



economics_{for}
energy

Where is the energy sector heading? Looking at the future

Pedro Linares

Madrid, February 16th 2017



Why look at the future?

...for strictly logical reasons, it is impossible for us to predict the future course of history.

Sir Karl R. Popper

We don't predict the future, we prepare for it
Pericles (or somebody)

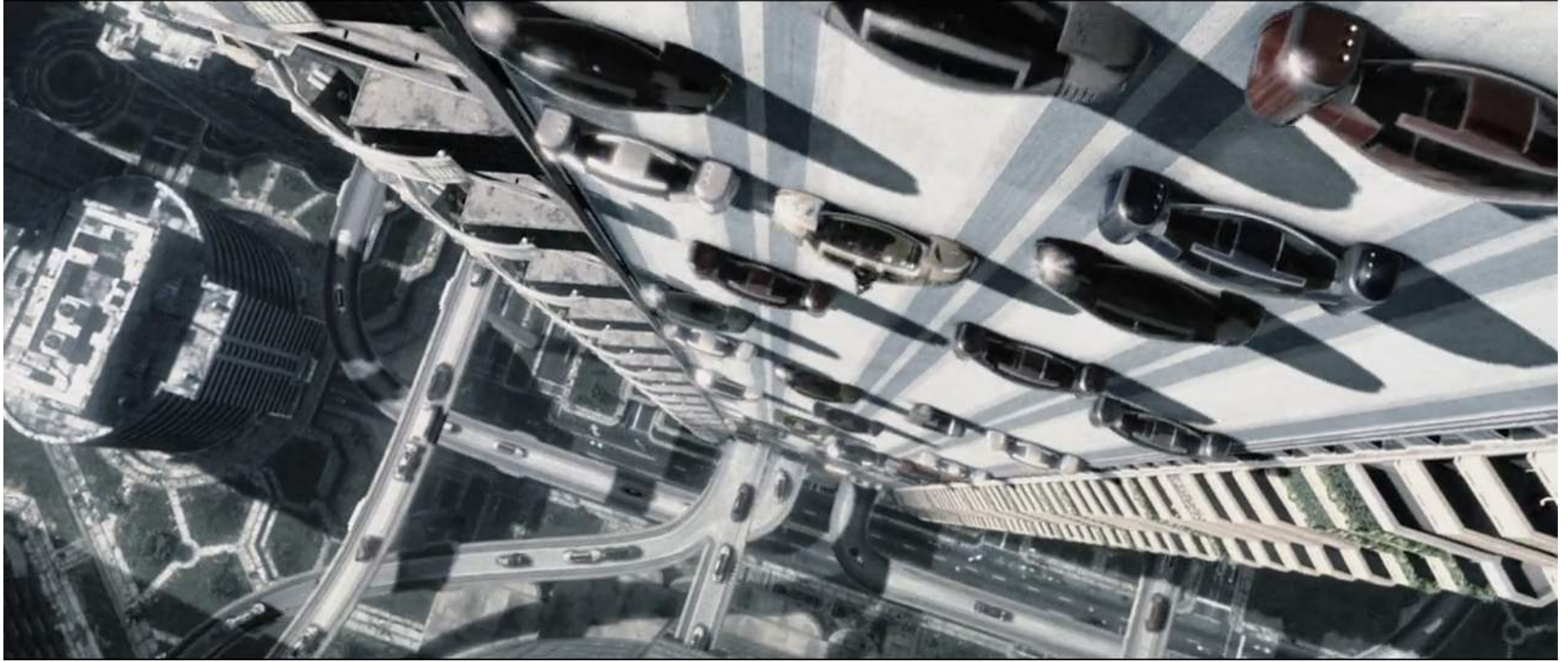
Many possible futures



Many possible futures



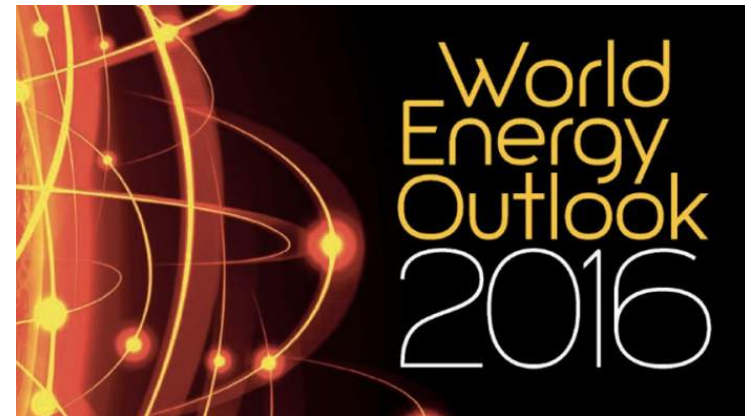
Many possible futures



Many possible futures



Many studies



