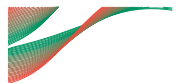


Conferência da AGN

Lisboa, 9 de Dezembro 2020

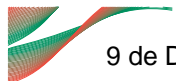
“NOVOS HORIZONTES para o GÁS NATURAL”



Conferência da AGN

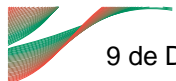
SUMÁRIO

- 1. *A Geopolítica da Energia e as Mudanças Estratégicas e Estruturais***
- 2. *“Energy Game Changers”***
- 3. *A Transição Energética, o Papel do Gás Natural e Desafios para o Futuro***



Conferência da AGN

1. A GEOPOLÍTICA da ENERGIA e as MUDANÇAS ESTRATÉGICAS e ESTRUTURAIS



ROBOTS THAT TEACH EACH OTHER





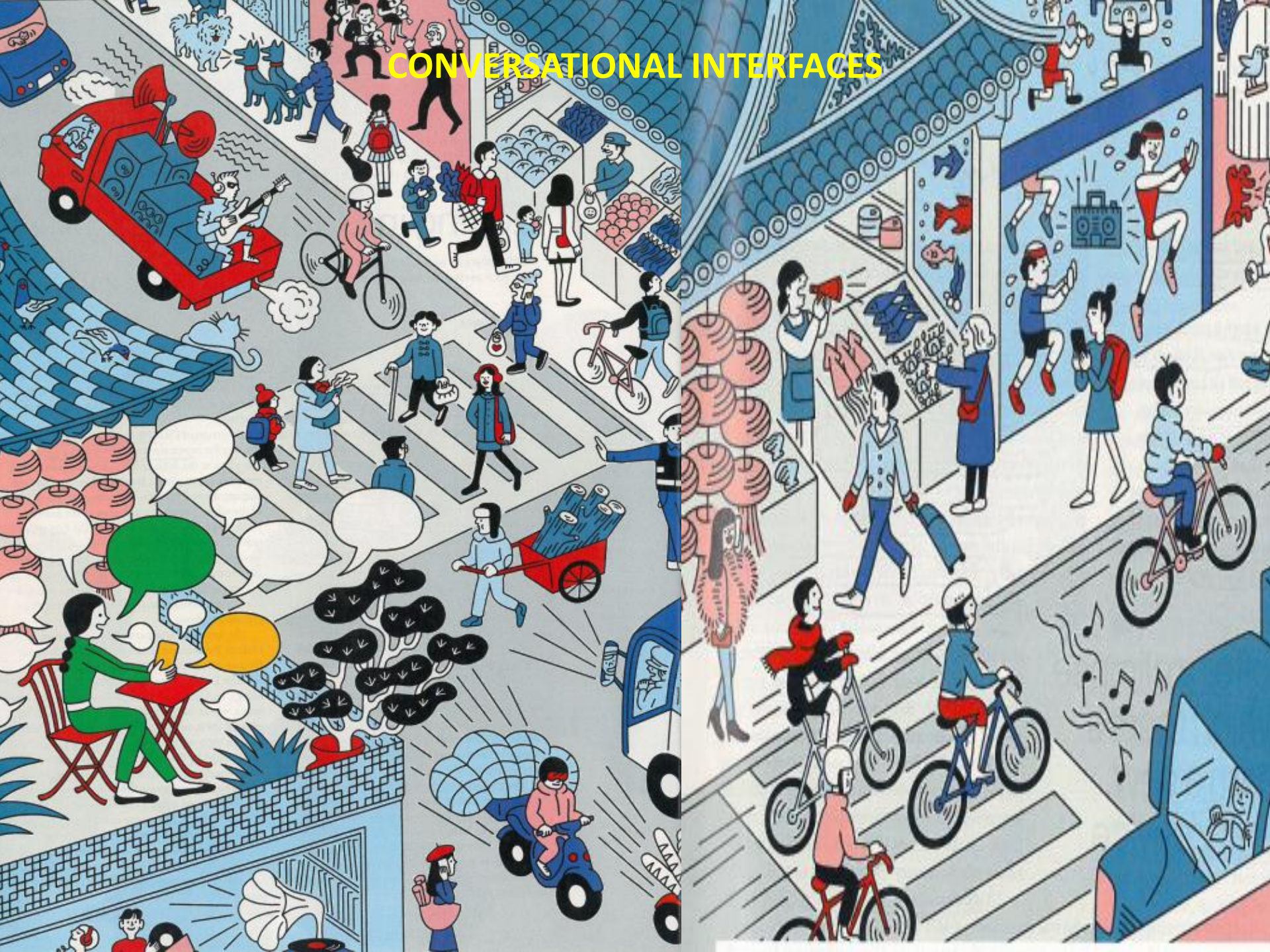
Conferência da AGN

9 de Dezembro de 2020

António Costa Silva – Presidente da Comissão Executiva

5

CONVERSATIONAL INTERFACES



MUNDO FÍSICO

- Veículos sem condutor
- Impressão 3D
- Robótica avançada
- Ciência de novos materiais



SÉCULO XXI

As IDEIAS QUE PODEM MUDAR O MUNDO



MUNDO DIGITAL

- Inteligência Artificial
- As Máquinas que aprendem
- A Internet das coisas
- O poder dos sensores



O MUNDO BIOLÓGICO

- A sequenciação do Genoma
- A Edição Genética e a Terapia
- A Técnica CRISPR
- A luta contra as doenças
- A Medicina com assistentes virtuais (robots)

2019

POPULATION

7.5 billion people

GDP

85 trillion US\$

CAR FLEET

1 billion cars

OIL USE in DEVELOPED WORLD

14 barrels/person/year

OIL USE in DEVELOPING WORLD

3 barrels/person/year

WORLD ENERGY MATRIX

- . Oil Production is 5 times greater than in 1957
- . Renewables have established a more secure foundation
- . Oil/Coal /Natural Gas provide 80% of supply

ELECTRICITY

1,5 billion people without access

WATER

700 million people with scarce resources

2030

POPULATION

8,5 billion people

GDP

130 trillion US

CAR FLEET

3 billion cars

OIL USE

Billions of people with better incomes go from 3 barrels/person/year up to 3 or 4 times more

WORLD ENERGY MATRIX

- . Dominance of Natural Gas?
- . Consolidation of Renewables
- . Solution for the transport system: (electric/biofuels/GTL/fuel-cells)?

ELECTRICITY

- . Reduction or not of inequality?

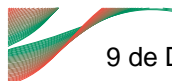
WATER

- . Reduction or not water access?

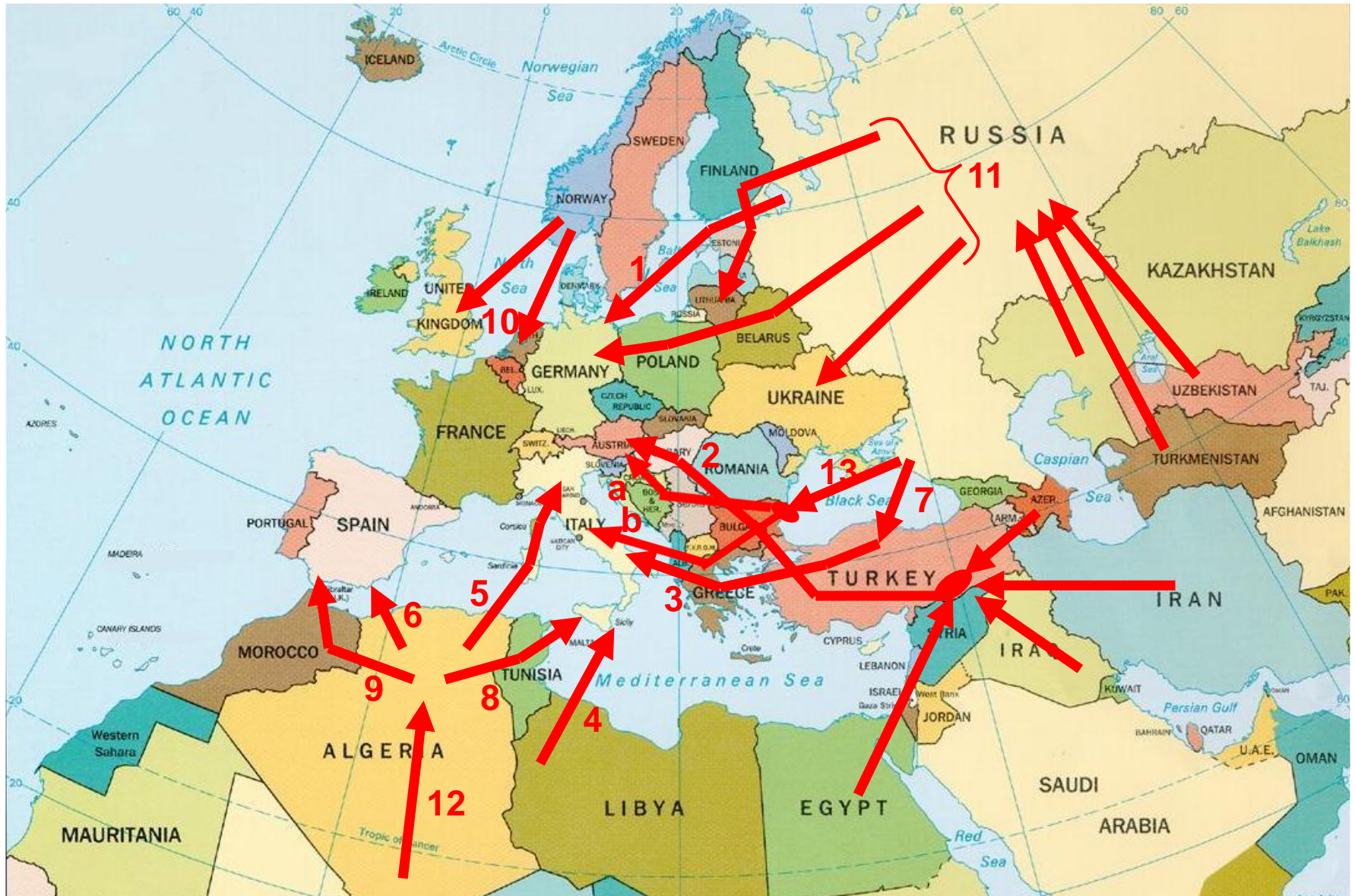
PRODUCTION of SELECTED COMMODITIES, 1950, 1975, and 2000 (in thousand metric tons, unless otherwise noted)

