

# Oil and Gas in the Grand Transition

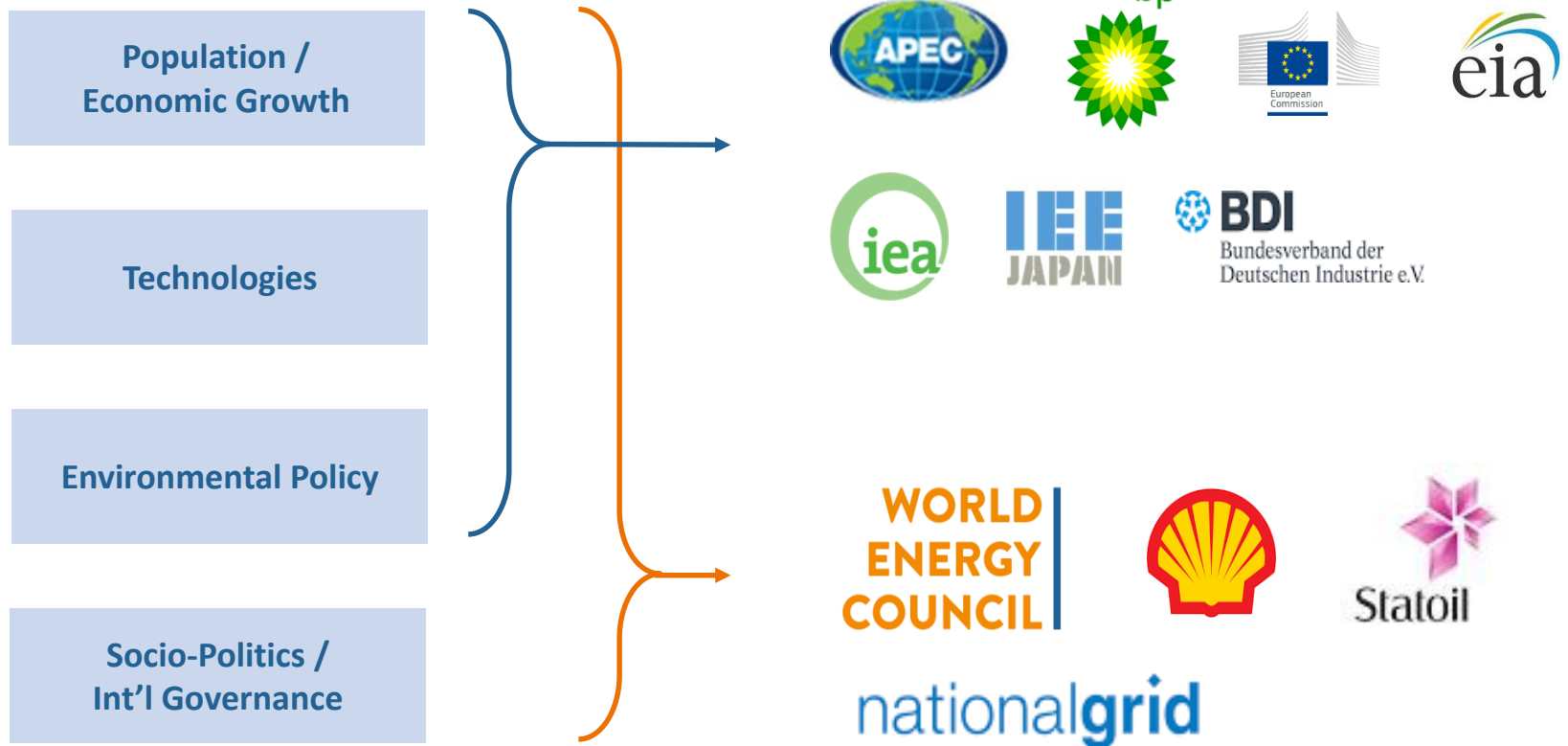
7<sup>th</sup> European Energy Forum

# World Energy Scenarios

# Energy Scenarios comparison

	PLAUSIBLE		PROBABLE (projections)	PREFERABLE
<b>WORLD ENERGY COUNCIL</b>	<ul style="list-style-type: none"> <li>Modern Jazz</li> <li>Unfinished Symphony</li> <li>Hard Rock</li> </ul>		<ul style="list-style-type: none"> <li>Reference</li> </ul>	<ul style="list-style-type: none"> <li>Improved Efficiency</li> <li>High renewables</li> <li>Alternative Power Mix</li> </ul>
<b>nationalgrid</b>	<ul style="list-style-type: none"> <li>Two Degrees</li> <li>Slow Progression</li> <li>Steady State</li> <li>Consumer Power</li> </ul>		<ul style="list-style-type: none"> <li>Evolving Transition</li> <li>ICE Ban</li> <li>Less Gas</li> <li>RE Push</li> </ul>	<ul style="list-style-type: none"> <li>Faster Transition</li> <li>Even Faster Transition</li> </ul>
	<ul style="list-style-type: none"> <li>Mountain</li> <li>Ocean</li> <li>Sky* (*normative approach)</li> </ul>		<ul style="list-style-type: none"> <li>Reference</li> <li>High / Low Growth</li> <li>High / Low Oil Price</li> </ul>	
	<ul style="list-style-type: none"> <li>Reform</li> <li>Renewal</li> <li>Rivalry</li> </ul>		<ul style="list-style-type: none"> <li>Reference</li> </ul>	
			<ul style="list-style-type: none"> <li>New Policies</li> <li>Current Policies</li> </ul>	<ul style="list-style-type: none"> <li>Sustainable Development</li> </ul>
			<ul style="list-style-type: none"> <li>Reference</li> <li>Advanced Technologies</li> </ul>	
			<ul style="list-style-type: none"> <li>Current Policy</li> </ul>	<ul style="list-style-type: none"> <li>85% GHG Reduction</li> <li>95% GHG Reduction</li> </ul>