CERA

GREENPEACE

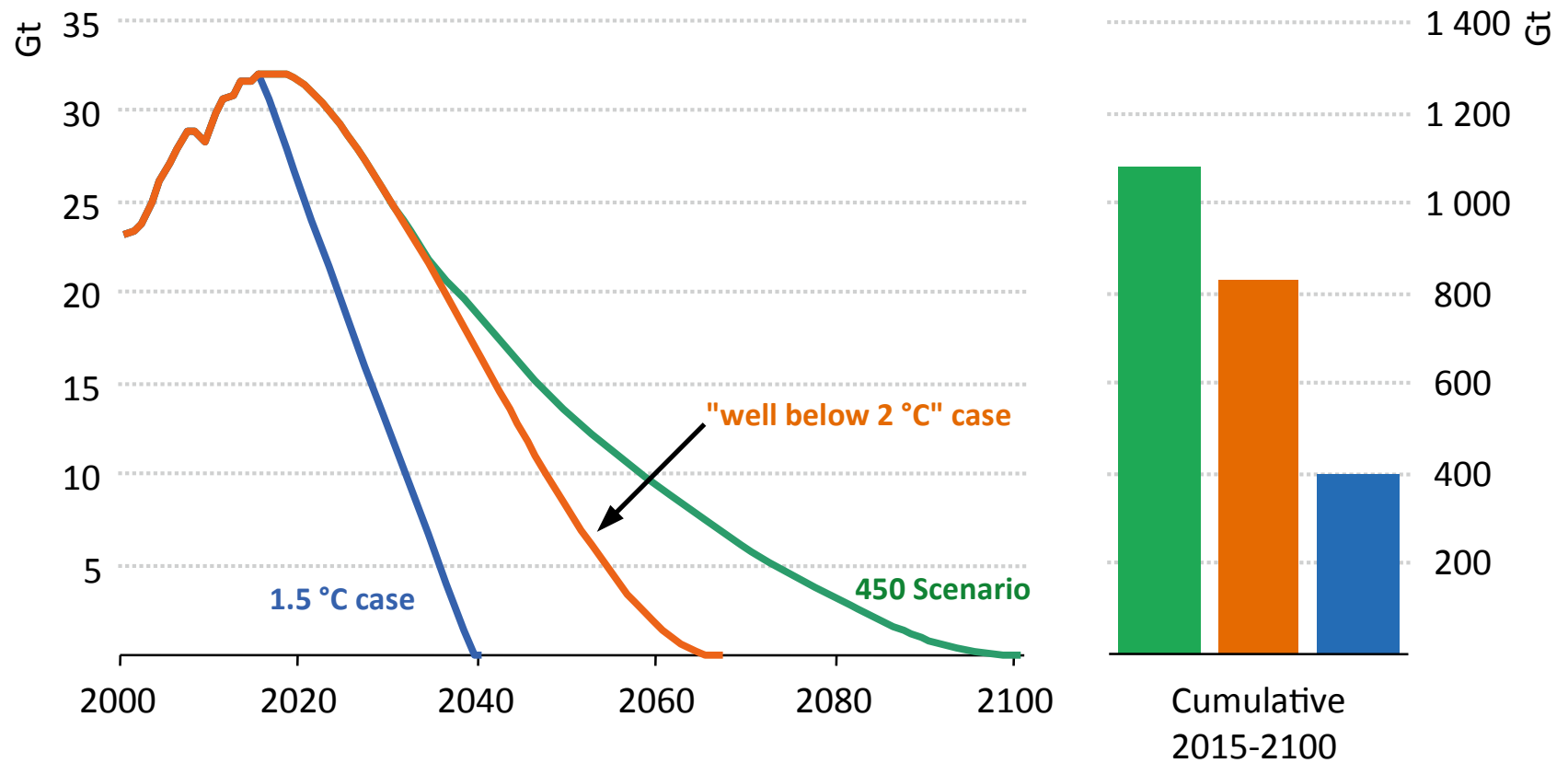
Bloomberg New Energy Finance



Normative vs Positive

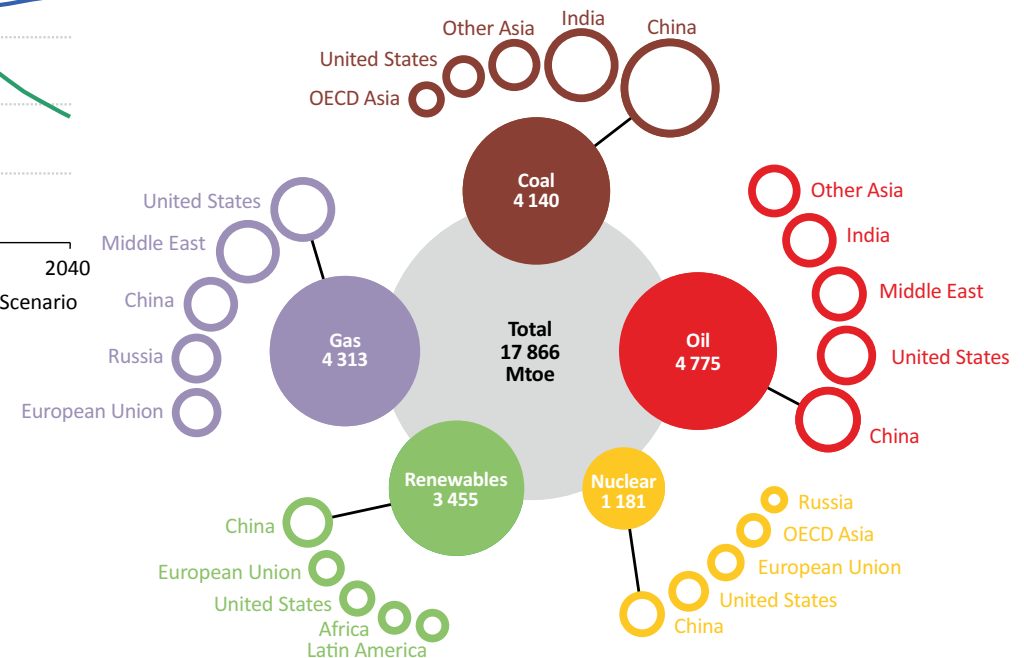
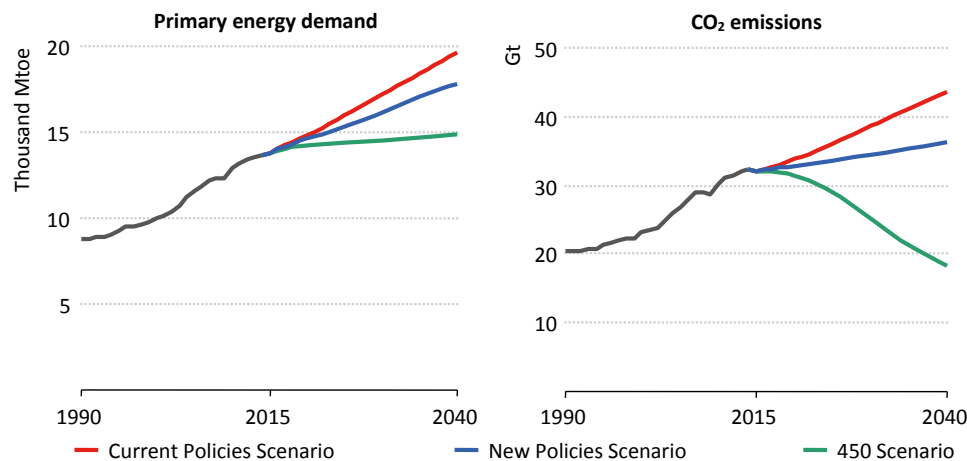
- Where is the energy sector going?
- Where do we want it to go?

