

Le défi de la décarbonisation

Entre rêve et réalité



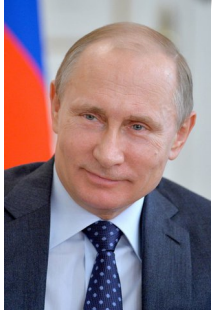
**ENERGY
CENTER**

François Vuille

15 Nov 2016

Ubiquité de la COP21 dans les discours

The world must focus on decarbonising its energy sector



V. Putin

But fossil fuel will continue to be essential to eliminate energy poverty

S-A want to see Paris contract implemented

But fossil exploration need to be kept high to meet demand

But renewable will not grow faster to contribute more than 15% by 2030.

BAU cannot continue. We know the endpoint which is alternative energy.



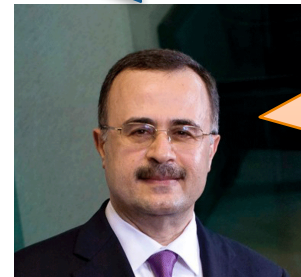
Al falih, Energy minister S-A

We are more aware than ever of the need to decarbonise

But oil & gas is still needed and US\$ 300 bn will be invested to grow fossil production.



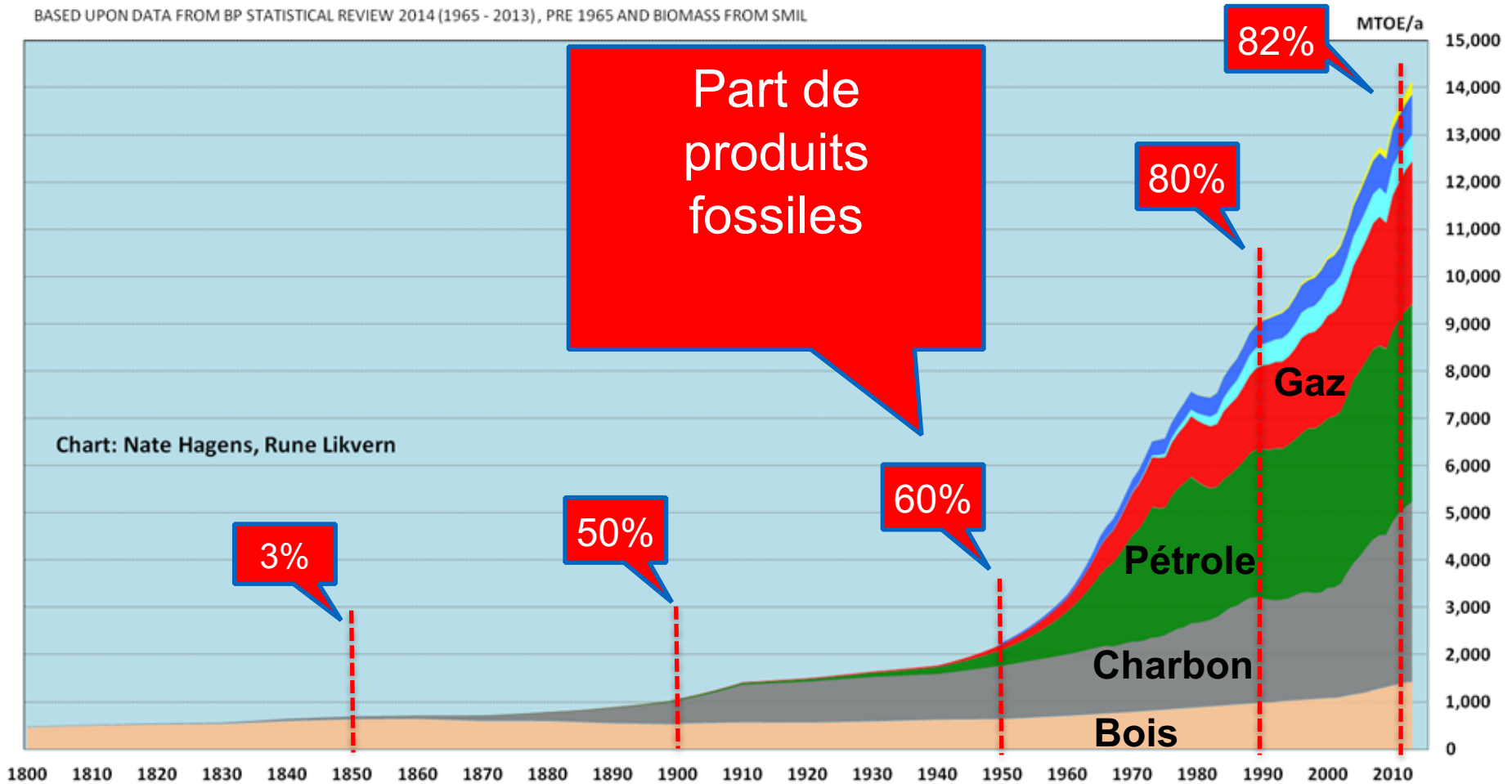
Dudley, CEO BP



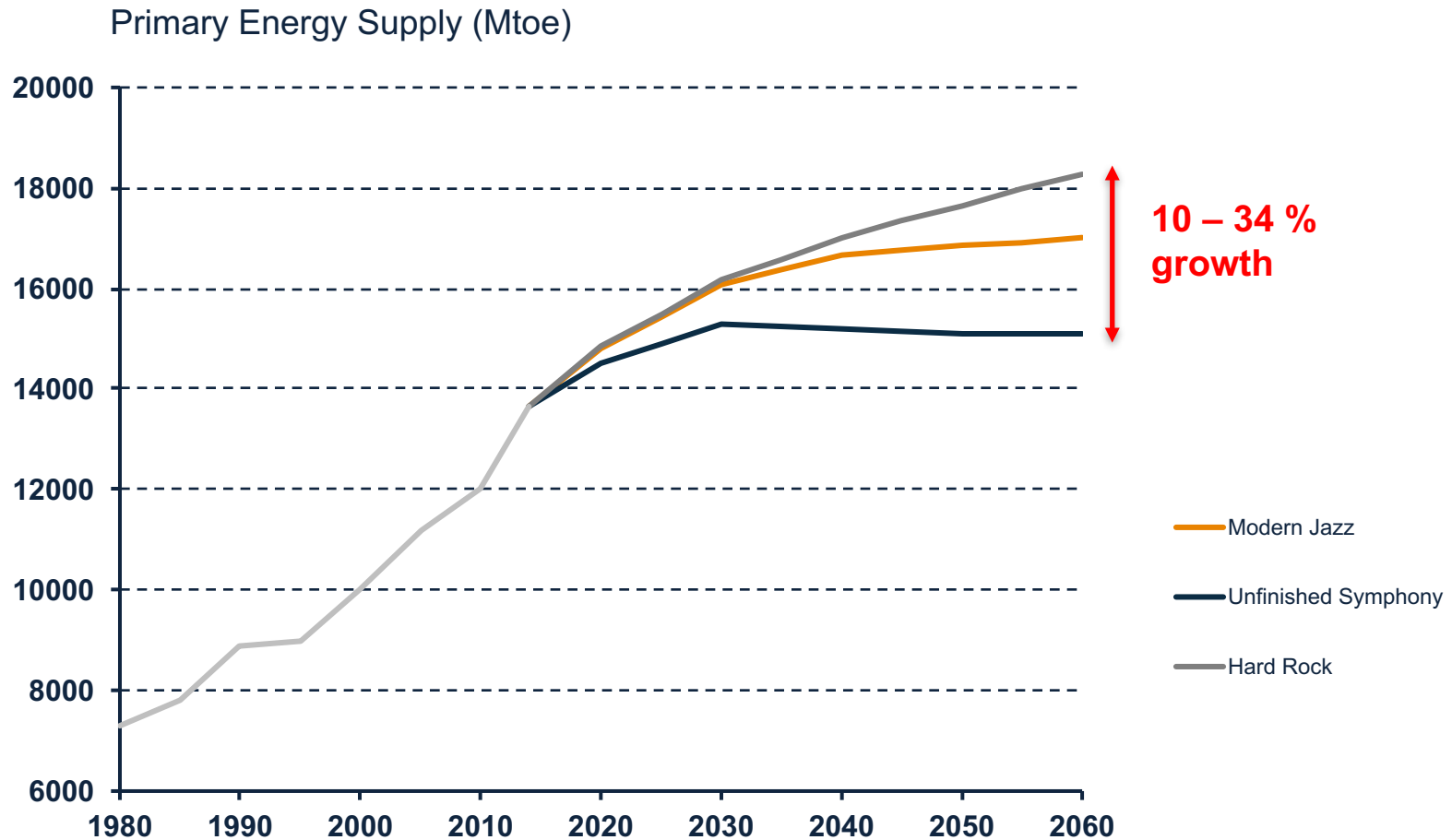
Nasser (CEO Aramco)