# Comparison of the key drivers



# Pre-determined elements of the Grand Transition

	Factors shaped world energy 1970 - 2015	Pre-determined elements 2015 - 2060
<b>Population / Workforce</b>	<ul style="list-style-type: none"> <li>Global population grew 2x (1.7% p.a.)</li> </ul>	<ul style="list-style-type: none"> <li>Global population will grow 1.4x (0.7% p.a.)</li> </ul>
<b>New Technologies</b>	<ul style="list-style-type: none"> <li>ICT revolution</li> <li>Productivity growth rate of 1.7% p.a.</li> </ul>	<ul style="list-style-type: none"> <li>Pervasive digitalisation; combinatorial impacts and productivity paradox</li> </ul>
<b>Planetary Boundaries</b>	<ul style="list-style-type: none"> <li>1,900+ Gt CO<sub>2</sub> consumed</li> </ul>	<ul style="list-style-type: none"> <li>Multiple challenges, including max. 1,000 Gt CO<sub>2</sub> consumed to 2100 for the 2°C target</li> </ul>
<b>Shifts in Power</b>	<ul style="list-style-type: none"> <li>Rapid economic rise of developing nations</li> <li>Growing role for global institutions, e.g. UNFCCC, IMF, WTO and G20</li> </ul>	<ul style="list-style-type: none"> <li>2030: India is most populous country</li> <li>2035-45: China is the world's largest economy</li> </ul>

# Grand Transition

## Critical Uncertainties

- **Pace of innovation and productivity**
- **Development of international governance and geopolitical change**
- **Priority given to sustainability and climate change**
- **Selected ‘tools for action’—the balance between the use of markets and state directed policy**

# Three Scenarios



## Modern Jazz

Market-driven approach to achieving individual access and affordability of energy through economic growth

- Market mechanisms
- Technology innovation
- Energy access for all



## Unfinished Symphony

Government-driven approach to achieving sustainability through internationally coordinated politics and practices

- Strong policy
- Long-term planning
- Unified climate action



## Hard Rock

Fragmented approach driven by desire for energy security in a world with low global cooperation

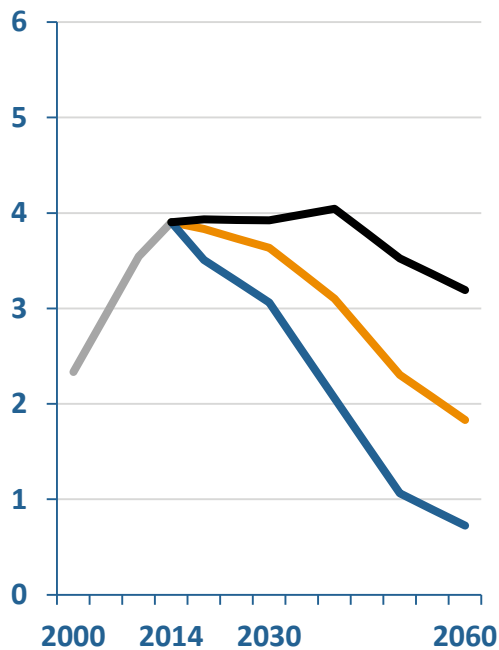
- Fragmented policies
- Local content
- Best-fit local solutions

# Demand peaks for coal, oil and gas

... have the potential to take the world from “Stranded Assets” to “Stranded Resources”.

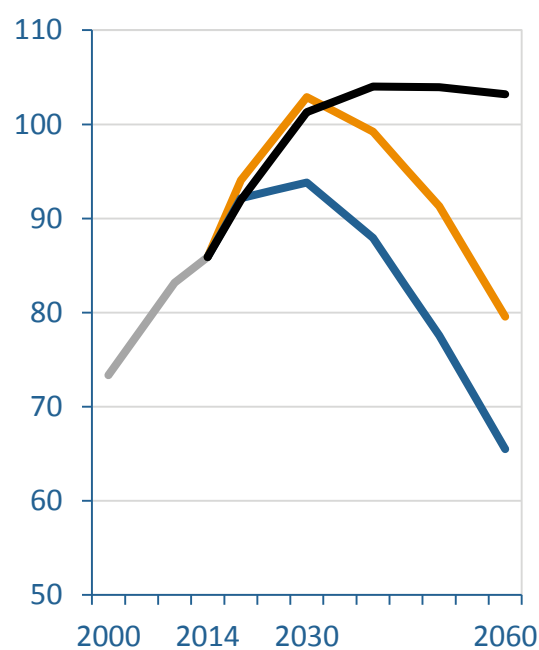
## Coal Demand

('000 MTOE)



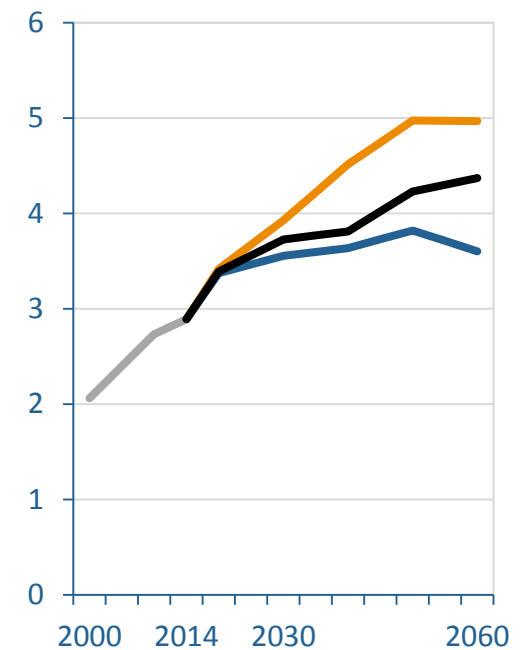
## Oil Demand

(mb/d)



## Natural Gas Demand

('000 MTOE or kbcm)