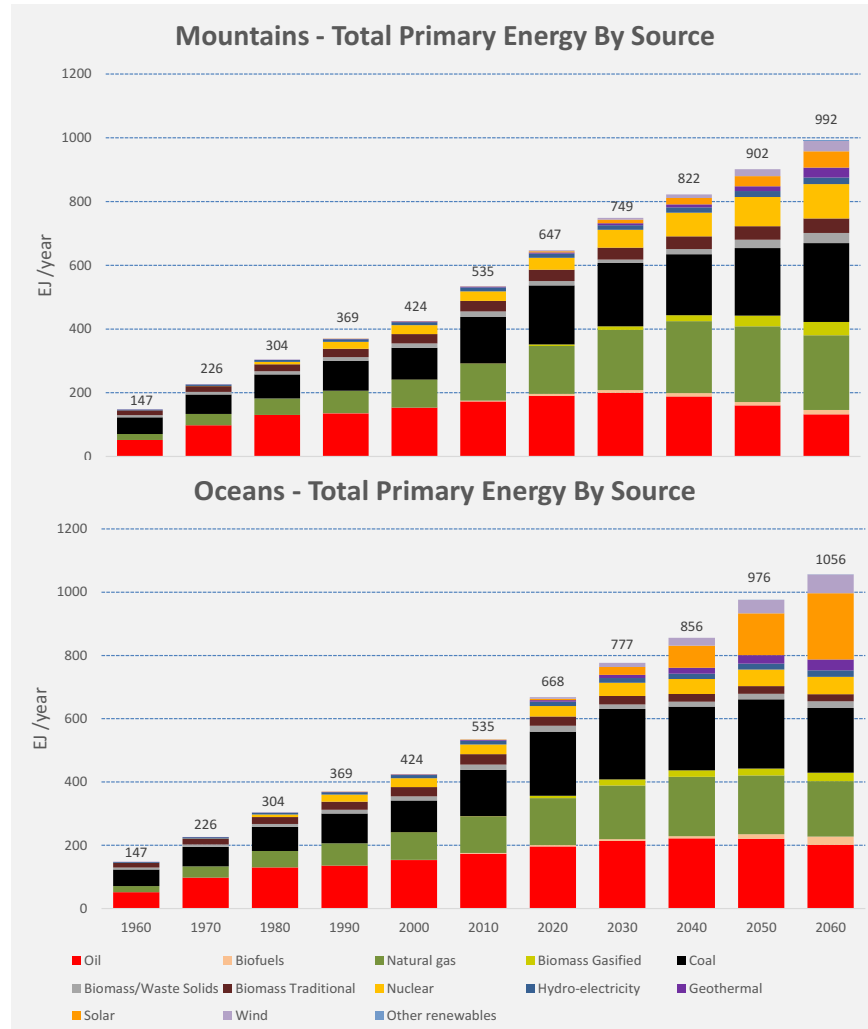
Deep decarbonization



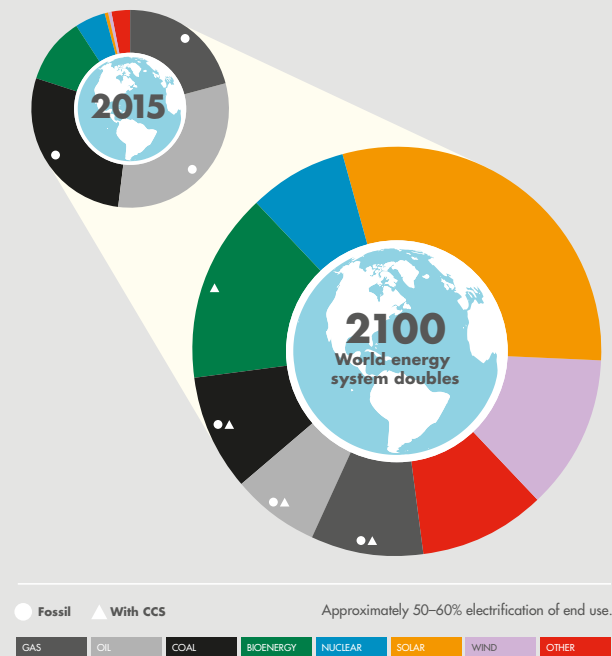
Without net-negative emissions, energy sector CO₂ emissions fall to zero by 2040 for a 50% chance of 1.5 °C and around 2060 for a 66% chance of 2 °C

