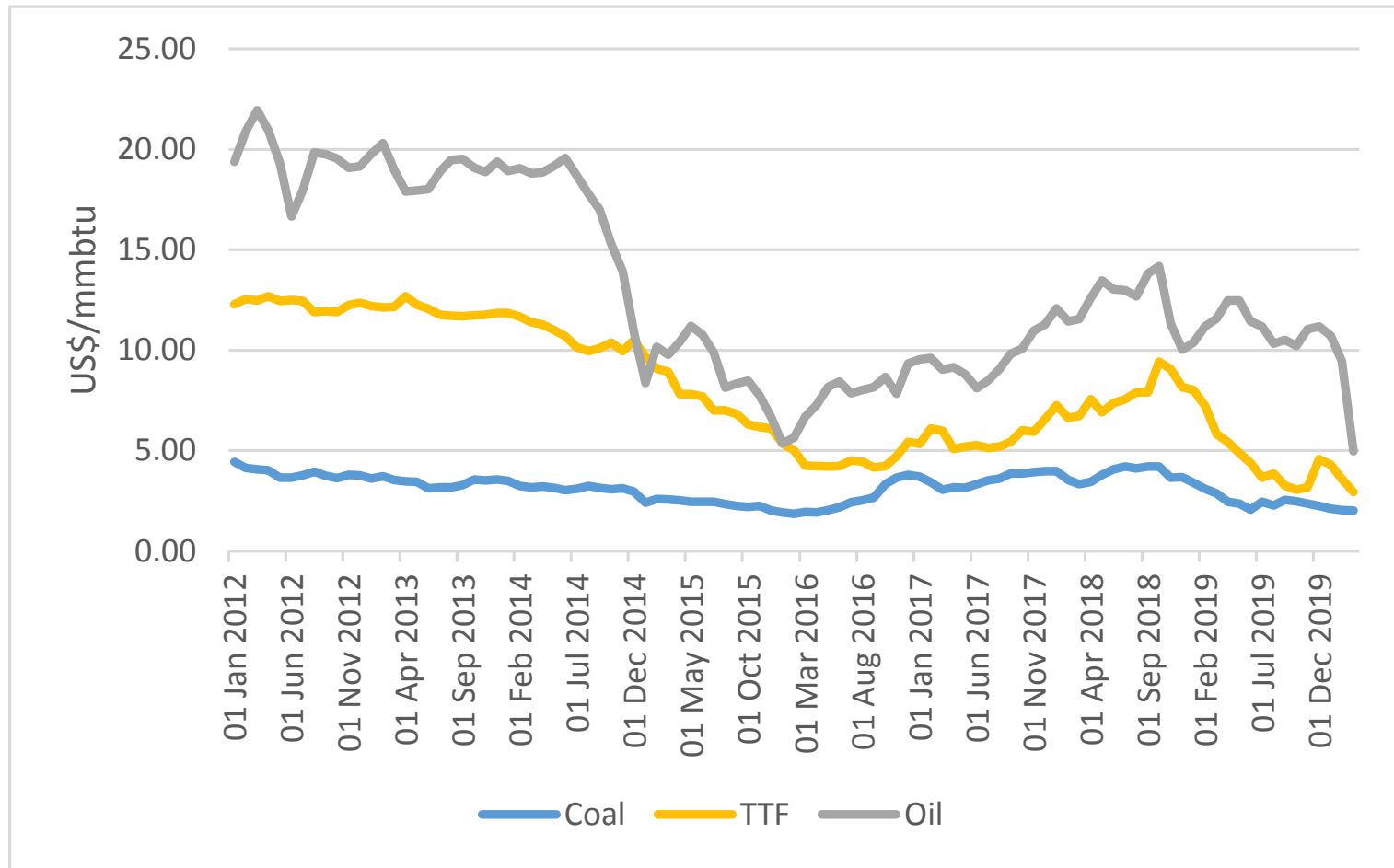
Shares of primary energy



- Rise of renewables now having a noticeable impact on hydrocarbons
- Incremental demand growth is increasingly being accounted for by non-fossil fuels, leading to oversupply and lower prices
- Are we seeing a new paradigm for oil, gas and coal pricing, with significant commercial and political consequences?



# Global energy prices – short and long-term trends



- Are we in a new era of lower commodity prices, or will there be a further rebound as supply and demand re-balance?