	PRODUCTION			PERCENT INCREASE 1950 - 2000
	1950	1975	2000	
Bauxite	8,370	25,401	135,000	1,513
Cobalt	7	30	33	371
Copper	2,645	6,960	13,200	399
Iron ore	250,000	887,389	1,061,148	324
Nickel	146	787	1,250	756
Titanium	814	3,298	5,187	537
Crude oil (billion barrels)	3,8	19,5	27,3	618
Natural gas (tillion cubic feet)	7,2	55,8	85,1	1,082

Source: US Geological Survey, Minerals Yearbook; BP, Statistical Review of Weorld Energy



THE GEOPOLITICS OF THE PIPELINES



SEGURANÇA do ABASTECIMENTO

- PORTUGAL: 45% gás Argélia
55% gás Nigéria
- Pipelines do Magrebe
- Instabilidade política MENA
- Dependência Energética do exterior 72%
- Europa: dependência da Rússia
- Papel da fachada Atlântica
- Segurança fluxos (pirataria)
- Cooperação geopolítica

SEGURANÇA ENERGÉTICA

SUSTENTABILIDADE AMBIENTAL

- Aposta nos recursos endógenos
- Mudança paradigma: do lixo para os recursos
- Economia Circular: design/reciclagem/produtos
- Papel das Energias Renováveis
- Controlo e declínio emissões CO₂
- COP 21 e mudança climática
- Ligação aos mecanismos do mercado (caso carvão exportado dos EUA para a Europa)

ESTABILIDADE e COMPETITIVIDADE dos PREÇOS

- Falhas Mercado Único Europeu de Energia
- Falhas liberalização /regulação dos mercados
- Fraquezas das Redes Europeias Energia (pipelines + redes eléctricas)
- Políticas Públicas desligadas dos mecanismos económicos do mercado

**PORTUGAL: PONTE
GEOPOLÍTICA entre EUROPA,
EUA, Ibero-América, África
Norte, Lusofonia, Atlântico
Sul e Ásias**

- TTIP
- CPLP
- Mercosul
- Repensar as Alianças

**PORTUGAL: ECONOMIA
ATLÂNTICA no CRUZAMENTO das
REDES da GLOBALIZAÇÃO**

- Modelo Estratégico de Desenvolvimento
- Novo “mind set”
- Planeamento Estratégico

**PORTUGAL CONECTADO
GLOBALMENTE**

- Portos
- Plataformas Logísticas
- Redes Comerciais
- Redes Energéticas
- Cadeias de Valor
- Porto de Gotemburgo/Suécia: ligado a 26 plataformas logísticas

**OS FUTUROS POSSÍVEIS
DE PORTUGAL**

**PORTUGAL: PLATAFORMA
TECNOLÓGICA INTEGRADA**

- Teste soluções tecnológicas
- Paradigma das cidades
- Atracção Investimento
- Alianças com países e Multinacionais

**PORTUGAL: DO HINTERLAND
PARA O EXTERIOR**

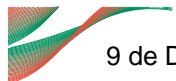
- Sectores tradicionais da economia
- Plataformas logísticas
- Sector Exportador
- Papel das Empresas e da Inovação Tecnológica

**PORTUGAL: ESPAÇO
GEOECONÓMICO
INTEGRADO**

- A geografia além da identidade territorial
- A ZEE
- Novos sectores económicos:
 - Recursos Marinhos
 - Biotecnologias
 - Ciências da Saúde
 - Indústria Alimentar
 - Indústria Farmacêutica
 - Indústria Cosmética
 - Energias Renováveis

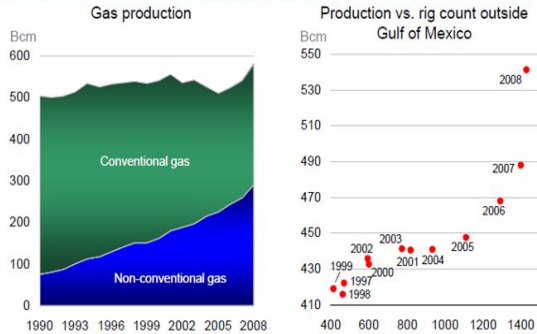
Conferências do Chiado

2. “Energy Game Changers”



ENERGY GAME CHANGERS in XXI CENTURY

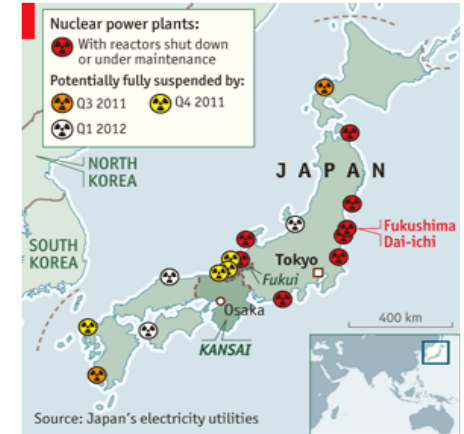
UNCONVENTIONAL GAS



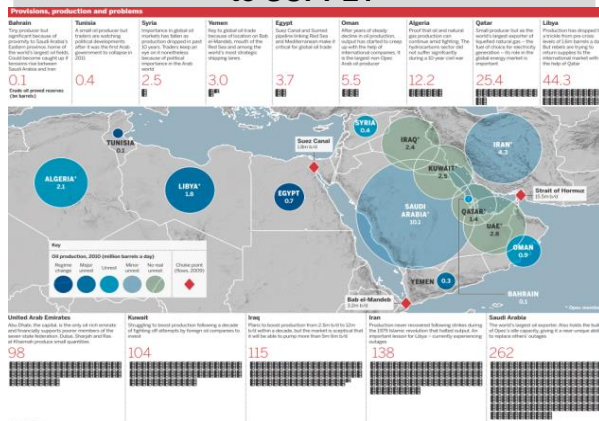
INDUSTRY CATASTROPHIC ACCIDENTS (e.g. OFFSHORE OIL Spills) and PUBLIC IMAGE



FUKUSHIMA NUCLEAR ACCIDENT



INSTABILITY in PRODUCING COUNTRIES and THREATS to SUPPLY



EMERGENCE of PACIFIC BASIN as TOP ENERGY CONSUMER

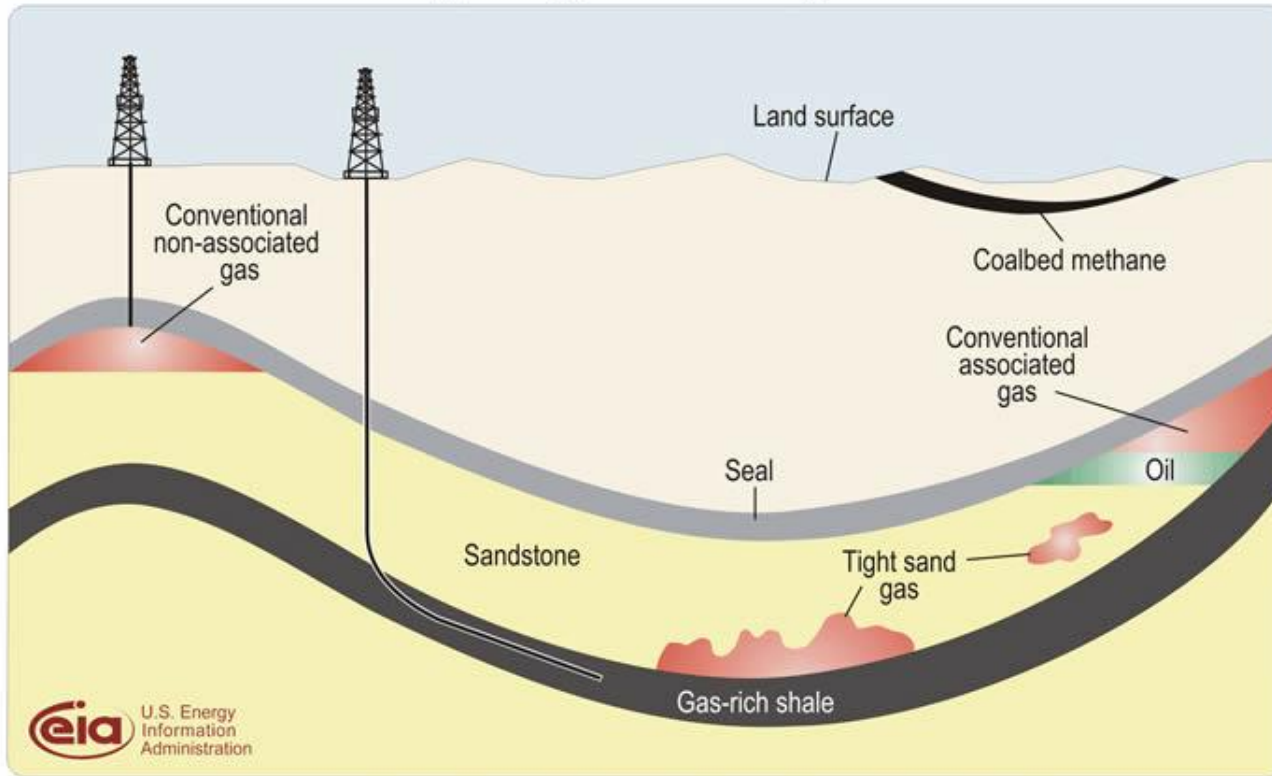


CLIMATE CHANGE and ENVIRONMENTAL REVOLUTION



What is the SHALE GAS?