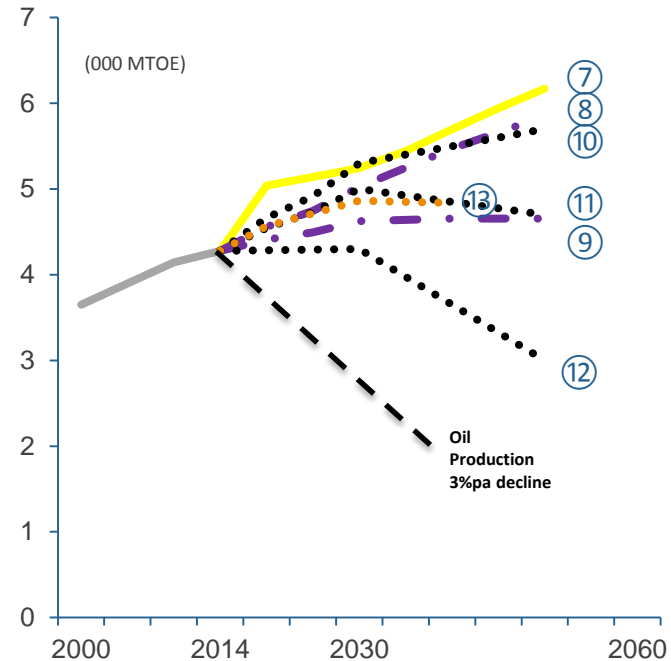
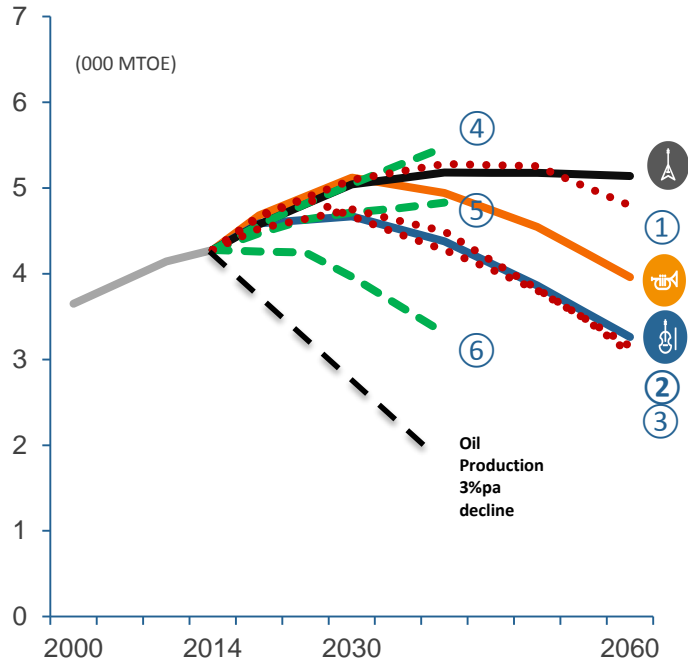


— History    — Modern Jazz    — Unfinished Symphony    — Hard Rock



# Oil Developments

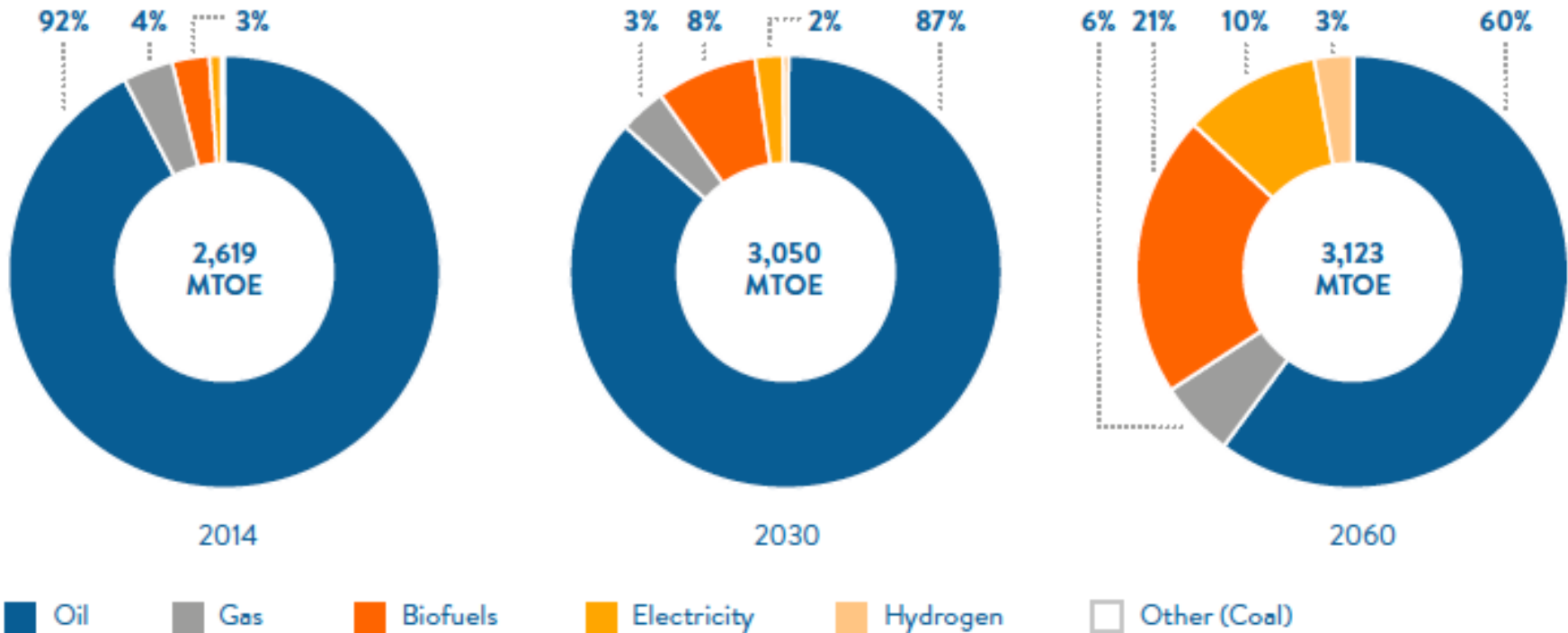
# Oil Demand—a comparative review



- ① Shell Ocean
- ② Shell Mountain
- ③ Shell Sky
- ④ IEA Current Policies
- ⑤ IEA New Policies
- ⑥ IEA Sustainable Development
- ⑦ EIA Reference
- ⑧ IEEJ Reference
- ⑨ IEEJ Advanced Tech
- ⑩ Statoil Rivalry

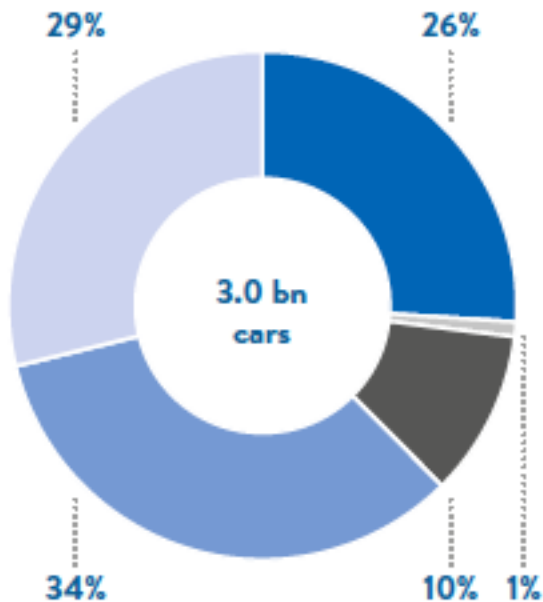
- ⑪ Statoil Reform
- ⑫ Statoil Renewal
- ⑬ BP Evolving Transition