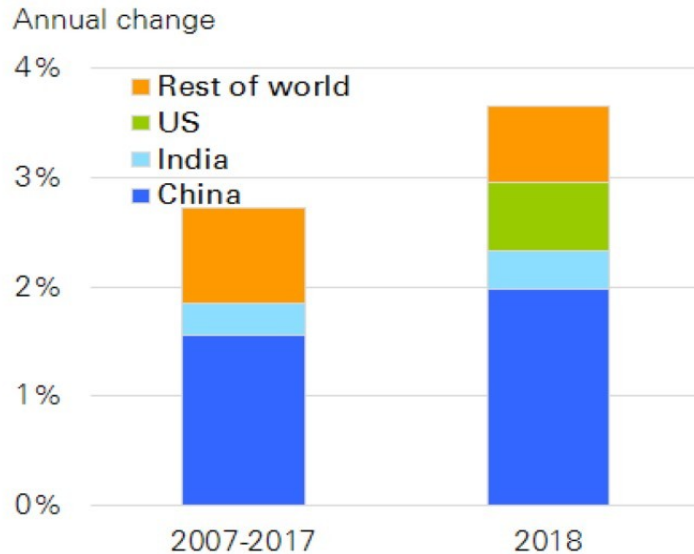


# Power Sector Trends

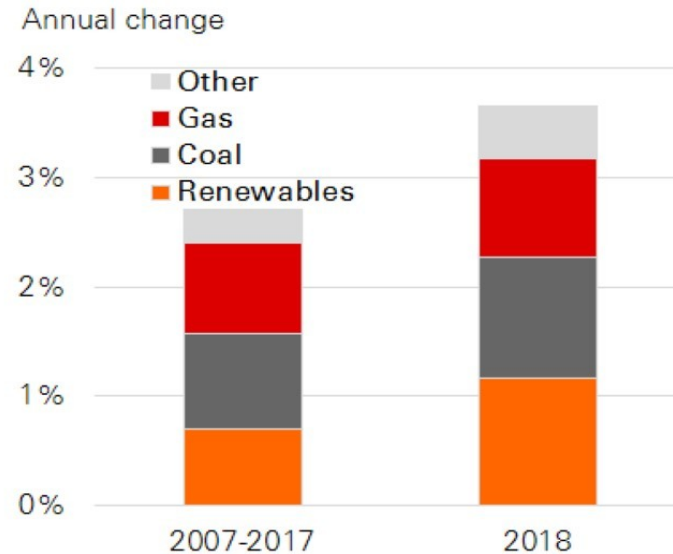


## Growth in power generation

Contributions by region



Contributions by fuel



BP Statistical Review of World Energy

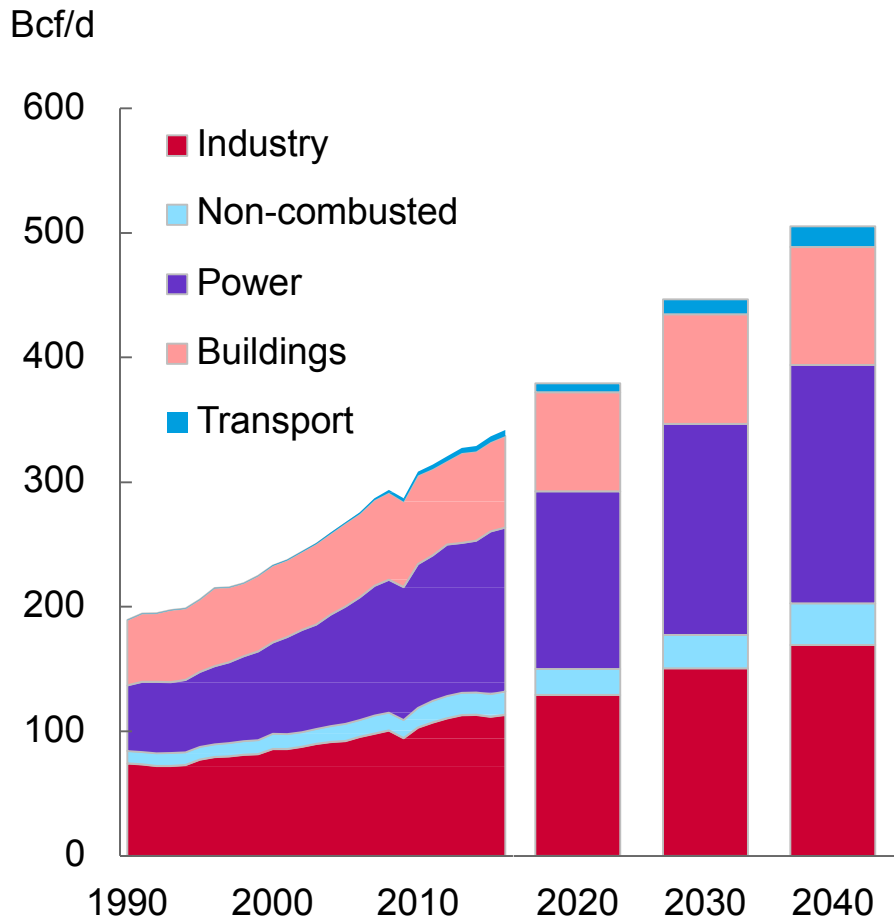
© BP p.l.c. 2019

- GDP growth and power demand are closely correlated
- Electricity demand continues to grow but mix of fuels is changing
- Renewables the largest growing segment, but hydrocarbons still playing a major role
- Existing capacity is cheap to use, even if new capacity is less welcome

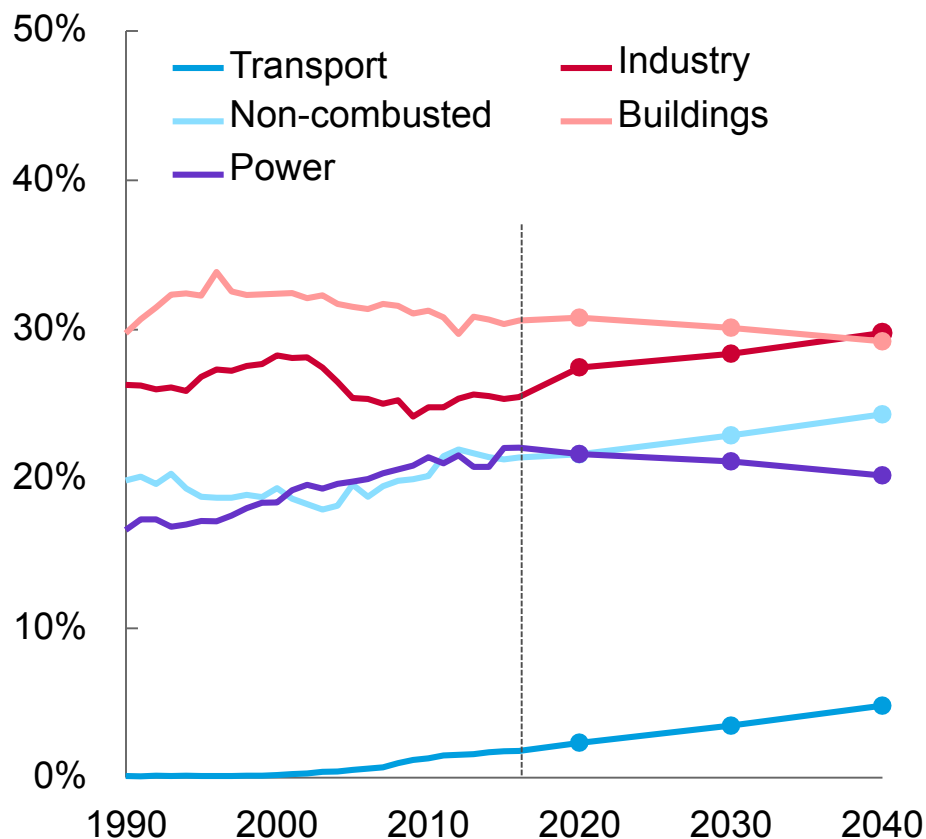


# Natural gas demand growth driven by power and industry

## Gas consumption by sector



## Gas share by sector

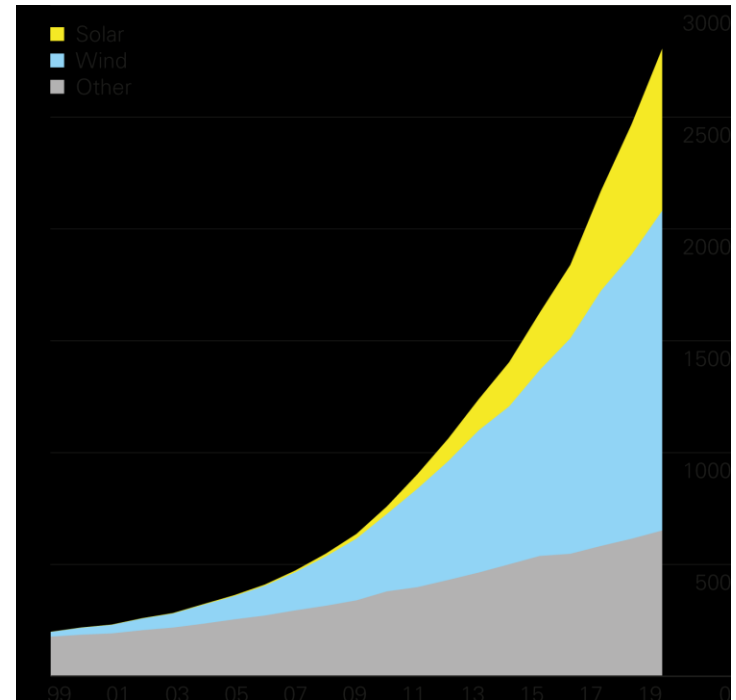
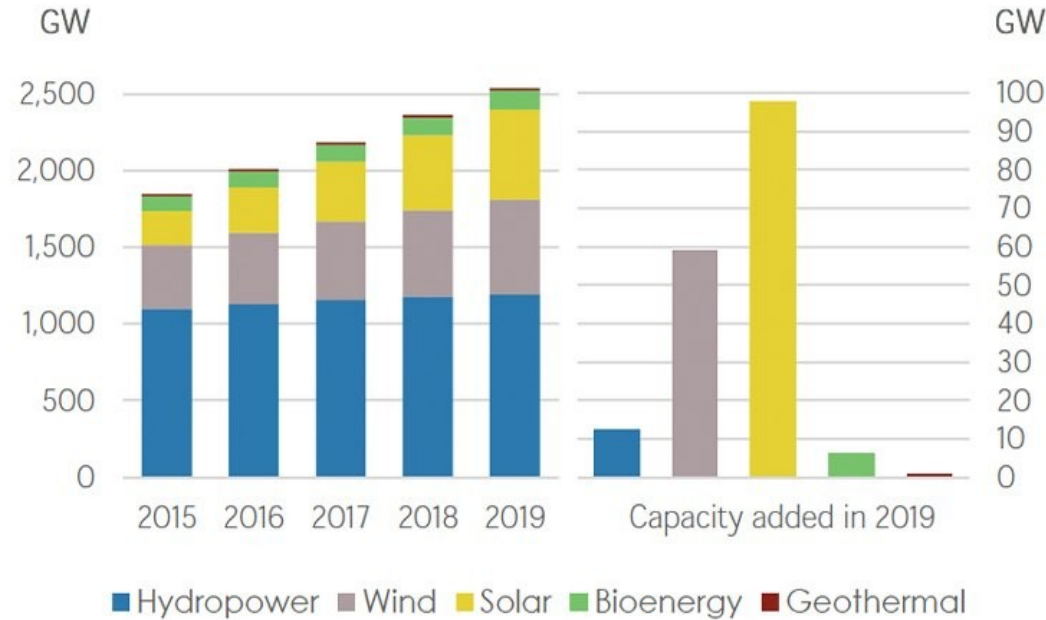


