

World Energy Congress 2016, Istanbul



Impressions et conclusions

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Impressions générales I

- Sujets très vastes:
prix OPEC blockchains dans les réseaux
- Nouveaux mots-clé:
«peak demand», «stranded resources»
- Asie et Amérique du Nord à peine représentées

Impressions générales II

1. La «Grande transition» est en marche, inexorable et irréversible

déclenchée par:

- vision commune d'une décarbonisation inévitable (Accord de Paris)
- croissance démographique et urbanisation
- (r)évolution technologique
 - *numérisation / accumulation etc.*
 - *développement des prix des NER/ des énergies non conventionnelles*
- prix du pétrole
- marchés à «zero marginal cost»
- résilience / vulnérabilité des systèmes

World Energy Scenarios 2016

- ▶ WEC partnership with PSI and Accenture
- ▶ Highlight at the 23rd World Energy Congress
 - 9,000 participants including head of states and CEOs
 - PSI present with 3 representatives
- ▶ **3 scenarios of the energy system** with regional-socioeconomic factors; continuation of 2013 study



Modern Jazz (market oriented)

- Market chooses technologies
- Technology innovation
- Energy access for all

Hard Rock (fragmented policies)

- Low global cooperation
- Focus on energy security
- Best fit local solutions

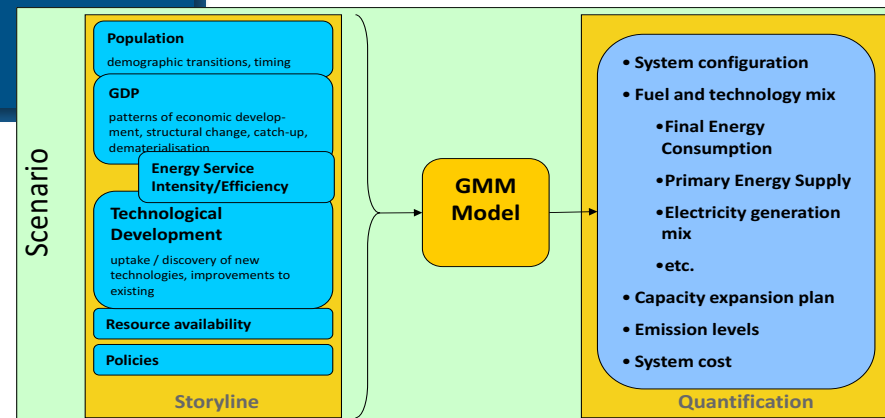
Unfinished Symphony (regulation oriented)

- Strong policies focusing on sustainability
- Unified climate action
- Targeted support for technologies

Analytical tool for quantification:

PSI's energy system model **GMM**

→ Cost optimal model with resources, energy flows, energy technologies and demand sectors in 15 regions



“Grande transition”

Pre-determined elements

Population /
Workforce
Growth



New
Technologies



Planetary
Boundaries



Shifts in
power



FACTORS THAT SHAPED WORLD ENERGY 1970 TO 2015

- Global population grew 2x
- 1.7% p.a. growth in employment

- Technology enables productivity of 1.8% p.a.

- Four planetary boundaries already crossed
- 1,900+ GtCO₂ consumed

- Policies shaped by Oil Embargoes
- Growing role for global institutions e.g. UNFCCC, IMF, WTO etc.

