

World Energy Scenarios: the Grand Transition

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CONSEIL FRANÇAIS DE L'ÉNERGIE

About the Conseil Français de l'Énergie



Founded in 1923, French Committee of the World Energy Council

Promote the sustainable supply and use of energy for the greatest benefit of all people

All resources and all energy technologies, both on supply and demand side

About the World Energy Council

Principal impartial network of leaders and practitioners



Almost 100 countries (2/3 of developing countries)
Over 3000 member organizations



government



business



energy
experts



academia, IGO's,
finance and other
stakeholders

23rd World Energy Congress, Istanbul



The Key Statistics from the 23rd World Energy Congress (9-13 October 2016)

“Embracing New Frontiers”

- 5,500 delegates from 151 countries
- 4 Heads of State
- 56 government ministers from 48 countries
- 266 speakers from 78 countries
- 50 sessions over 4 days :
 - Vision and Scenarios for the Future
 - Identifying the Business Opportunities: Resources and Technologies
 - Policy Solutions to Secure Prosperity: Embracing the Trilemma
 - Africa: Securing a Sustainable Energy Future
- 75 Future Energy Leaders' Programme participants from 56 countries
- 34 sponsors, ± 2000 exhibitors, 42 media partners



World Energy Scenarios

**Modern
Jazz**



**Unfinished
Symphony**



**Hard
Rock**



Starting point

- Factors that shaped world energy 1970-2015
 - Population and labour force growth
 - New technologies and productivity
 - Environmental priorities
 - International governance and geopolitics
 - Energy policies and the role of the state

Starting point

- Factors that will shaped world energy 2015-2060
 - Population and labour force growth
 - New technologies and productivity
 - Environmental priorities
 - International governance and geopolitics
 - Energy policies and th role of the state

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

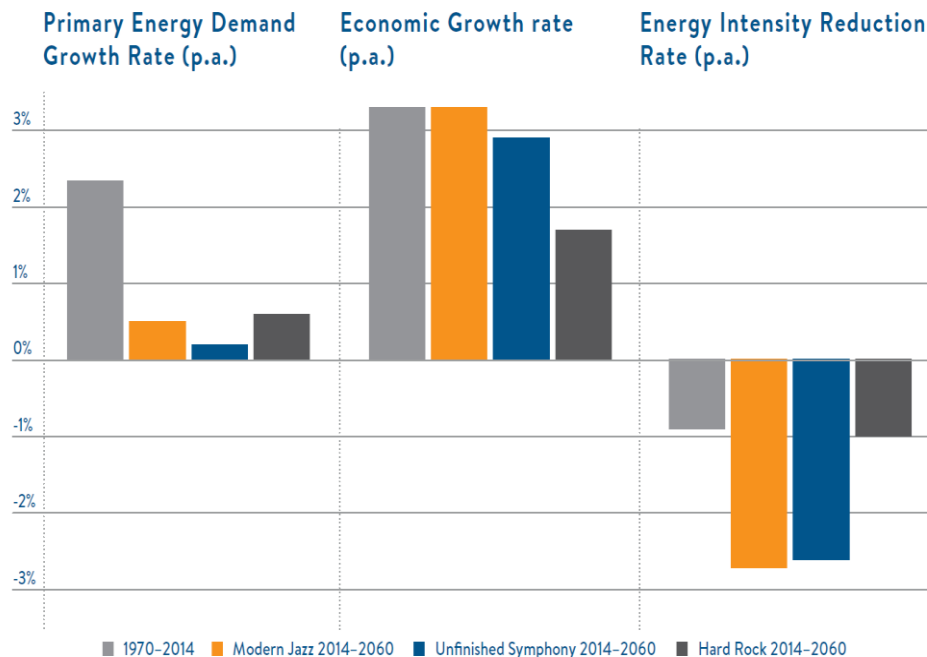
Fragmented approach driven by desire for energy security in a world with low global cooperation

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

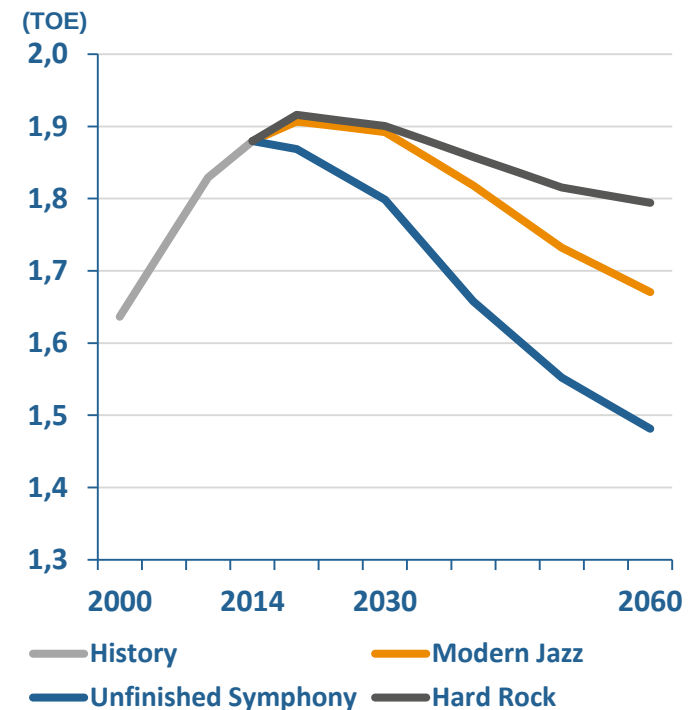
1 THE WORLD'S PRIMARY ENERGY DEMAND GROWTH