# Transport demand in Unfinished Symphony (% share)

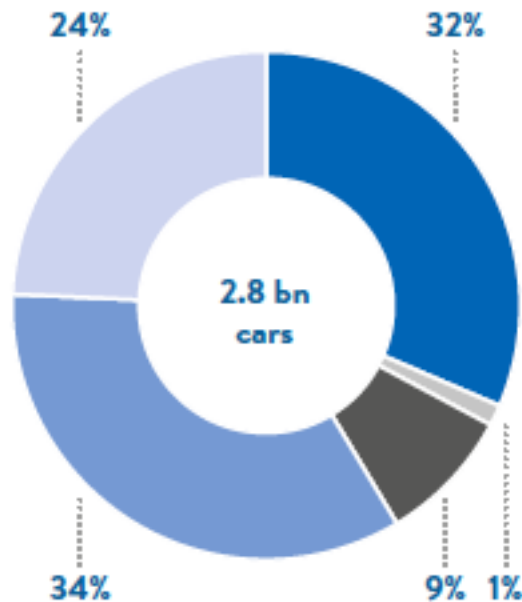


# Diversification of LDV fleet in 2060

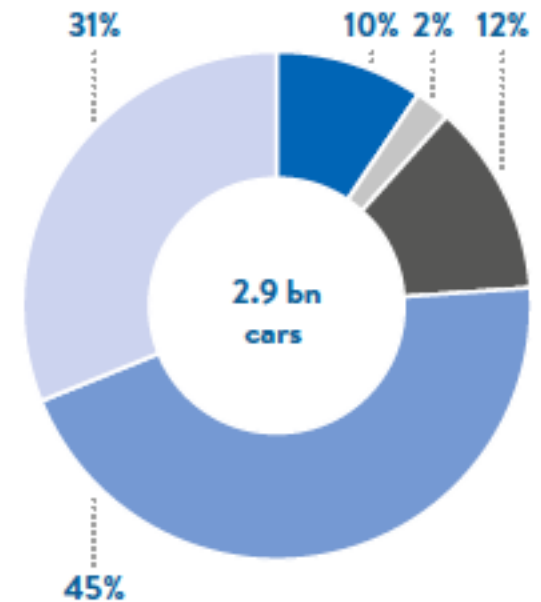
**Modern Jazz  
2060**



**Unfinished Symphony  
2060**



**Hard Rock  
2060**



Source: The World Energy Council, Paul Scherrer Institute and Accenture Strategy

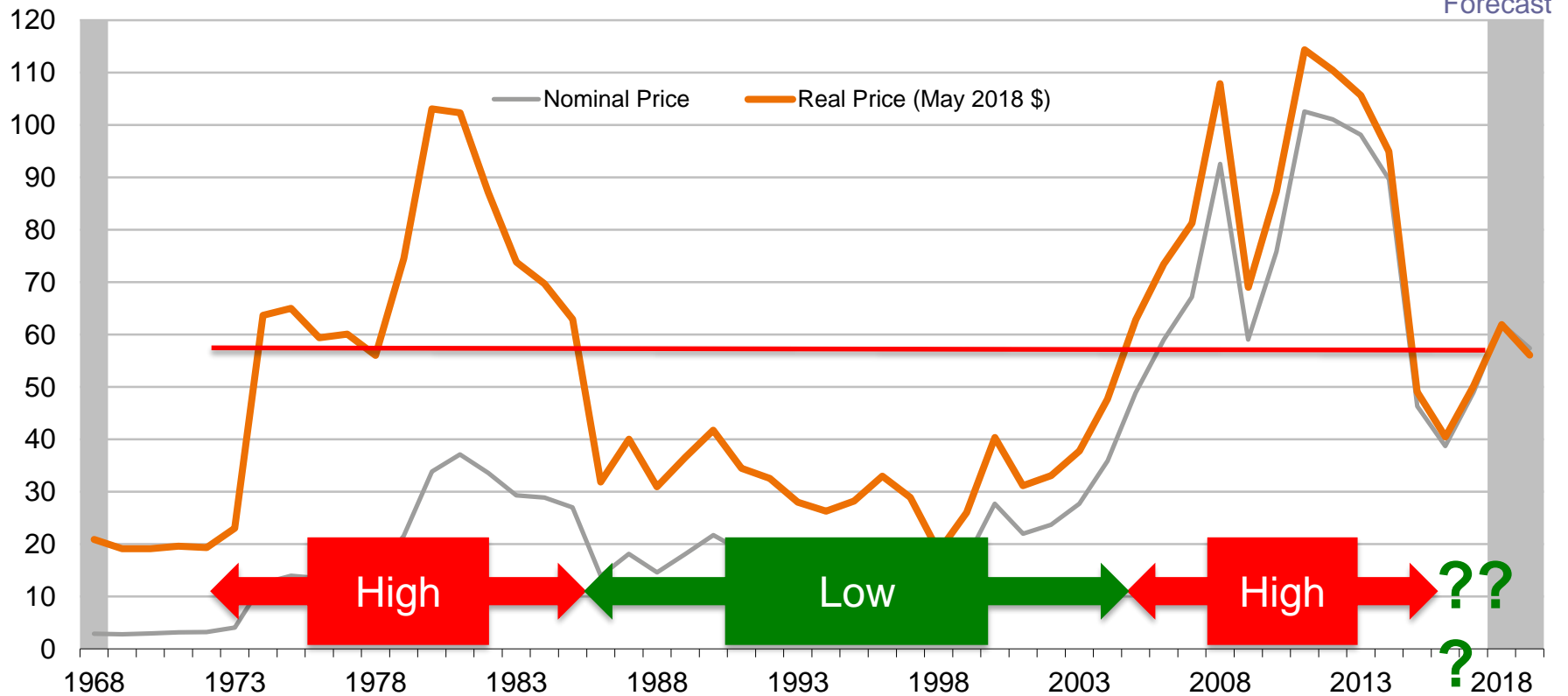
# **‘Stranded Resources’–adaptation options**

- **Improve efficiency of oil production**
- **Expand downstream**
- **Develop gas: displace oil in power generation**
- **Develop solar/wind options**
- **Lower social costs, e.g. reduce oil subsidies**
- **Expansion of the economy, e.g. into new tech**
- **Adjust currency value or remove US\$ peg**

