

World Energy Scenarios

THE GRAND TRANSITION

APERC Annual Conference 2017

World Energy Scenarios

Modern
Jazz



Unfinished
Symphony



Hard
Rock



Pre-determined Elements of the Grand Transition

Factors shaped world energy 1970 - 2015

Pre-determined elements 2015 - 2060

Population / Workforce

- Global population grew 2x (1.7% p.a.)

- Global population will grow 1.4x (0.7% p.a.)

New Technologies

- ICT revolution
- Productivity growth rate of 1.7% p.a.

- Pervasive digitalisation; combinatorial impacts and productivity paradox

Planetary Boundaries

- 1,900+ Gt CO₂ consumed

- 1,000 Gt CO₂ consumed to 2100 for the 2°C target

Shifts in Power

- Rapid economic rise of developing nations
- Growing role for global institutions, e.g. UNFCCC, IMF, WTO, G20

- 2030: India is most populous country
- 2035-45: China is the world's largest economy

Critical Uncertainties of the Grand Transition

	Modern Jazz	Unfinished Symphony	Hard Rock
Productivity / Economic Growth	▪ GDP 3.3% p.a. (2015-2060) ▪ Digital boost ▪ Tech innovation ▪ GDP per capita 2060 US\$ 30,600	▪ GDP 2.9% p.a. (2015-2060) ▪ Sustainable growth ▪ Circular economies ▪ GDP per capita 2060 US\$ 25,200	▪ GDP 1.7% p.a. (2015-2060) ▪ Fragmented markets ▪ Local content ▪ GDP per capita 2060 US\$ 14,700
Climate Challenge	▪ Cumulative carbon emission 2015-60 1,491 Gt CO2	▪ Cumulative carbon emission 2015-60 1,165 Gt CO2	▪ Cumulative carbon emission 2015-60 1,642 Gt CO2
International Governance	▪ Economics focused international governance	▪ Broad-based international governance	▪ Fractured and weak international system
Tools for Action	▪ Markets	▪ States	▪ Patchwork of states and markets

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

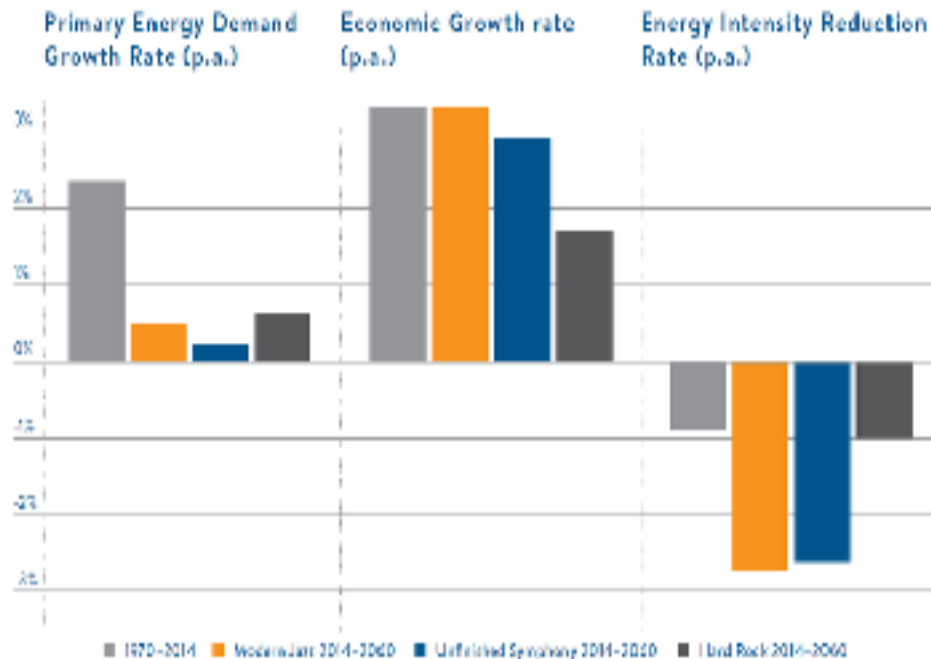
- Fragmented policies
- Local content
- Best-fit local solutions