... 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

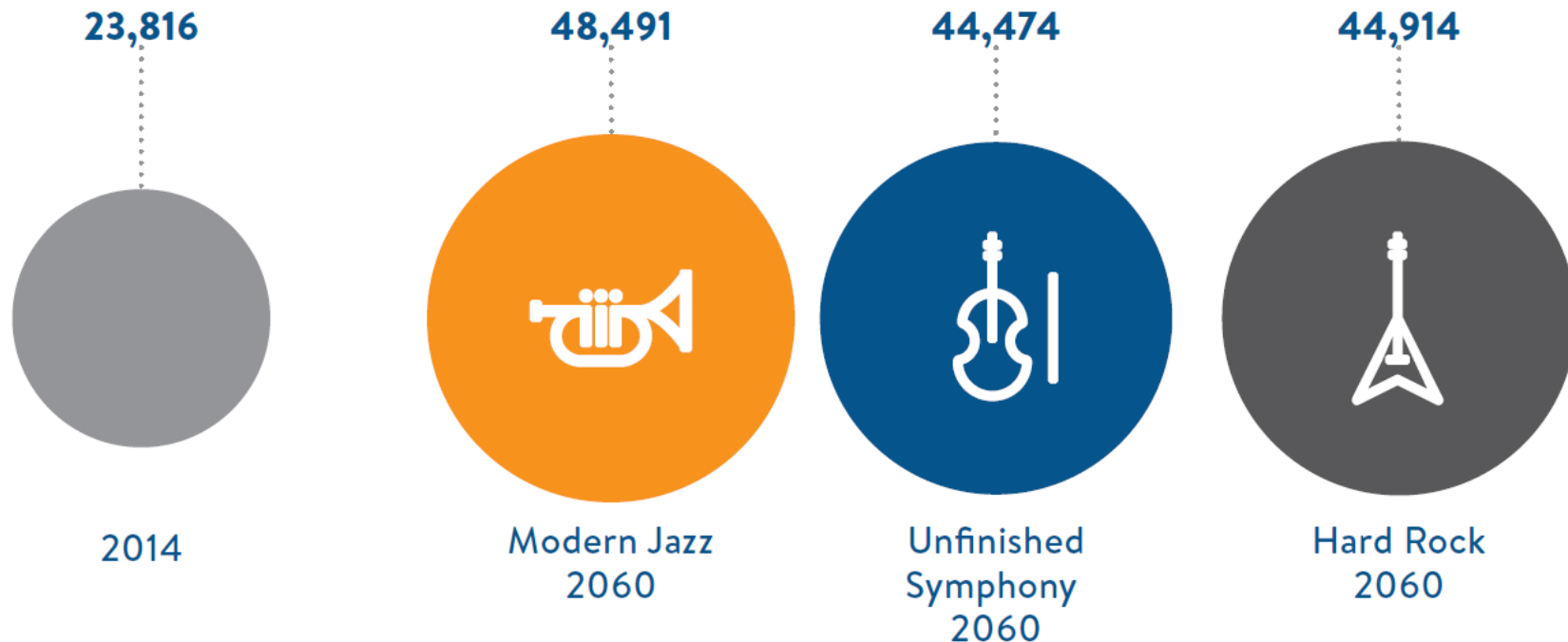


2 DEMAND FOR ELECTRICITY

... 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)

