



## World Energy Scenarios Composing Energy Futures to 2050

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Promoting the sustainable supply and use of energy for the greatest benefit of all

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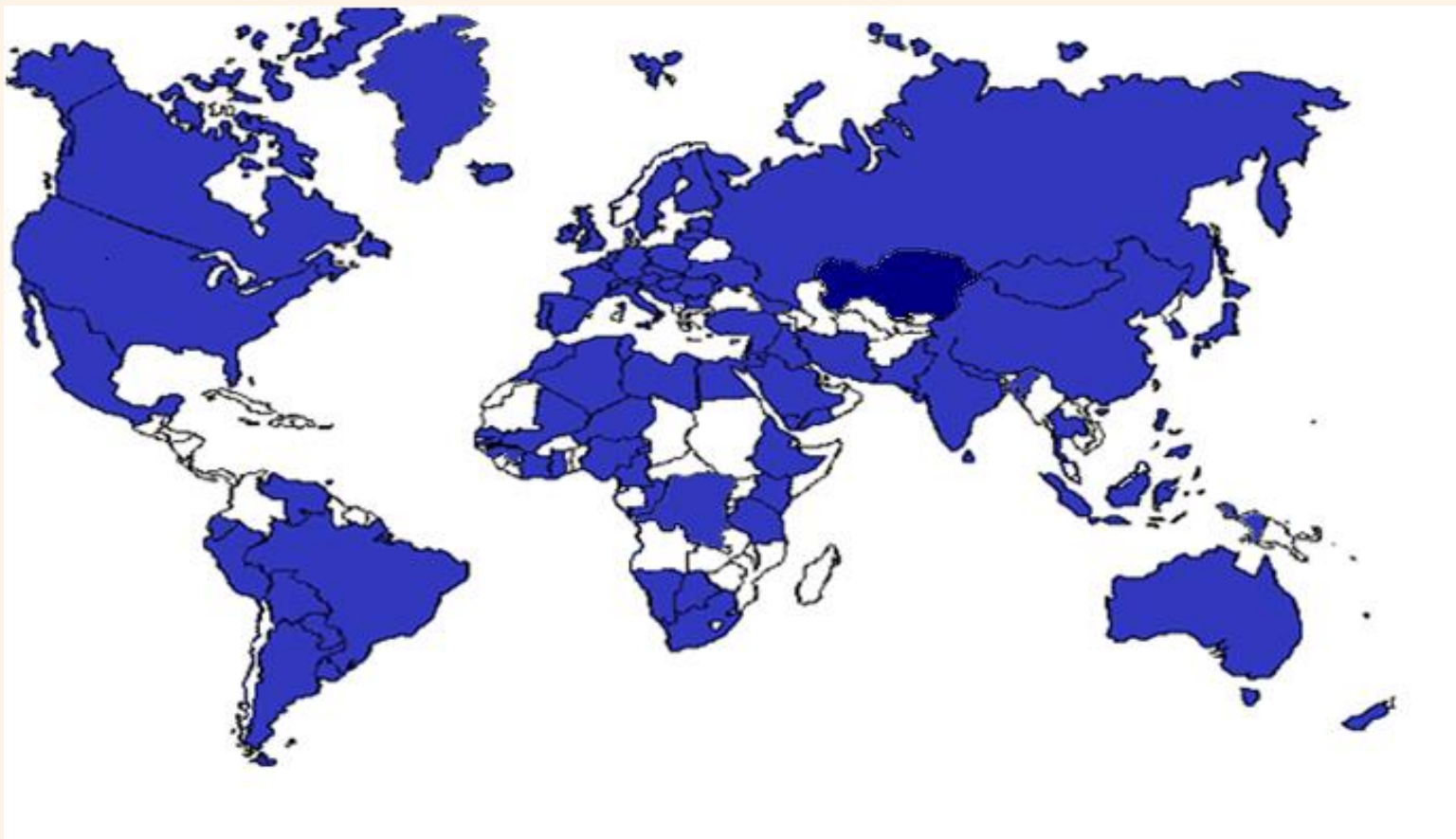
## World Energy Council (WEC)

- ▶ Established in 1923, WEC is one of the biggest multi-energy International Organisations
- ▶ WEC is UN-accredited, non-governmental, non-commercial and non-aligned
- ▶ WEC produces many regional, inter-regional and world studies
- ▶ WEC organises the World Energy Congress every three years, the most important Multi-energy Congress in the World:  
Last round Daegu 2013, South Korea;  
**Next rounds: Istanbul 2016, Turkey, and Abu Dhabi 2019, United Arab Emirates.**

### Mission

*“To promote the sustainable supply and use of energy  
for the greatest benefit of all people”*