- Industrial demand is key to gas growth, especially petrochemicals
- Demand from power sector also grows, although overall share falls



# Wind power leads the way for renewables

Renewable power capacity growth

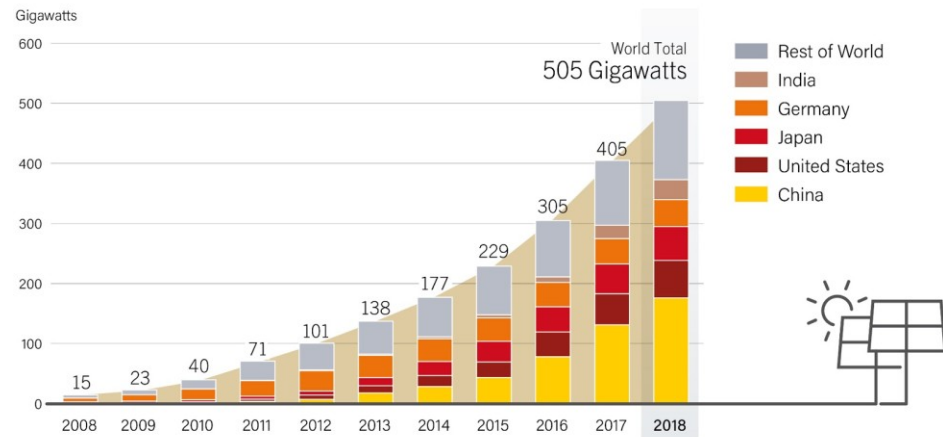


- Although renewable energy only accounts for 4% of total energy, it grew by 15% in 2018
- It accounted for all the increase in global power generation and nearly 40% of total energy growth
- Solar is growing very fast (33% in 2018) but wind power still leads the way in terms of generation

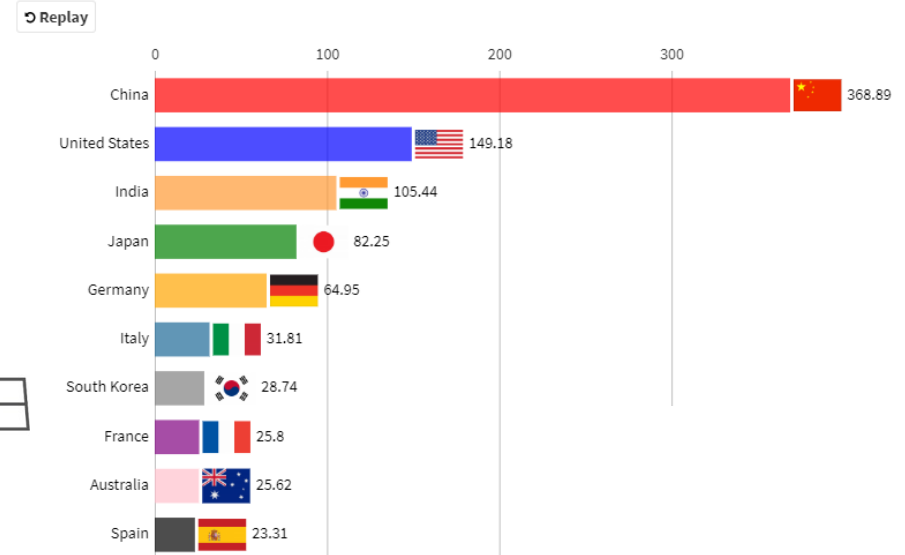


# Solar Power continues to show rapid growth

Solar PV Global Capacity, by Country and Region, 2008-2018



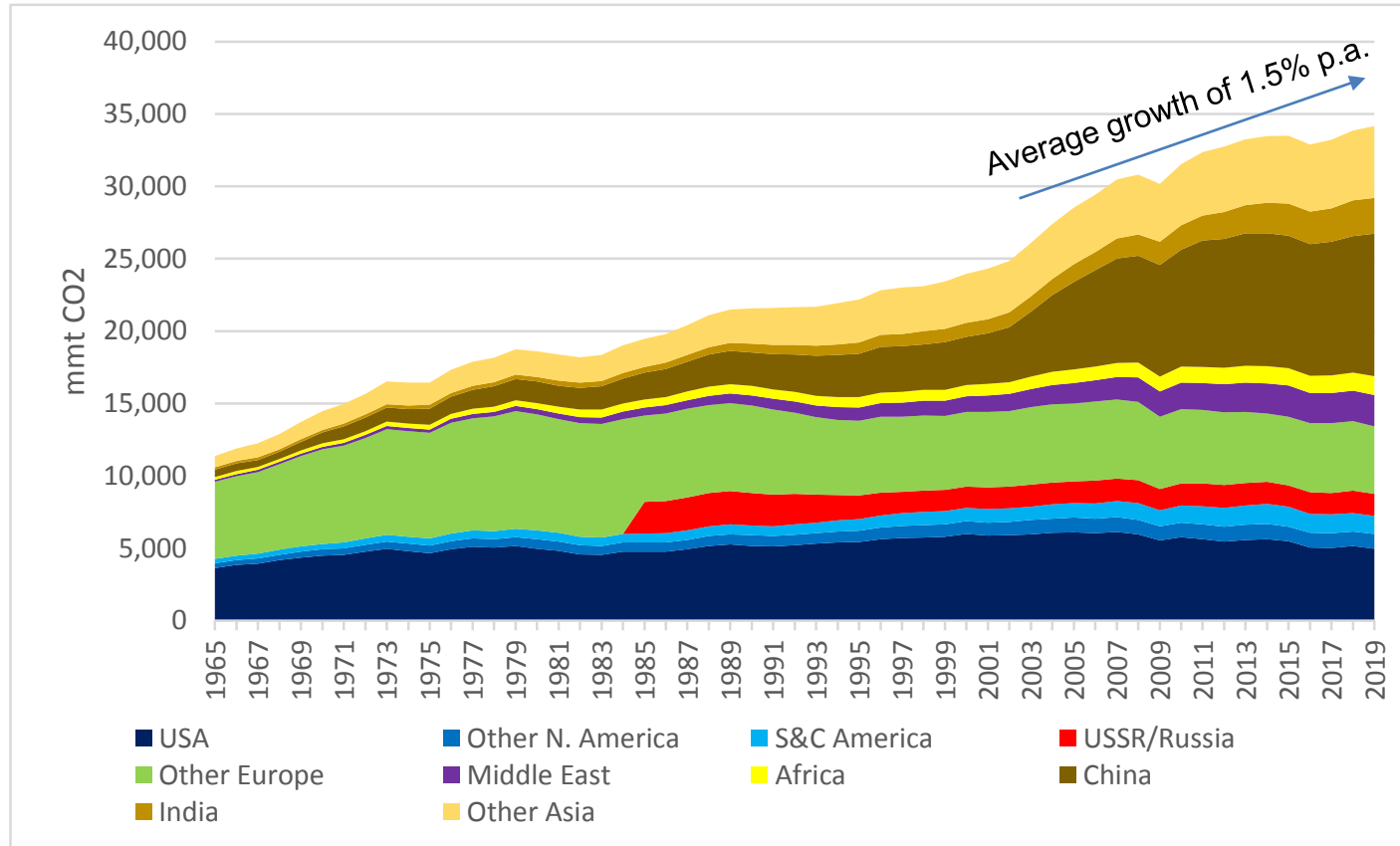
Cumulative annual PV installations by country, 2001 - 2024E (GWdc)



- China is leading the way, both as a consumer and as a developer of technology
- The next generation of solar technology could have a dramatic impact and make a significant change to energy security issues