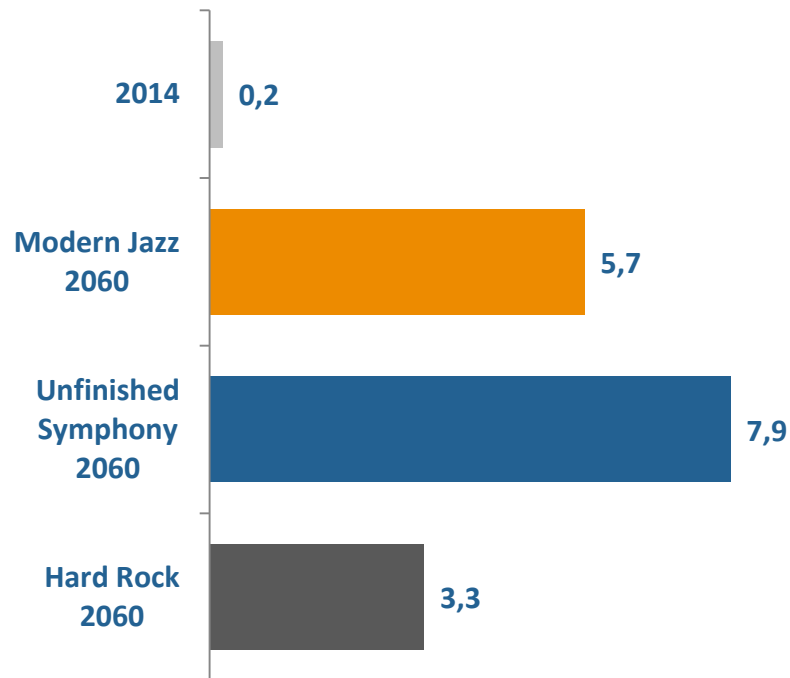


3 THE PHENOMENAL RISE OF SOLAR AND WIND ENERGY

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

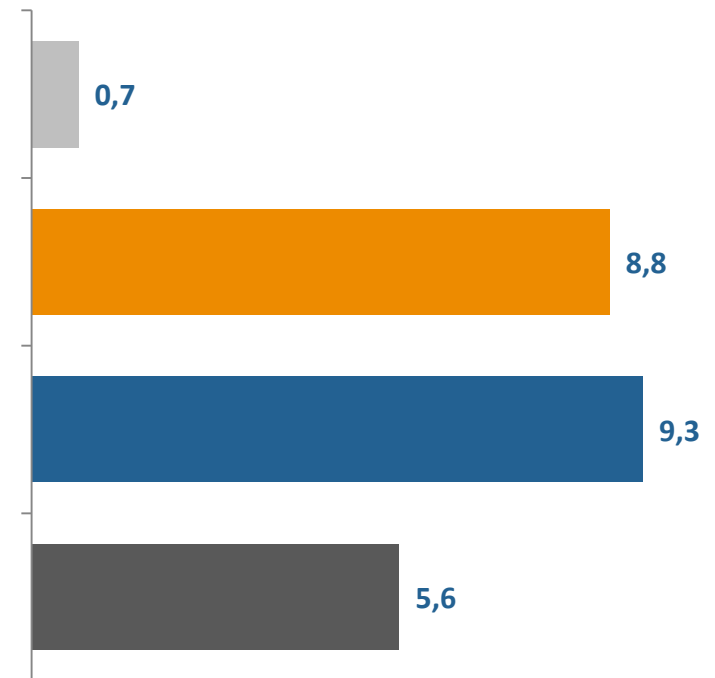
Solar Electricity Generation

('000 TWh)

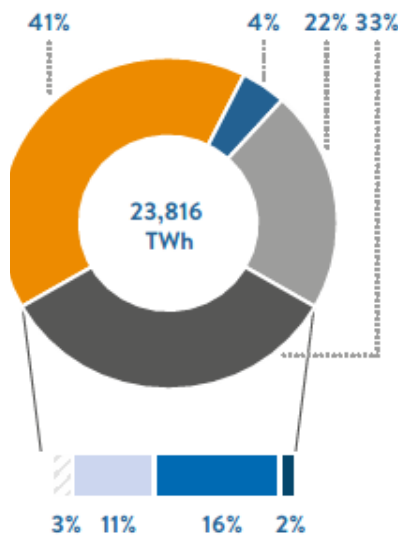
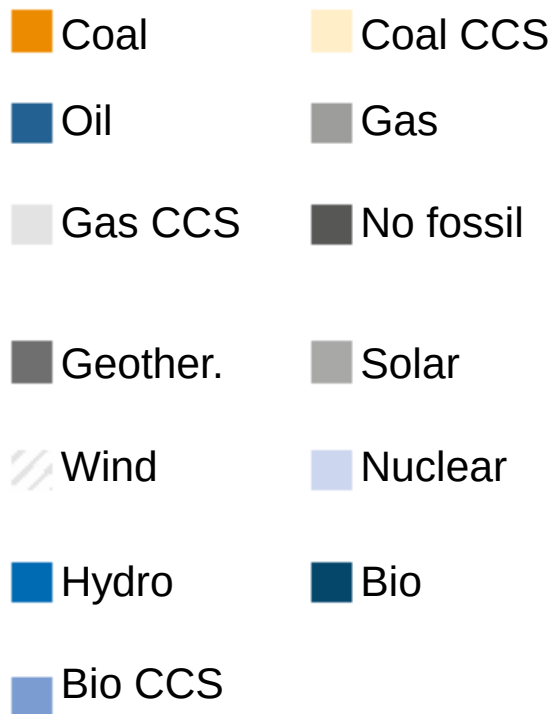


Wind Electricity Generation

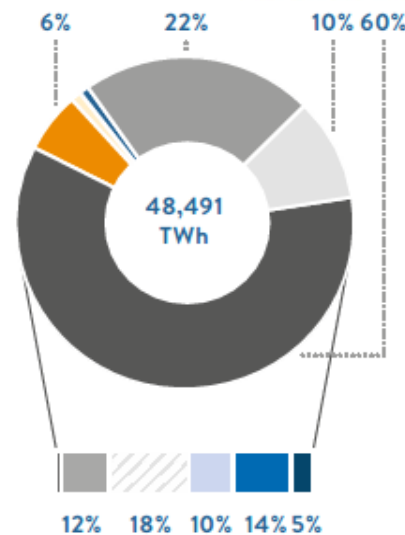
('000 TWh)