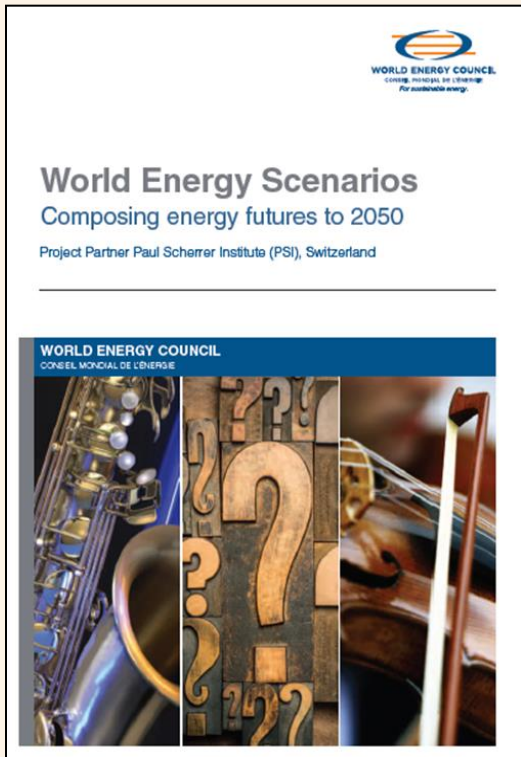
## WEC IN THE WORLD



***National Member Committees in nearly 100 countries***

# WEC's Flagship Studies

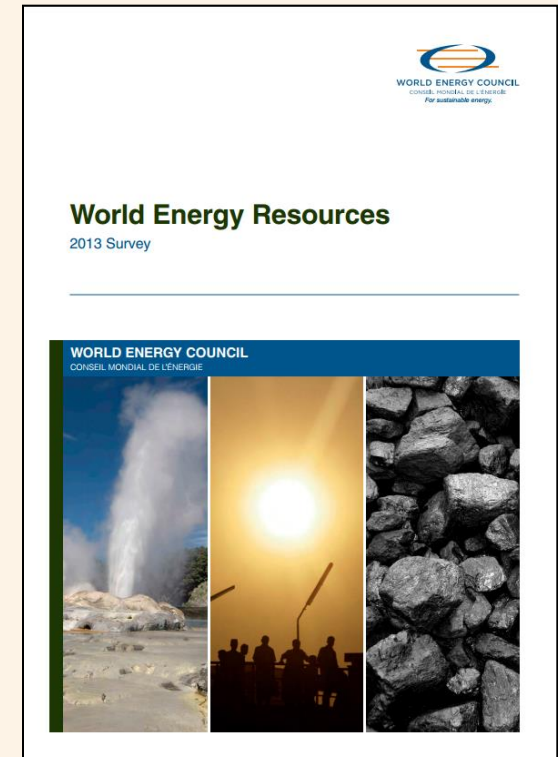
## Scenarios



## Trilemma



## Resources



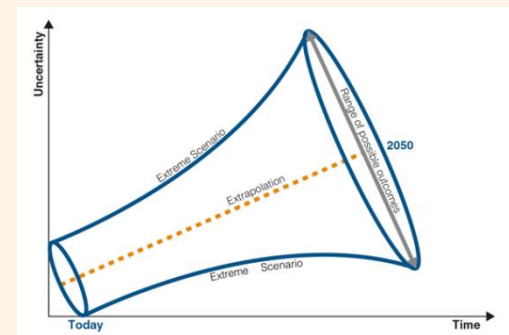
Study activity aims to provide energy leaders, policymakers, opinion leaders and voters with proper data and information about energy issues in order to help them making decisions.



## World Energy Scenarios - Composing energy futures to 2050

### What are scenarios?

The Organisation has put together plausible and pragmatic assessments of the reality of what is actually happening and not what WEC would like to happen in an ideal or politically directed world.



*The WEC's World Energy Scenarios to 2050 are therefore exploratory, rather than normative*

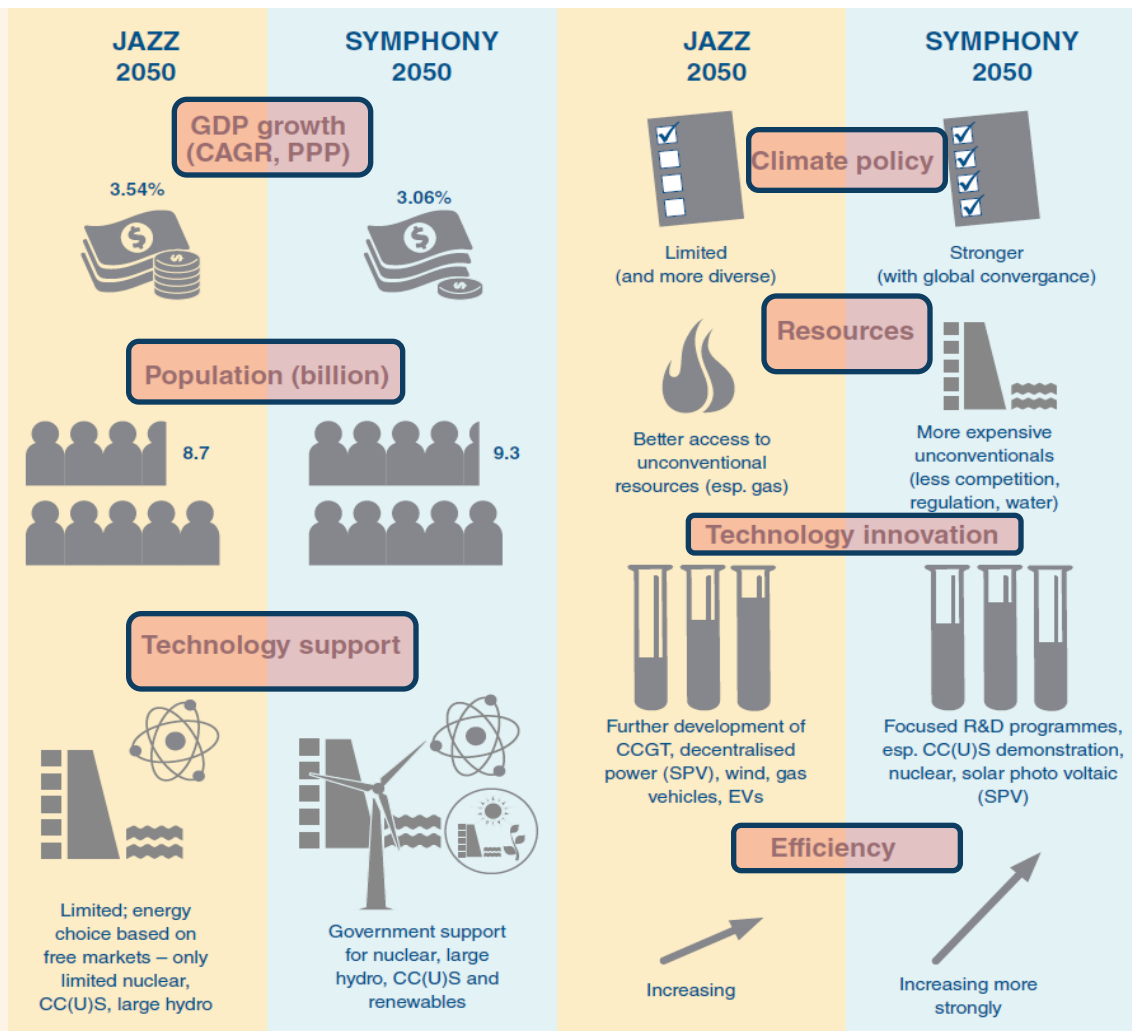


**Jazz:** trade based, consumer driven, focussed on access and affordability; achieving growth through low cost energy; Governments facilitate GHG actions.