# History of CO2 Emissions



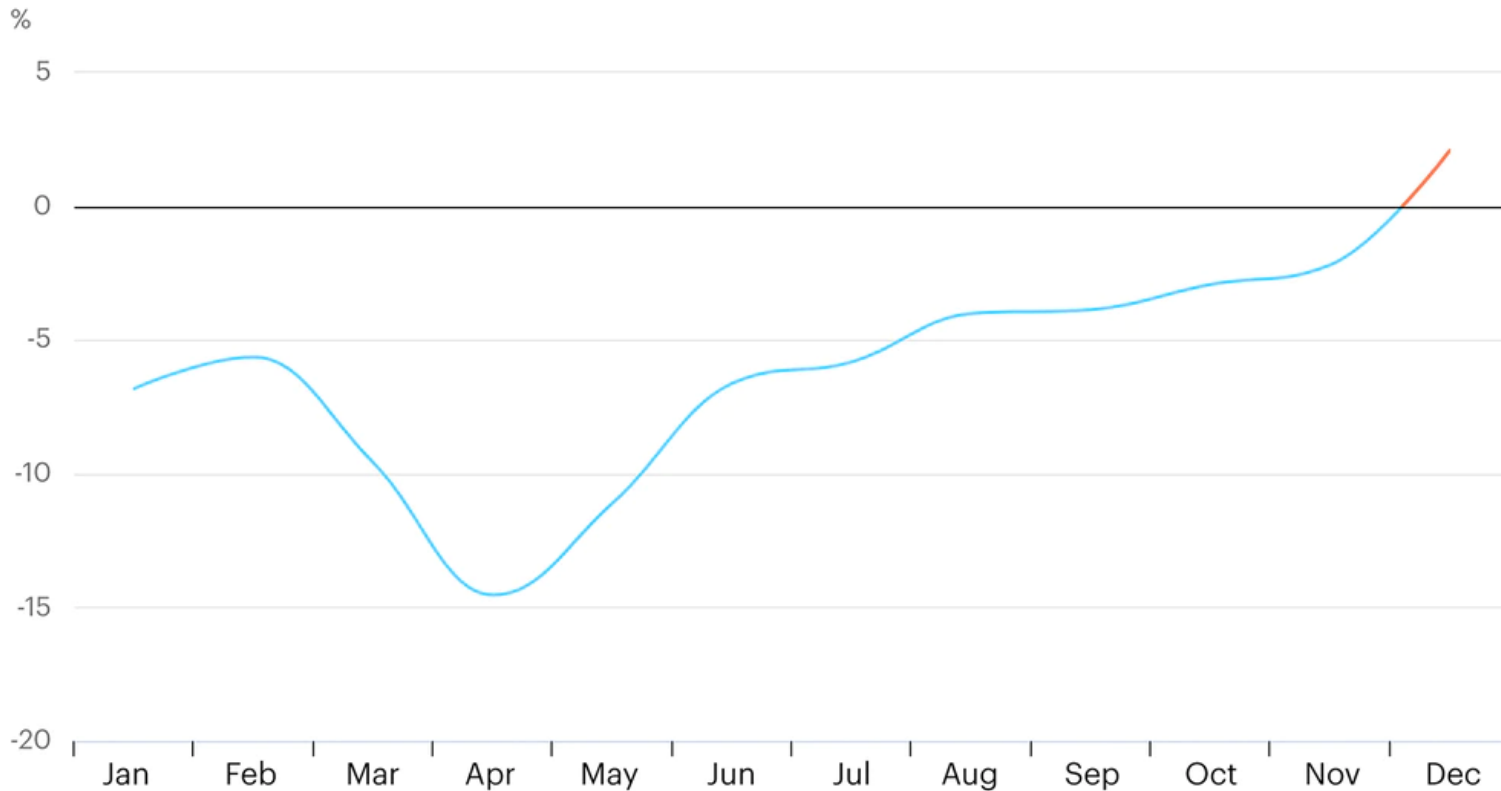
- Carbon emissions have grown consistently to 2014, but were then declined in 2015 and 2016 due to sluggish economic growth and greater energy efficiency
- Key question is whether we have reached a peak, or is this just a cyclical downturn? 2017-2019 would suggest the latter



# Carbon emissions fell sharply in 2020 but are rebounding

## Monthly evolution of global CO<sub>2</sub> emissions, 2020 relative to 2019

Global Energy Review: CO<sub>2</sub> Emissions in 2020



International  
Energy Agency

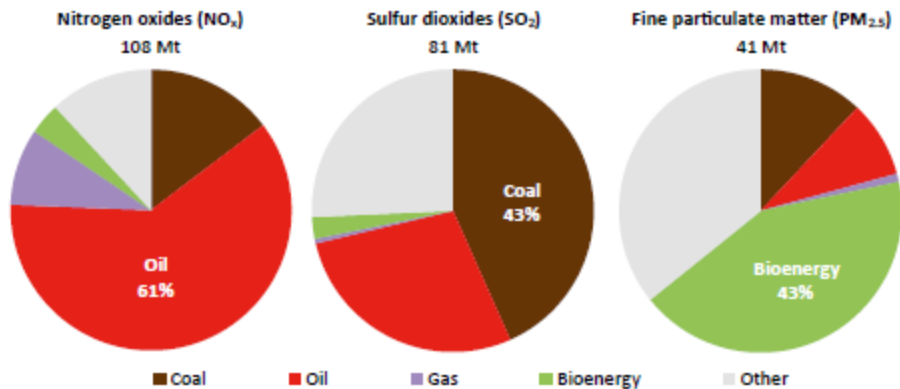
- Will the world just revert to its previous trend or have we seen a fundamental shift in lifestyles?





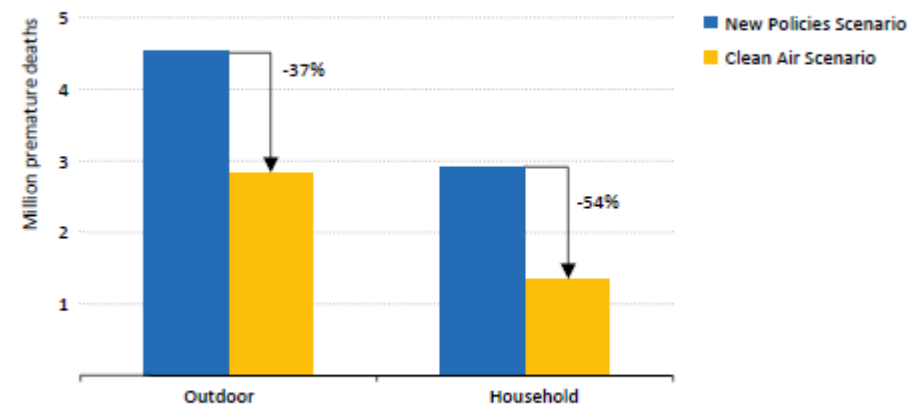
# Air pollution is becoming an almost more important short-term issue

**Figure 2.10** ▶ Estimated anthropogenic emissions of the main air pollutants by source, 2015



*Combustion of oil, coal and biomass was responsible for most of the man-made emissions of the main air pollutants in 2015*

**Figure 2.12** ▶ Premature deaths attributable to global air pollution in the New Policies and Clean Air Scenarios, 2040



*With a 7% increase in investment, premature deaths attributable to air pollution are down sharply in a Clean Air Scenario*

