World Energy Scenarios

- Modern Jazz
- Unfinished Symphony
- Hard Rock
# Pre-determined Elements of the Grand Transition

## Factors shaped world energy 1970 - 2015

<table>
<thead>
<tr>
<th>Population / Workforce</th>
<th>Global population grew 2x (1.7% p.a.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Technologies</td>
<td>ICT revolution</td>
</tr>
<tr>
<td></td>
<td>Productivity growth rate of 1.7% p.a.</td>
</tr>
<tr>
<td>Planetary Boundaries</td>
<td>1,900+ Gt CO₂ consumed</td>
</tr>
<tr>
<td>Shifts in Power</td>
<td>Rapid economic rise of developing nations</td>
</tr>
<tr>
<td></td>
<td>Growing role for global institutions, e.g. UNFCCC, IMF, WTO, G20</td>
</tr>
</tbody>
</table>

## Pre-determined elements 2015 - 2060

<table>
<thead>
<tr>
<th>Global population will grow 1.4x (0.7% p.a.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pervasive digitalisation; combinatorial impacts and productivity paradox</td>
</tr>
<tr>
<td>1,000 Gt CO₂ consumed to 2100 for the 2°C target</td>
</tr>
<tr>
<td>2030: India is most populous country</td>
</tr>
<tr>
<td>2035-45: China is the world’s largest economy</td>
</tr>
</tbody>
</table>
# Critical Uncertainties of the Grand Transition

## Modern Jazz
- **Productivity / Economic Growth**
  - GDP 3.3% p.a. (2015–2060)
  - Digital boost
  - Tech innovation
  - GDP per capita 2060: US$ 30,600

## Unfinished Symphony
- **Productivity / Economic Growth**
  - GDP 2.9% p.a. (2015–2060)
  - Sustainable growth
  - Circular economies
  - GDP per capita 2060: US$ 25,200

## Hard Rock
- **Productivity / Economic Growth**
  - 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**
  - Modern Jazz: 1,491 Gt CO2
  - Unfinished Symphony: 1,165 Gt CO2
  - Hard Rock: 1,642 Gt CO2

## International Governance
- **Economics focused international governance**
  - Modern Jazz
  - Unfinished Symphony
  - Hard Rock: Fractured and weak international system

## Tools for Action
- **Markets**
  - Modern Jazz
  - Unfinished Symphony: States
  - Hard Rock: 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
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 (TOE)

- **Primary Energy Demand Growth Rate (p.a.)**
- **Economic Growth rate (p.a.)**
- **Energy Intensity Reduction Rate (p.a.)**

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2.0</td>
<td>1.9</td>
<td>1.8</td>
<td>1.7</td>
</tr>
<tr>
<td>2014</td>
<td>1.9</td>
<td>1.8</td>
<td>1.7</td>
<td>1.6</td>
</tr>
<tr>
<td>2030</td>
<td>1.8</td>
<td>1.7</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>2060</td>
<td>1.7</td>
<td>1.6</td>
<td>1.5</td>
<td>1.4</td>
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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)**

- 2014: 23,816
- Modern Jazz 2060: 48,491
- Unfinished Symphony 2060: 44,474
- Hard Rock 2060: 44,914
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**

<table>
<thead>
<tr>
<th>Year</th>
<th>2014</th>
<th>Modern Jazz 2060</th>
<th>Unfinished Symphony 2060</th>
<th>Hard Rock 2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar ('000 TWh)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar</td>
<td>0.2</td>
<td>5.7</td>
<td>7.9</td>
<td>3.3</td>
</tr>
</tbody>
</table>

**Wind Electricity Generation**

<table>
<thead>
<tr>
<th>Year</th>
<th>2014</th>
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<th>Unfinished Symphony 2060</th>
<th>Hard Rock 2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind ('000 TWh)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>0.7</td>
<td>8.8</td>
<td>9.3</td>
<td>5.6</td>
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</table>
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)

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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
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)

- **History**
- **Modern Jazz**
- **Unfinished Symphony**
- **Hard Rock**
- **IPCC 2°C Target**

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Carbon Budget
1,000 Gt CO₂
Wrap up

1. World’s Primary Energy Demand will slow down and per capita demand will peak before 2030

2. Demand for electricity will double until 2060

3. Phenomenal rise of Solar and Wind energy will continue

4. Demand peaks for coal and oil between 2030-2040

5. Transition of the global transport system is one of the biggest challenges

6. Limiting Global warming and tackle the climate challenge will require exceptional and unprecedented effort
Thank you

Christoph Menzel
christoph.menzel@outlook.com

Please see the full report for further details.