**Symphony:** government led, voter driven, focussed on environmental goals and energy security, national and regional measures to increase share of renewables in energy mix; binding international agreement on GHG emissions

# The WEC's scenario storyline and quantification assumptions



The WEC's scenario stories were quantified into these figures which acted as constraints in the two models

## Scenarios Highlights

### Share of fossil fuels in the total primary energy supply:

- Jazz 2050: 77%
- Symphony 2050: 59%

(share of fossils in 2010: 80%)

### Global final energy demand:

- Jazz 2050: 629 EJ
- Symphony 2050: 491 EJ

(demand in 2010: 373 EJ)

### Per capita electricity consumption:

- Jazz 2050: 5440kWh/y (+110%)
- Symphony 2050: 4600kWh/y (+78%)

(consumption in 2010: 2580kWh/y)

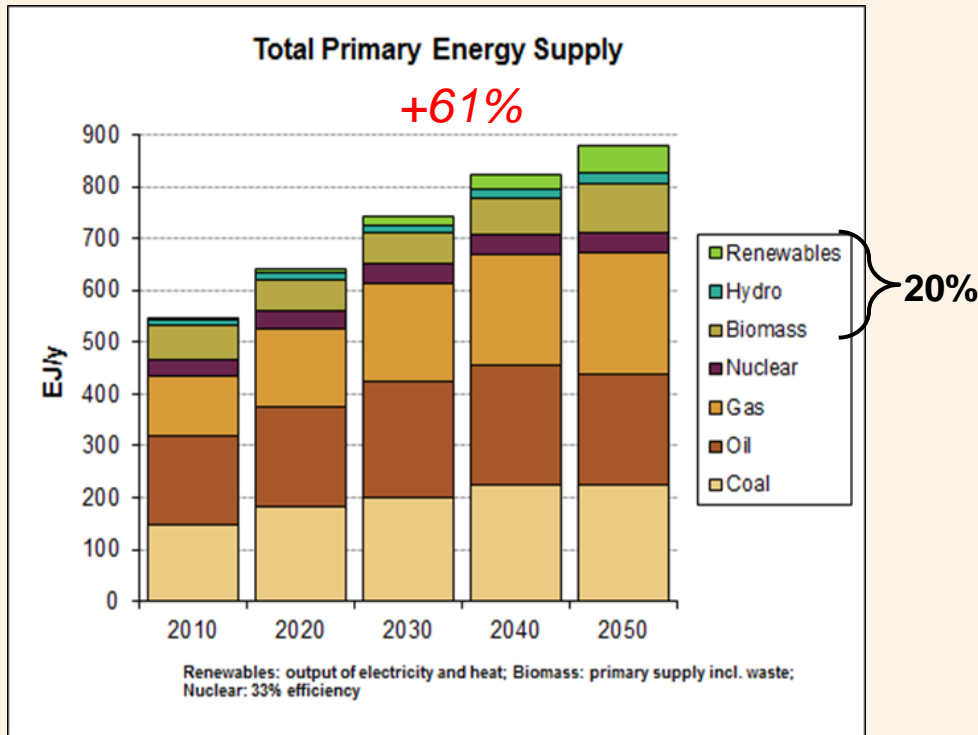
### The cumulative CO<sub>2</sub> emissions are for 2010 to 2050:

- Jazz: 2000Gt (44 Gt/y in 2050 or 45% higher than in 2010)
  - Symphony: 1400Gt (19 Gt/y or 40% lower than in 2010)
- (1000Gt from the period 1900-2004)