Schematic geology of natural gas resources



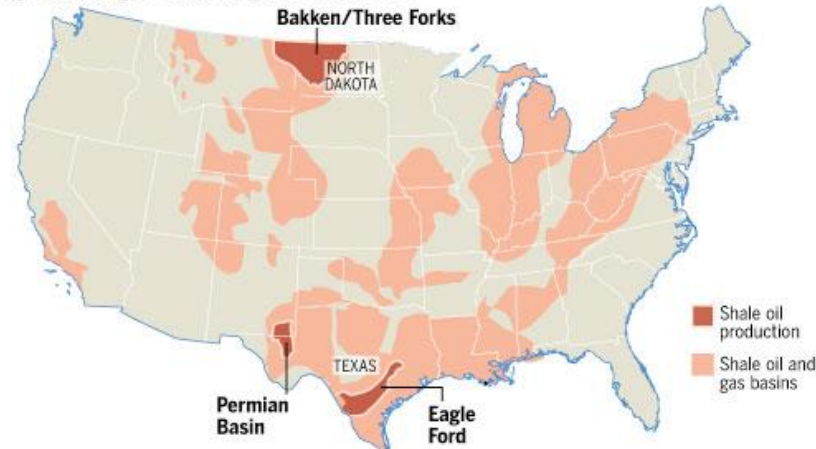
A world class source rock and a potential shale gas reservoir – the Devonian-Mississippian Woodford Shale

US OIL SHALE: TEXAS HEARTLAND HEADS THE US OIL REVIVAL

Re-energising America



Key oil and gas shale regions in the US



Companies leading exploration in Bakken and Eagle Ford

Bakken-Three Forks

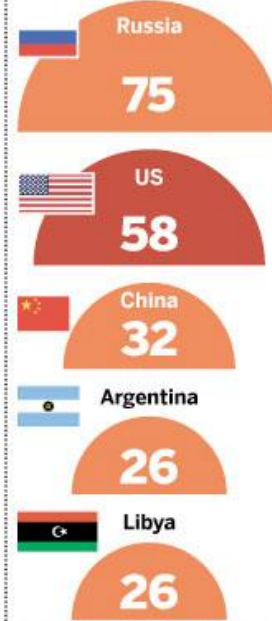
Continental Resources	ExxonMobil
Whiting Petroleum	Marathon Oil
Hess Corporation	Petro-Hunt
Statoil	Slawson Exploration
EOG Resources	Kodiak Oil & Gas

Eagle Ford

EOG Resources	EP Energy
ConocoPhillips	Marathon Oil
Chesapeake Energy	Murphy Oil
GeoSouthern Energy	Pioneer Natural Resources
Anadarko	
Plains Exploration & Production	

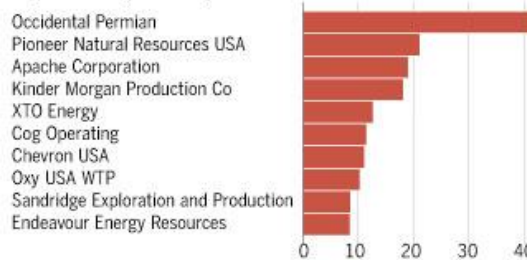
Top countries with shale oil resources

Technically recoverable (Barrels bn)



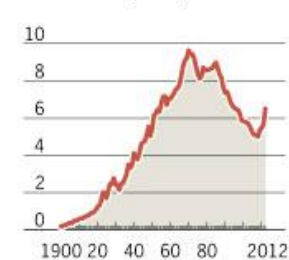
Top 10 Permian Basin operators, 2012

Oil production (Barrels m)



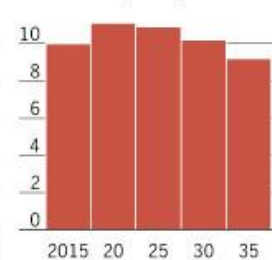
US oil production

Million barrels per day



US oil production forecasts

Million barrels per day



Sources: EIA; IEA

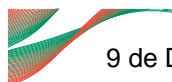
FT graphic Photo: Bloomberg

Source: FT, 8th July 2013

WORLD TOTAL GAS RESERVES



Source: *The Economist*, 6th August 2011

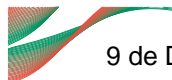


The IEA calculates that electricity prices for German industry have tripled since 2000



Source: OECD

Fonte: The Economist, 14th June 2014



APPLICATIONS

- . Gas is most versatile of fossil fuels
- . Used both in power generation and transportation
- . GTL may be competitive solution for transport in Medium Term

DECARBONIZATION OF ECONOMY

- . Gas is the least poluent of fossil fuels
- . May play key role in transition of energy paradigm

GAS DRIVERS

EFFECTS OF JAPAN NUCLEAR CRISIS

- . Decision of some countries to slowdown nuclear power (Germany, Italy, Japan)
- . Opens a more decisive role for Gas

Citizenship Issue

- Mobilization
- Change of behaviour
- Global economy vs local governance
- Multilateral institutions
- Restructuring of world economy

CLIMATIC CHANGE

- Is an issue of Security and survival

THE CLIMATIC THREAT

- Concentration of CO₂ in atmosphere before the Industrial Revolution : 280 ppm
- Current concentration : 400 ppm
- Projection at the end of the XXI Century: 560 ppm ("Business as usual")
- Increase of Earth temperature: 3 – 4° C
- Instability of life on Earth

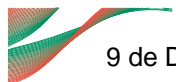
Need of action focused on polluter centers:

- Power stations
- Electricity System
- Transport System

Reduction of CO₂ Emissions
to be successful needs to be linked to MARKET mechanisms