Systeme énergétique aussi fossile qu'inertiel

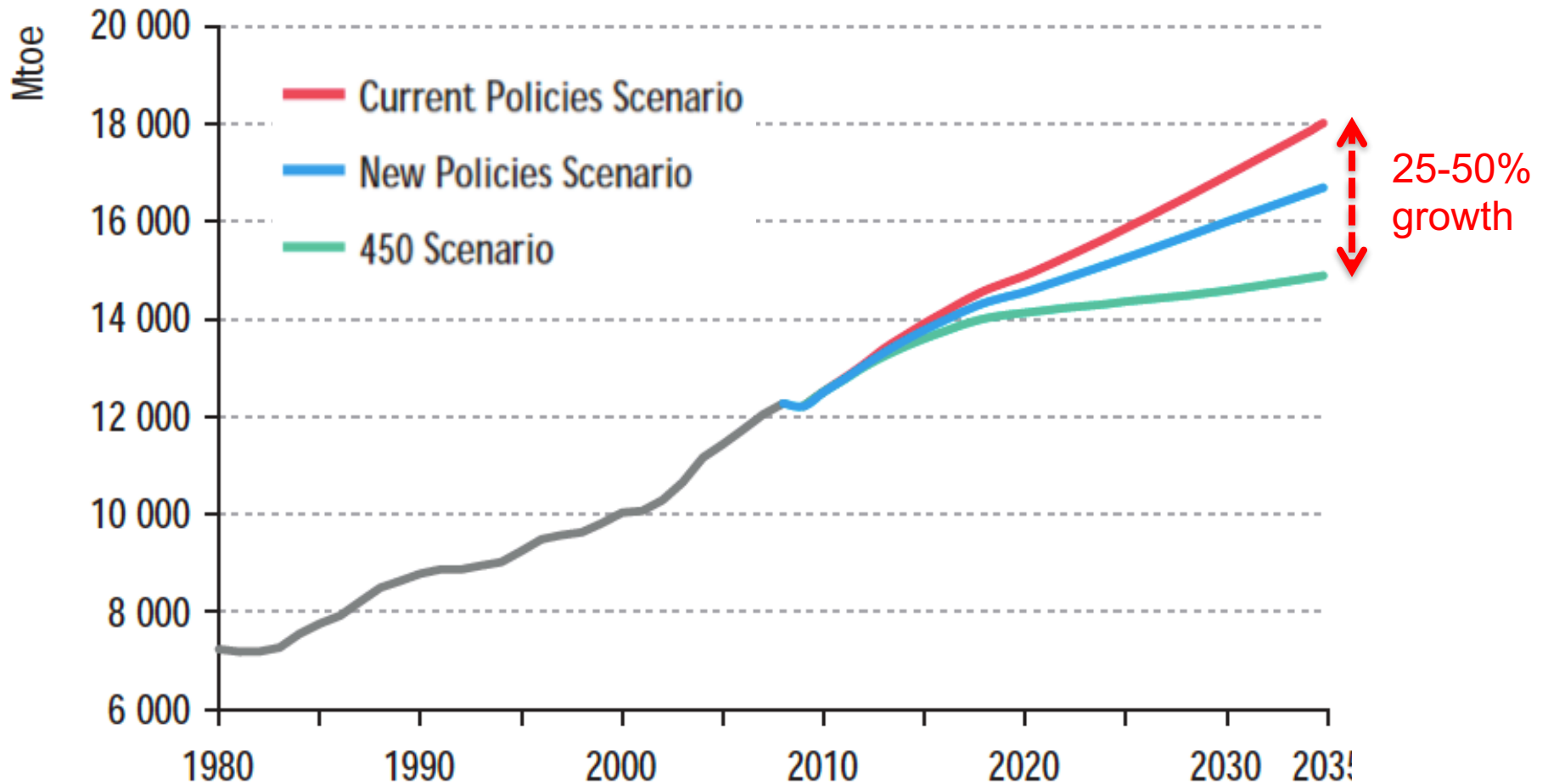
BASED UPON DATA FROM BP STATISTICAL REVIEW 2014 (1965 - 2013), PRE 1965 AND BIOMASS FROM SMIL



Demande croissante selon WEC



... et selon l'Agence International de l'Energie (IEA)



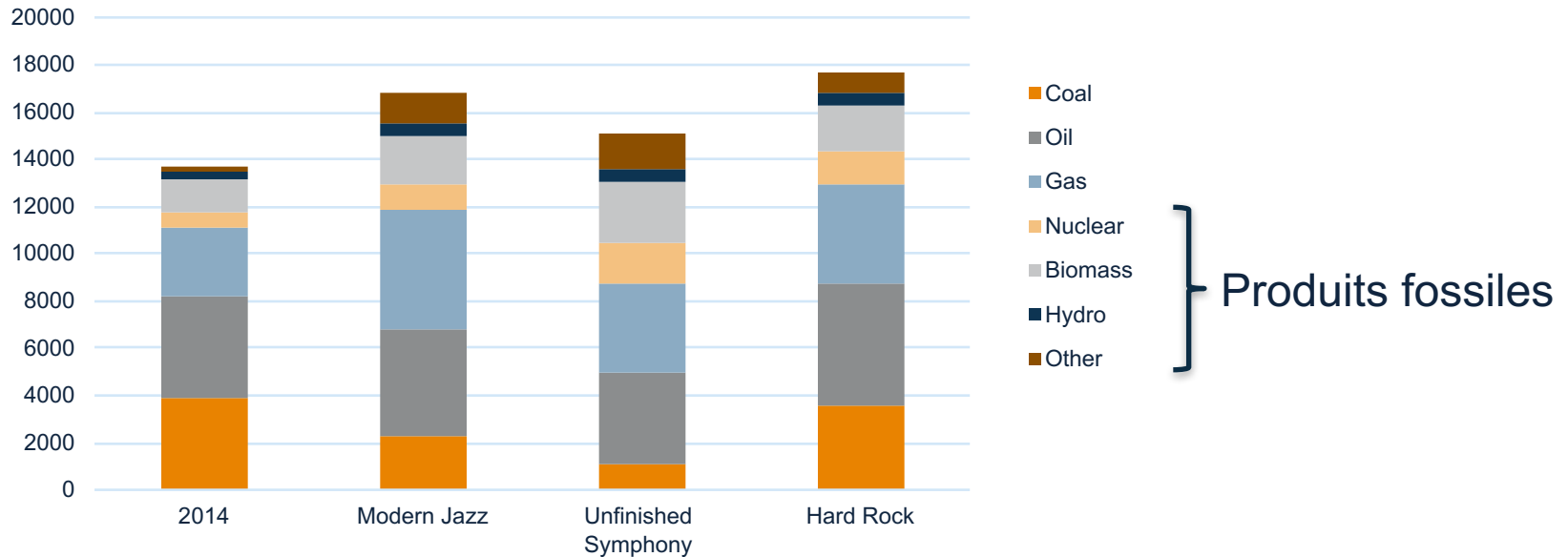
L'Asie va augmenter massivement sa demande

Primary energy demand, 2035 (Mtoe)