- Large investment needs to keep supply flowing, even more to decarbonize
- The Paris goal (1.5°C) is almost unachievable



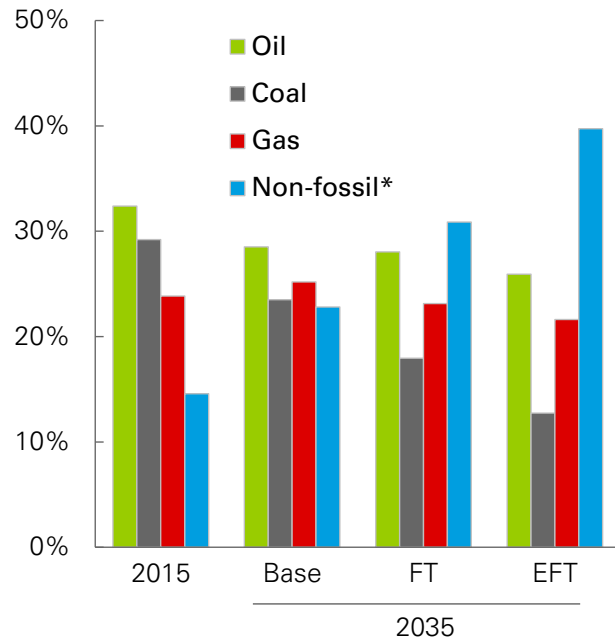


Plausible energy mix in an emerging net-zero emissions world

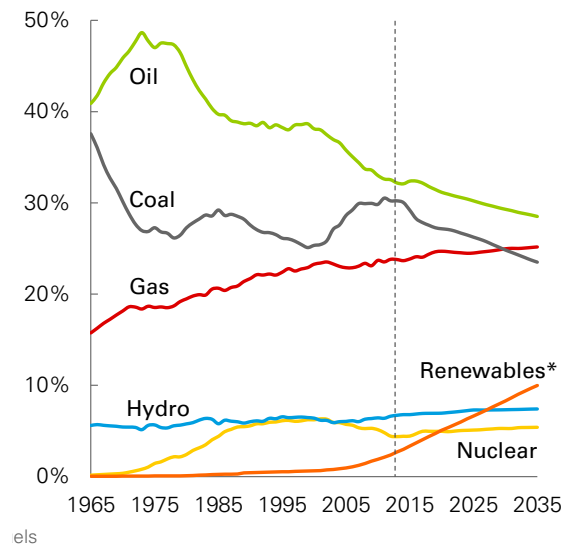


BP Outlook

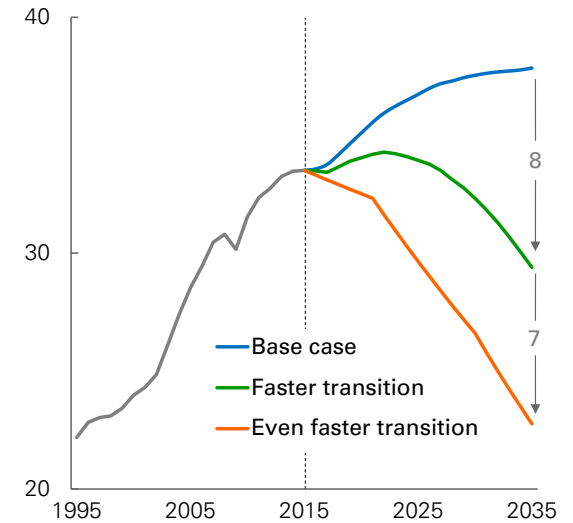
% of primary energy



Shares of primary energy



Billion tonnes CO₂



- Global resource abundance
- Increased car ownership – but electric cars remain anecdotal
- Oil demand for cars keeps growing
- Resources are not the problem
- Demand revised down, RES revised up