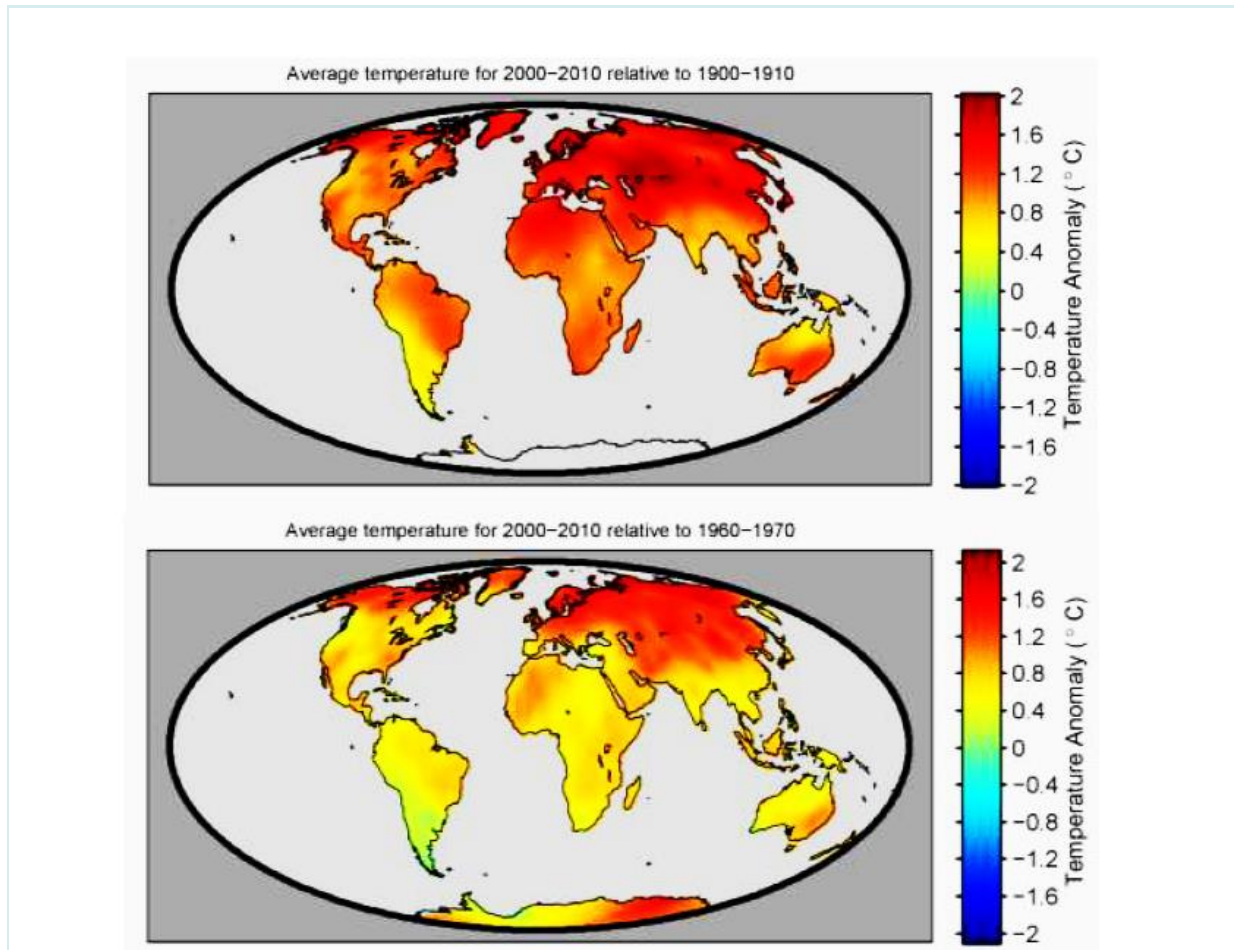
NEED BUILD a Low-Carbon ECONOMY

- Till today action led to poor results
- New Action Plans

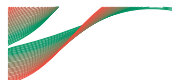


BERKELEY EARTH TEMPERATURE STUDY

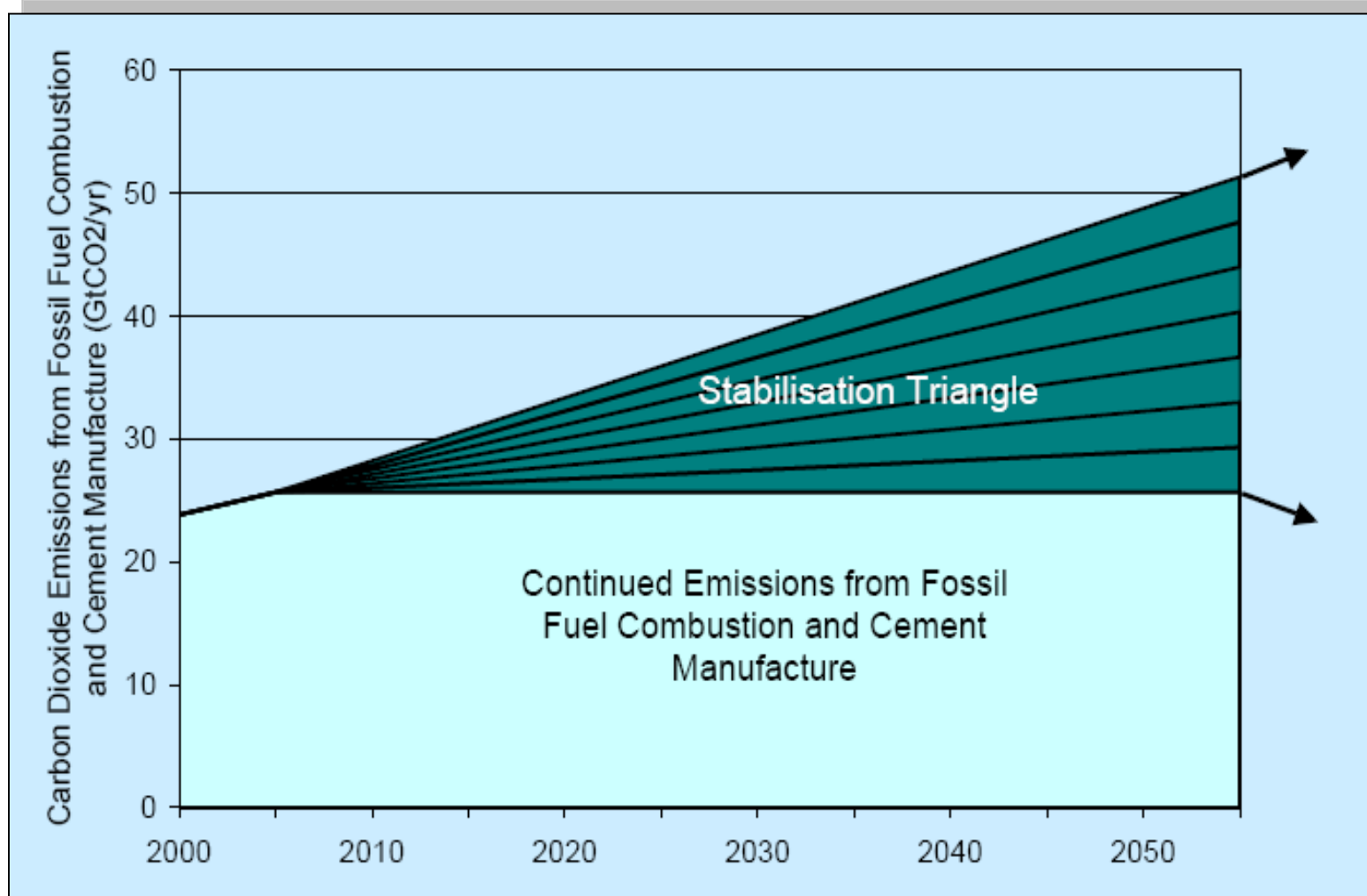
Prof. Richard A. Muller Team, November 2011



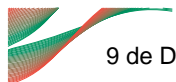
Maps showing the decadal average changes in land temperature field. In the upper plot, the comparison is drawn between the average temperature in 1900 to 1910 and the average temperature in 2000 to 2010. In the lower plot, the same comparison is made but using the interval 1960 to 1970 as the starting point. We observe warming over all continents with the greatest warming at high latitudes and the least warming in southern South America



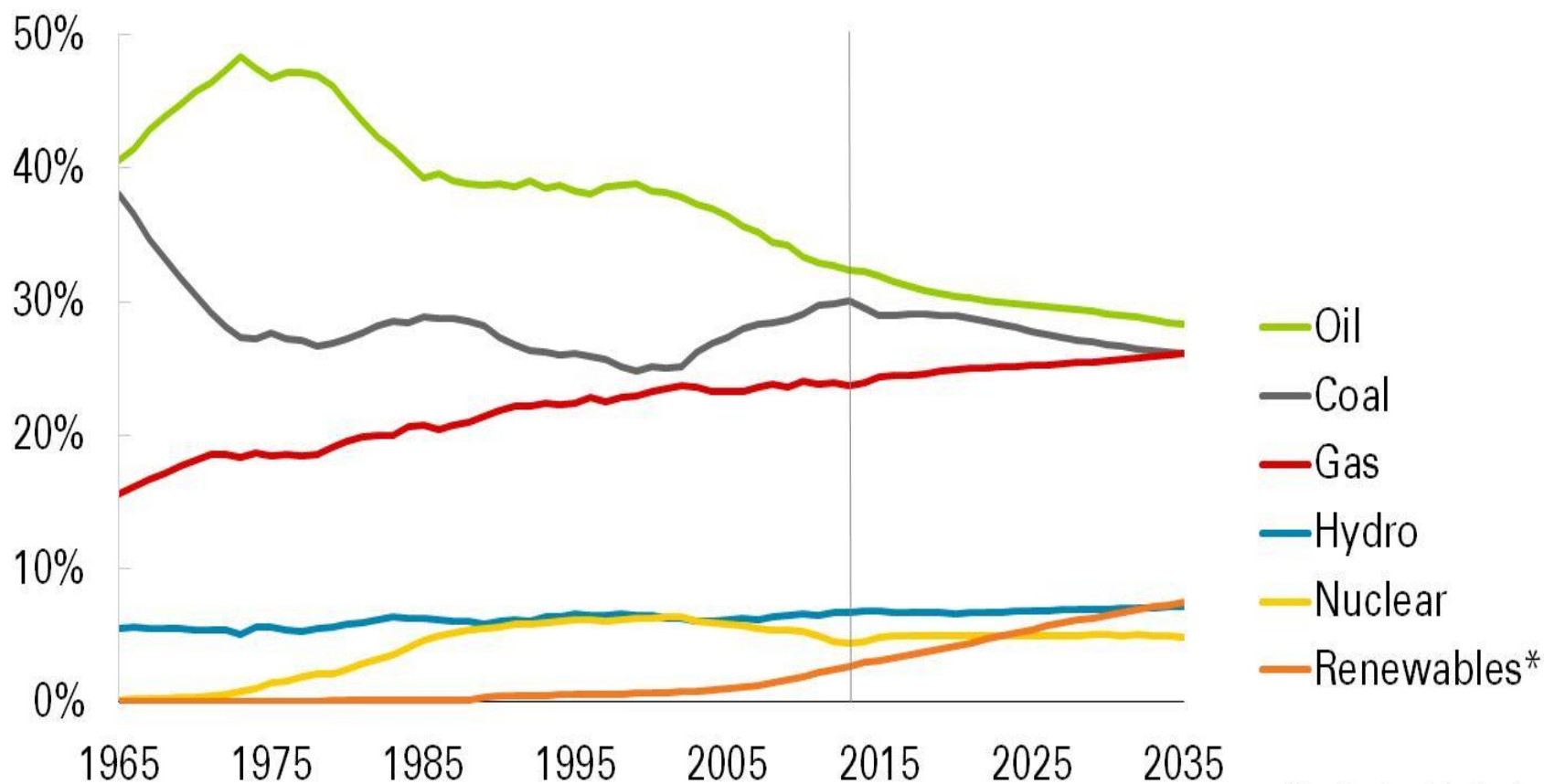
Socolow and Pacala's "wedges"



Source: Pacala and Socolow (2004)



Shares of primary energy



*Includes biofuels

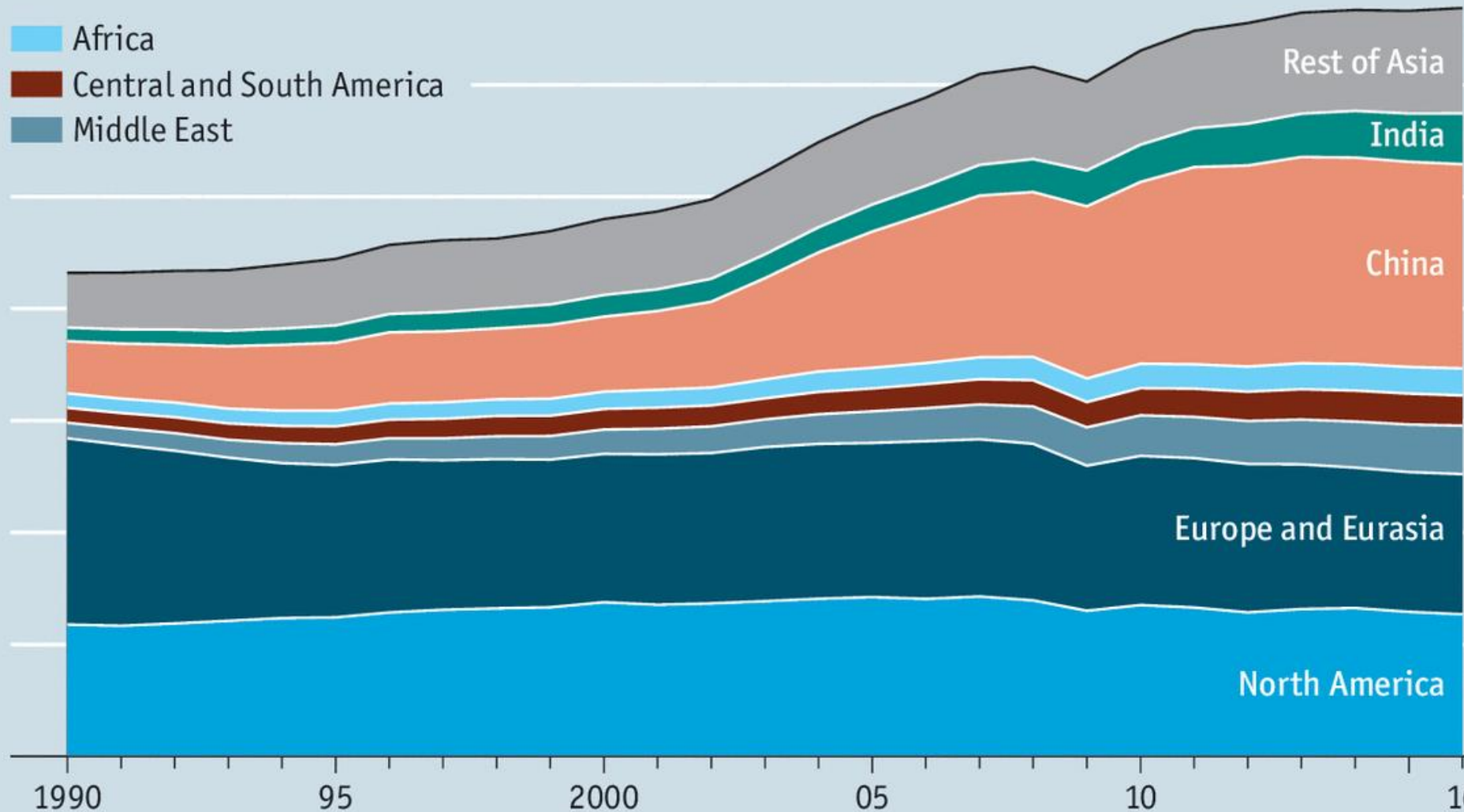
CO₂ emissions

Tonnes, bn

Africa

Central and South America

Middle East



Source: BP

FOUR MAJOR TRENDS CHANGING WORLD ENERGY MATRIX

- Growing electrification
- Decarbonization
- Localization
- Optimization

MAJOR ROLE of GAS

- Increasing share of world energy matrix
- Shale Gas revolution and magnitude of reserves
- Gas is most versatile of fossil fuels and least pollutant
- Used both in power generation and transportation (GTL)
- “Gaseification” of economy