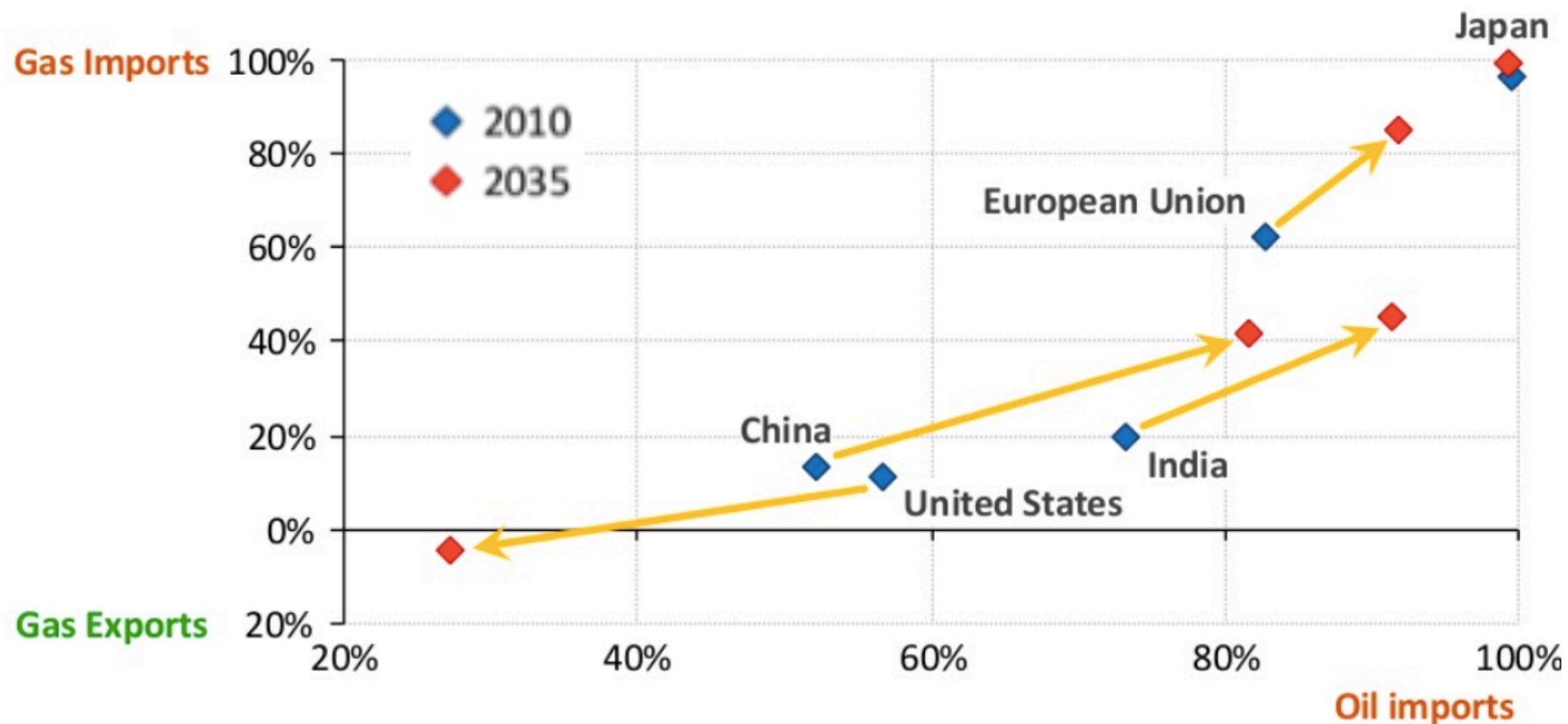


Part de produits fossiles en 2050

► 75% en 2050 (KIM- Chairman WEC)

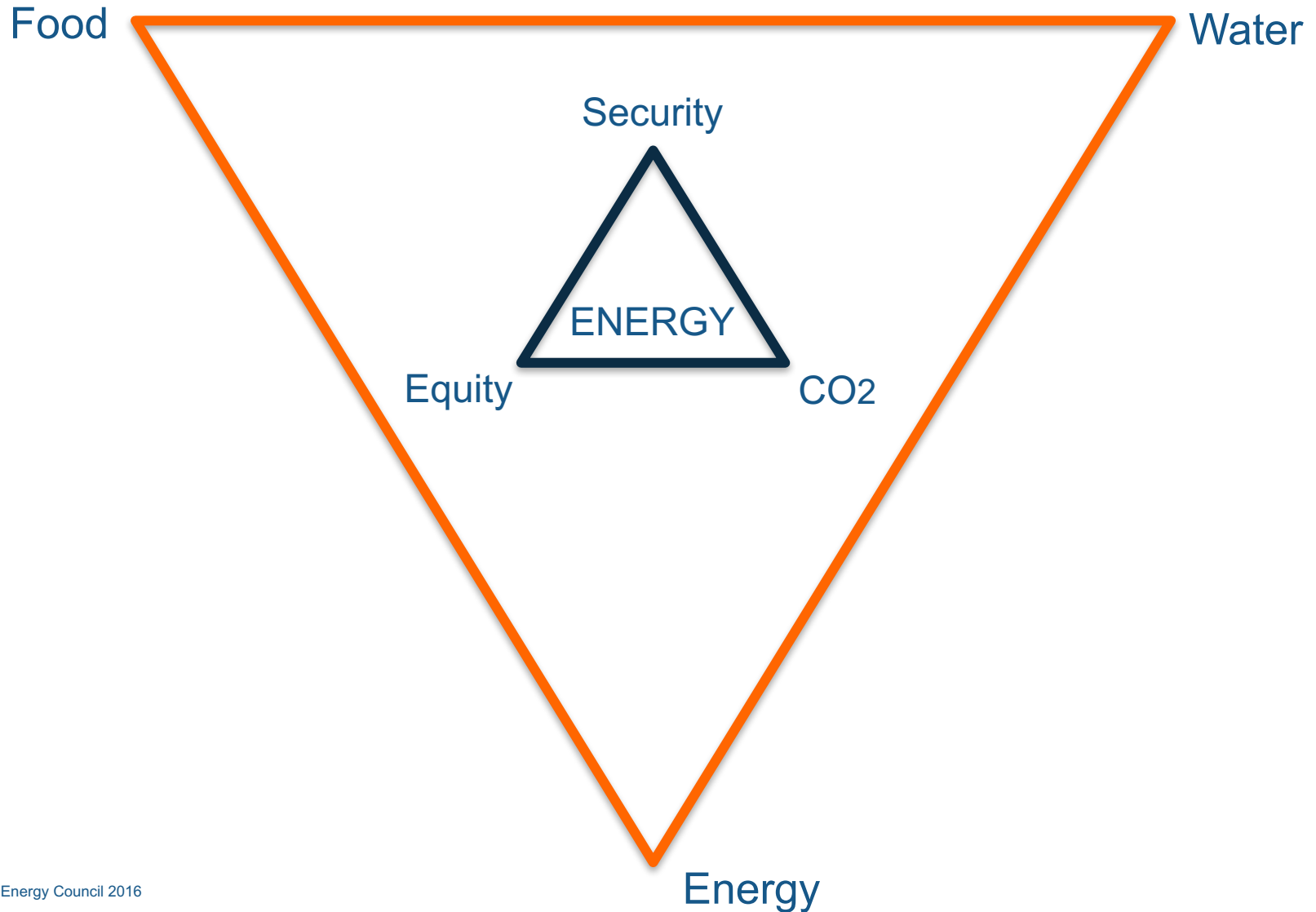


La dépendance énergétique de la plupart des pays va augmenter => Moteur #1 de la transition