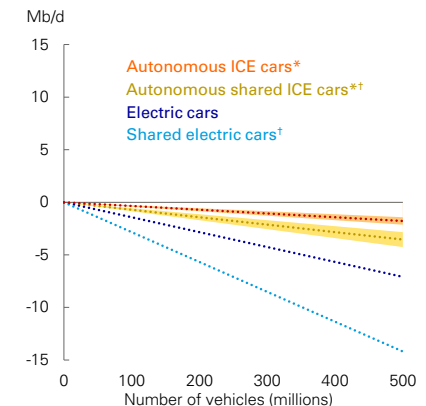
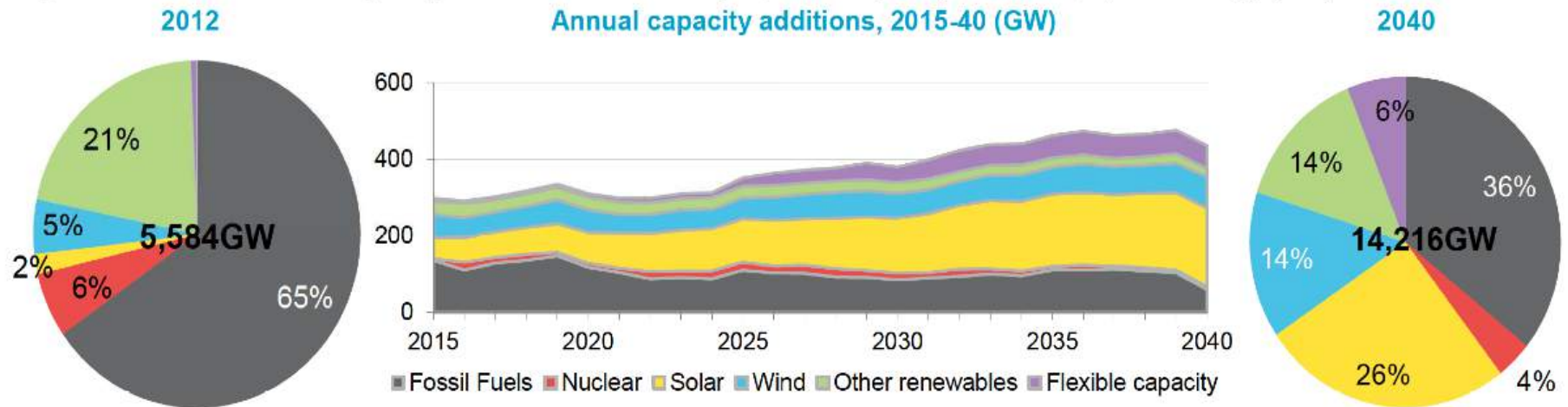


Figure 1: Global installed capacity in 2012 and 2040 and projected capacity additions, by technology (GW)



Source: Bloomberg New Energy Finance. Note: Flexible capacity includes power storage, demand response, and other potential resources.

- Renewables rule
- Thanks to technological development
- Decentralized in developed countries, centralized in developing ones

Large differences in building blocks

	Faster transition	Even faster transition	IEA 450	MIT 2° Base	IHS Markit 'Solar Efficiency'	Greenpeace 'Revolution'
CAGR (%)* 2015-2035						
Carbon emissions	-0.7%	-2.0%	-2.0%	-2.0%	-2.8%	-3.2%
Total energy	0.9%	0.8%	0.4%	0.5%	-0.7%	-0.1%
Energy intensity	-2.4%	-2.5%	-3.0%	-2.9%	-4.0%	-3.5%
Carbon intensity	-1.5%	-2.7%	-2.3%	-2.5%	-2.1%	-3.5%
Share of total energy, 2035						
Oil & gas	51%	48%	48%	46%	51%	39%
Renewables [†]	16%	23%	17%	29%	19%	38%
Share of abatement vs. 2015						
Power sector	>100%	89%	77%	74%	58%	35%