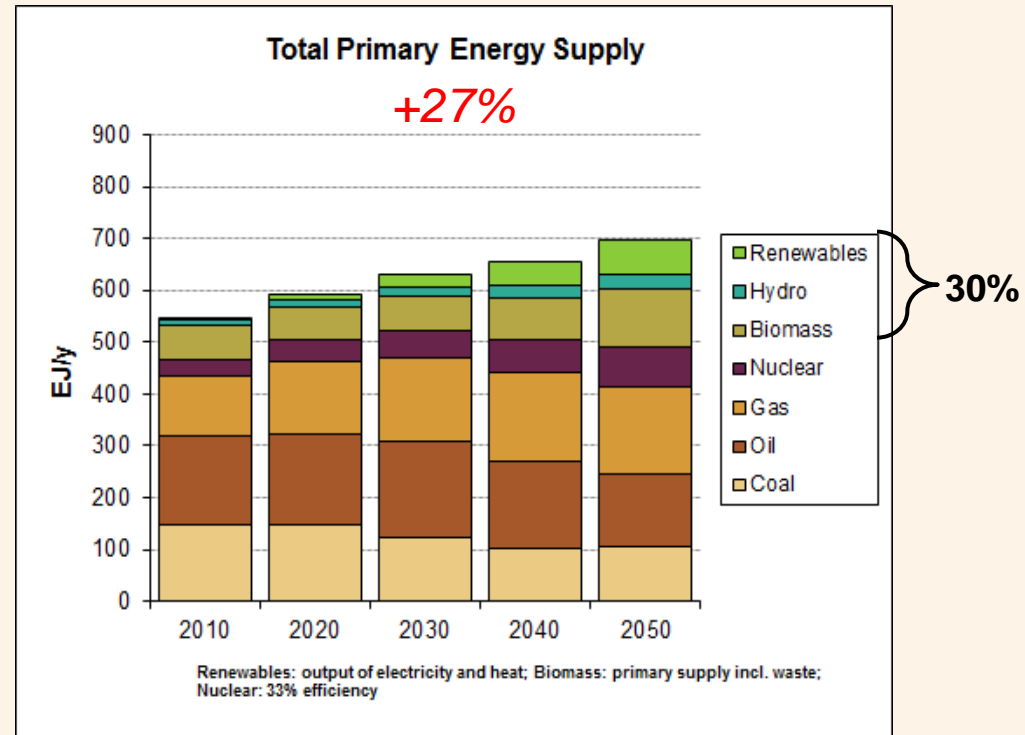
# Global primary energy supply

## JAZZ



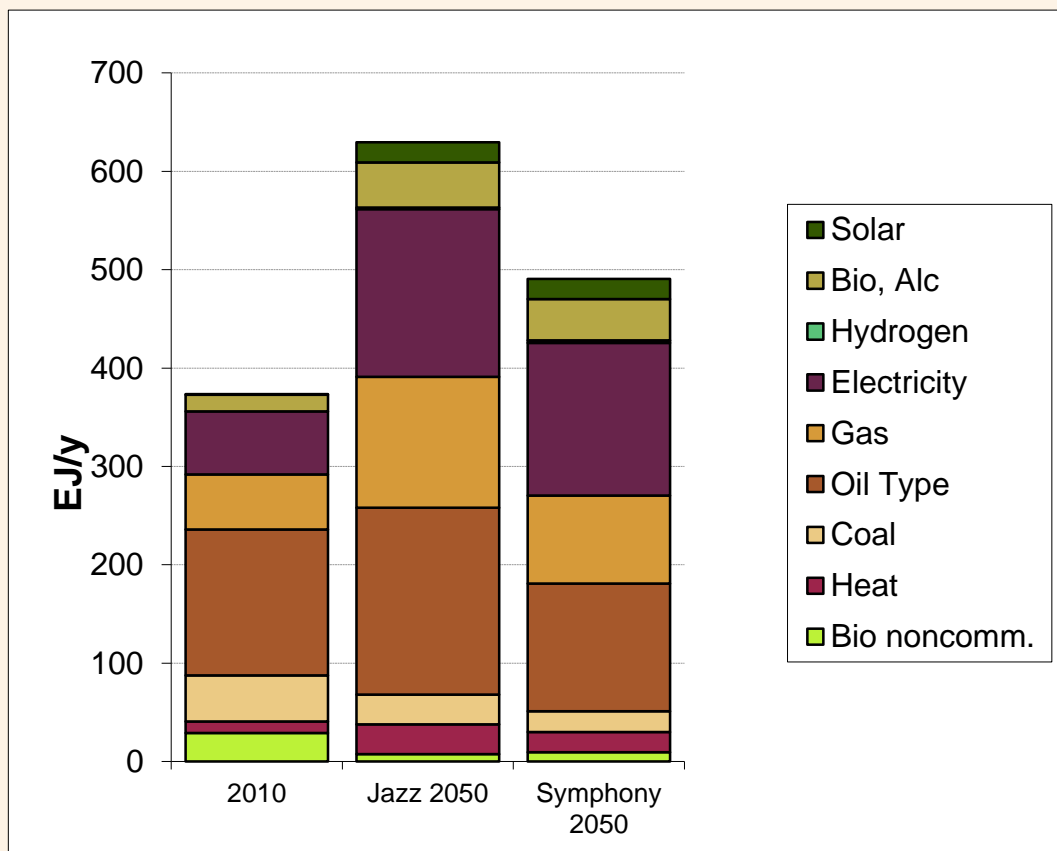
Upstream liberalized;  
Technology development;  
Supply surge/more producers;  
Coal remains dominant in some regions.

## SYMPHONY

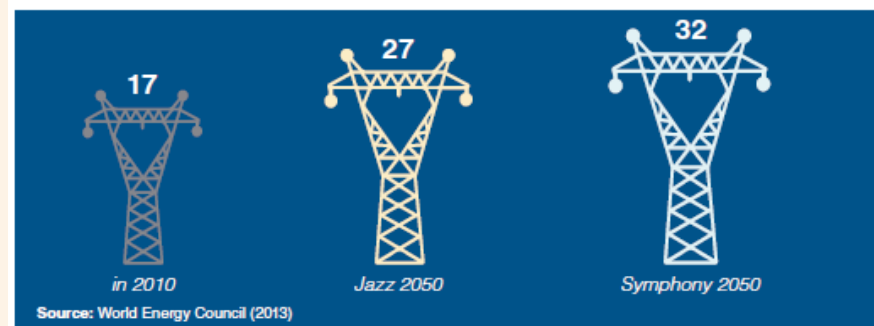


Tighter supply (lower E&P);  
Higher infrastructure costs;  
Energy security drives reduced fossil use.

# Total fuel consumption by fuel type: the increasing share of the electricity



Electrification (in terms of the share of electricity in final energy consumption) (%)



## JAZZ:

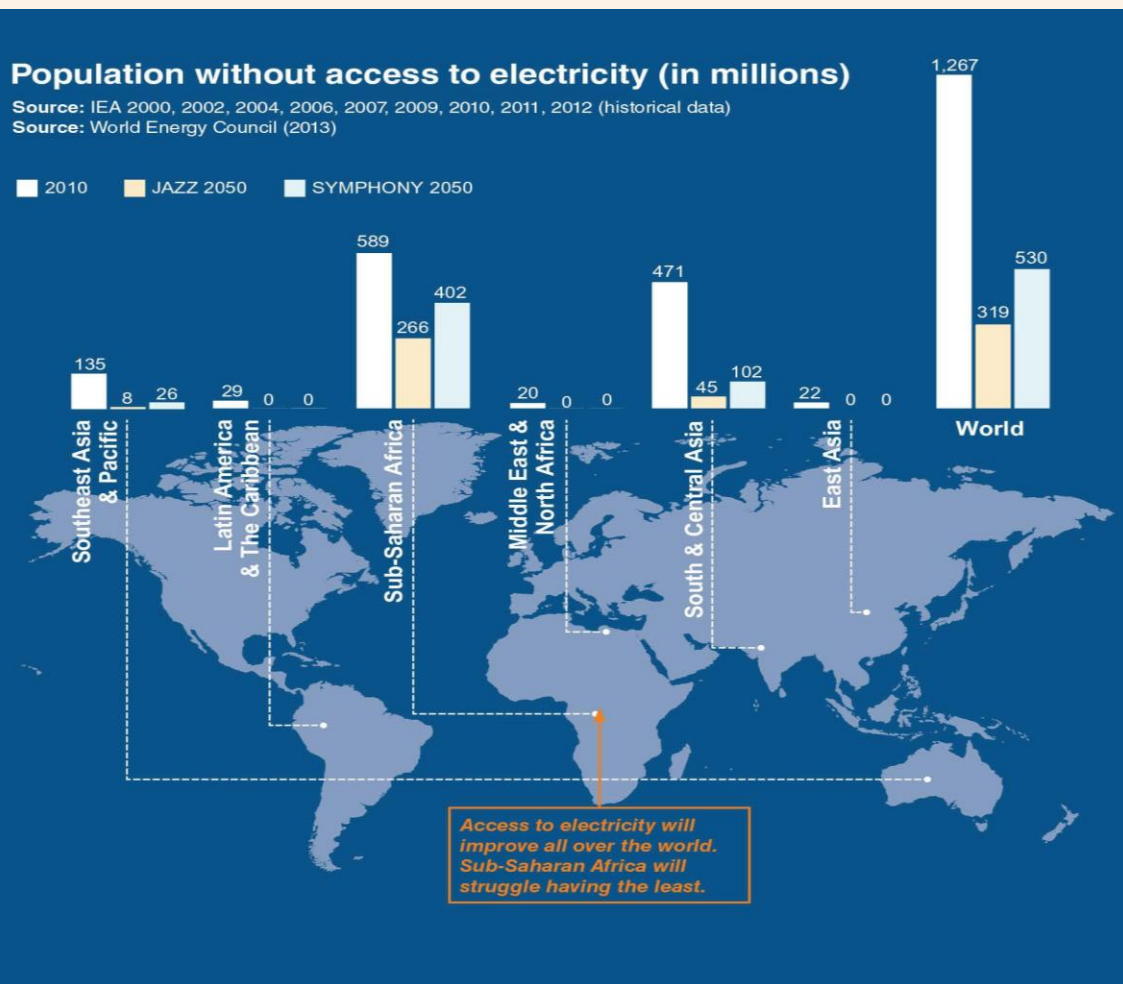
- economic growth leads to higher consumption;
- improved access to energy.