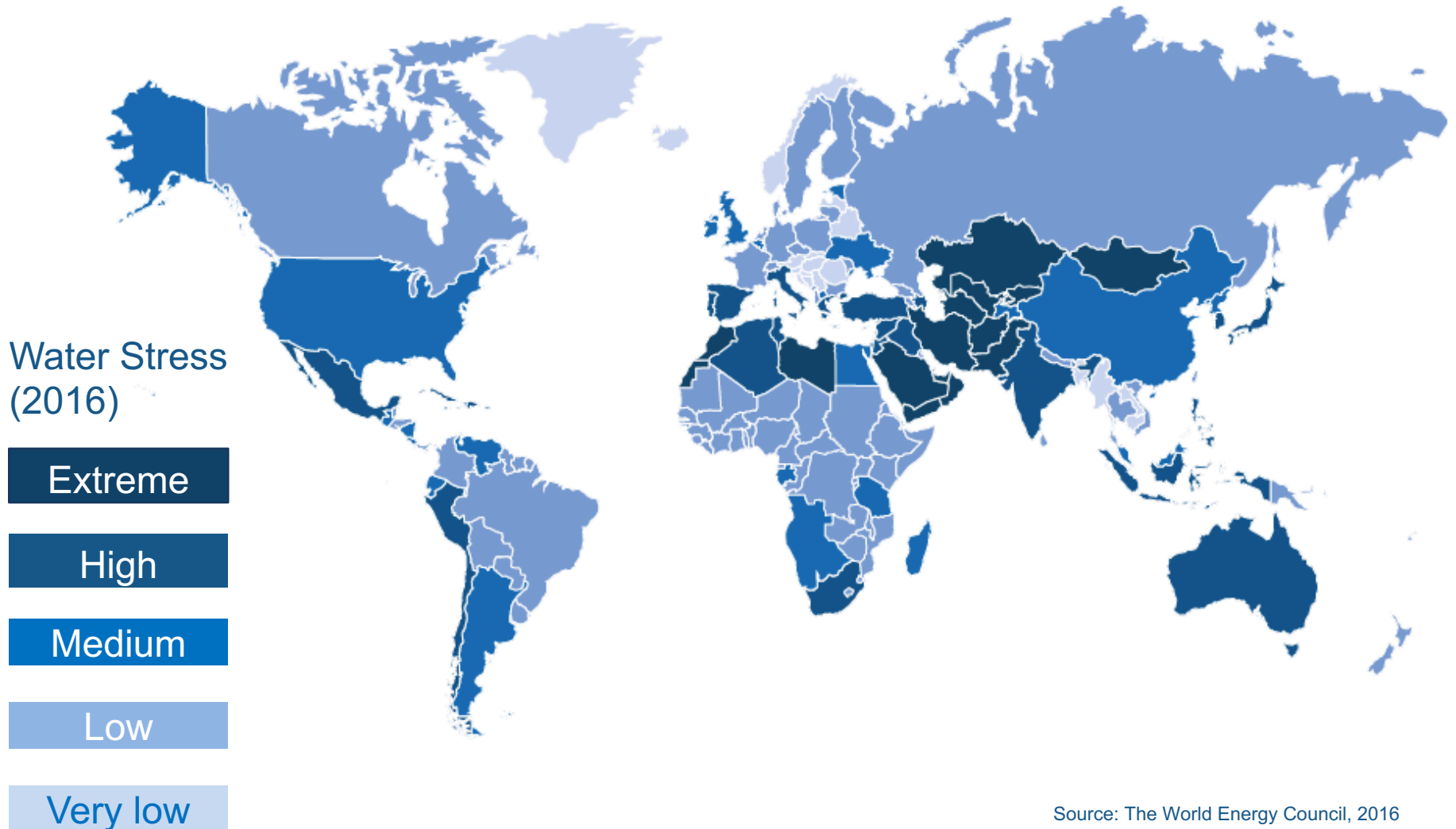


Source: IEA World Energy Outlook

Double “energy trilema”



Water-Energy-food nexus



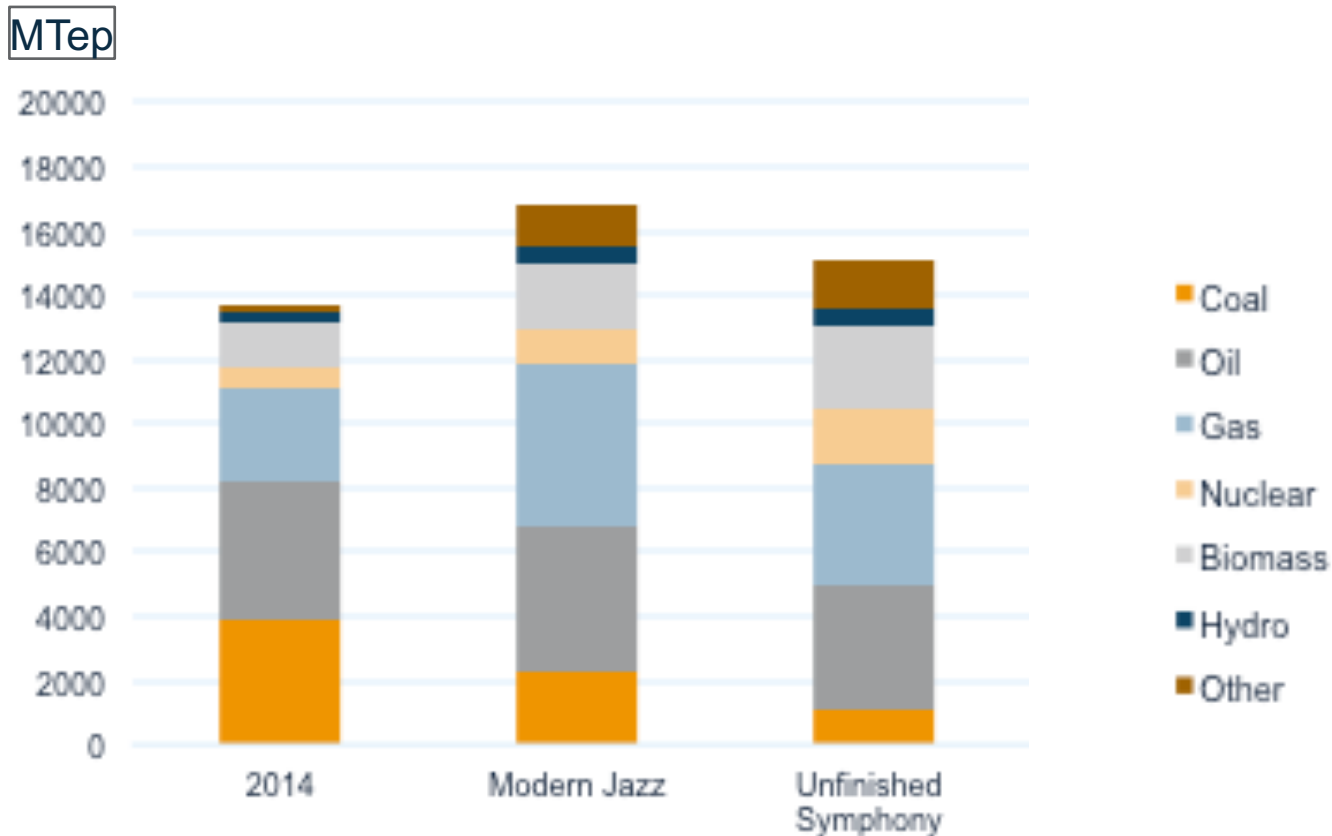
Source: The World Energy Council, 2016

OPTIONS DE DECARBONISATION

Décarbonisation du secteur fossile

1. Fuel switching
2. Eviter les centrales sous-critiques
3. Eliminer le flaring
4. Capture, utilisation et stockage du CO₂ (CCUS)
5. Hybridisation des véhicules
6. Compensation