LOW CARBON SOLUTIONS

- Buildings
- Electric/Thermal Generation
- Transportation systems

GROWTH and SUSTAINABILITY

LNG and EFFECTS of JAPAN NUCLEAR CRISIS

- Decision of some countries to slowdown nuclear power (Germany, Italy, Japan)
- Open more decisive role for gas and specially LNG

Clean Technologies and Reduction of CO₂ Emissions

- Tolerance zero for Gas Flaring
- CO₂ sequestration and injection into oil reservoirs (win-win approach)
- Control/reduction of VOC emissions (surface facilities)
- Improve Market “design mechanisms” to promote energy efficiency

OIL & GAS INDUSTRY PUBLIC IMAGE

- Recent record of catastrophic accidents does not help
- Need to improve risk management to address public concerns
- Industry engaged in environmental and emissions cutting technologies
- Better communication with the public
- Better environmental regulations without jeopardizing expansion of required projects

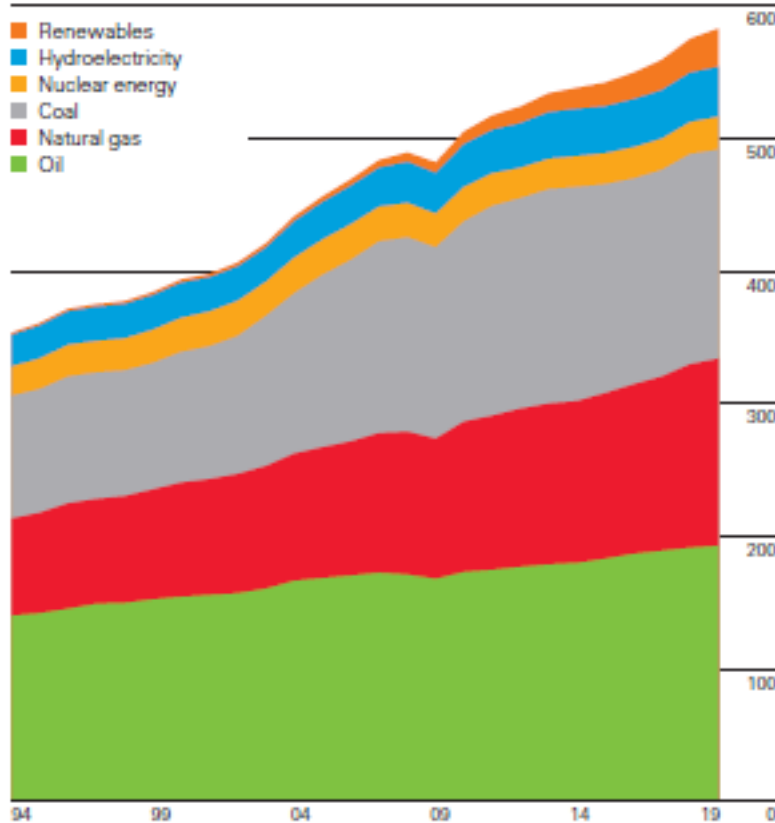
Conferências do Chiado

3. *A Transição Energética, o Papel do Gás Natural e Desafios para o Futuro*

Primary Energy Consumption

World consumption

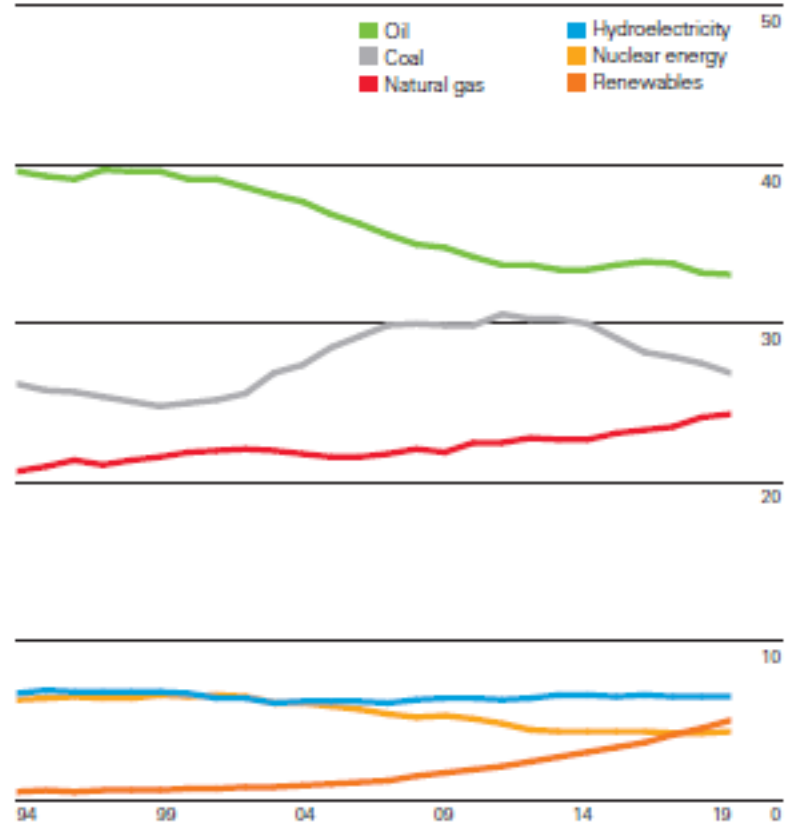
Exajoules



Primary energy consumption rose by 1.3% last year, less than half its rate in 2018 (2.8%). Growth was driven by renewables (3.2 EJ) and natural gas (2.8 EJ), which together contributed three quarters of the increase. All fuels grew at a slower rate than their 10-year averages, apart from nuclear, with coal consumption falling for the fourth time in six years (-0.9 EJ). By region, consumption fell in North America, Europe and CIS and growth was below average in South & Central America. In the other regions, growth was roughly in line with historical averages. China was the biggest individual driver of primary energy growth, accounting for more than three quarters of net global growth.

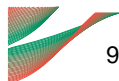
Shares of global primary energy

Percentage



Oil continues to hold the largest share of the energy mix (33.1%). Coal is the second largest fuel but lost share in 2019 to account for 27.0%, its lowest level since 2003. The share of both natural gas and renewables rose to record highs of 24.2% and 5.0% respectively. Renewables has now overtaken nuclear which makes up only 4.3% of the energy mix. The share of hydroelectricity has been stable at around 6% for several years.

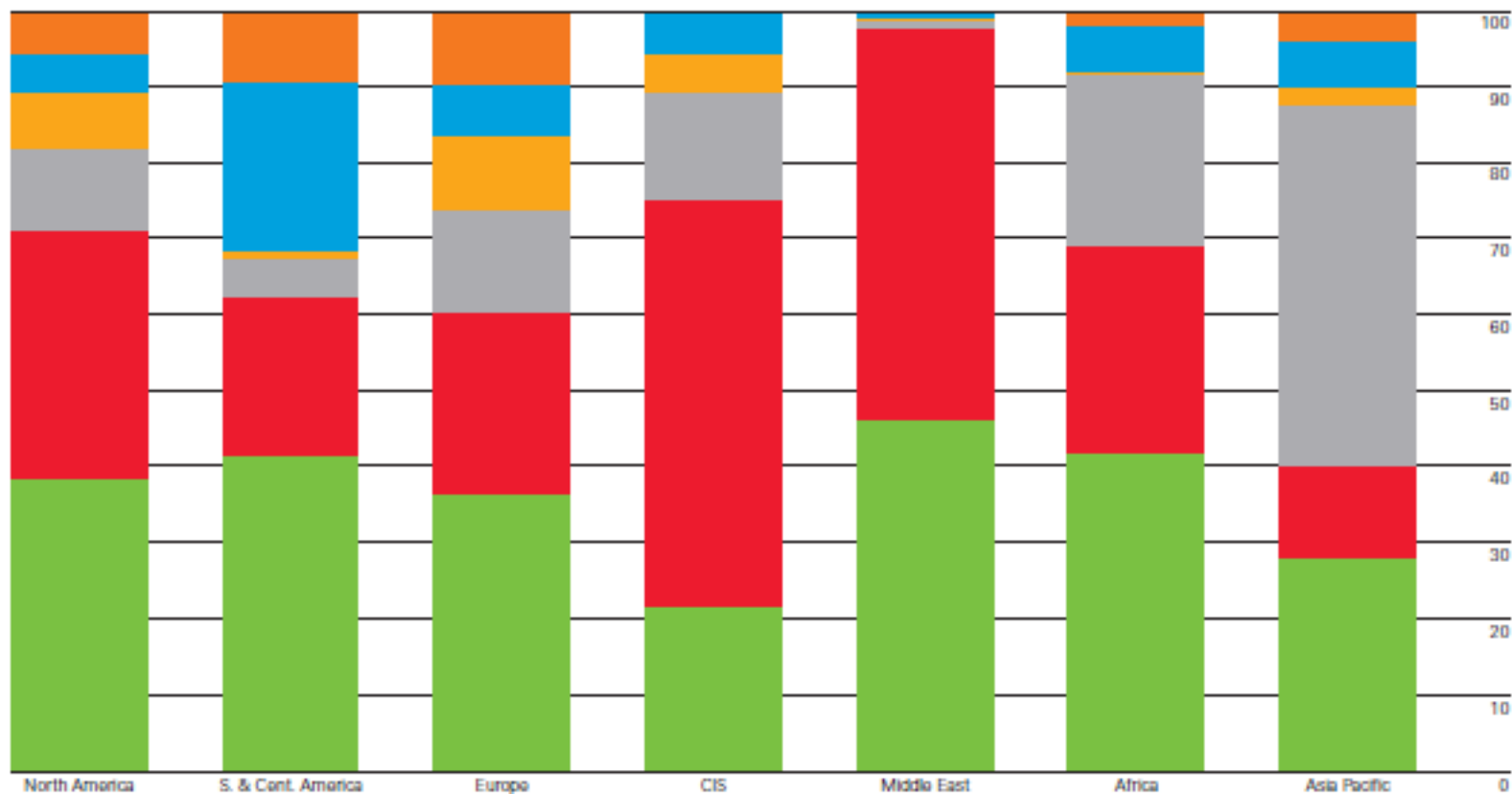
Source: bp Statistical Review of World Energy 2020



Regional Consumption Pattern

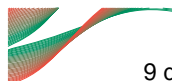
Regional consumption pattern 2019

Porcentagem



Oil remains the dominant fuel in Africa, Europe and the Americas, while natural gas dominates in CIS and the Middle East, accounting for more than half of the energy mix in both regions. Coal is the dominant fuel in the Asia Pacific region. In 2019 coal's share of primary energy fell to its lowest level in our data series in North America and Europe.