## SYMPHONY:

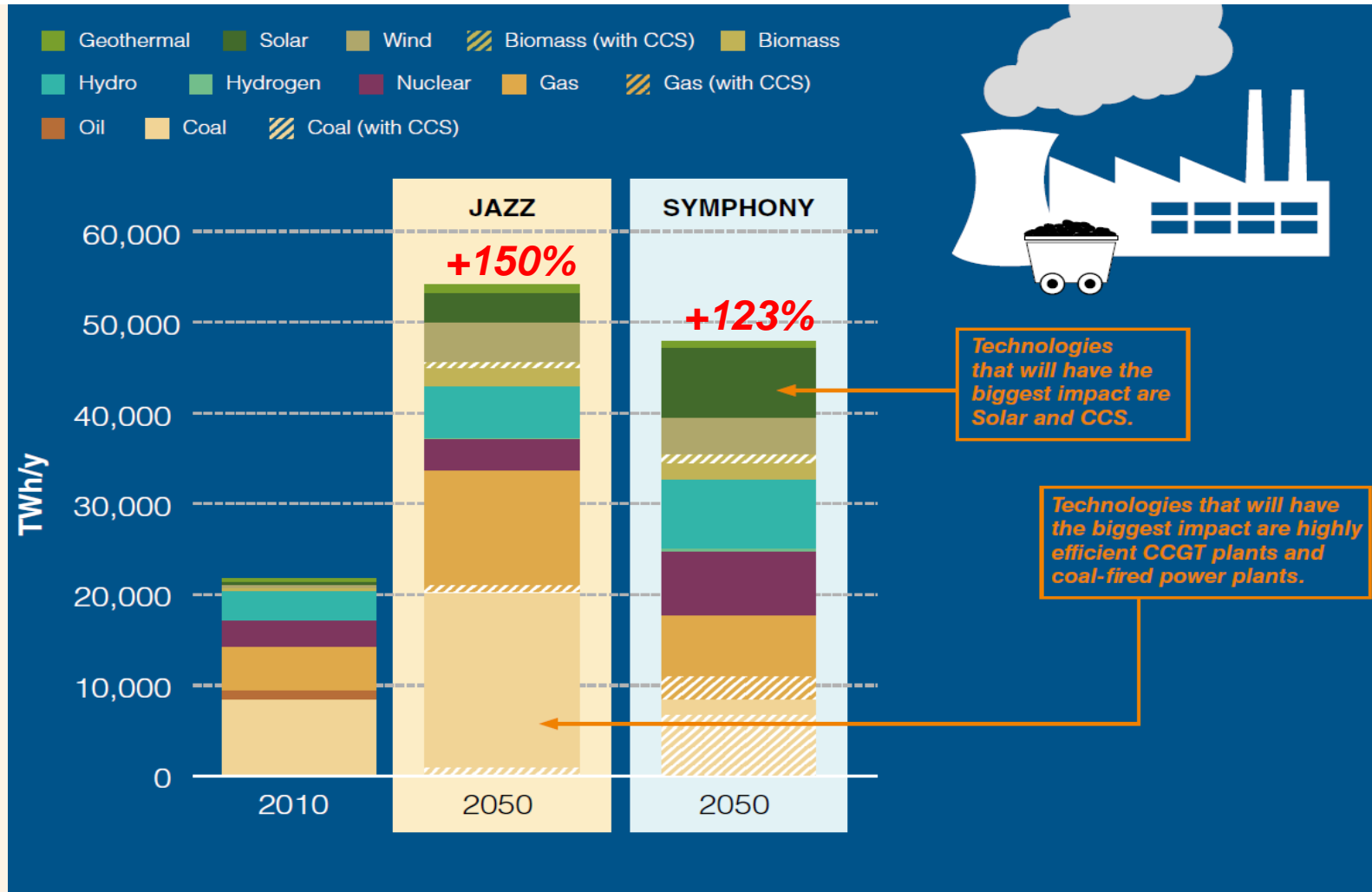
- lower consumption, high impact of energy saving (and lower growth);
- switching away from fossil fuels (peak in 2030).