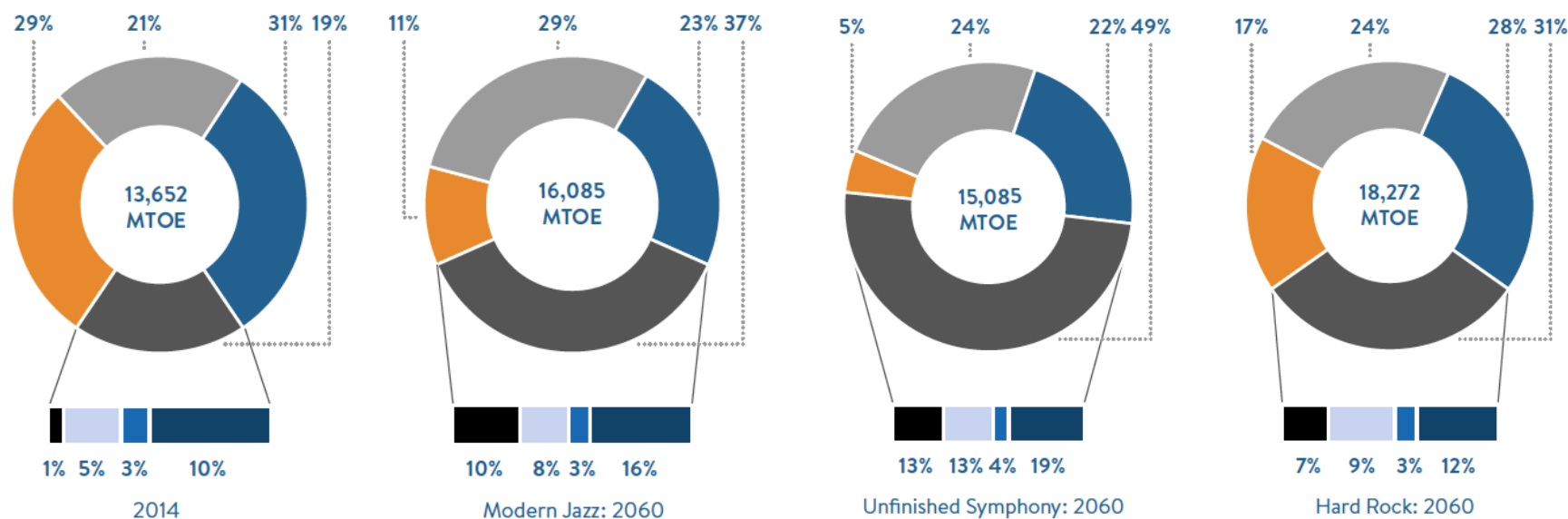
Fuel switching – Coal/oil => Gas



Décarbonisation du secteur fossile

► Fuel switching: Charbon / Pétrole => gaz naturel

FIGURE 48: PRIMARY ENERGY MIX (2014-60)



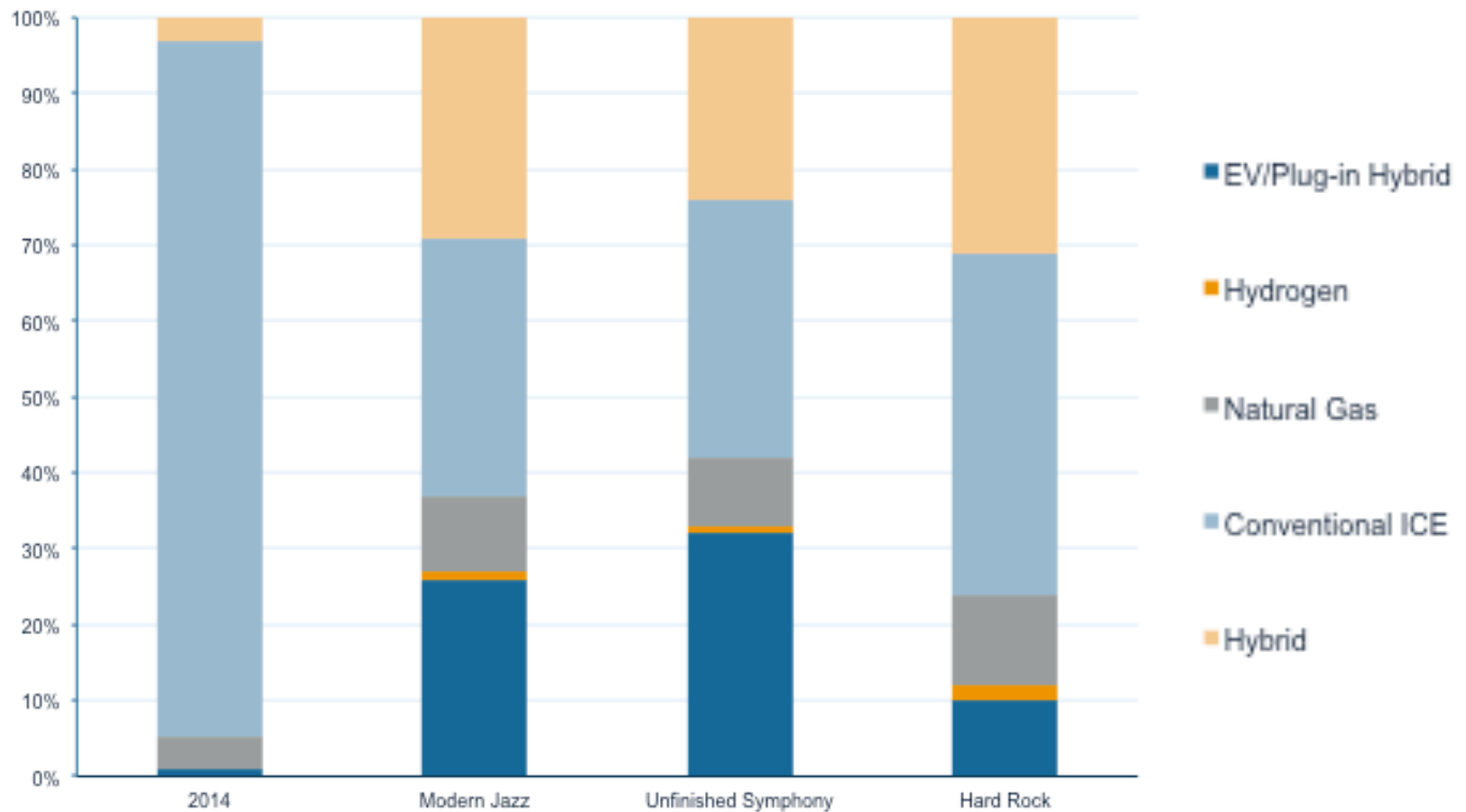
Source: The World Energy Council, Paul Scherrer Institute and Accenture Strategy



Décarbonisation du secteur fossile

1. Fuel switching
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4. Capture, utilisation et stockage du CO₂ (CCUS)
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6. Compensation
 - Investissement dans l'électricité renouvelable
 - Reforestation ?!

Diversification des véhicules



Décarbonisation du secteur fossile

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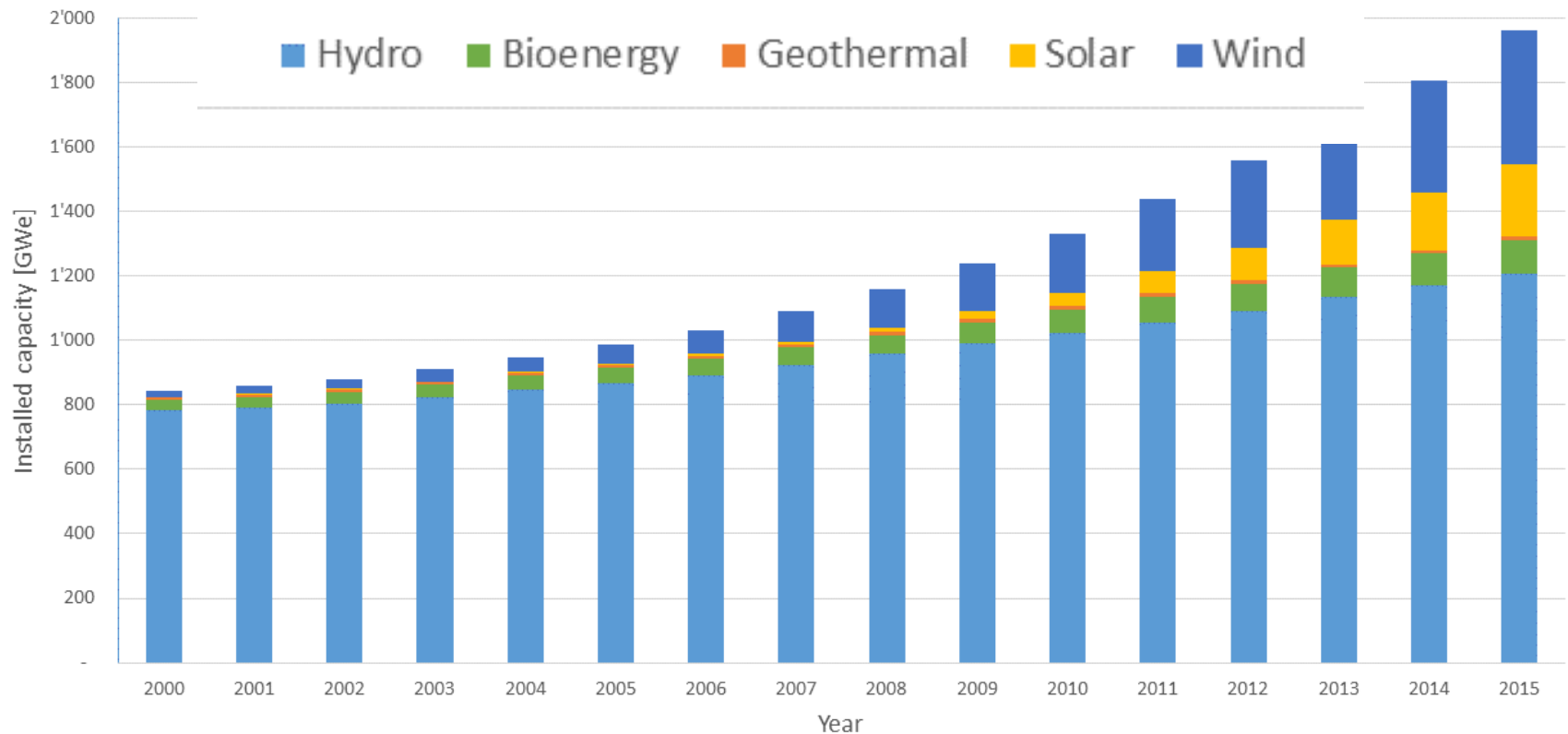
L'option renouvelable