Implications for Energy Sector

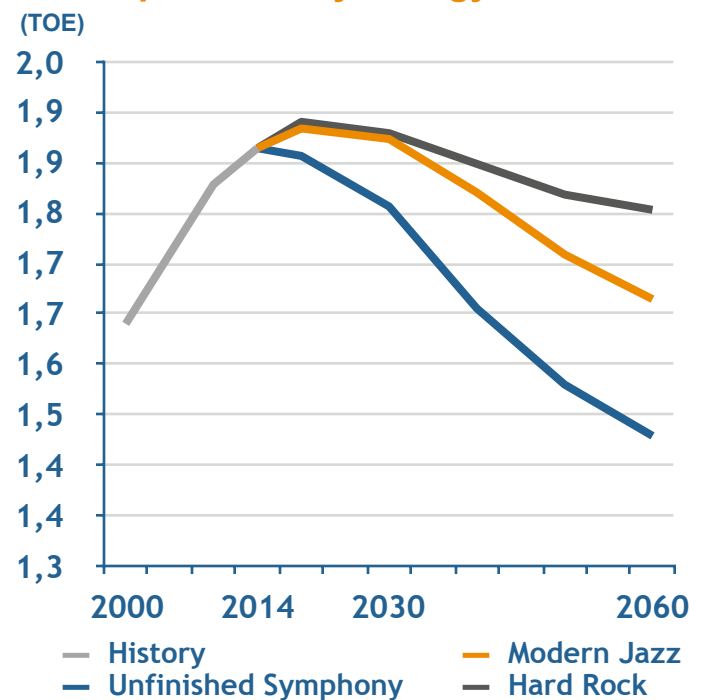
1 THE WORLD'S PRIMARY ENERGY DEMAND GROWTH

... will slow and per capita energy demand will peak before 2030 due to unprecedented efficiencies created by new technologies and more stringent energy policies.