PRE-DETERMINED ELEMENTS 2014 TO 2060

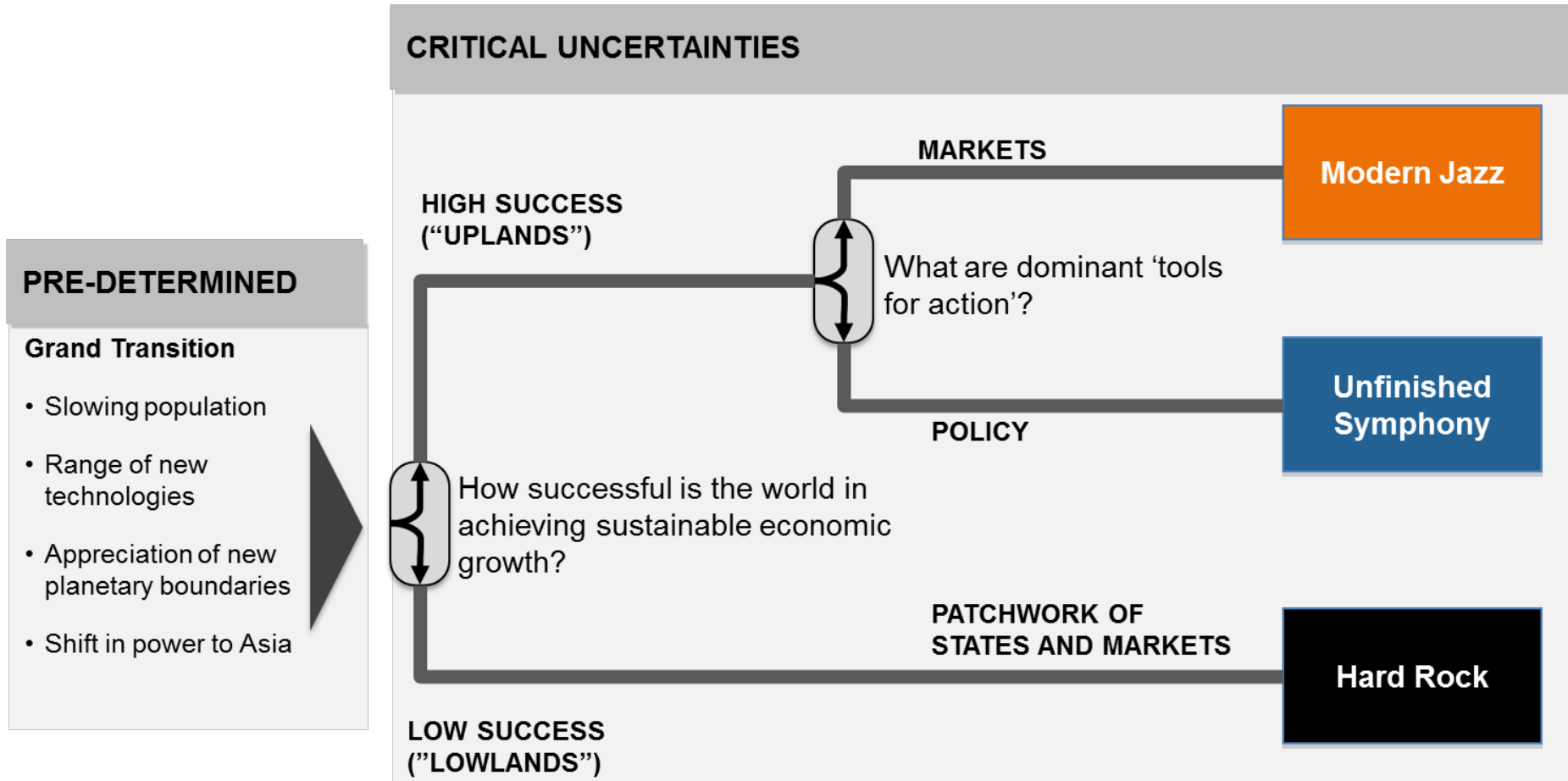
- Global population grows 40%
- 0.7% p.a. growth in employment
Demographics favour developing economies

- Combinatorial effect of new technologies is disruptive
- Productivity varies from 1.0-2.6% p.a.

- Water stress in high risk regions
- 1,000 GtCO₂ to 2100 to avoid 2 °C
- Societal values support climate action