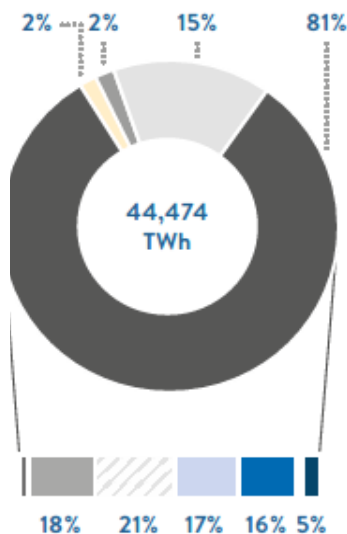
Electricity mix



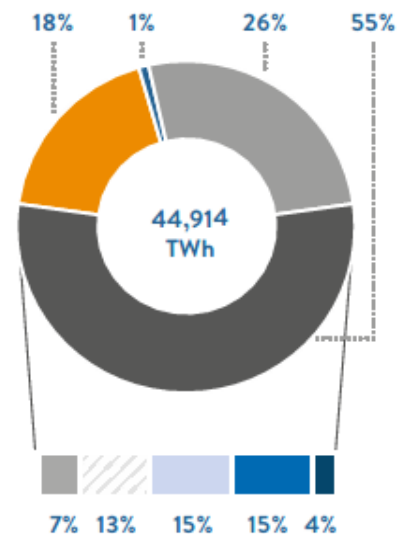
2014



Modern Jazz 2060



Unfinished Symphony 2060



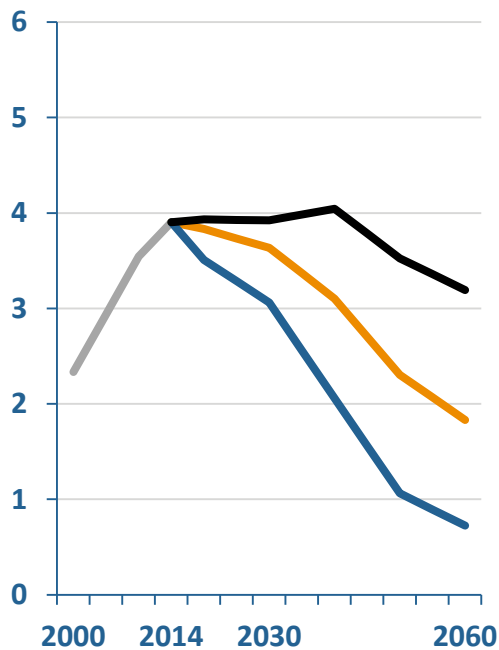
Hard Rock 2060

4 DEMAND PEAKS FOR COAL AND OIL

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

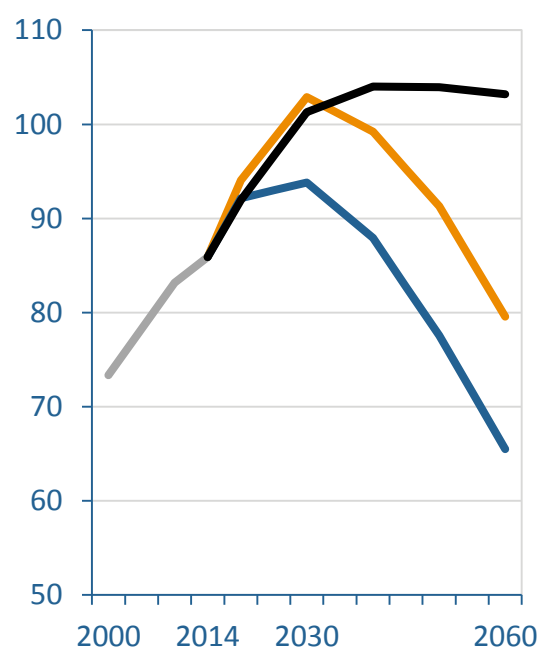
Coal Demand

('000 MTOE)



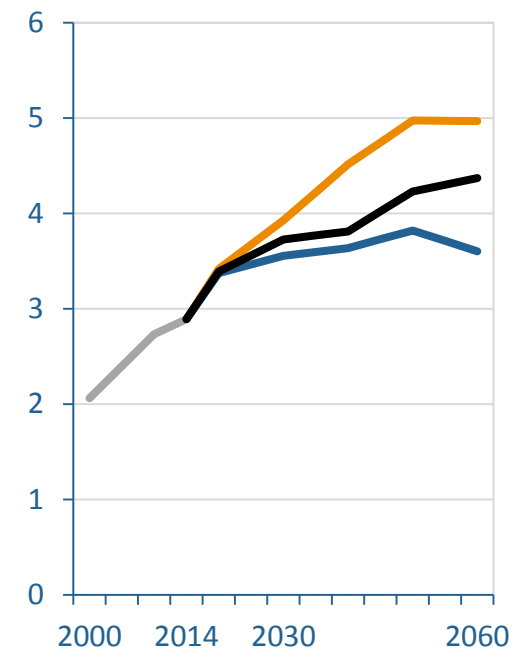
Oil Demand

(mb/d)