Slower Primary Energy Demand Growth



Per Capita Primary Energy Demand

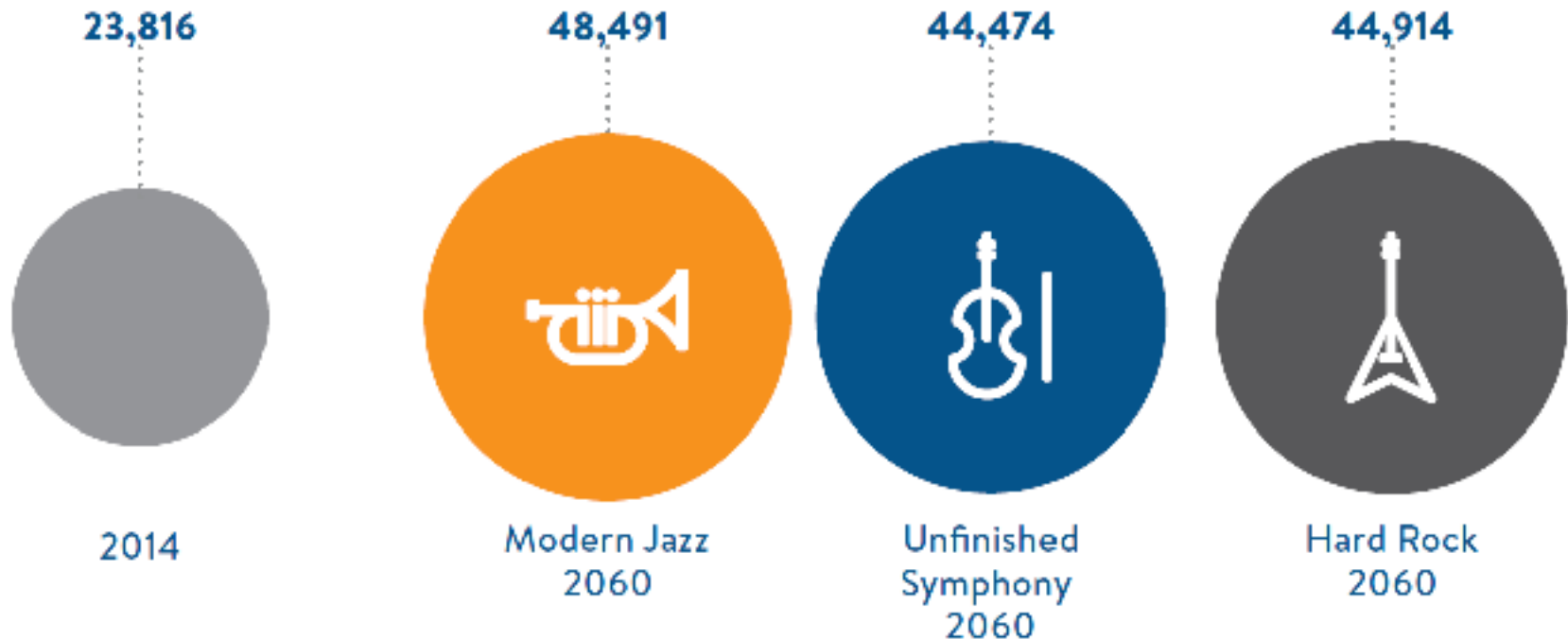


2 DEMAND FOR ELECTRICITY

... will double to 2060. Meeting this demand with cleaner energy sources will require substantial infrastructure investments and systems integration to deliver benefits to all consumers.

Electricity Generation

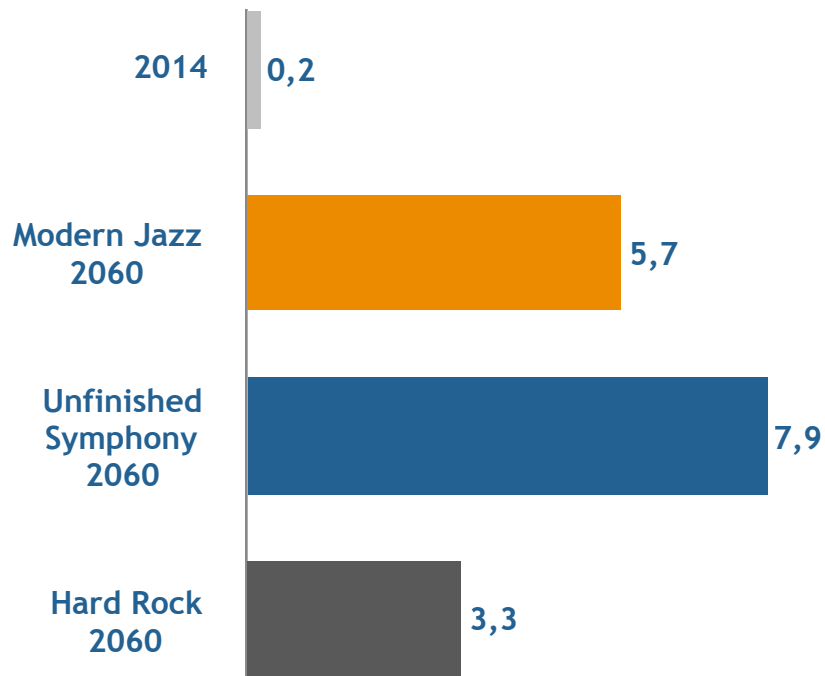
(TWh)