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

World Energy Scenarios 2016



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Incertitudes cruciales

Critical uncertainties

Productivity and Economic Growth



MODERN JAZZ

- Open economies
- Digital boost

UNFINISHED SYMPHONY

- Intelligent growth
- Circular economies

HARD ROCK

- Domestic growth and expertise
- Local content emphasis

Tools for Action



- Free markets
- Enabling policies
- New business models

- Climate focused policy
- Global policy convergence

- Security focused policy action

Climate Challenge



- Consumer driven technology adoption
- Technology support

- Local support
- Global mandates
- Unified action

- Lower GDP growth
- Energy security drives renewables

International Governance



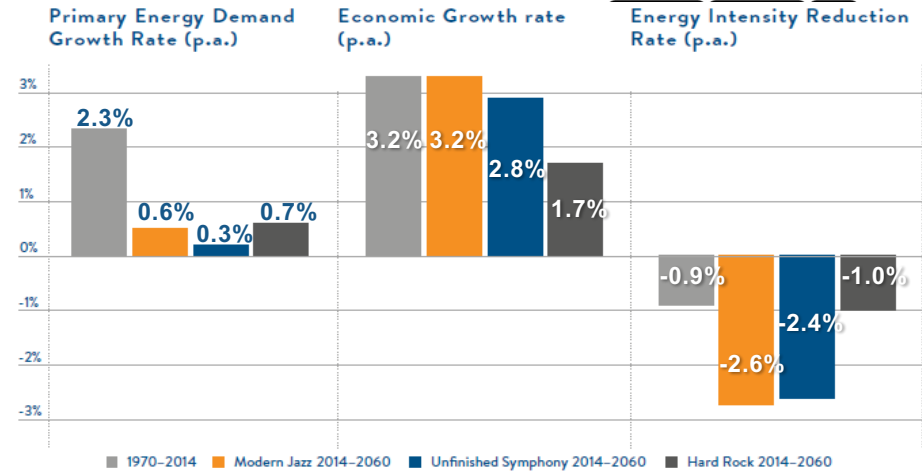
- Complex globalisation
- Shifting hubs
- Growing global connections

- Strong global cooperation
- Regional integration

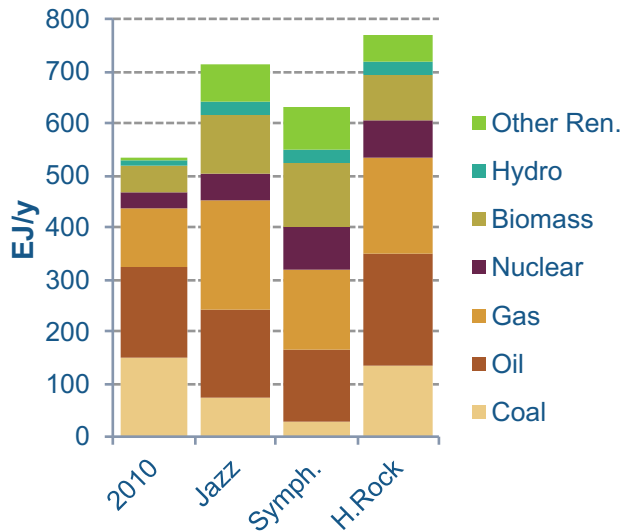
- Fragmented political and economic systems
- Power balancing alliances

Overview

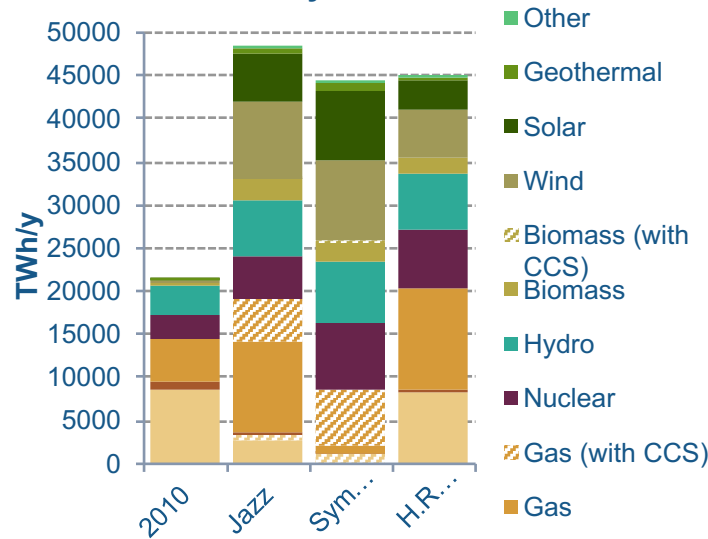
- ▶ Slower energy demand growth due to:
 - Efficiency gains
 - Changes in demand patterns and behaviour