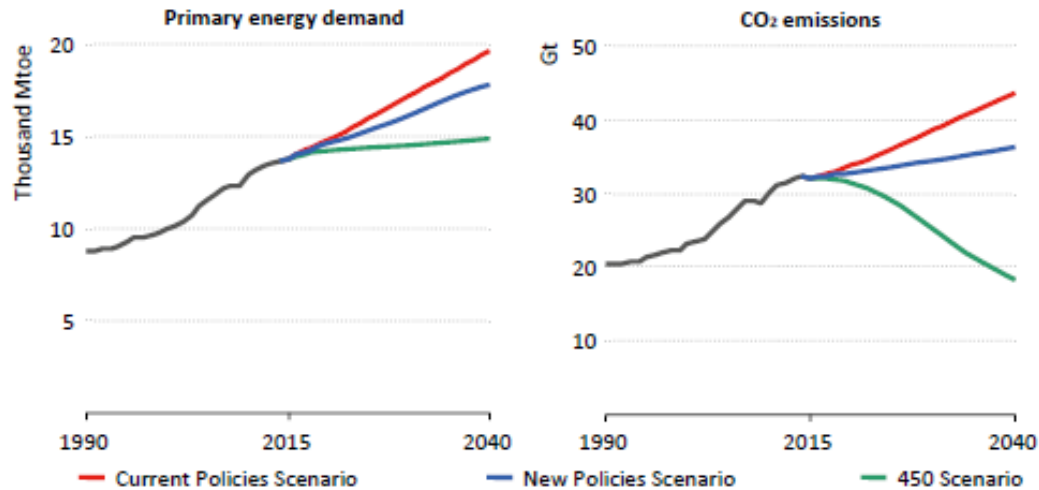
- Air pollution is a more immediate social and political issue than carbon emissions
- China is well known for its poor air quality in many cities, but even in Europe a number of regions are well below acceptable levels
- Governments are aware that a failure to react on a key health issue could lead to a violent backlash
- Air pollution could therefore be a key driver towards a cleaner energy economy



Having said that, in the longer term global warming is the key issue, and things clearly need to change if we are to meet 2 degree target

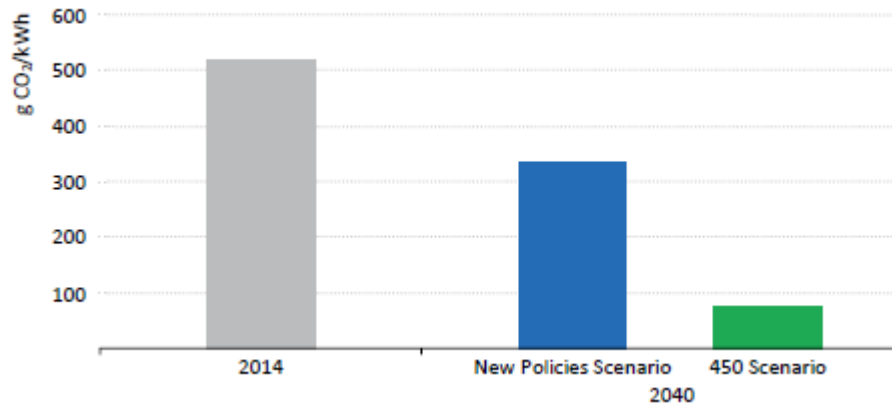
### *Energy demand and CO2 emissions in different IEA scenarios*

Demand must not grow...