# Oil pricing regimes

## Annual Imported US Crude Oil Price

dollars per barrel



EIA Short-Term Energy Outlook, May 2018

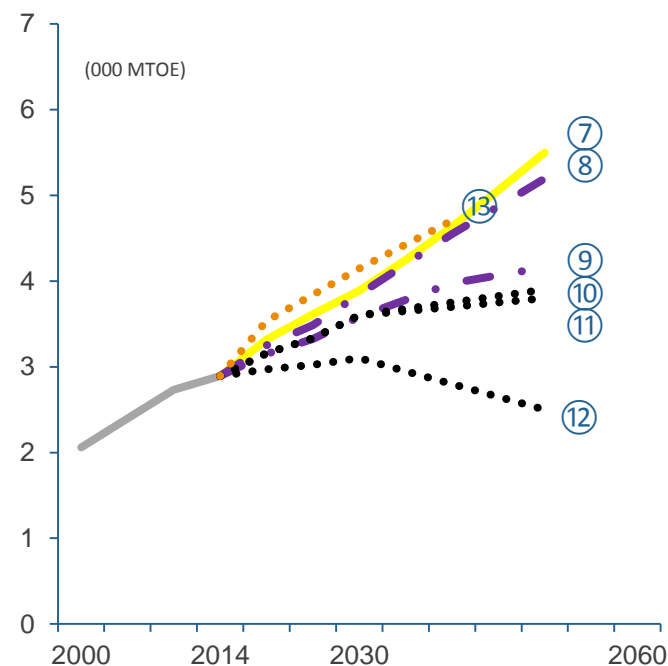
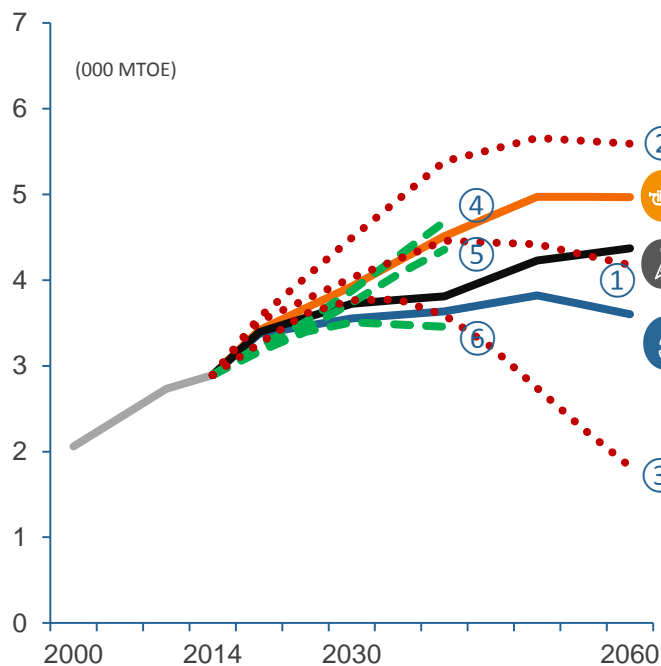
# Crude oil pricing in the Grand Transition

- **Modern Jazz:** crude oil available in abundance; high tech, low cost, low price environment; highly competitive; concern over ‘stranded resources; oil producers’ social costs squeezed and prices settle below \$50/bbl (and then one more cycle of higher prices?).
- **Unfinished Symphony:** strong commitment to climate change policies; significant pollution taxes and carbon pricing; emphasis on improved efficiencies and displacement of oil in transport; promotion of EVs, etc. Early focus on ‘stranded resources’; greater focus on solar-based industries; displacement of oil and gas use in electricity generation; crude oil pricing? Next high price cycle aborted?
- **Hard Rock:** lower economic growth and less infrastructure build-out; mercantilist trading system—bilateral reciprocity; protectionist, nationally oriented—security concerns; preferred partners for trade, others could be sanctioned. In this ‘low trust’ world are geopolitical accidents—may be difficult to maintain cohesion in OPEC. Oil plateaus later with periods of volatile pricing.