Source: Statistical Review of World Energy 2020

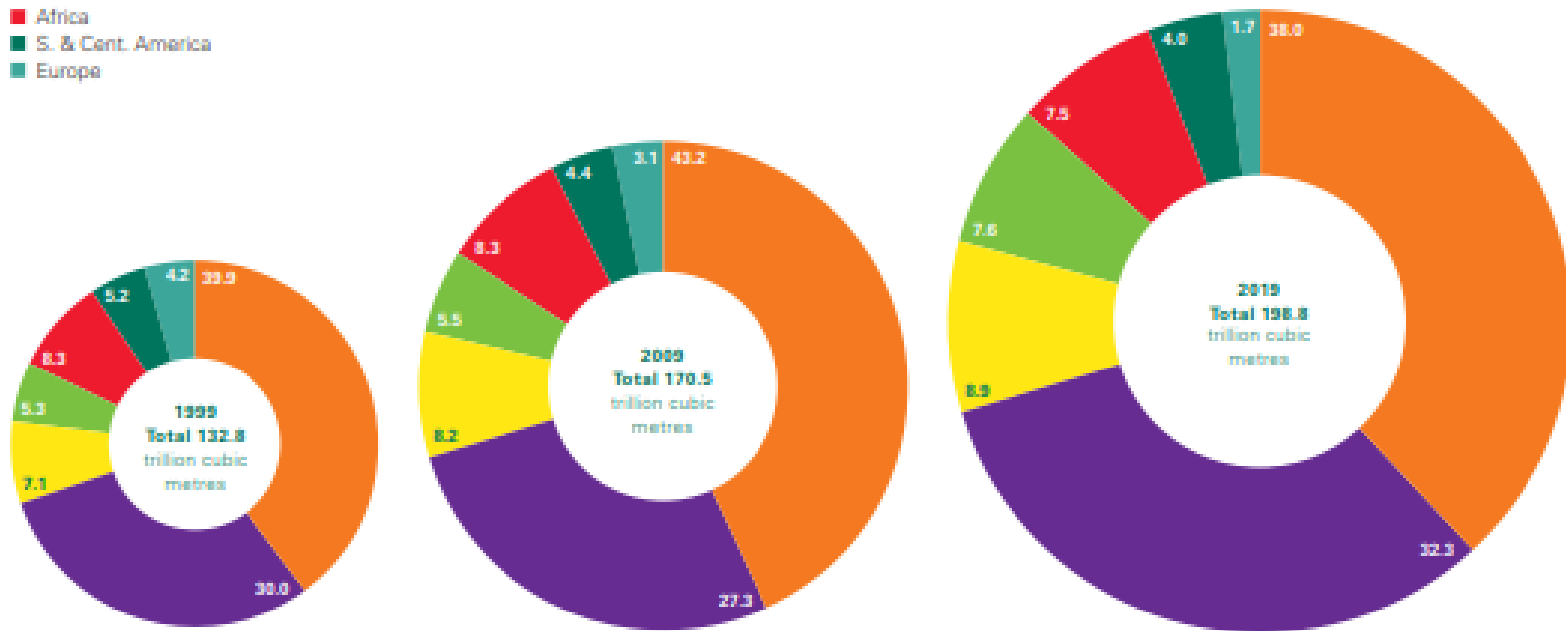


Proved Gas Reserves

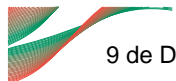
Distribution of proved reserves in 1999, 2009 and 2019

Percentage

- Middle East
- CIS
- Asia Pacific
- North America
- Africa
- S. & Cent. America
- Europe



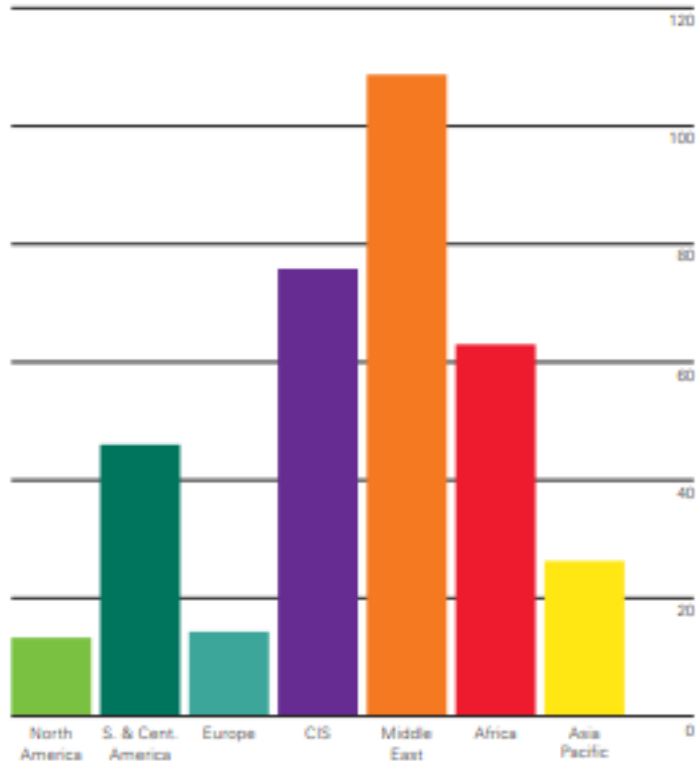
Source:bp Statistical Review of World Energy 2020



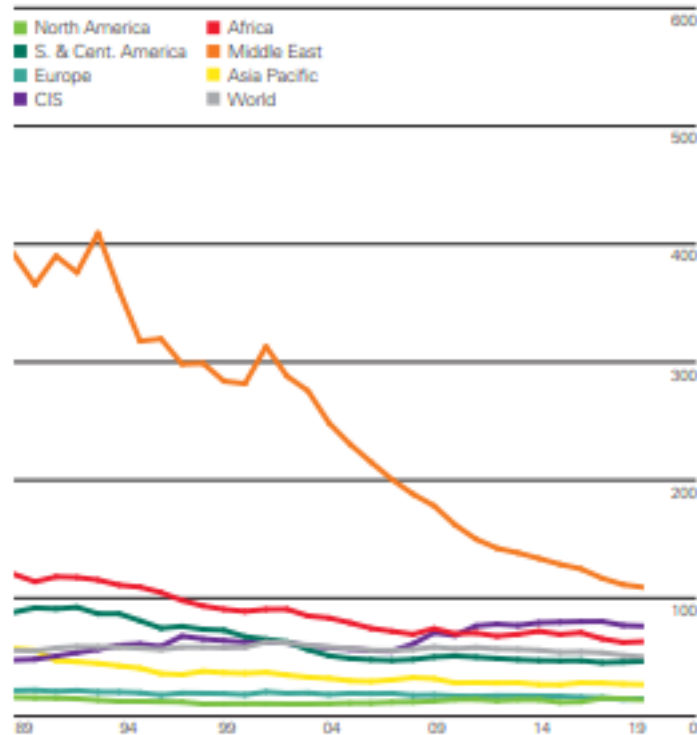
Reserves-to-production (R/P) ratios

Years

2019 by region

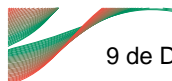


History

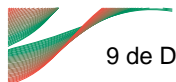


World proved gas reserves increased by 1.7 Tcm to 198.8 Tcm in 2019. China (2 Tcm) and Azerbaijan (0.7 Tcm) provided the largest increments, although this was partially offset by a 1.3 Tcm decline in Indonesian reserves. Russia (38 Tcm), Iran (32 Tcm) and Qatar (24.7 Tcm) are the countries with the largest reserves. The current global R/P ratio shows that gas reserves in 2019 accounted for 49.8 years of current production. The Middle East (108.7 years) and CIS (75.8 years) are the regions with the highest R/P ratio.

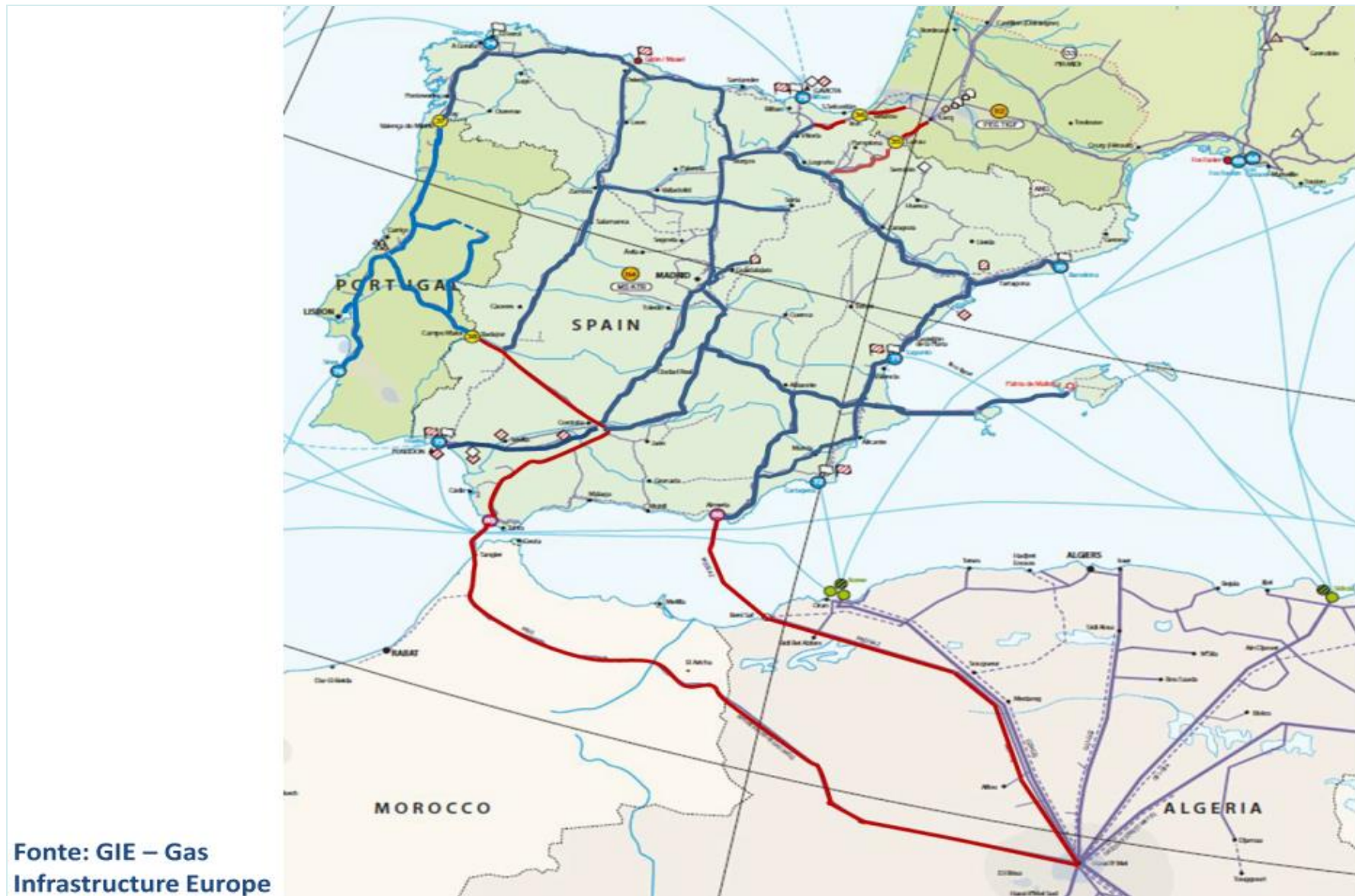
Source: bp Statistical Review of World Energy 2020