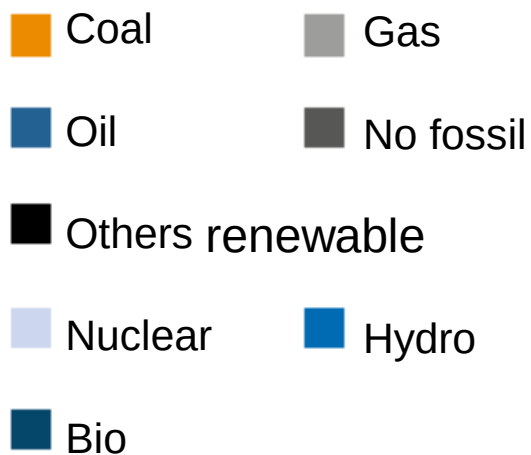
Natural Gas Demand

('000 MTOE)

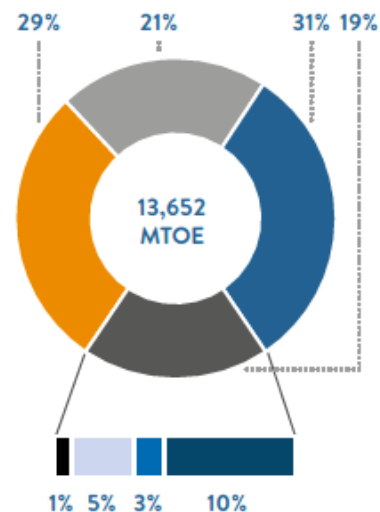


History Modern Jazz Unfinished Symphony Hard Rock

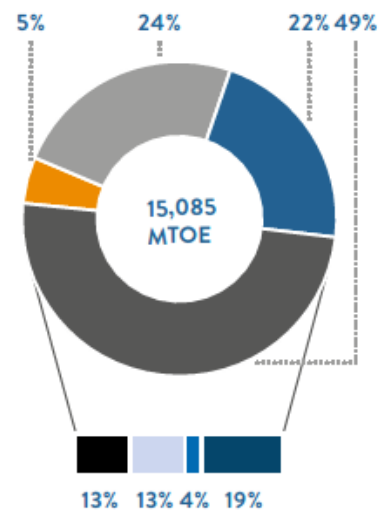
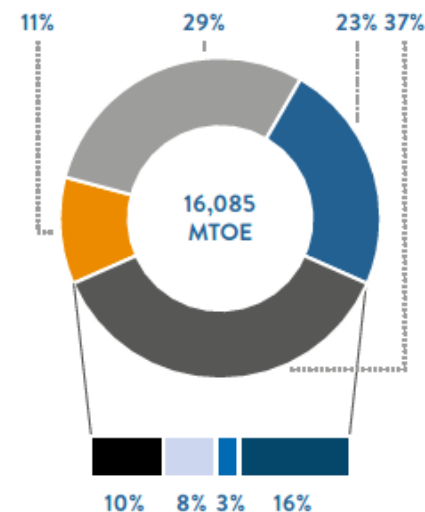
Energy mix