# Gas Developments



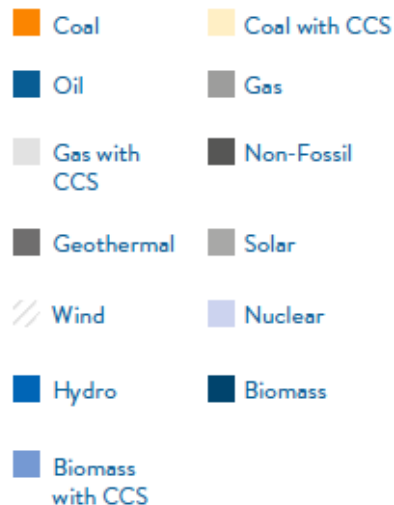
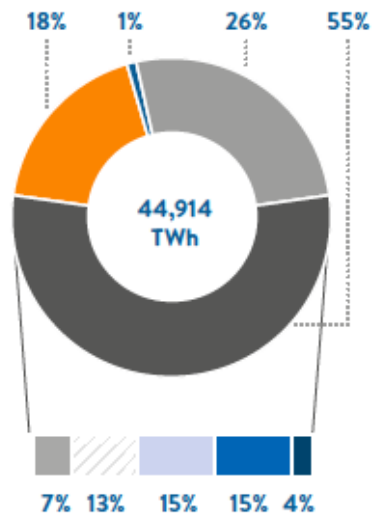
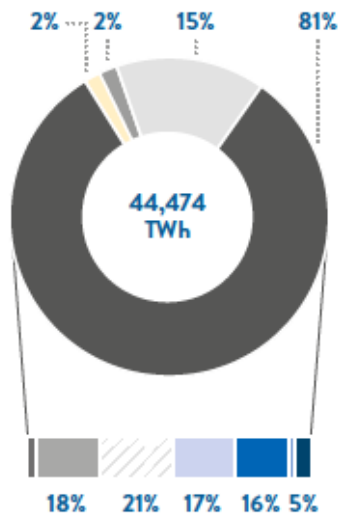
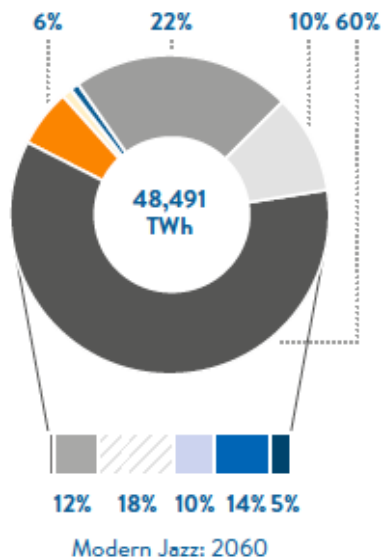
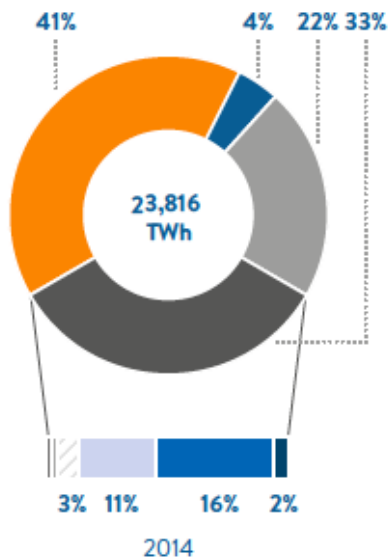
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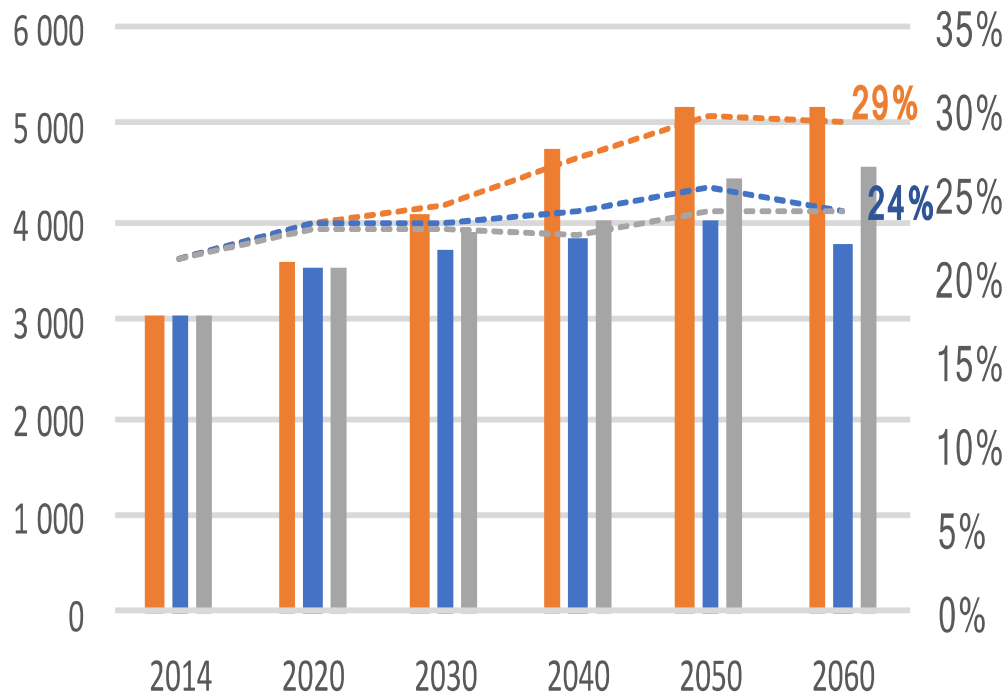
# Electrification in three scenarios



# Natural gas: holds essential place in the global energy mix

- Market share between 25% and 30% of global primary energy demand
- Benefiting from an increasing global energy demand in all scenarios
- Only fossil energy retaining a significant place
- Bright future until mid-century, after that prospects are more uncertain

## Gas Demand (bcm) and Market Share



## Key energy source in **Modern Jazz**:

- Demand increases by 70% between 2014 and 2050
- Stable after 2050, same as total primary energy demand

## A bridging fuel in **Unfinished Symphony**

- Demand rises moderately until it peaks around 2050
- Beyond 2050, decline begins with more than 5% drop in 10 years

## A major player in **Hard Rock**

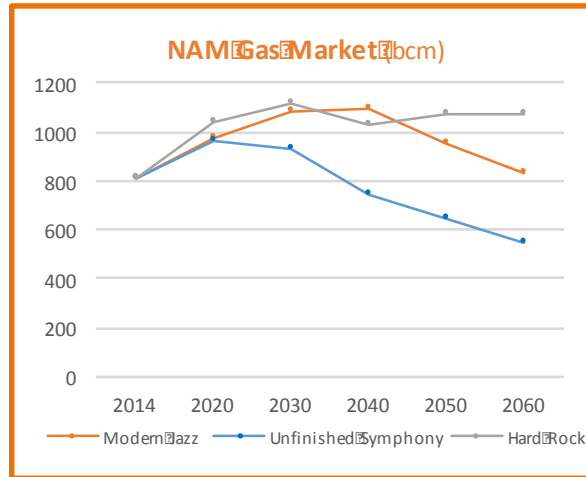
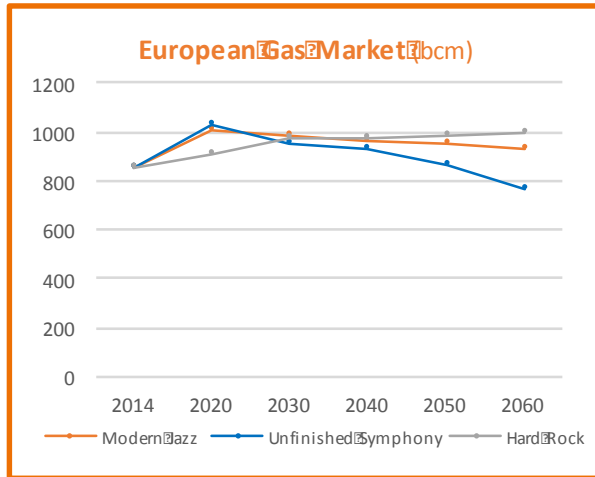
- but in a scenario that is not sustainable because of its environmental impacts

# Natural gas: uncertainty in power, shift to Asia, opportunity in transport

- Gas market share in power generation is main driver of gas demand growth but with great uncertainty across the scenarios: By 2060, this could decrease from 22% (2014) to 17% in Unfinished Symphony or increase to 26% in Hard Rock and 32% in Modern Jazz and corresponds to additional gas demand for power generation between 300 bcm in Unfinished Symphony to close to 1,500 bcm in Modern Jazz.
- In 2014, the Asian gas market (710 bcm) accounted for 23% of global gas market. By 2060 we see that volume increase by a factor 3.0 in Modern Jazz (2,164 bcm), 2.2 in Unfinished Symphony (1,540 bcm), and 1.9 in Hard Rock (1,384 bcm)
- Decarbonisation of the transport sector is one of the most challenging issues of energy transition. Gas contribution is limited and mostly for heavy-duty freight and marine transport, with a potential market share of around 7%-8% of transport fuels by 2060 (up to 300 bcm).