**Both Scenarios foresee a significant increase of the electricity in the total fuel consumption**

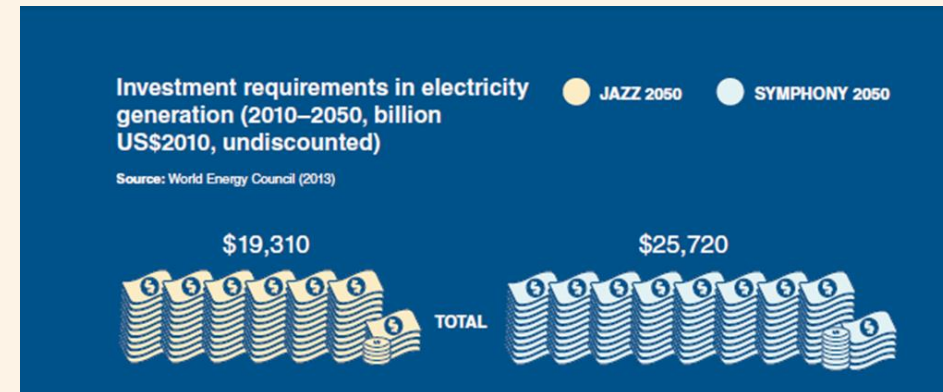
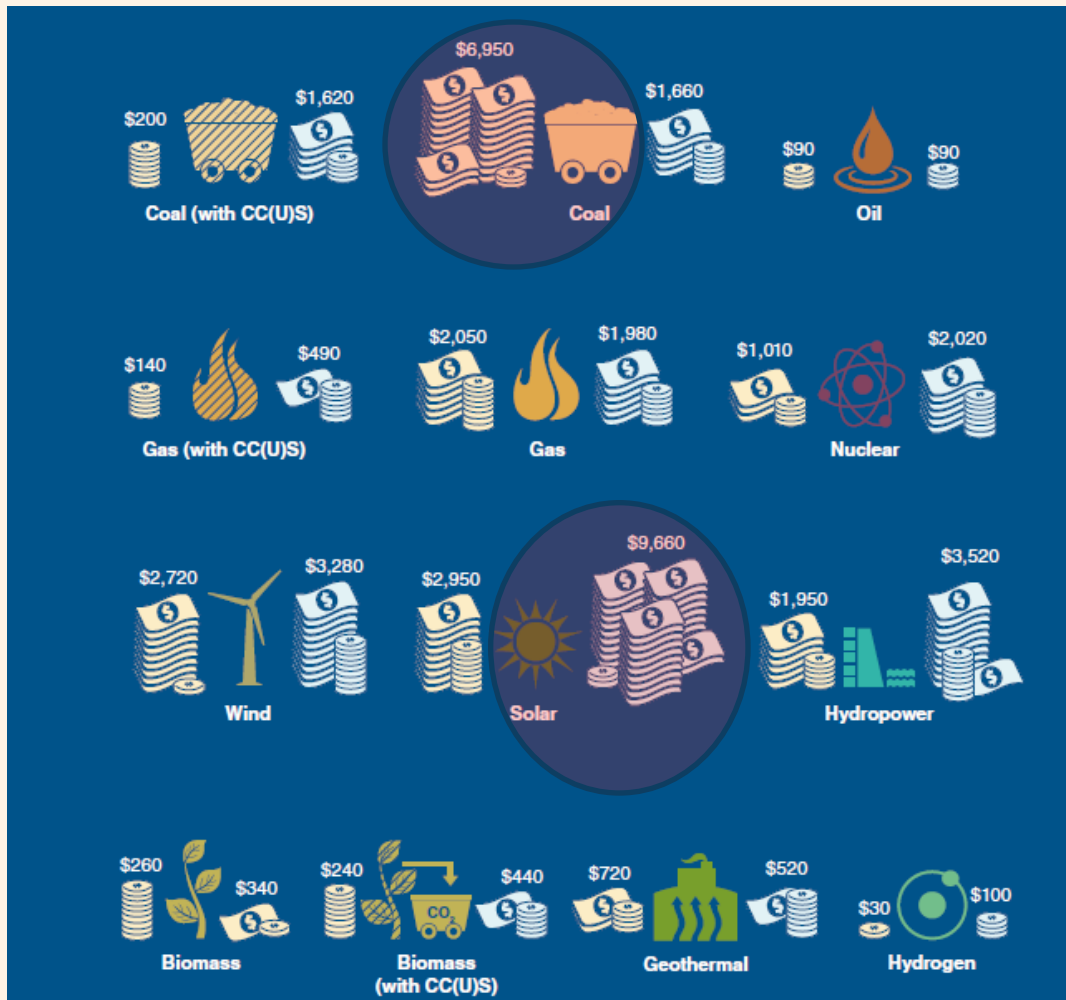
# The main driver: population without access to electricity



# Global electricity generation by fuel type



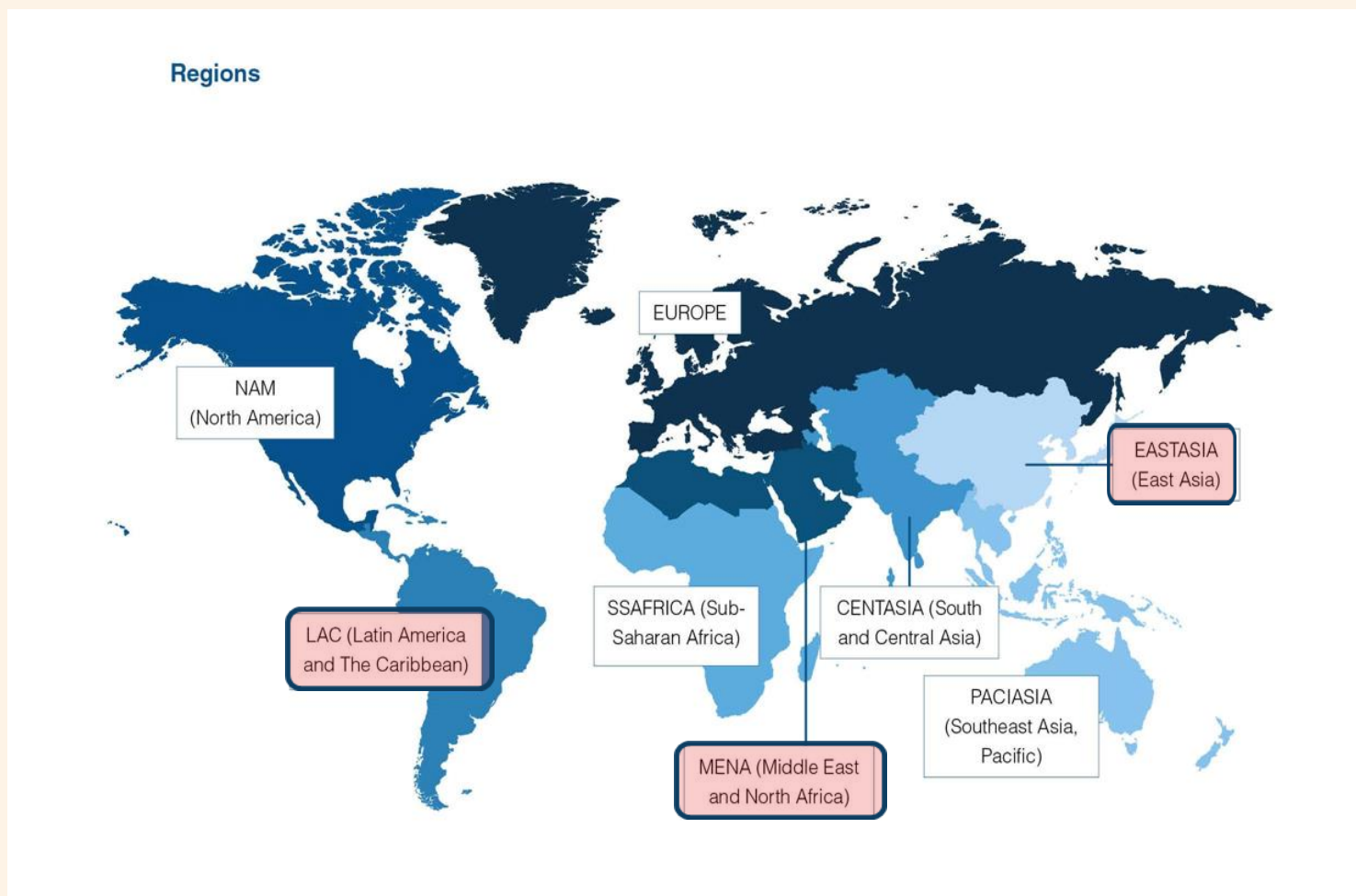
# Global investment in Electricity Generation Cumulative 2010-2050 in GW



- **Coal and Solar** are the technologies that will require the largest amount of investments in the long run respectively in the Jazz and in the Symphony scenario;
- **Wind and Hydropower** will follow with huge requirements of money in both scenarios;
- **Natural gas** technologies will require less investment despite the significant growth of the capacities in both scenarios.