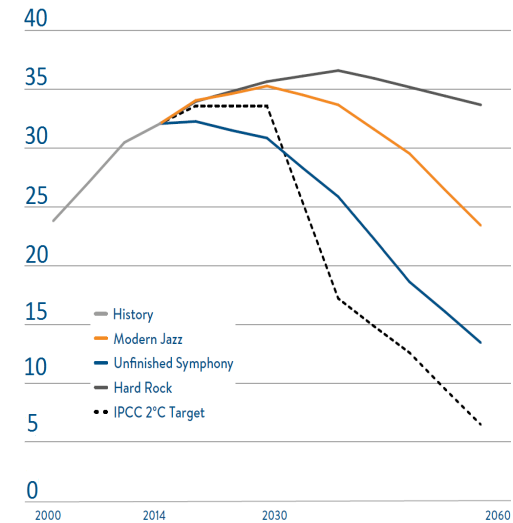
Global Primary Energy 2060



Electricity Production 2060



CO₂ emissions



- Peak in per capita demand before 2030
- Fossil share falls: 80%(2010) → 60%/50%/70%
- Less CO₂ intensive electricity: 67% → 30%/3%/45%
- Investments in infrastructure: 55/59/48 trillion USD2010
- Jazz is on track for +3°C
- Symphony is slightly above +2°C
- H. Rock is on track for 3.5 - 4°C

Nuclear energy: Installed capacity, in GW

Modern Jazz (market oriented)

- limited market for large-scale projects
- slowly emerging, regional CO₂ markets
- some nuclear plants under advanced planning are not commissioned

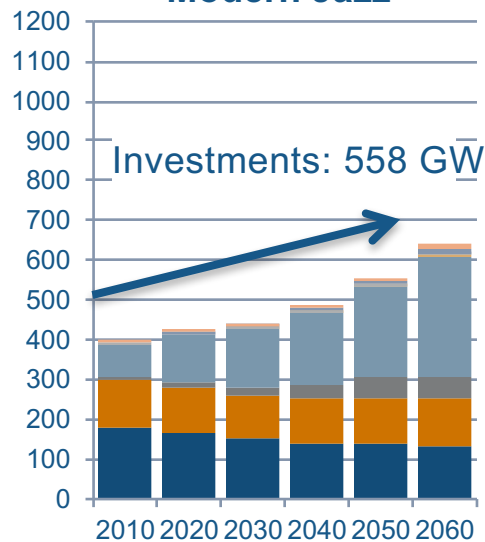
Unf. Symphony (regulation oriented)

- nuclear growth is enabled by states because of security of supply (quasi-domestic)
- internationally convergent, more stringent CO₂ price

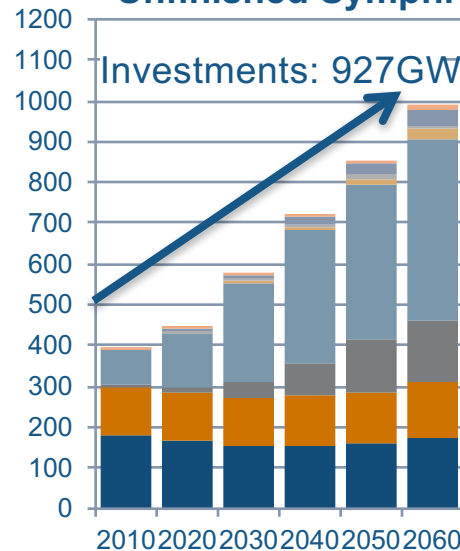
Hard Rock (fragmented policies)

- nuclear growth is enabled by states because of security of supply
- low economic growth hampers investments

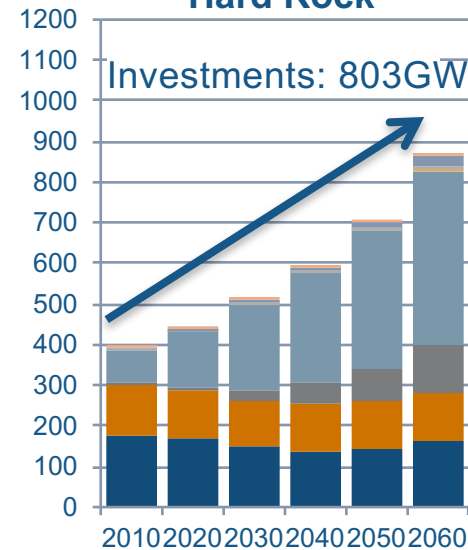
Modern Jazz



Unfinished Symph.