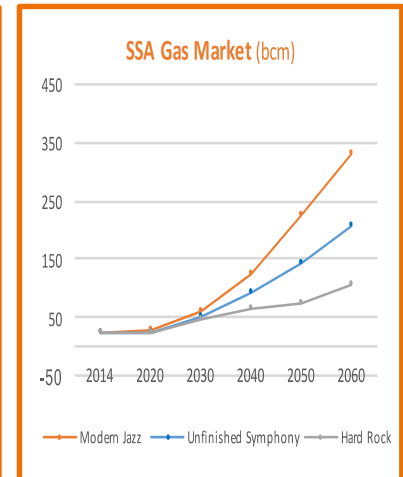
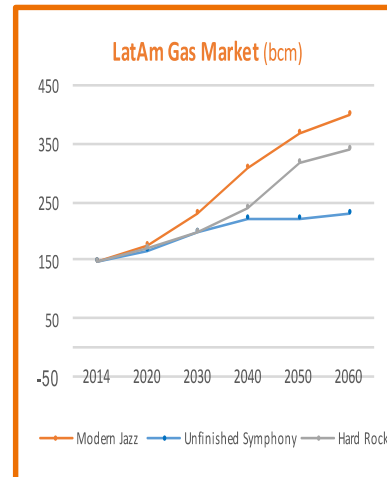
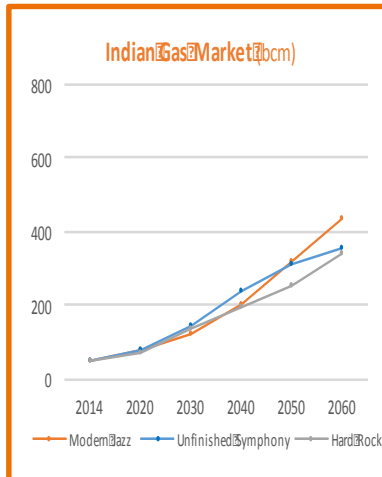
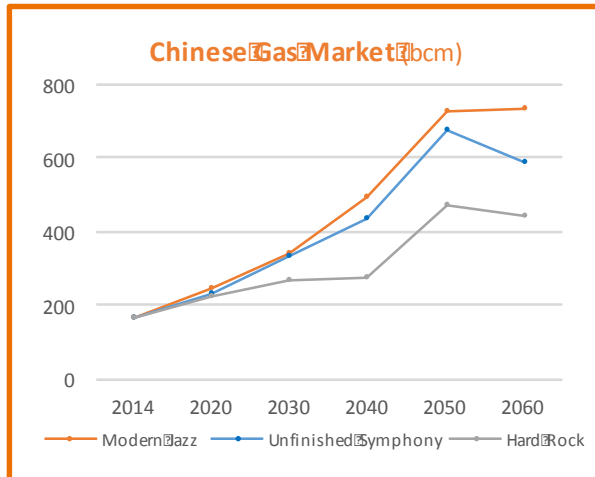
# Natural gas: diverse regional market dynamics

## MATURE MARKETS



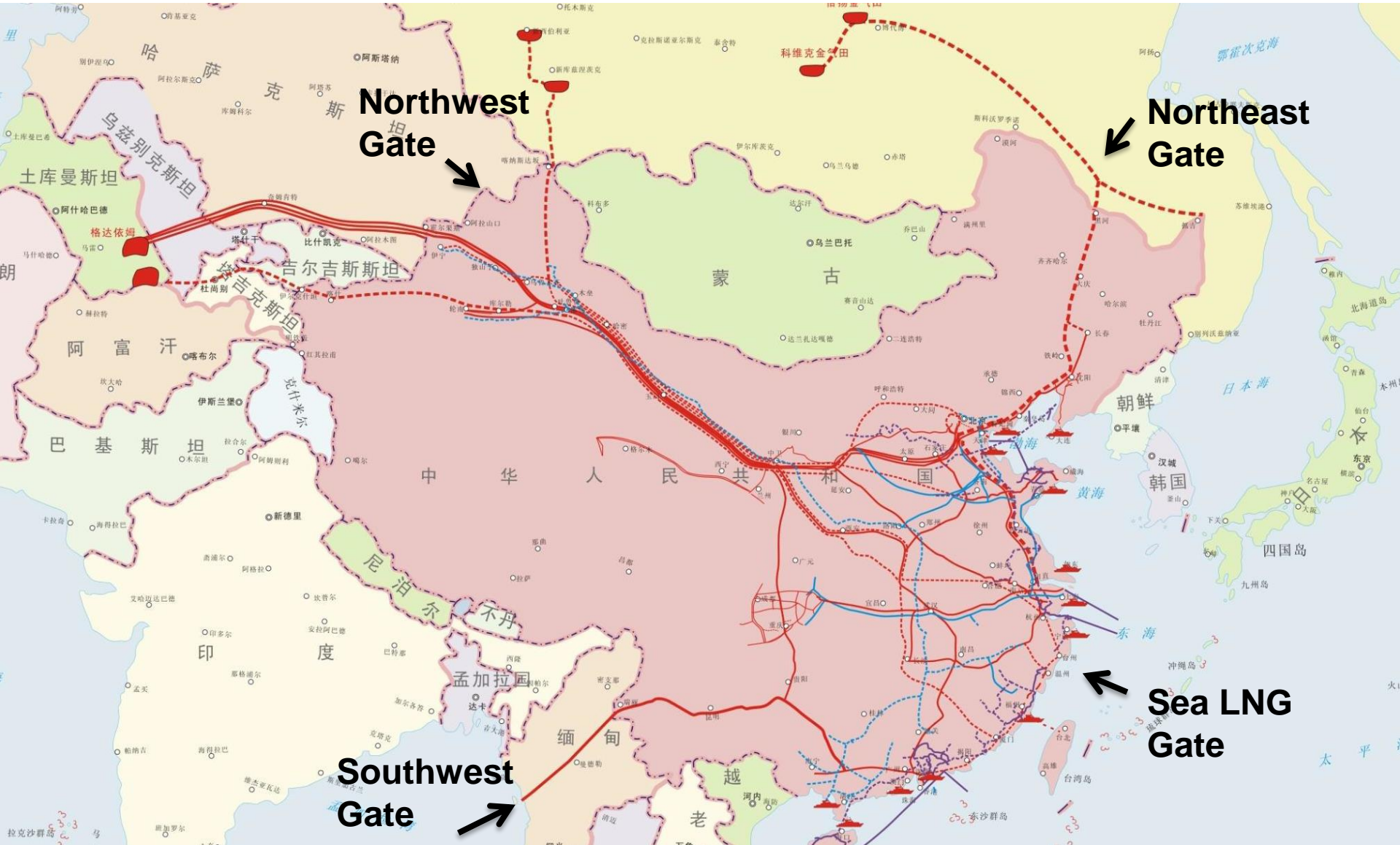
- Demand shift to Asia
- Coal substitution then decline in mature economies
- Peak in EU, N. America, China points to transition fuel
- Markets are liquid; short-term trade continues to grow
- Question of stranded resources