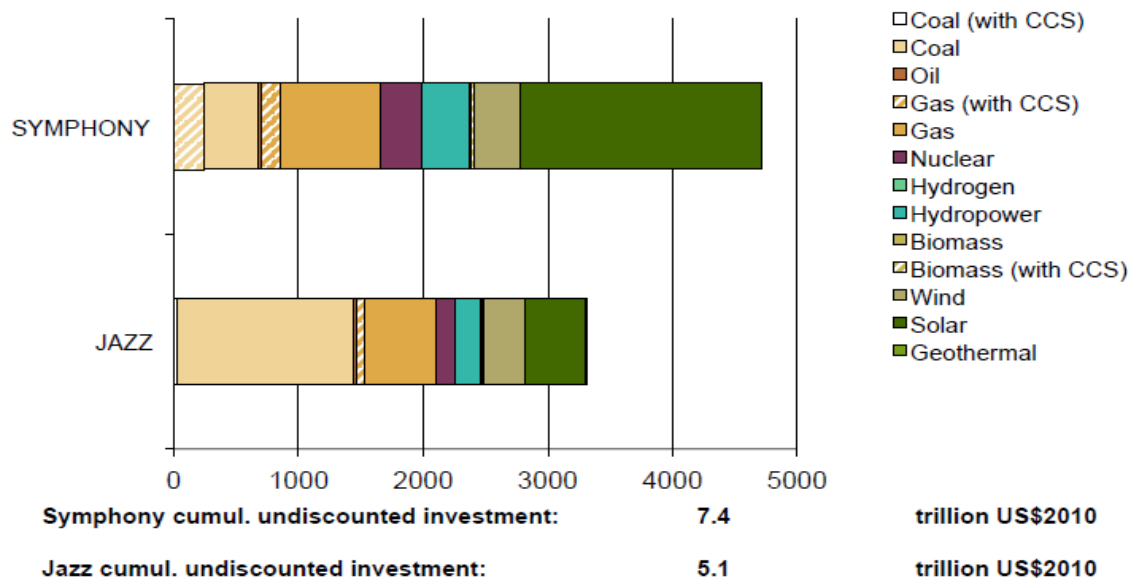
# Regional focus on: East Asia, MENA and Latin America and Caribbean





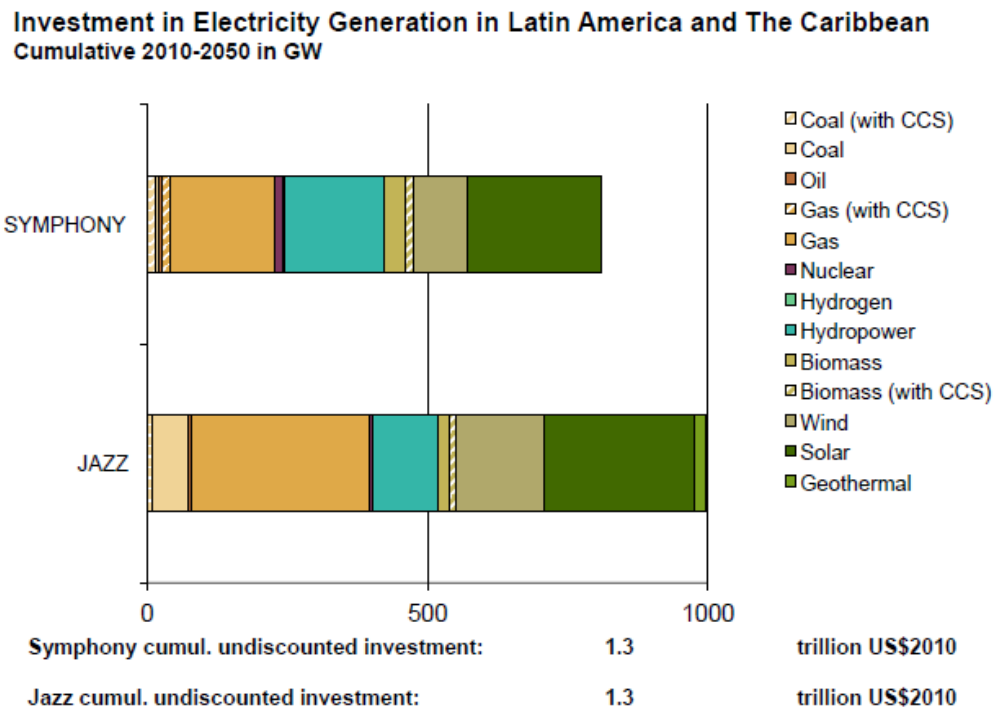
# Investment needs in electricity generation in the East Asia (China, South Korea and Japan)

**Investment in Electricity Generation in East Asia**  
Cumulative 2010-2050 in GW



Jazz 2050	Symphony 2050
<ul style="list-style-type: none"> <li>• Dominance of supercritical coal generation.</li> <li>• Penetration of gas from 2030 onwards.</li> </ul>	<ul style="list-style-type: none"> <li>• Coal generation switches to IGCC with CC(U)S in 2050.</li> <li>• Nuclear share increases (led by governments).</li> <li>• State investment is made in solar and other renewable energy.</li> </ul>

# Investment needs in electricity generation in Latin America and the Caribbean



## Jazz 2050

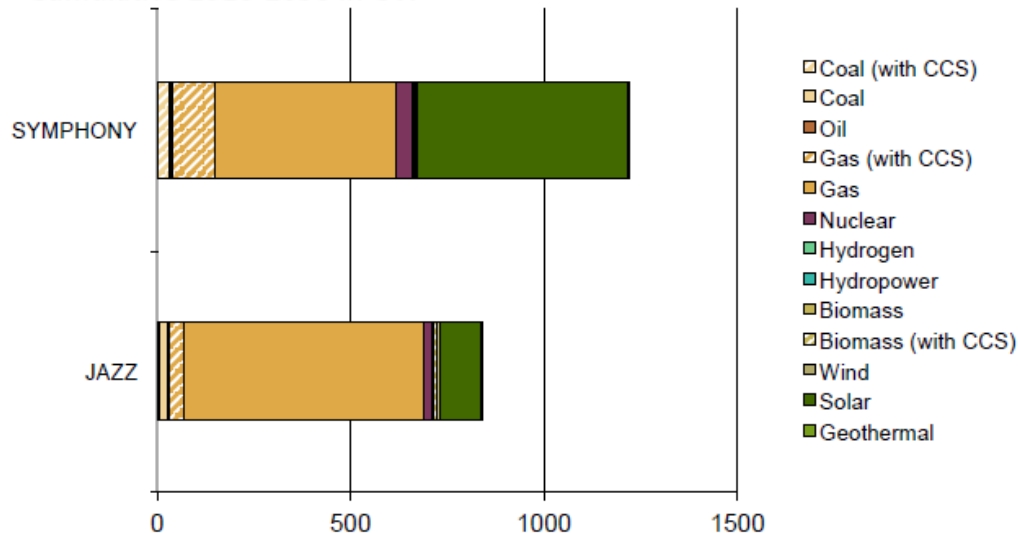
- Hydro-based electricity is the dominant source.
- Gas emerges as a fuel for power generation (Brazil).