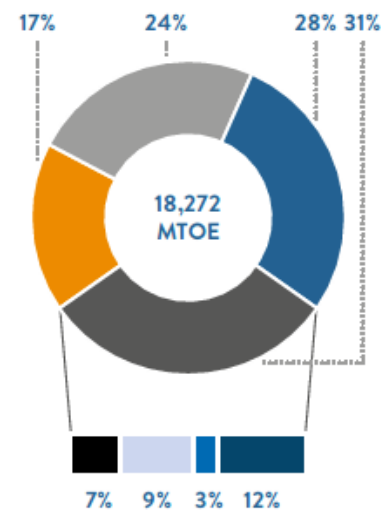
2014



Modern Jazz
2060



Unfinished Symphony
2060



Hard Rock
2060

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

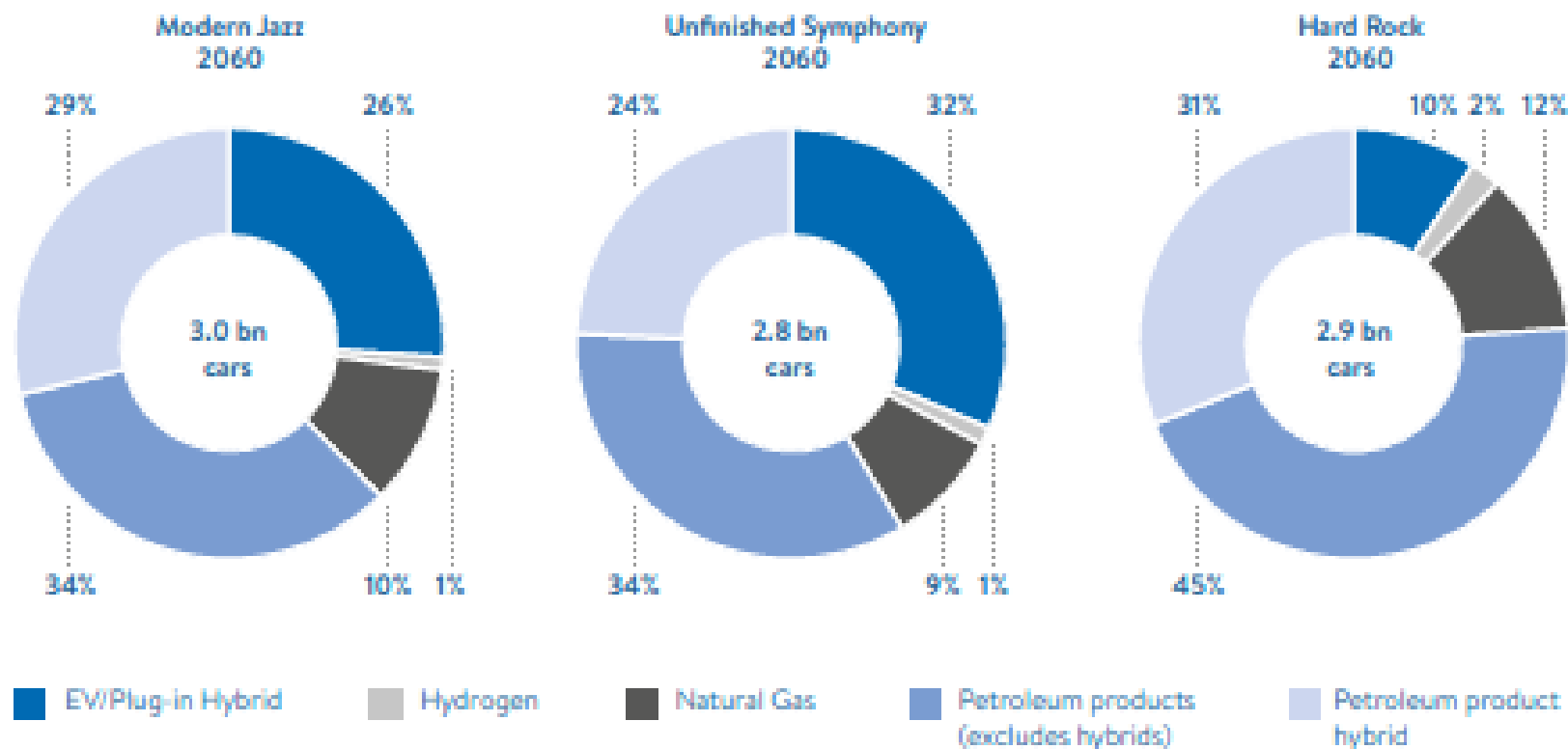


Hard Rock
2060



9% of 2.9 billion

Diversification of light-duty vehicle fleet

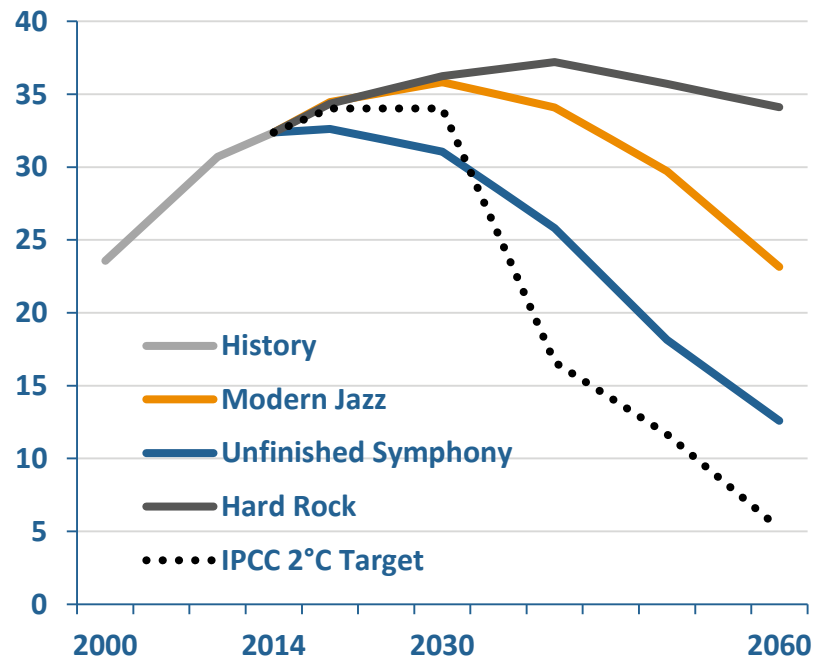


6 LIMITING GLOBAL WARMING...

... 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.

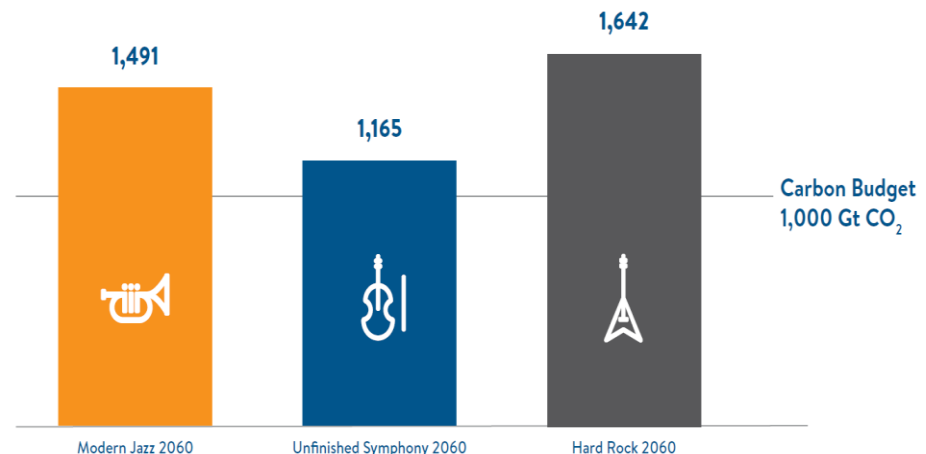
Annual Carbon Emissions

(Gt CO₂)