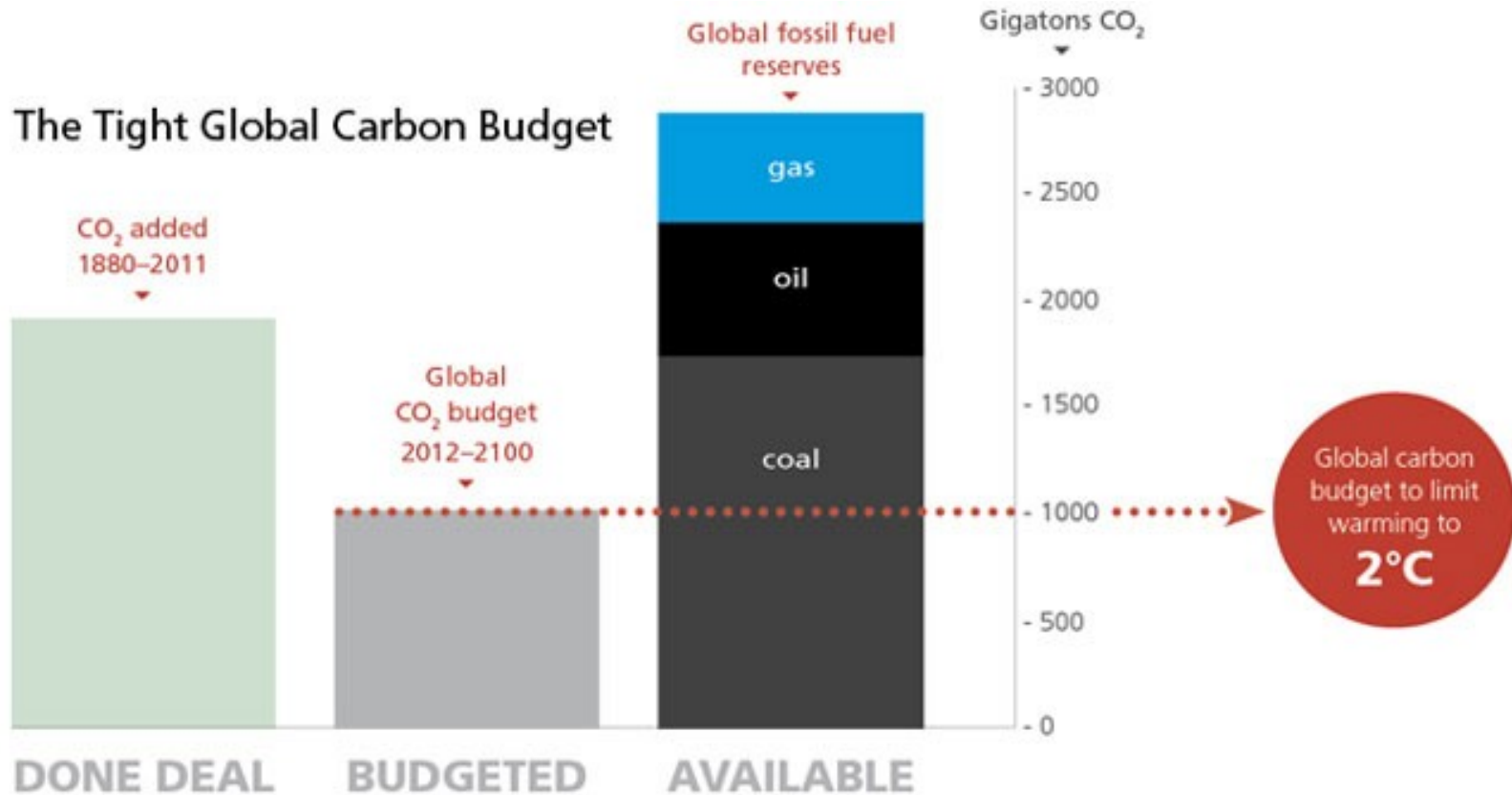


### *Emissions intensity from power sector*

...and renewable output must



# Looking at the global carbon budget, the race is on to produce fossil fuels while you can

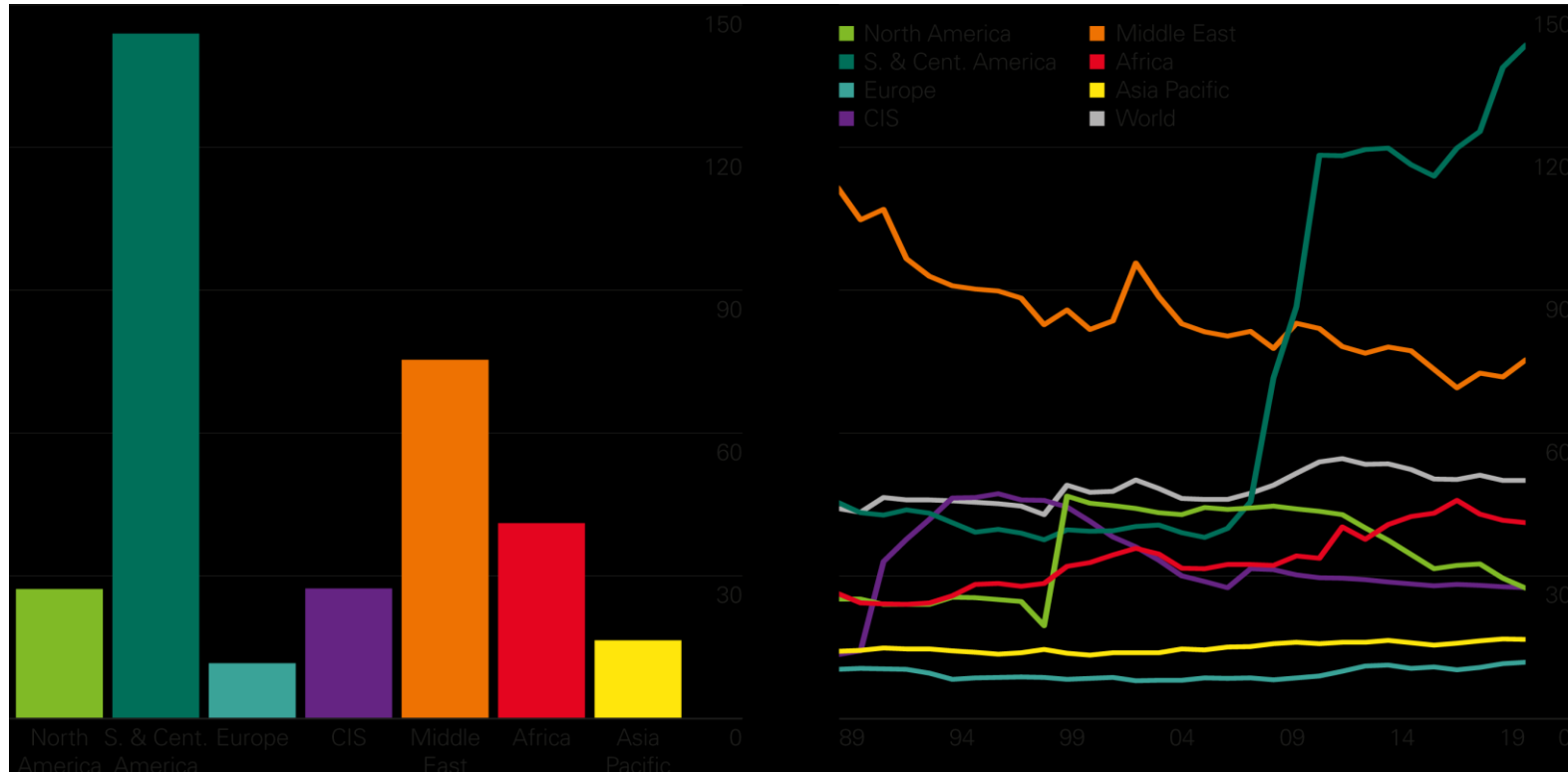


- This has vast political and commercial consequences, as countries and companies have to react to a fast changing energy economy
- The futures of Russia and the Middle East are closely bound up to the issue of whether this carbon budget will or can be enforced



# This leaves a vital question for companies / regions with large fossil fuel reserves

Fossil fuels reserves to production ratios (years)



- Coal reserves would last well over 100 years in most regions, while oil and gas reserves have a 50 year reserves life on average
- This assumes that no further exploration is ever carried out
- Will these reserves ever be produced, and perhaps more importantly who can get theirs out of the ground first?



# World Energy Demand by Fuel and Scenario

			New Policies		Current Policies		450 Scenario	
	2000	2014	2025	2040	2025	2040	2025	2040
Coal	2 316	3 926	3 955		4 361	5 327	3 175	
Oil	3 669	4 266	4 577	4 775	4 751	5 402	4 169	3 326
Gas	2 071	2 893	3 390		3 508	4 718	3 292	3 301
Nuclear	676	662	888	1 181	865	1 032	960	1 590
Hydro	225	335	420	536	414	515	429	593
Bioenergy*	1 026	1 421	1 633	1 883	1 619	1 834	1 733	2 310
Other renewables	60	181	478		420	809	596	
<b>Total</b>	<b>10 042</b>	<b>13 684</b>	<b>15 340</b>	<b>17 866</b>	<b>15 937</b>	<b>19 636</b>	<b>14 355</b>	<b>14 878</b>
<i>Fossil-fuel share</i>	<i>80%</i>	<i>81%</i>	<i>78%</i>		<i>79%</i>	<i>79%</i>	<i>74%</i>	
<b>CO<sub>2</sub> emissions (Gt)</b>	<b>23.0</b>	<b>32.2</b>	<b>33.6</b>	<b>36.3</b>	<b>36.0</b>	<b>43.7</b>	<b>28.9</b>	<b>18.4</b>

- The outcomes for hydrocarbons are very different in scenarios that look at current likely outcomes versus outcomes needed to meet climate targets
- In a world where we meet the 2 degree target, coal demand would halve from current levels and oil demand would fall by 25%
- However, fossil fuel share would still be 58% in 450 Scenario



# Capital Spending in the Energy Sector

	2010-15*	New Policies		Current Policies		450 Scenario	
	Per year	Cumulative	Per year	Cumulative	Per year	Cumulative	Per year
Fossil fuels	1 112	26 626	1 065	32 849	1 314	17 263	691
Renewables	283	7 478	299	6 130	245	12 582	503
Electricity networks	229	8 059	322	8 860	354	7 204	288
Other low-carbon**	13	1 446	58	1 259	50	2 842	114
<b>Total supply</b>	<b>1 637</b>	<b>43 609</b>	<b>1 744</b>	<b>49 098</b>	<b>1 964</b>	<b>39 891</b>	<b>1 596</b>
Energy efficiency	221	22 980	919	15 437	617	35 042	1 402

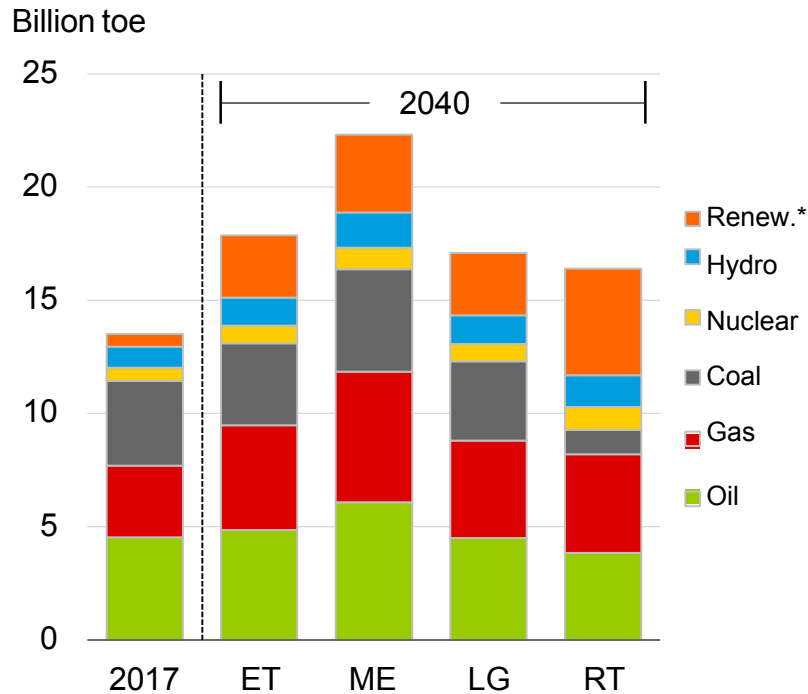
\* The methodology for energy efficiency investment derives from a baseline of efficiency levels in different end-use sectors in 2014, the annual figure for energy efficiency in this column is the figure only for 2015. \*\* Includes nuclear and CCS.

- Uncertainty creates a reluctance to invest, but huge amounts of capital will be required to provide energy for a growing population
- Two interesting questions emerge:
  - Will sufficient capital be found to maintain growth in renewables, especially if subsidies start to be removed?
  - Will there be sufficient incentive to invest in the hydrocarbons that will still be needed, if competition drives prices down?
- How much should be left to markets and how might governments intervene?