Large differences among regions





Common themes

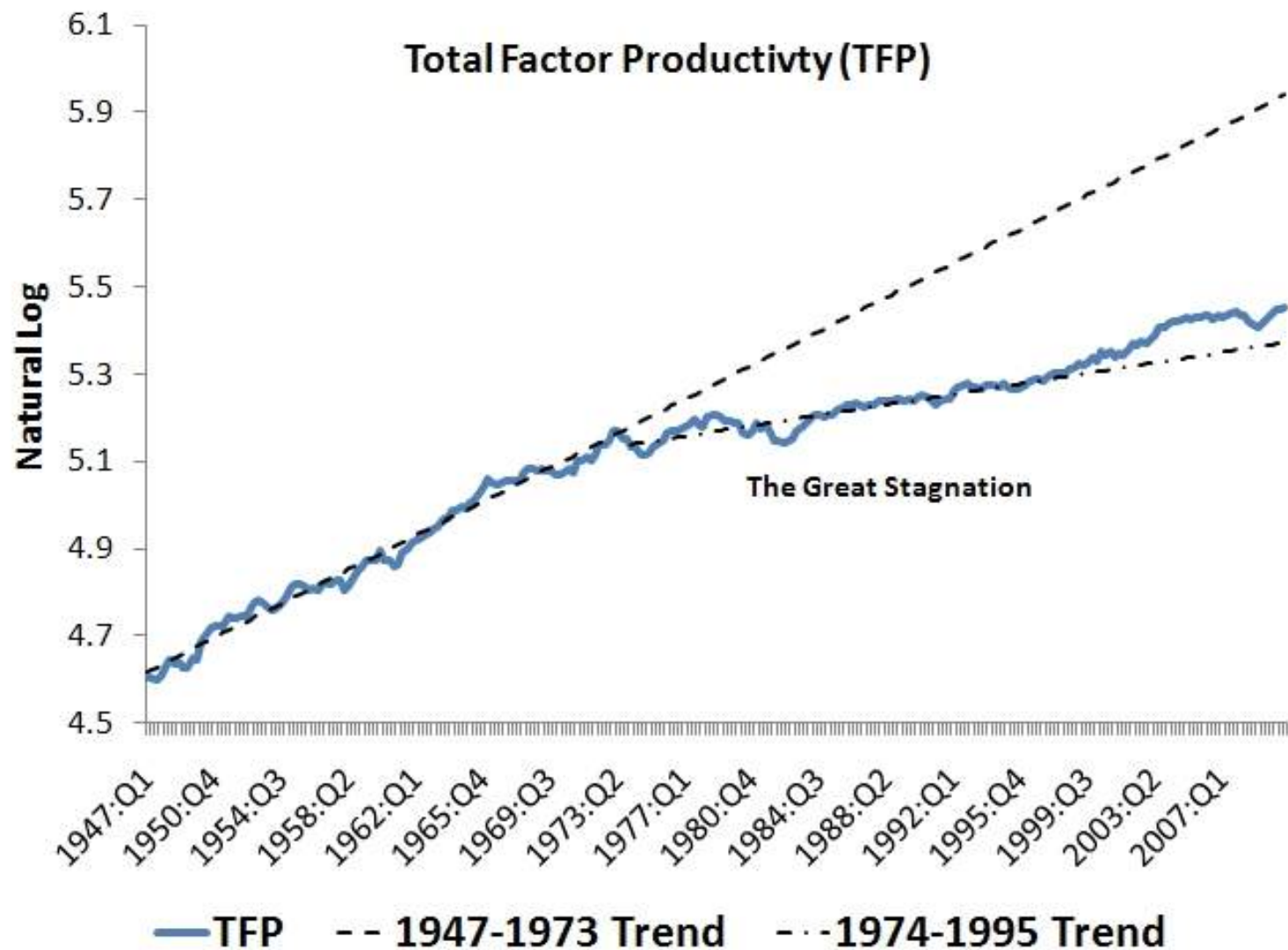
- The economy grows fast (3-4% pa)
- Energy demand continues growing (30-35% by 2040)
 - In non-OCDE countries
- Electricity grows faster
- Fossils maintain their rule
 - Decarbonization is not fast enough
 - Increasing role of gas and renewables
 - Renewables increase due to technological advances
 - But climate goals cannot be achieved
- Geopolitical changes



Neglected (?) scenarios

- Secular stagnation
- Fossil abundance
- The impact of distributed generation

Secular stagnation



Fossil abundance



Not only Carbon Capture



BUT Storage

Distributed generation





Some points for discussion

- Many scenarios are plausible
 - But demand growth is critical
- Gas vs Coal: Leaks and atmospheric emissions
- Electrification seems the cheaper way
- The role of nuclear
- Transport: NatGas vs Biofuels vs Electricity
- Do we need more storage?



And some additional questions

- How to deal with bridge technologies (and the associated infrastructure)?
- How to deal with networks (and their fixed costs)?
- Markets vs Regulation?

economics_{for}
energy



Thanks for your attention

www.upcomillas.es/personal/pedrol