- ▶ Grosse divergence de vue sur la capacité de déploiement
- ▶ Si RE déploiement plus rapide que n'importe quel fuel par le passé, il ne couvriront au mieux 15% de la demande en 2035.
- ▶ Solar: 2.5 cents in UAE
- ▶ Solaire & éolien vont poursuivre leur boost (30% de la capacité installée et 23% de la prod en 2015) (CEO CESI)
- ▶ Low tech can be particularly effective (KIM)
- ▶ Jump-start might be an effective option for the developing world, avoiding costly and CO2 intensive infrastructures
- ▶ Plus de biocarburants dans le discours, mais des fuels synthétiques

Croissance renouvelable suffisante ?

- ▶ Grosse divergence de vue sur la capacité de déploiement malgré compétitivité et croissance historique
- ▶ Biocarburants => fuels synthétiques

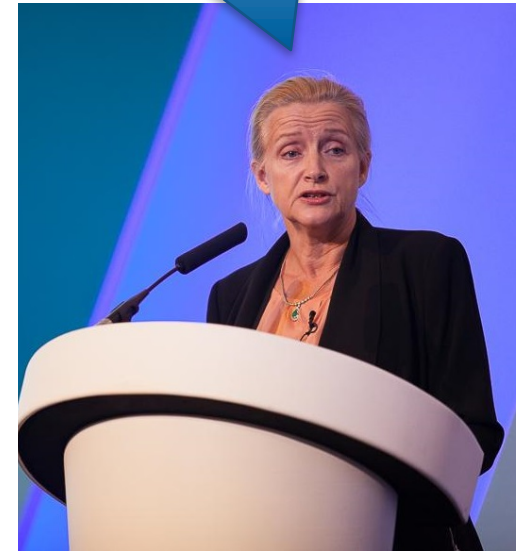
World renewable electricity installed capacity



Le rôle croissant du nucléaire

- ▶ EU en sort, le Monde y entre
- ▶ Objectif WNA: 1000 GW d'ici 2050
- ▶ Surprises:
 - Manque d'objectivité chronique de la branche.
 - Peu sur les 3G / 4G.

We need a safety paradigm where the excellent record of nuclear is put in full context



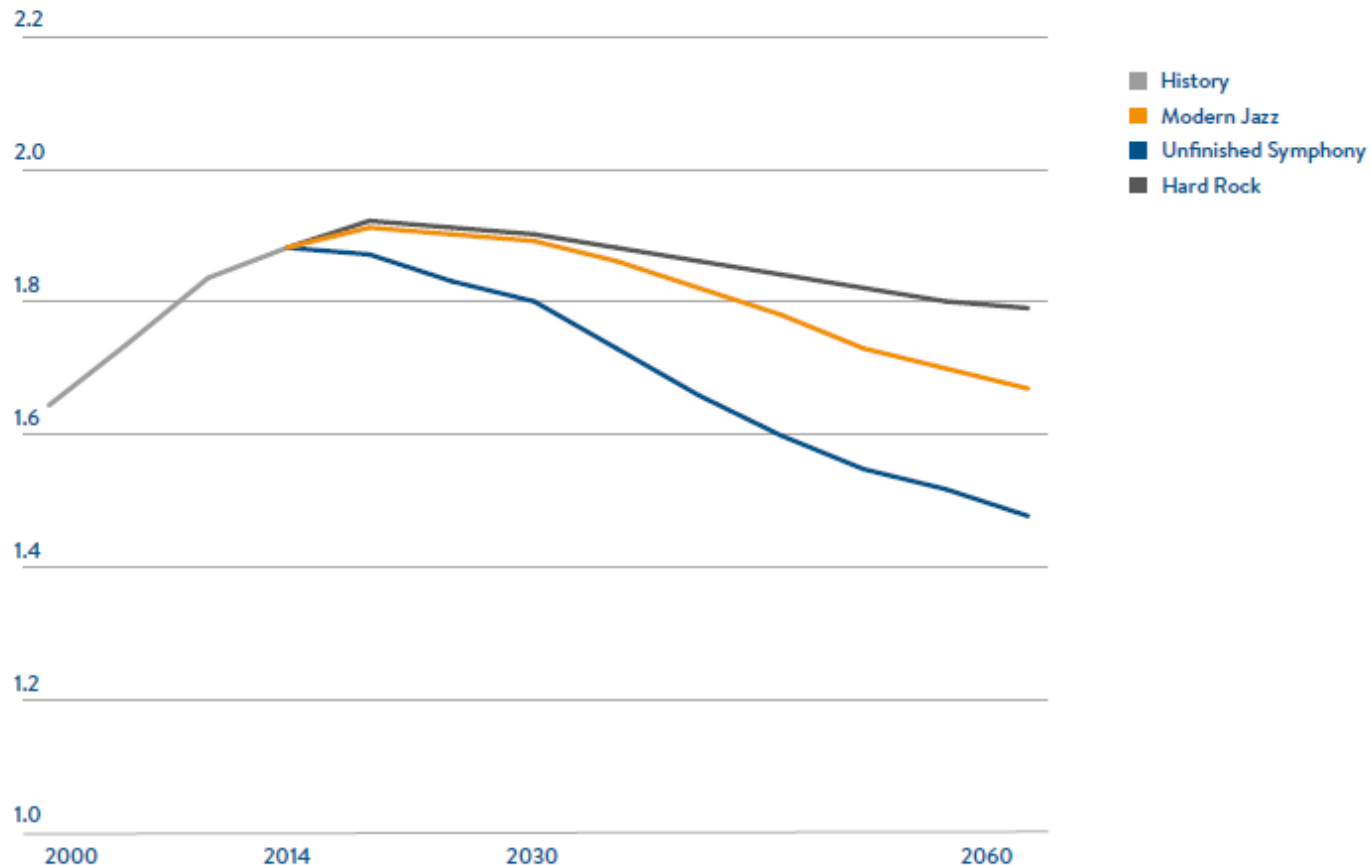
Agneta Rising
DG World Nuclear Association

Le défi de l'efficacité énergétique (EE)

- ▶ EE is #1 fuel. Fait trop souvent ignoré (Birof, ED IEA).
- ▶ Economiquement viable: 1\$ in EE évite 2\$ de génération
- ▶ Mais:
 - Retour sur investissement trop long
 - Manque d'approche globale
- ▶ Cible: 2.6% de baisse de l'intensité énergétique ne sera pas atteint