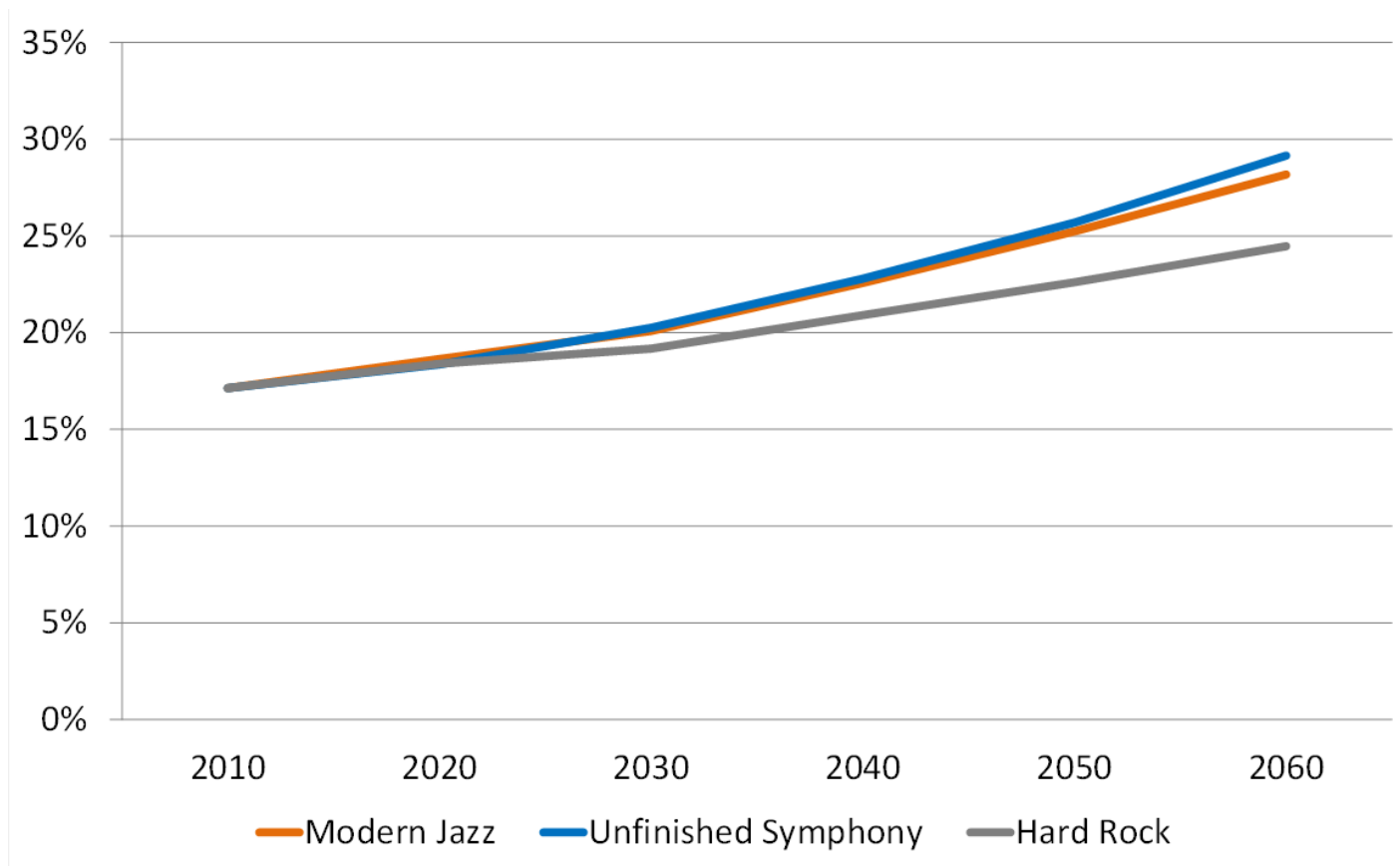


Hard Rock



- ▶ China in 2060: +193 GW in Jazz, +333 GW in Symphony, +340 GW in Hard Rock from 2010
- ▶ India in 2060: +53 GW in Jazz, +132 GW in Symphony, +106 GW in Hard Rock from 2010
- ▶ Cumulative undiscounted investment in new nuclear capacity (in billion USD₂₀₁₀):
Jazz: 2300 , Symphony: 3500, Hard Rock: 3200

Consommation finale d'électricité



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