## EMERGING MARKETS



# China's Four Natural Gas Import Gateways

WORLD ENERGY COUNCIL



# Russian supply of Natural Gas to Asia

\*Indicative map - Not to scale



# Yamal LNG transportation costs: East vs West routes



Transportation costs to Asia <sup>(2)</sup>	YAMAL LNG		Navigation via NSR 12 months (Kamchatka)
	Navigation via NSR 5 months	Navigation via NSR 9 months	
<b>\$/mmBtu</b>	<b>Costs</b>	<b>Costs</b>	<b>Costs</b>
Western route via transshipment	2.49	2.49	NA
Eastern route via NSR	1.84	1.84	1.65
<b>Average costs to Asia</b>	<b>2.22</b>	<b>2.00</b>	<b>1.65</b>
<b>Average costs across the portfolio including sales to France and Spain</b>	<b>1.40</b>	<b>1.32</b>	<b>NA</b>

(1) Including costs for passage through the Suez Canal  
 (2) NOVATEK



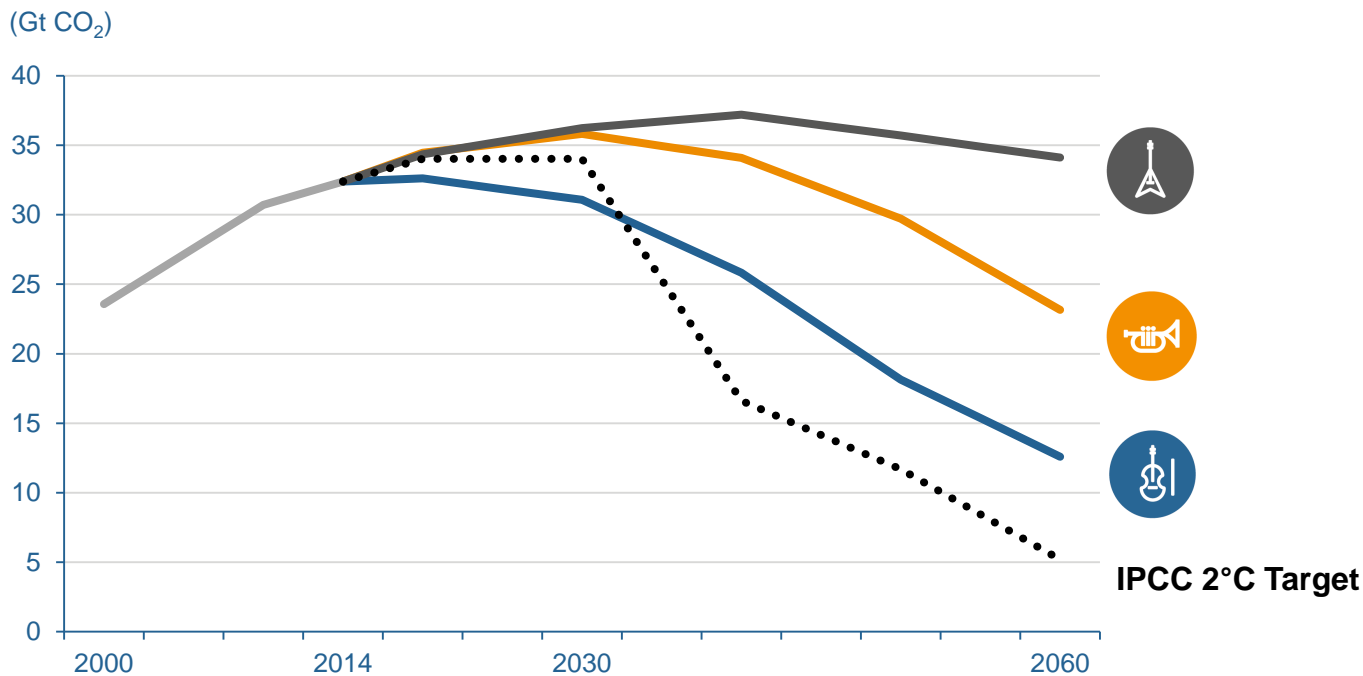
# Natural gas pricing in Asia

- **Modern Jazz:** abundant gas worldwide—not always near markets; highly competitive environment; gas needs to be priced to replace coal in power generation, e.g. China Sea Gate at \$5/mmbtu; overall more terminals, expansion of storage and spot markets. New market opportunities open beyond transport.
- **Unfinished Symphony:** high carbon prices, provides stronger incentive to displace coal at gas prices above \$5/mmbtu; some market weakness later as CCS required for gas-fired plants.
- **Hard Rock:** growth hampered by lower economic growth, lower overall investment in economy and fractious international politics; government-to-government deals (e.g. China/Russia), in the context of bilateral reciprocity, a key tool. Gas pricing could be higher reflecting higher cost and risky environment.

# Limiting Global Warming...

... to no more than a 2°C increase will require an exceptional and enduring effort, far beyond already pledged commitments, and with very high carbon prices.

## Global Annual Carbon Emissions



Source: World Energy Council, Paul Scherrer Institute and Accenture Strategy

# Thank you

**Ged Davis**  
Executive Chair of Scenarios,  
World Energy Council