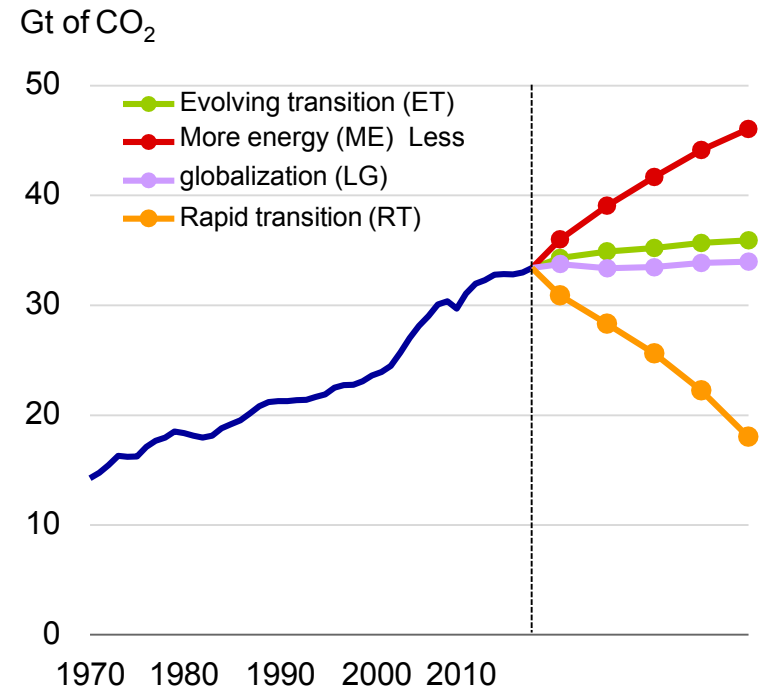


# Which scenario are we heading for?

Primary energy consumption by fuel



CO<sub>2</sub> emissions



- What level of overall energy demand will there be?
- How much policy implementation will there be to achieve climate targets?
- What will the energy mix be?
- Many of these questions will be answered by politicians, not the market



# Strategic thinking for the Energy Transition

## Sales and marketing



## Exploration



## Transport and trading



## Development and extraction



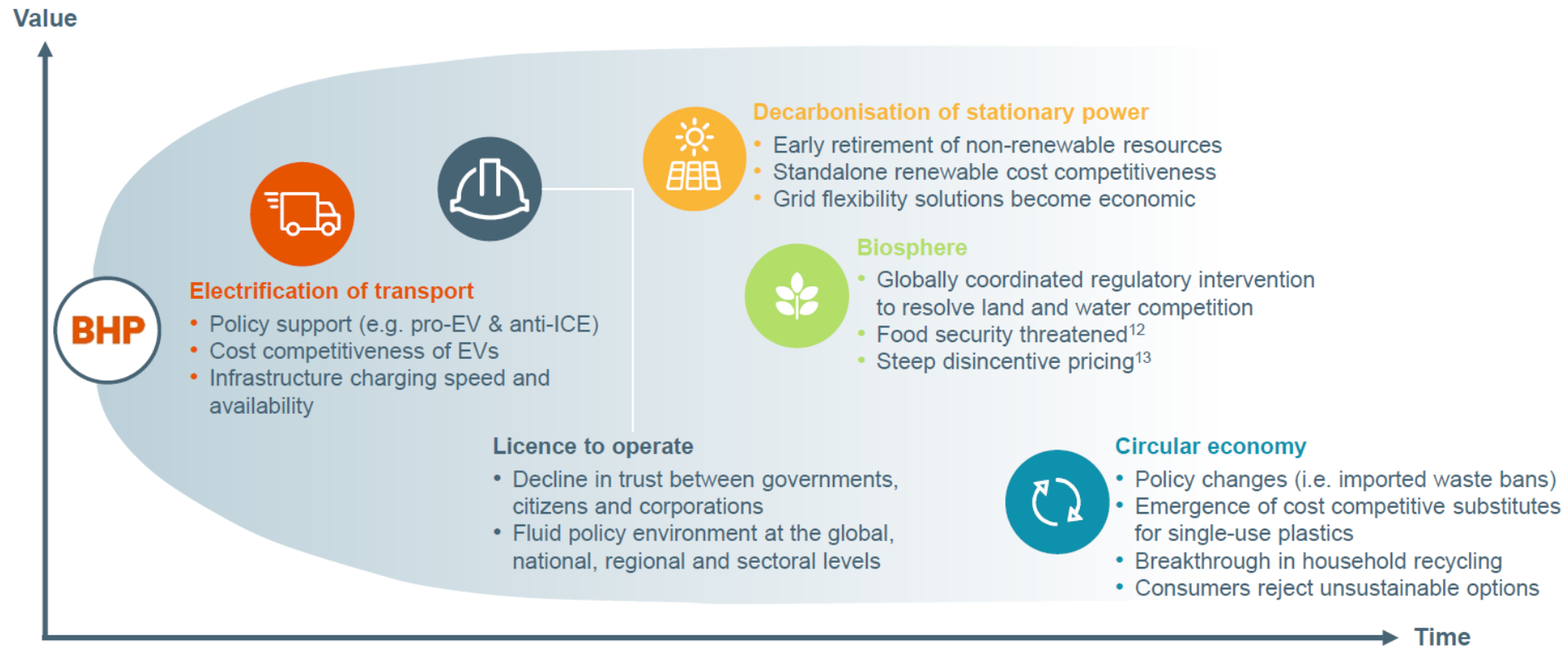
## Manufacturing and Energy Production





# What are the key signposts to tell us which scenario we may be facing?

Understanding the signposts allows us to identify common no-regret actions and future decision points



Note: Represents possible impact on our portfolio if no action is taken to mitigate against risks or seize opportunities. Themes are not mutually exclusive or exhaustive, outcomes from one theme could impact our view on severity, timeframes, or strategic considerations for other themes.

Strategy briefing  
22 May 2019

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**BHP**

- Key differences in timescale and potential cost to the business
- For example, EVs are a relatively short-term risk to the oil business with a fairly significant impact



# Net zero target now a major company objective for BP

Three focus areas where we can make the most difference



*Get to net zero*

Become a net zero company by 2050 or sooner, and help the world get to net zero

*Care for our planet*

Make a positive difference to the environment where we operate


*Improve people's lives*

Support a just energy transition, promoting wellbeing for our workforce and communities where we work

**SUSTAINABLE DEVELOPMENT GOALS**

- Sustainable development goals now a priority
- What will this do to investor returns?
- What are the priorities for key shareholders?

Get bp to net zero

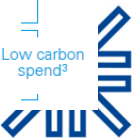


	2025 Targets	2030 Aims	2050, or sooner Aims
Aim 1 <i>Net Zero operations</i>	20%	30-35%	100% <sup>1</sup>
Aim 2 <i>Net Zero oil and gas</i>	20%	35-40%	100% <sup>2</sup>
Aim 3 <i>Halving intensity</i>	5%	>15%	50%
Aim 4 <i>Reducing Methane</i>	0.20% <small>Measurement approach in place by 2023</small>		Timeline to achieve 50% reduction to follow
Aim 5 <i>More \$ for new energy?</i>	\$3-4bn	~\$5bn	↑

Emissions reductions

Low carbon spend<sup>3</sup>

(1) Net zero across operations (2) Net zero for our entire marketable footprint



# Equinor is slightly more nuanced – keep production growing while shifting business model

## Key messages

### Growing production, cash flow and returns

- Around 3% annual production growth 2019-2026
- Organic cash flow around USD 30 billion 2020-2023
- RoACE around 15% in 2023

### Driving long term value creation, in line with the Paris Agreement

- Industry leading carbon efficiency
- Value driven growth in renewables
- Reducing net carbon intensity by at least 50%

### Delivering competitive capital distribution

- Quarterly dividend of 27 cents per share
- Second tranche of share buyback around USD 675 million



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- Equinor is rather between BP and Exxon – use current business to fund transition strategy
- Logical but could cause conflict of interest over capital allocation