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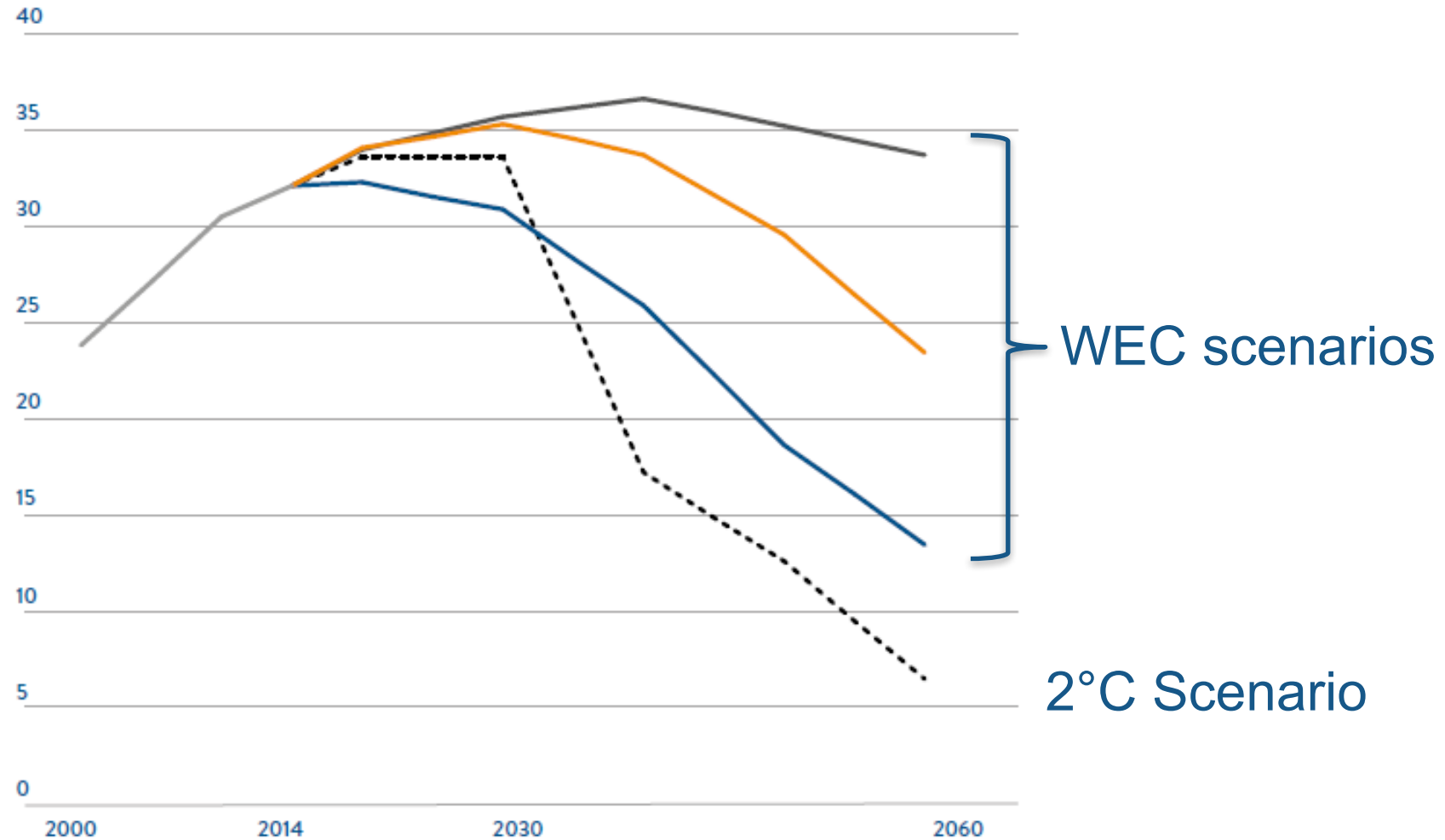
Per Capita Primary Energy Demand (TOE)



Source: World Energy Council, Paul Scherrer Institute, Accenture Strategy

=> Décarbonisation insuffisante

Annual Carbon Emissions (Gt CO₂)



Drivers and barriers

- ▶ Digitalisation (smart & big data) is #1 enabler of energy transition (CEO GE, Teyssen CEO? EON, Kim, Chairman WEC)
 - Enables demande response & prosumers
 - Disruptive to operation and business model, inp particular in a context of market liberalisation which allows for new entrants.
- ▶ Customer desire is also critical
- ▶ Money is not an issue, key bottleneck is policy (CEO Engie)
- ▶ Low oil price might actually play in favour of renewables as this defers investment in fossil exploration which threatens long term supply. (CEO Aramco)
- ▶ No single option: energy transition will differ significantly between countries depending on socio-economic context and energy system legacy (CEO CLP)
- ▶ Standardisation will be critical
- ▶ Cyber security issues increases with grid interconnectivity and poor technology choices.
- ▶ Removing subsidies to fossil fuels (500 bn/year) will see NG emerge as a winner
- ▶ CO2 pricing (70-80 is needed, 60 allows sorting market)

Money is not an issue

▶ Figures:

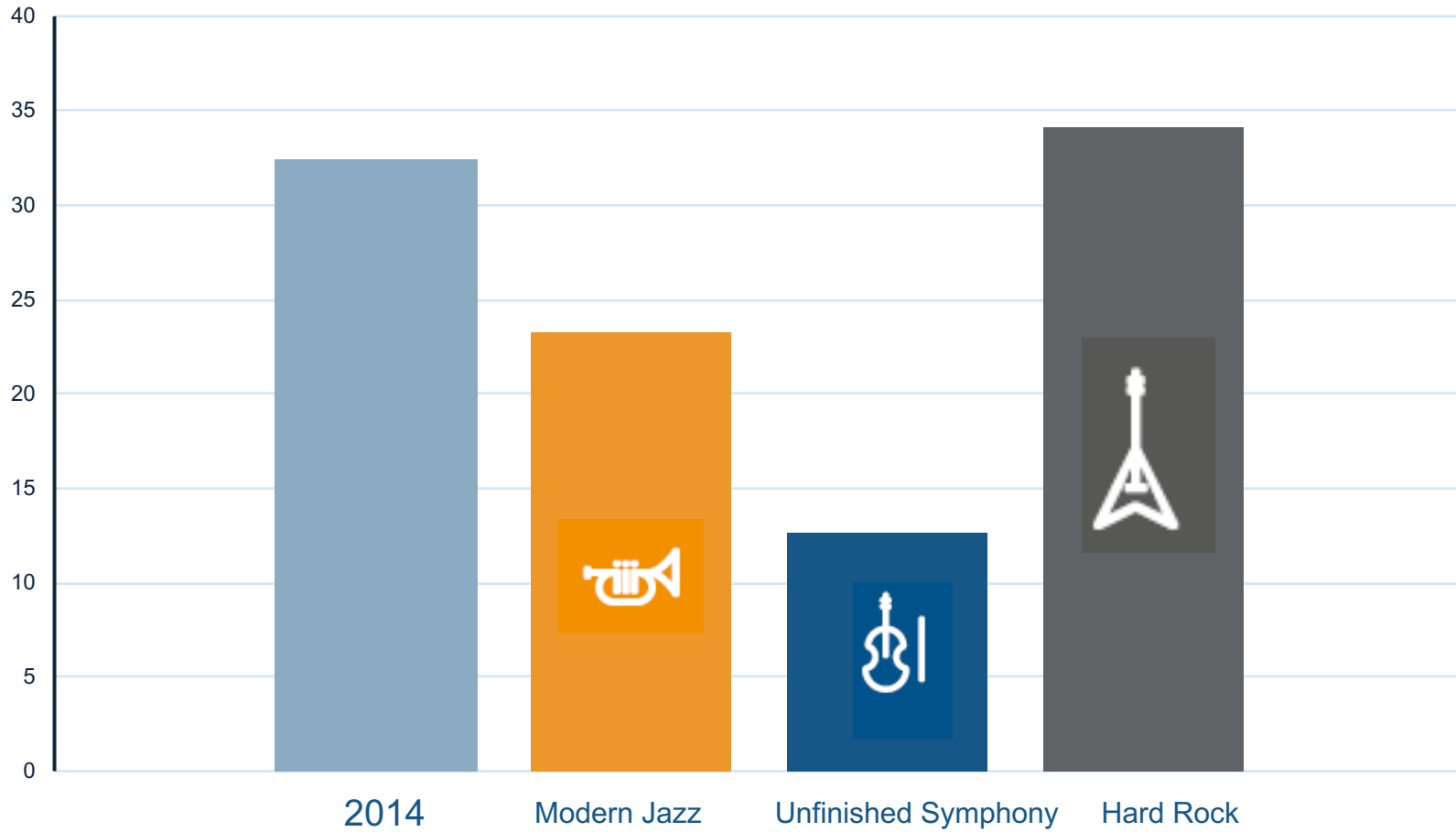
- 20-50 bn/year to finance trilema
- 40 trillions for grid to 2060 (
- But figures don't consider the cost of BAU (fossil and nuclear will increase significantly in price)

▶ Projects bancable

▶ Remove uncertainty with clear Market signal is missing (e.g. stable carbon price)

- More divestment from fossil than investment in renewables

Carbon Emissions 2060 (GtCO₂/yr)



And the winner is...