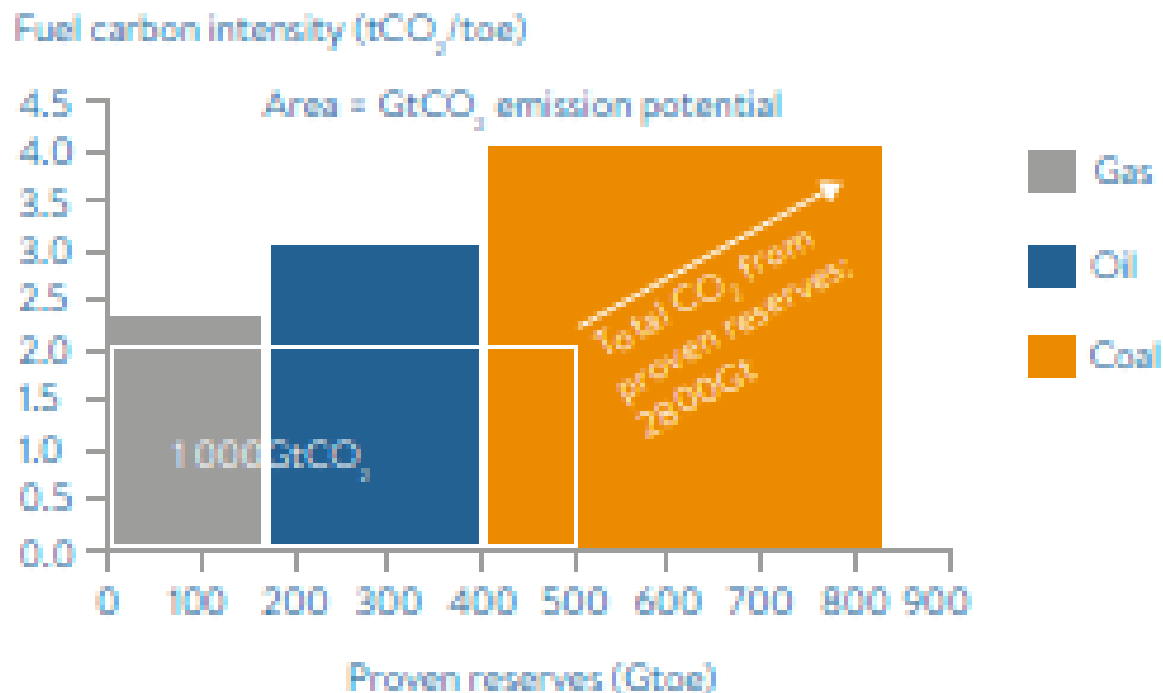


Cumulative Carbon Emissions 2015-2060

(Gt CO₂)



6 LIMITING GLOBAL WARMING...



7 ENERGY TRILEMMA IN 2060



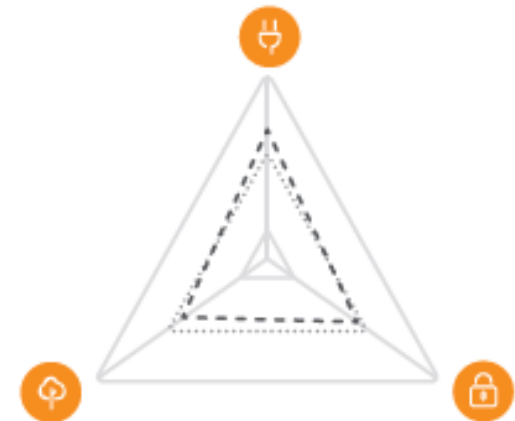
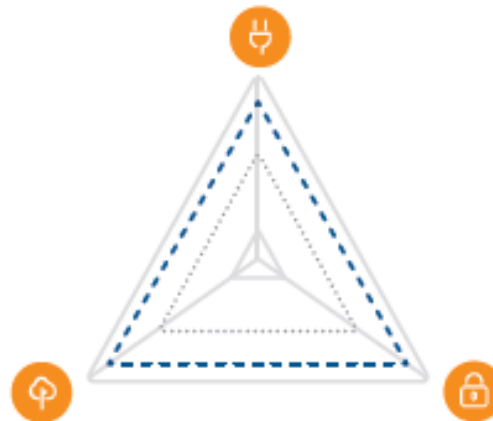
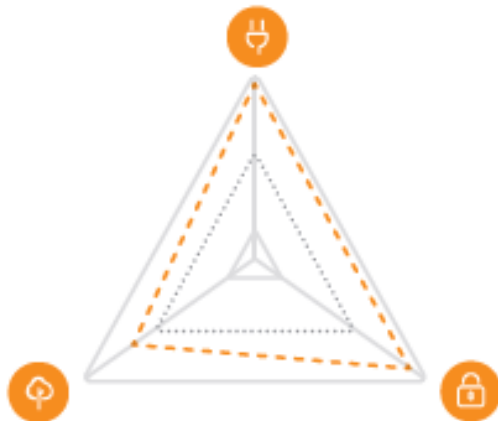
**Modern Jazz
2060**