# The ExxonMobil View

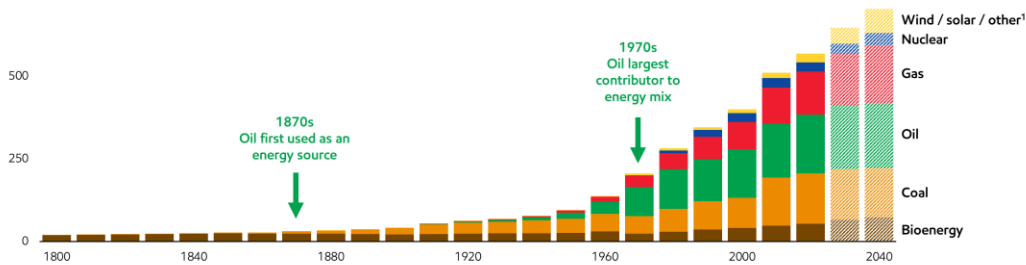
## ENERGY EVOLUTION

Scale and infrastructure requirements limit pace of energy transition

PRIMARY ENERGY DEMAND, IEA STATED POLICIES SCENARIO

Quadrillion BTUs

750



- Evolution of energy system will require time given scale, complexity, and society's needs
- Availability and affordability critical for wide-scale adoption

Source: 1800 - 1960 from Smil; 1970 - 2000 from IEA and ExxonMobil analysis; 2010 - 2040 from IEA World Energy Outlook STEPS scenario

<sup>1</sup>Other includes geothermal and hydro  
See supplemental information

- The world is going to continue on a similar path
- Energy demand will rise and hydrocarbons will continue to have a vital role
- Change will be slow and incremental

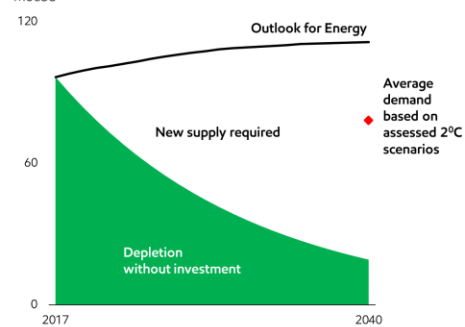
- Oil and gas demand are in natural decline from existing assets
- Demand still needs to be met, even if it does start to fall
- The most efficient and low cost companies can prosper

## LIMITED ALTERNATIVES SUPPORT INVESTMENTS

Depletion drives level of investments

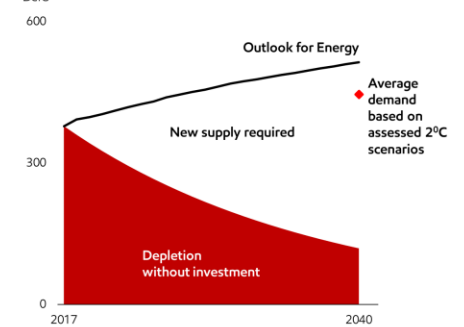
GLOBAL OIL SUPPLY AND DEMAND

Moebd



GLOBAL NATURAL GAS SUPPLY AND DEMAND

Bcfd



Source: 2019 ExxonMobil Outlook for Energy

- Significant new supplies needed across range of demand scenarios
- IEA estimates approximately \$20 trillion<sup>1</sup> of oil and natural gas investment needed by 2040

# NOCs in Asia also see growth to fuel developing economies

## ONGC: Growth Pursuits



### ➤ Aggressive Investment in Upstream

- E&P expenditure of about ₹ 1,50,000 Crore in last 5 years
- 10 Projects costing ₹ 13,000 Crore completed during FY'19

### ➤ 25 Projects under execution

- 18 Development and 7 Infrastructure Projects - Investment more than ₹ 83,000 Crore
- Envisaged lifecycle Gains of 72 MMT (Oil) and 116 BCM (Gas)

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- India's ONGC is very keen to find new hydrocarbons to reduce the country's import bill and to supply growing domestic demand
- In addition, gas to replace coal and also improve the environment

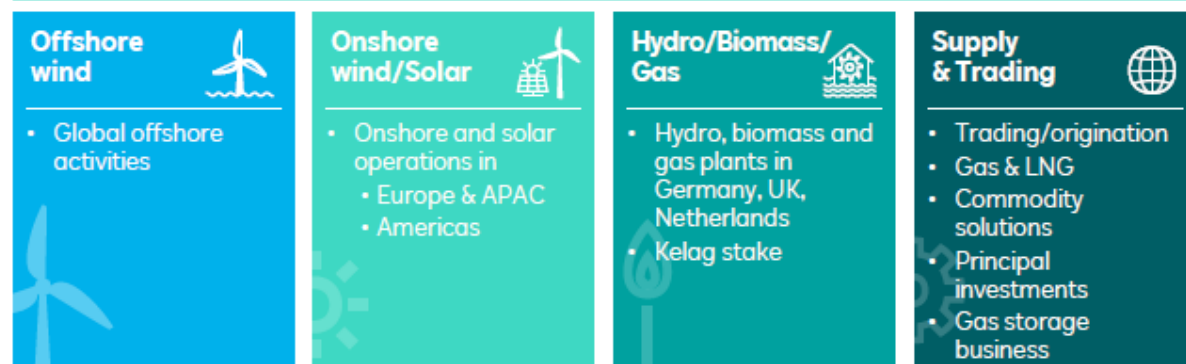




# RWE is diversifying its asset base away from hydrocarbon-fired power

## Business model fully aligned with our strategic focus on the energy transition

### Core



**~28 GW**

Installed capacity<sup>1</sup>

**299 g/kWh**

Carbon factor<sup>2</sup>

### Coal/Nuclear



**23%**

Share of coal in Group revenues

<sup>1</sup> Pro rata installed capacity of core business. | <sup>2</sup> Calculated for pro forma generation portfolio of core business. | Note: Figures for FY 2019.

- RWE manages a significant part of Germany's lignite-fuelled power fleet
- However, it is gradually reducing its exposure and selling off nuclear assets
- Renewables becoming a the main focus of the business, but trading activity is also growing in order to offset volatility and intermittency risks



# ENEL, Italy's main power company, has committed to leadership in renewable power

Our positioning

## Enel's leadership in the new energy world



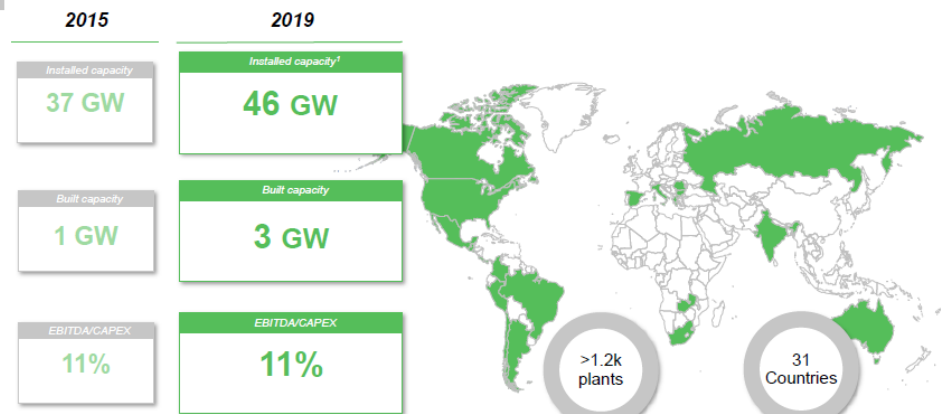
1. By number of end users. Publicly owned operators not included
2. By installed capacity. Includes managed capacity for 3.7 GW
3. Including customers of free and regulated power and gas markets

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- Global renewables business model
- Operates across the electricity value chain
- Rapid increase in capacity and output

Sustainability = Value

## ...to become the world leader in renewables



1. Including managed capacity by 3.7 GW

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# Key Questions for Company Management

- How much profit can I generate?
- How can I grow the business?
- Where can I grow the business?
- What are the long-term prospects for my industry?
- What are my competitors doing?
- What rules must I abide by?
- What government support can I expect?
- What do my owners / shareholders want out of their investment?
- Have I got enough money to invest in my business?
- How do I stay competitive?
- How important is public opinion and how do I keep it on my side?