THE FUTURE OF NATURAL GAS



INTERLIGAÇÕES DA REDE DE GASODUTOS

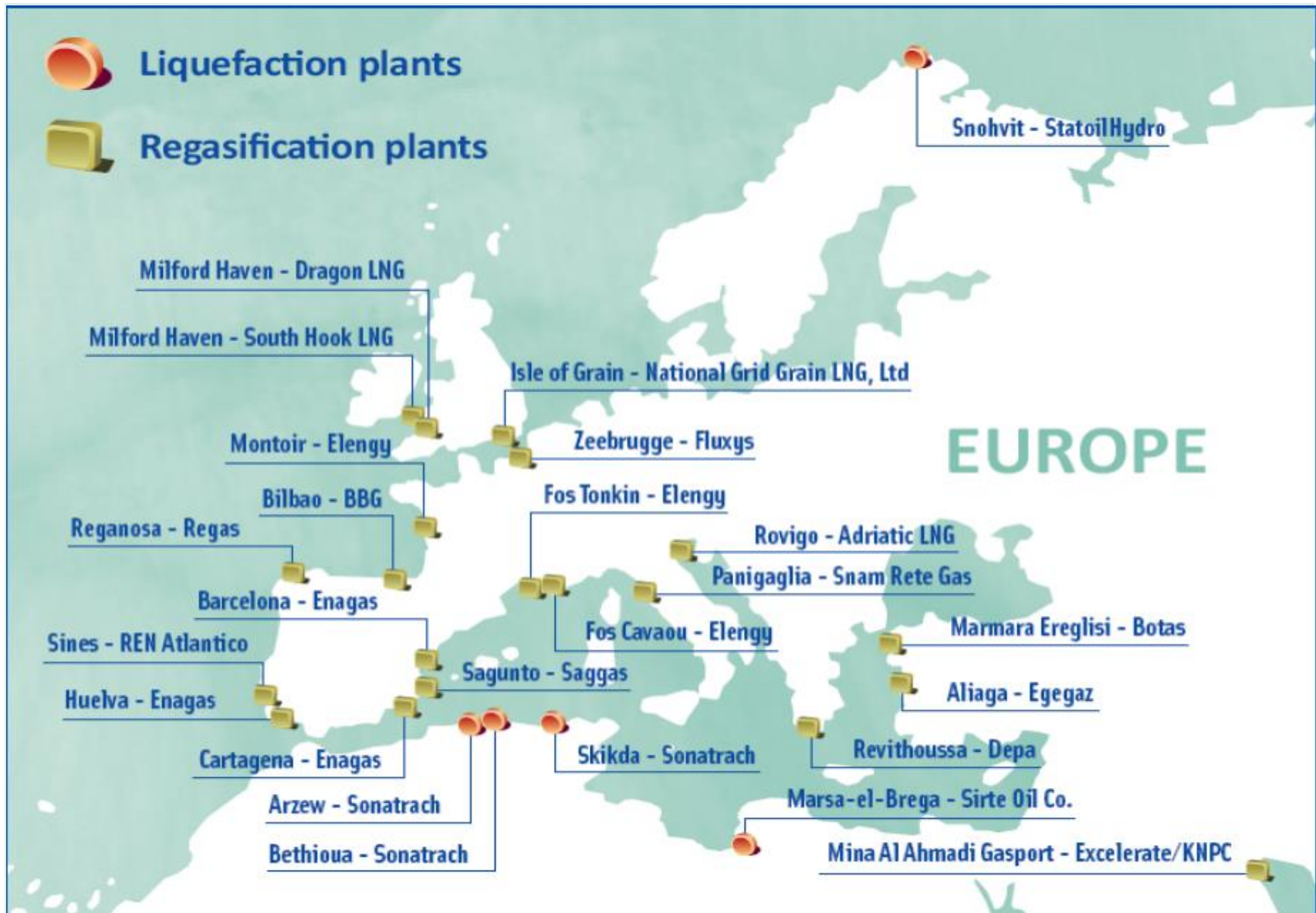


Fonte: GIE – Gas Infrastructure Europe

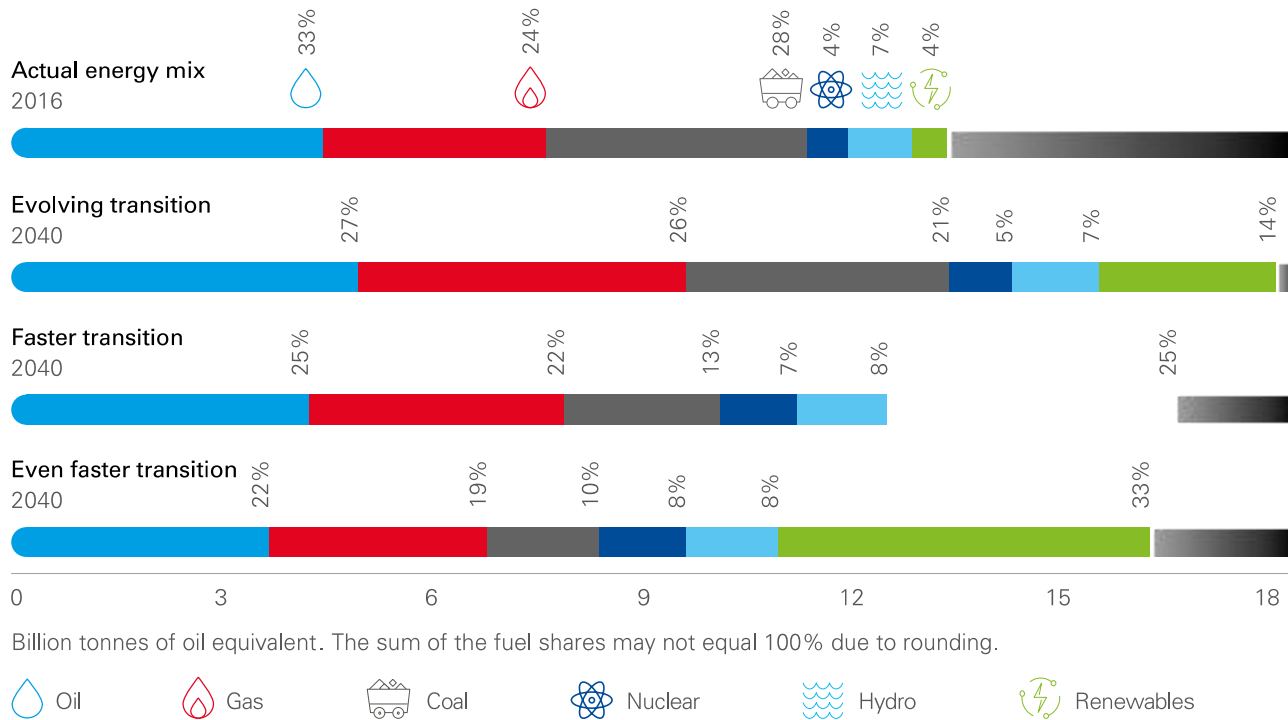
Portugal Natural Gas Consumption



TERMINAIS de GNL na EUROPA



THREE SCENARIOS for the ENERGY TRANSITION



Evolving transition

In this scenario, government policies, technology and social preferences evolve in a manner and speed seen in the recent past. The growing world economy requires more energy but consumption increases less quickly than in the past.