**Unfinished
Symphony 2060**

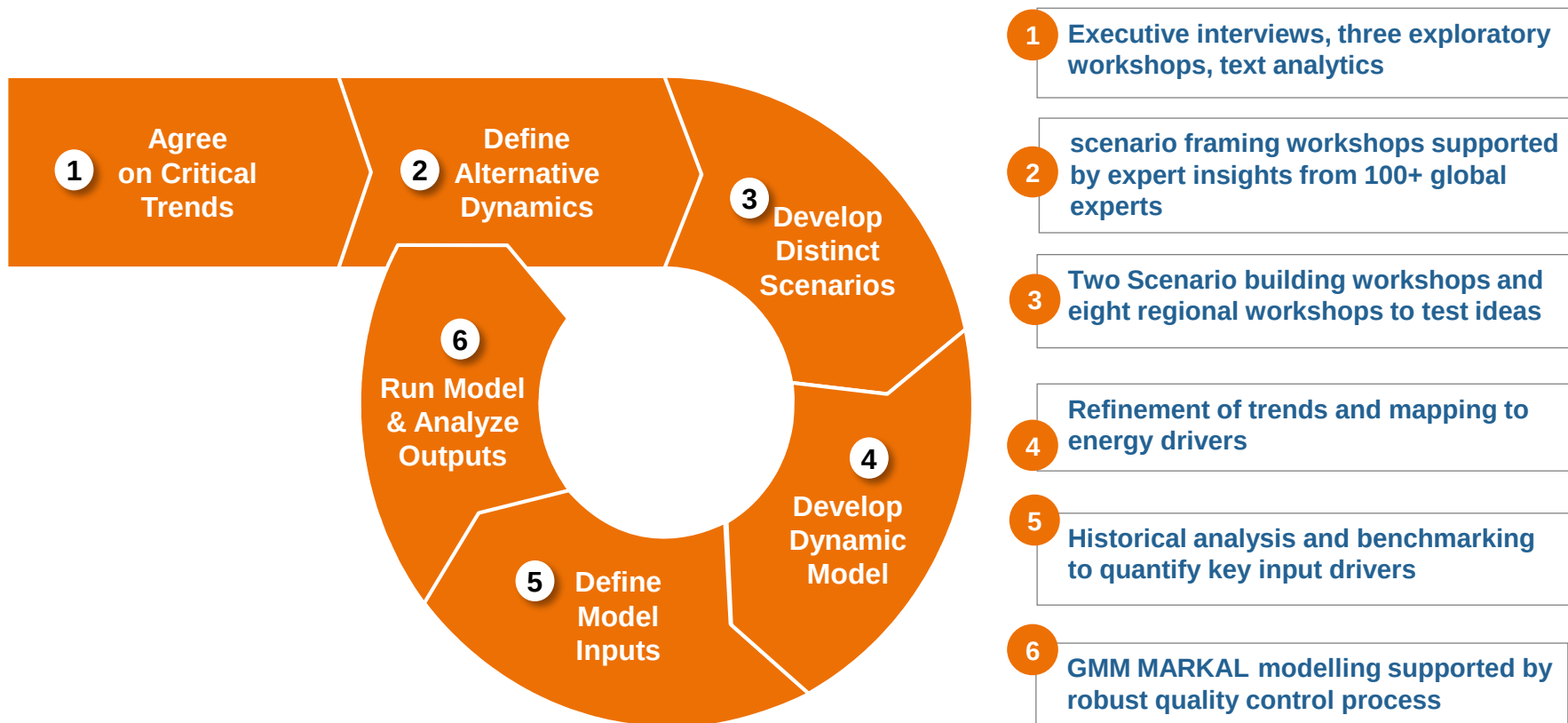


**Hard Rock
2060**



2014

Methodology of the Global Scenarios



World Energy Scenario Workshops

Global Scenario Study Group Workshops
(London: Mar '15 ✓, May '15 ✓, July '15 ✓,
Sep '15 ✓, Jan '16 ✓, April '16 ✓)

EU Regional Scenarios
(Paris: 21-22 Mar '16 ✓)

22nd World Energy Congress
Launch of Global Scenarios
(Istanbul: Oct '16)

North America Regional Workshop
(DC: 4-5 May '16 ✓)

China WELD
(Beijing: March '16 ✓)

**Asian Clean Energy
Forum / WELS**
Smart Innovation and
LNG presentations
(Manila: Jun '15 ✓)

**Latin America
Regional Workshop**
(Rio: 17 Nov '15) ✓

India Energy Congress
India Regional Workshop
(Delhi: Jan '15 ✓)

2015 WEC Executive Assembly
Presentation of initial Global
Scenario Findings, e-Mobility and
Natural Gas Reports
(Addis Ababa: Oct '15 ✓)

Africa Indaba
African Regional Workshops
(Johannesburg: Feb '15 ✓, Feb '16 ✓)

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