L'hydraulique
n'est pas
renouvelable,
mais c'est quand
même une
énergie propre...



Ministre de l'énergie, Afghanistan

Left over material

▶ Novak

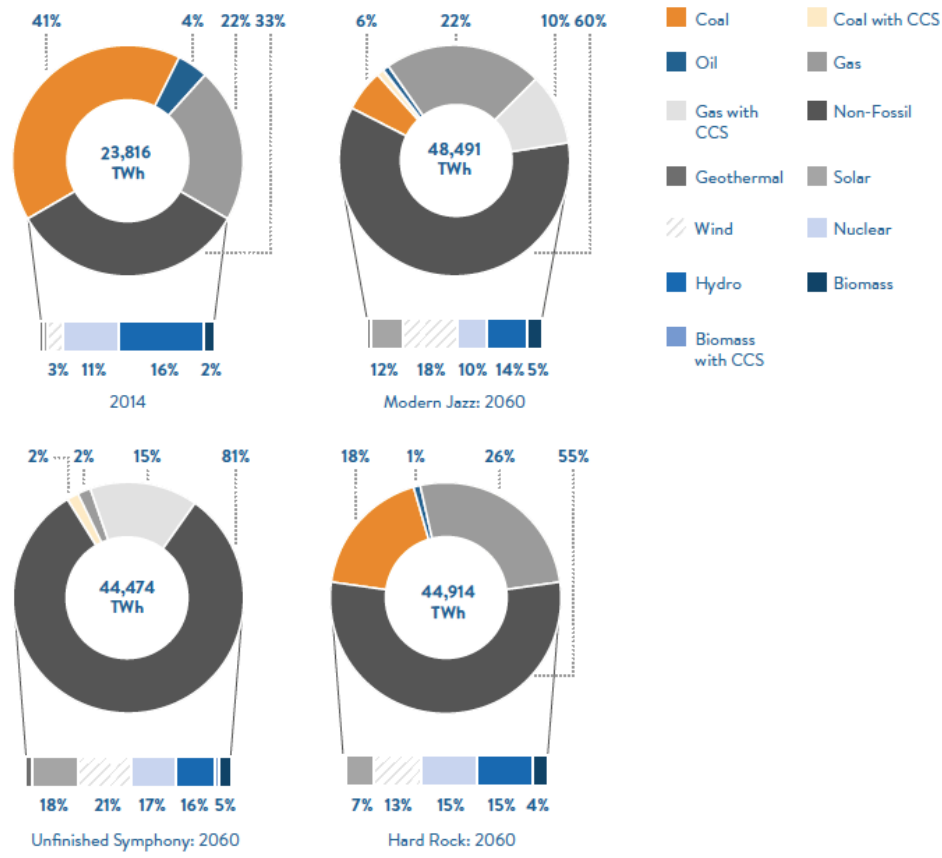
- Shorter investment cycles in fossil (<12 years) due to new technologies generate higher volatility. This is normal.
- Volatility kills investment

▶ Fedun: Low price does not allow for exploration in particular when the new resources found are high cost non-conventional stuff.

▶ Eating our way up the food chain is a big issue for water

China

FIGURE 46: GLOBAL ELECTRICITY GENERATION (TWh)



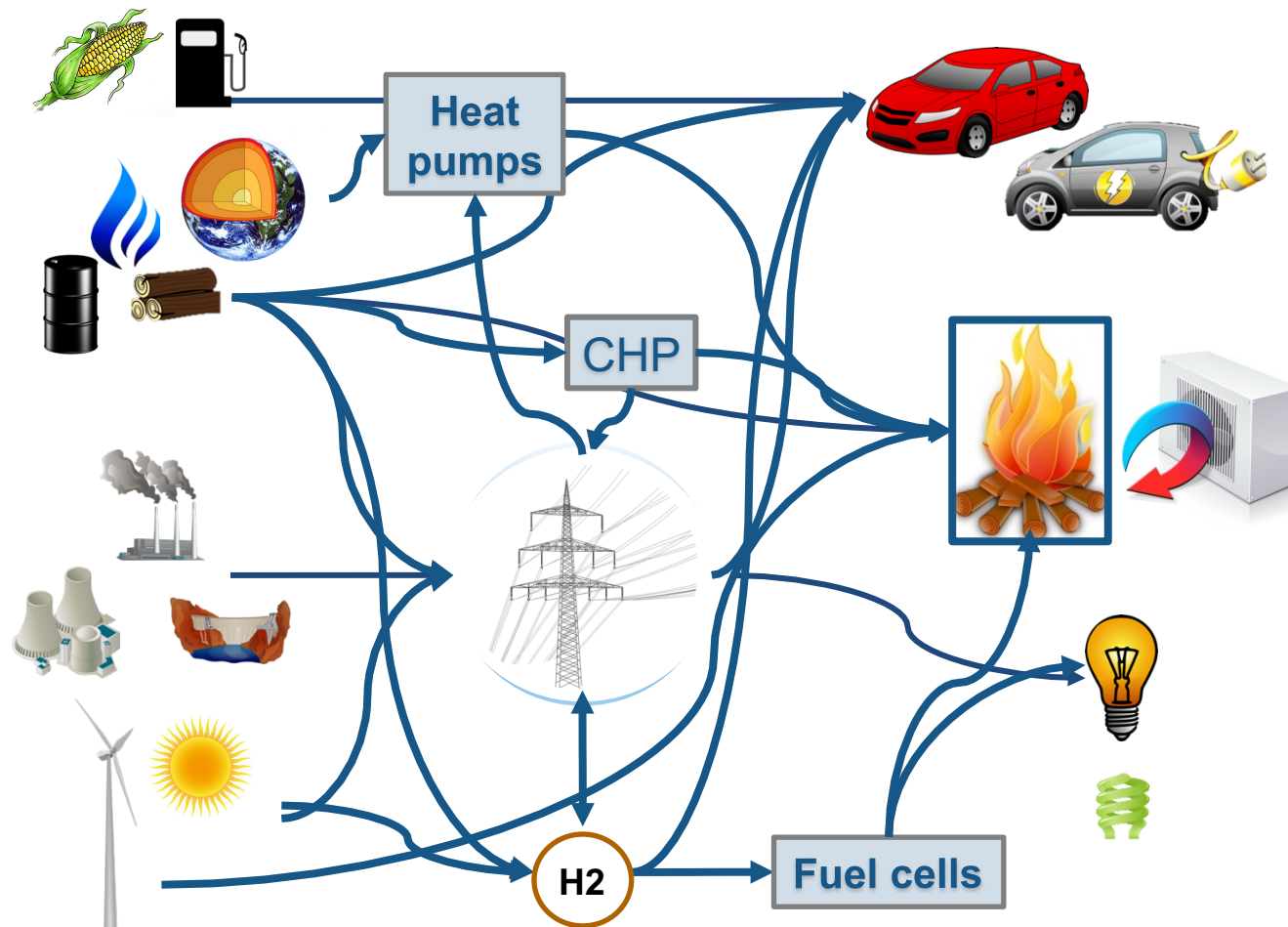
Source: The World Energy Council, Paul Scherrer Institute, Accenture Strategy

Notre système énergétique actuel est simple



- Pétrole pour transport
- Gaz, Mazout et bois pour chaleur
- Charbon, nucléaire et hydrau pour électricité

Tomorrow's energy system will be integrated



- Renewable energy sources will be increasingly exploited.
- Efficiency raise thanks to novel conversion and demand-side technologies lead to fuel switching
- Power system will play an increasingly important role