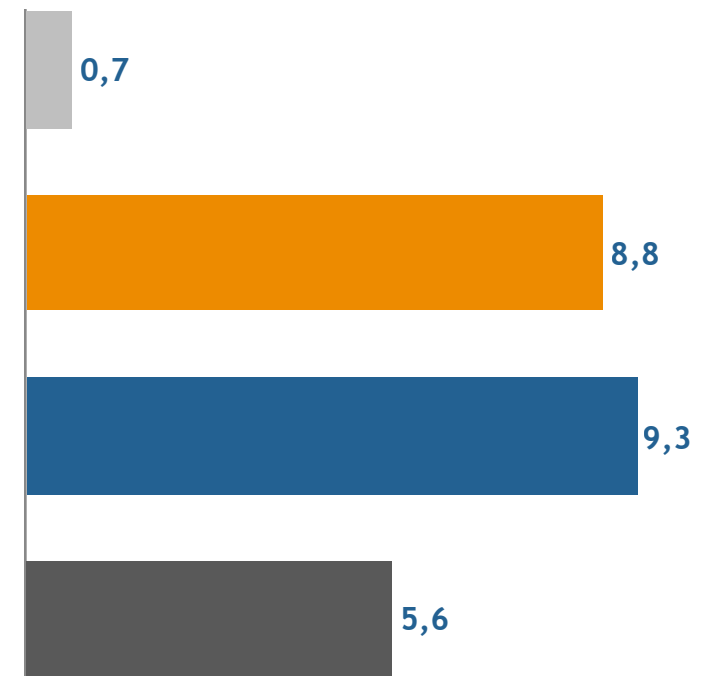
3 THE PHENOMENAL RISE OF SOLAR AND WIND ENERGY

... will continue at an unprecedented rate and create both new opportunities and challenges for energy systems.

Solar Electricity Generation
(‘000 TWh)



Wind Electricity Generation
(‘000 TWh)

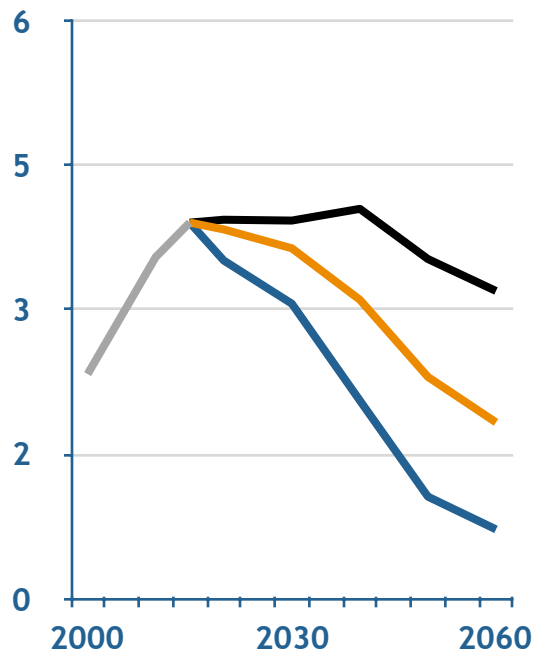


4 DEMAND PEAKS FOR COAL AND OIL

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

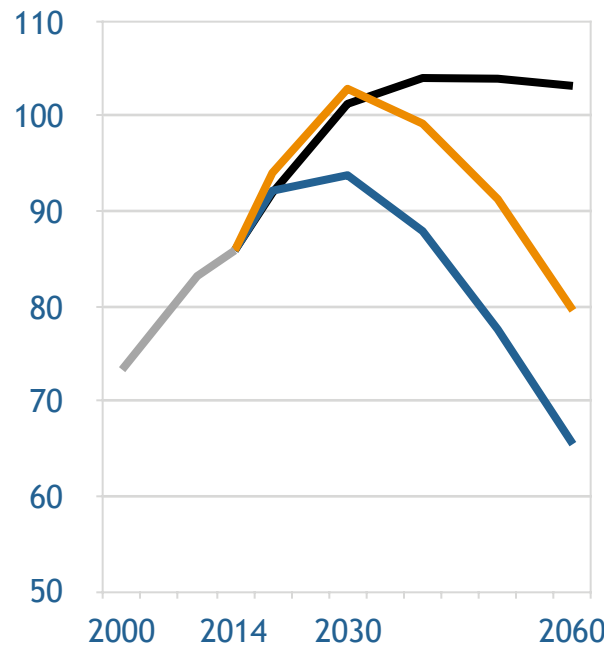
Coal Demand

('000 MTOE)