## Symphony 2050

- Development of hydropower facilitated by improvements in grid infrastructure (LAC-wide grid).
- Gas is used mainly for peak load generation.

# Investment needs in electricity generation in the Middle East and North Africa

**Investment in Electricity Generation in Middle East and North Africa**  
Cumulative 2010-2050 in GW



Symphony cumul. undiscounted investment: 1.4 trillion US\$2010

Jazz cumul. undiscounted investment: 0.7 trillion US\$2010

### Jazz 2050

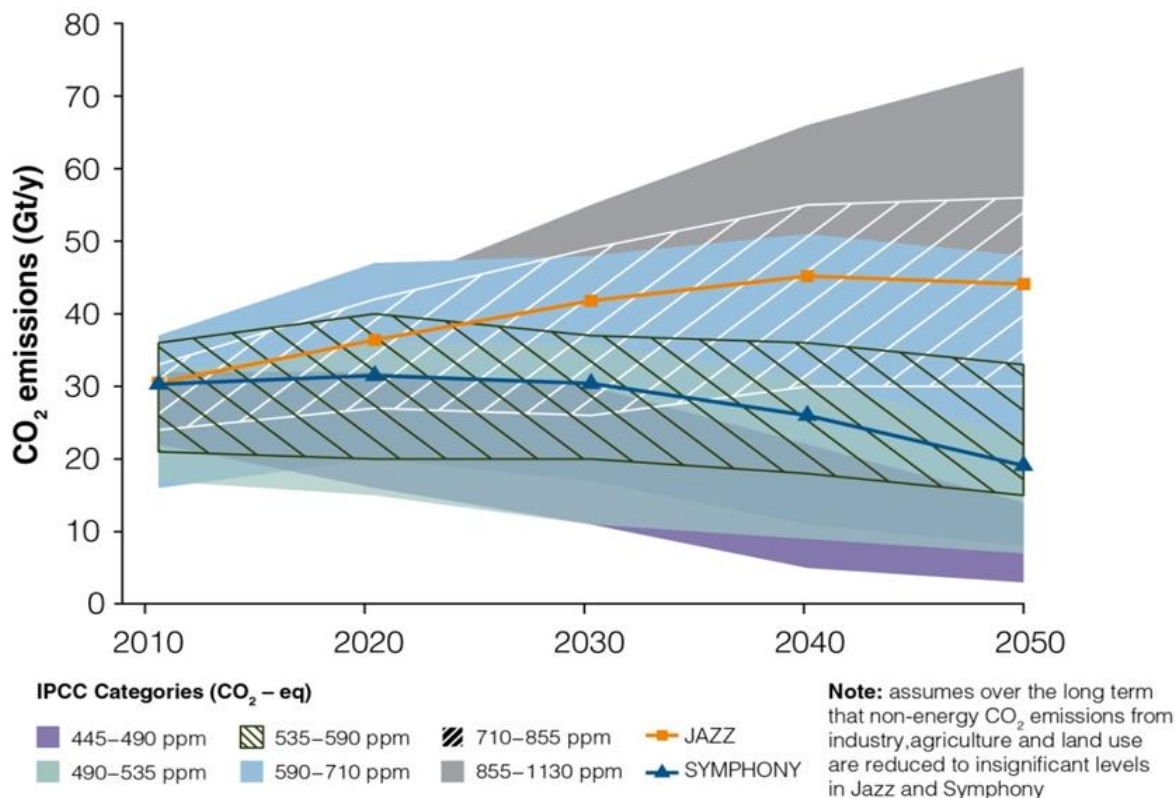
- Gas is the main choice for power generation.
- Oil-generated electricity drops sharply.
- Solar and nuclear capacity is added.

### Symphony 2050

- Gas remains the main choice for power generation.
- Large investments in solar.
- Nuclear electricity is led by the government.

## Global CO<sub>2</sub> emissions by region

Emissions trajectories for atmospheric GHG concentrations



### JAZZ:

- Energy choice based on free markets
- limited regulations supporting low-carbon energy (but regional diversity)

### SYMPHONY:

- Priority to environmental sustainability
- CO<sub>2</sub> reduction obligations, carbon taxes, CC(U)S mandates, renewable energy subsidies
- consequently: global carbon price emerges

***The global economy will be challenged to meet the 450 ppm target without enormous economic costs***

## Global issues of high uncertainty and high impact on the energy future

the WEC has identified key global issues of high uncertainty and high impact that will shape the energy landscape until 2050, in particular:

- The post-Fukushima nuclear future.
- The game-changing shale gas, especially in North America.
- Supply uncertainty and price volatility related to the 'Arab Decade' in the MENA region.
- The shift of demand to the East, in particular East Asia.
- Tumbling solar cell prices and related trade disputes between Europe and China or the US and China.
- Climate framework uncertainty.
- Global economic trends and the global recession.

## Conclusions: energy and electricity generation mix in 2050

- **Energy efficiency** is absolutely crucial in dealing with demand outstripping supply in both Scenarios;
- **Coal** remains a dominant fuel (especially in China and India), CCS is critical to coal in Symphony;
- **Natural gas** will gain more importance in the energy share especially in Jazz;
- **Oil** will continue to be the dominant fuel in transport with growth in natural gas in Jazz and Biofuels and electricity in Symphony;
- **Nuclear** is not a game changer but is important in Symphony;
- **Hydro**: great economic potential of hydro electricity generation especially in SSA and LAC ;
- Share of **renewables** increases in Symphony. Solar takes off;
- **Future electricity generation mix will be subject to tremendous changes up to 2050 with an increasing complexity of the system.**



*THANK YOU FOR YOUR  
ATTENTION!*

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