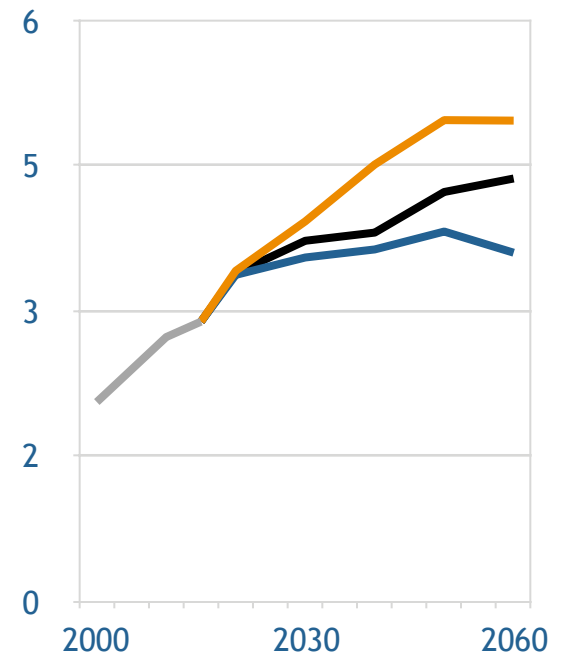
Oil Demand

(mb/d)



Natural Gas Demand

('000 MTOE)



— History — Modern Jazz — Unfinished Symphony — Hard Rock

5 TRANSITIONING GLOBAL TRANSPORT...

... forms one of the hardest obstacles to overcome in an effort to decarbonise future energy systems.

Electric Vehicles of Light-duty Vehicle Fleets



Modern Jazz
2060



26% of 3.0 billion



Unfinished Symphony
2060



32% of 2.8 billion



Hard Rock
2060



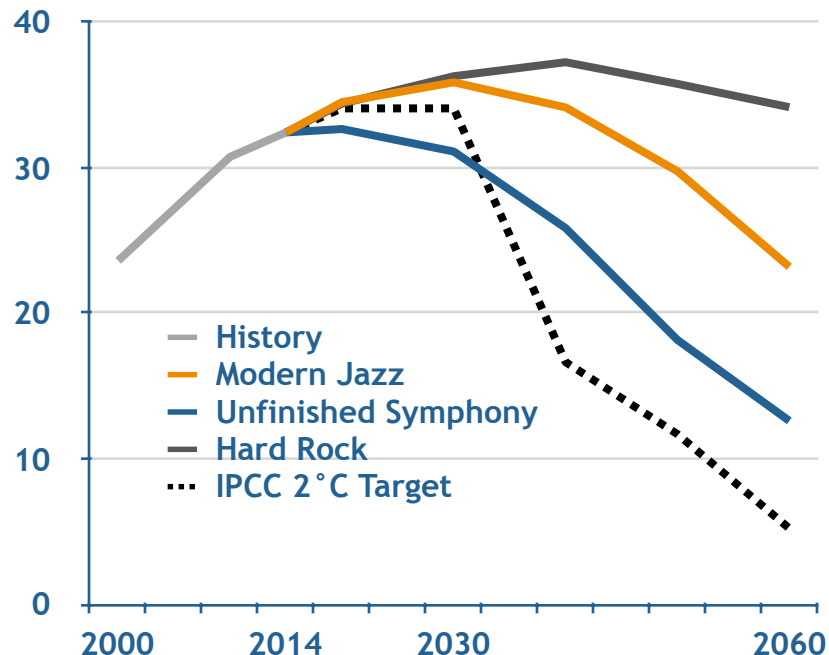
9% of 2.9 billion

6 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.

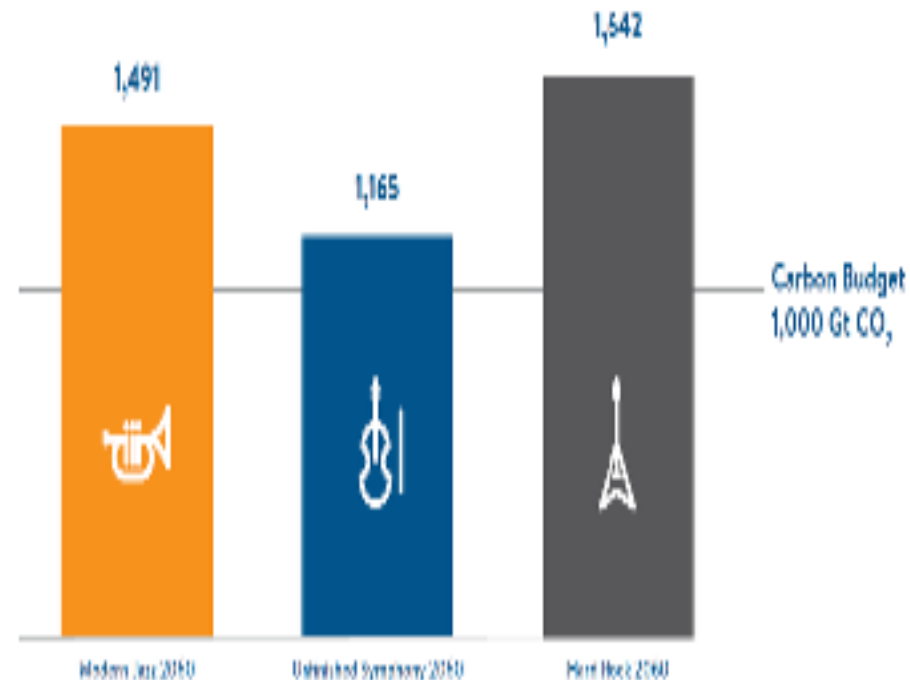
Annual Carbon Emissions

(Gt CO₂)



Cumulative Carbon Emissions 2015-2060

(Gt CO₂)



7 ENERGY TRILEMMA IN 2060



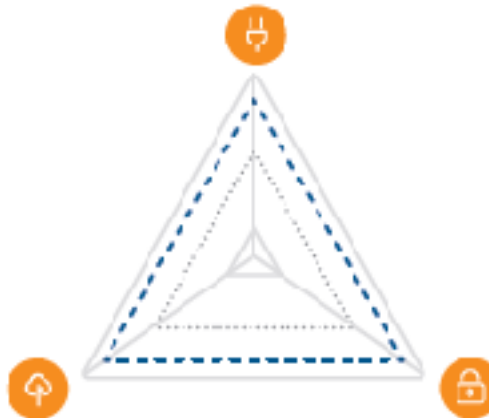
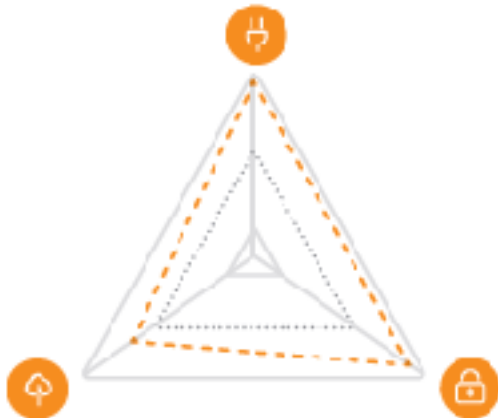
Modern Jazz
2060



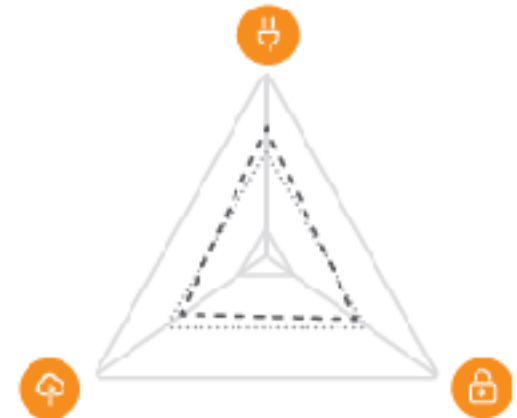
Unfinished Symphony
2060



Hard Rock
2060



2014



Thank you

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