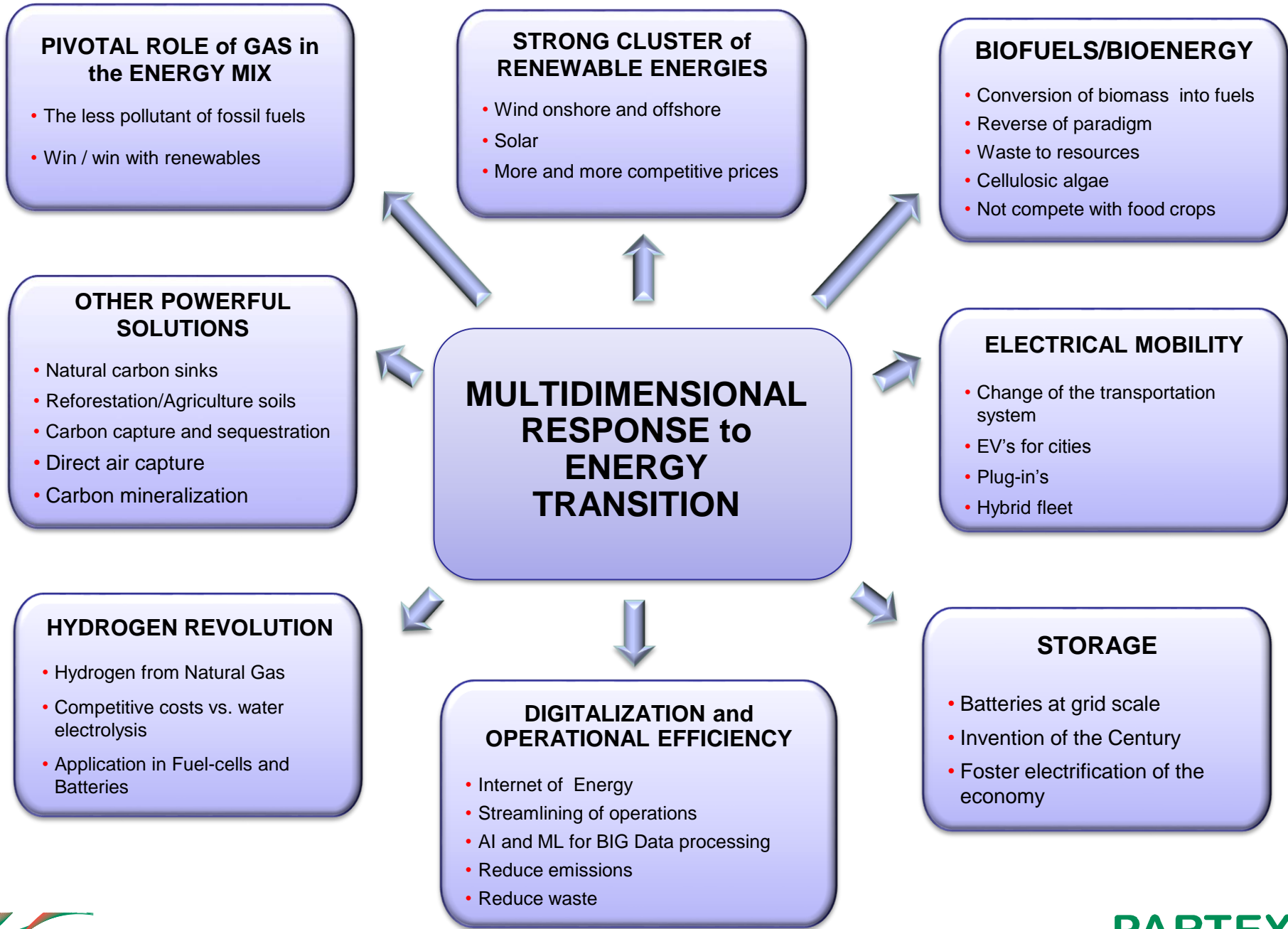
Faster transition

This scenario sees carbon prices rising faster than in the evolving transition scenario, with other policy interventions encouraging more rapid energy efficiency gains and fuel switching.

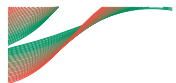
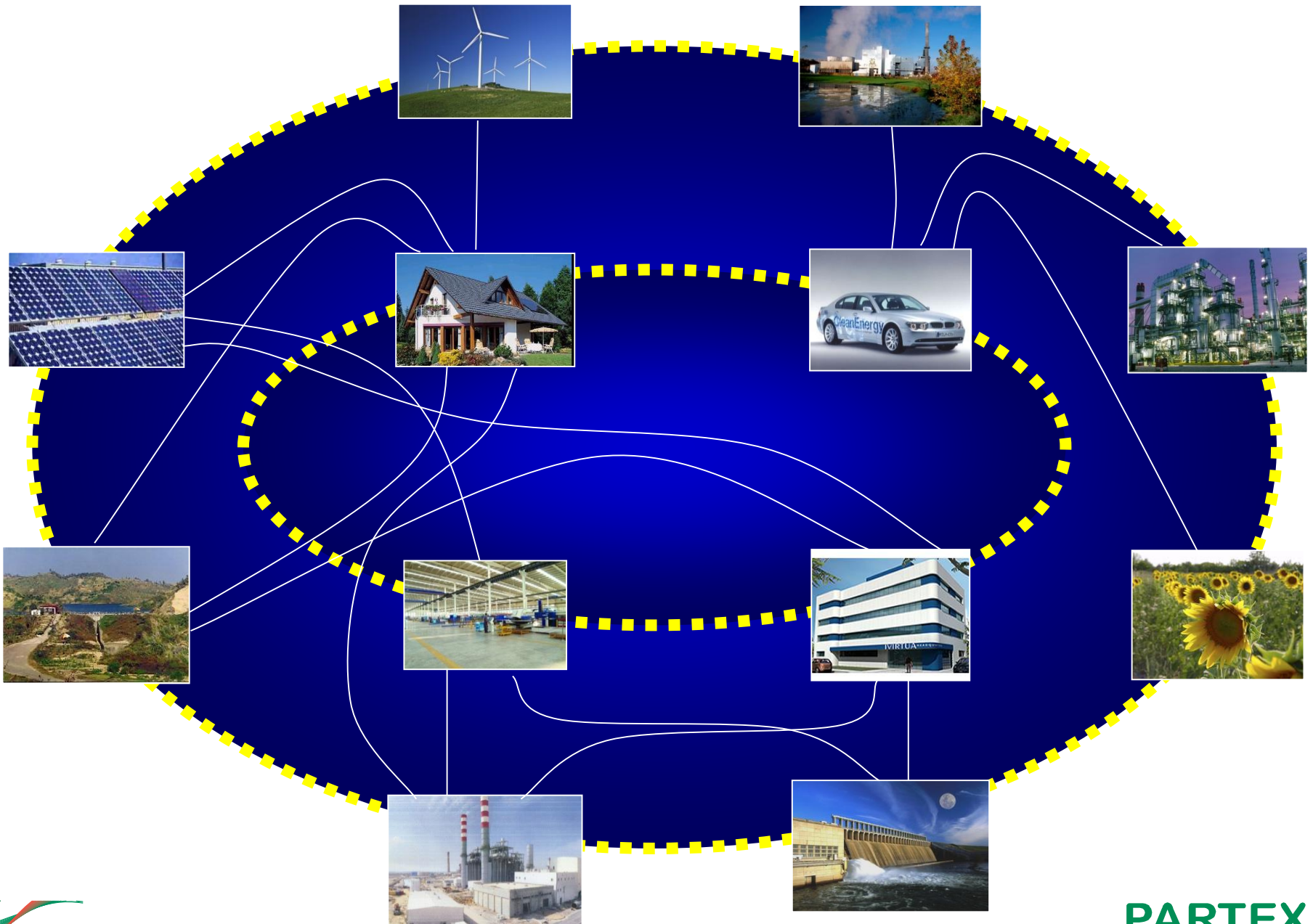
Even faster transition

This scenario matches carbon emissions similar to the International Energy Agency's sustainable development scenario, which aims to limit the global temperature rise to well below 2°C.

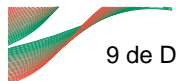
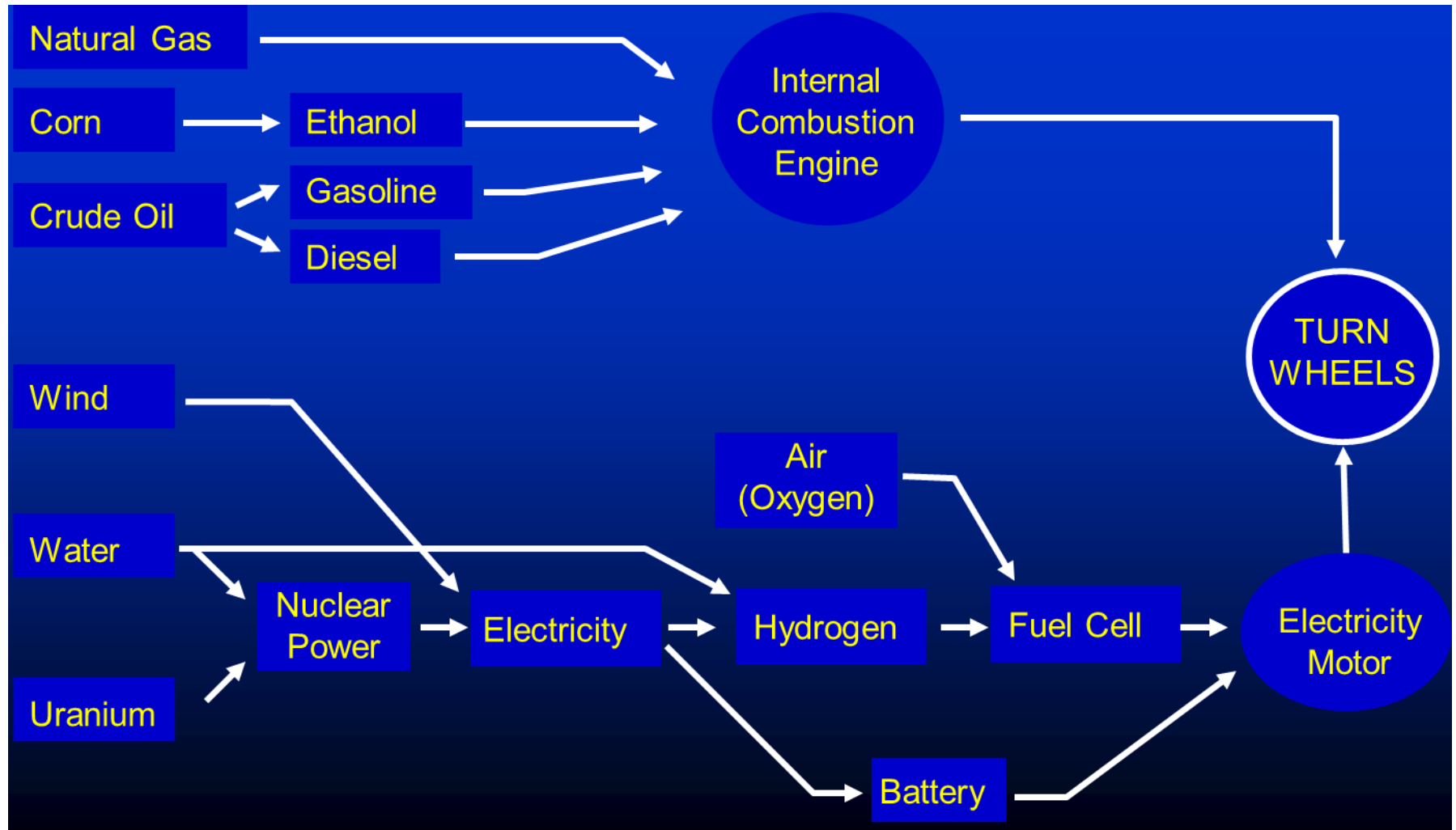
Source: BP

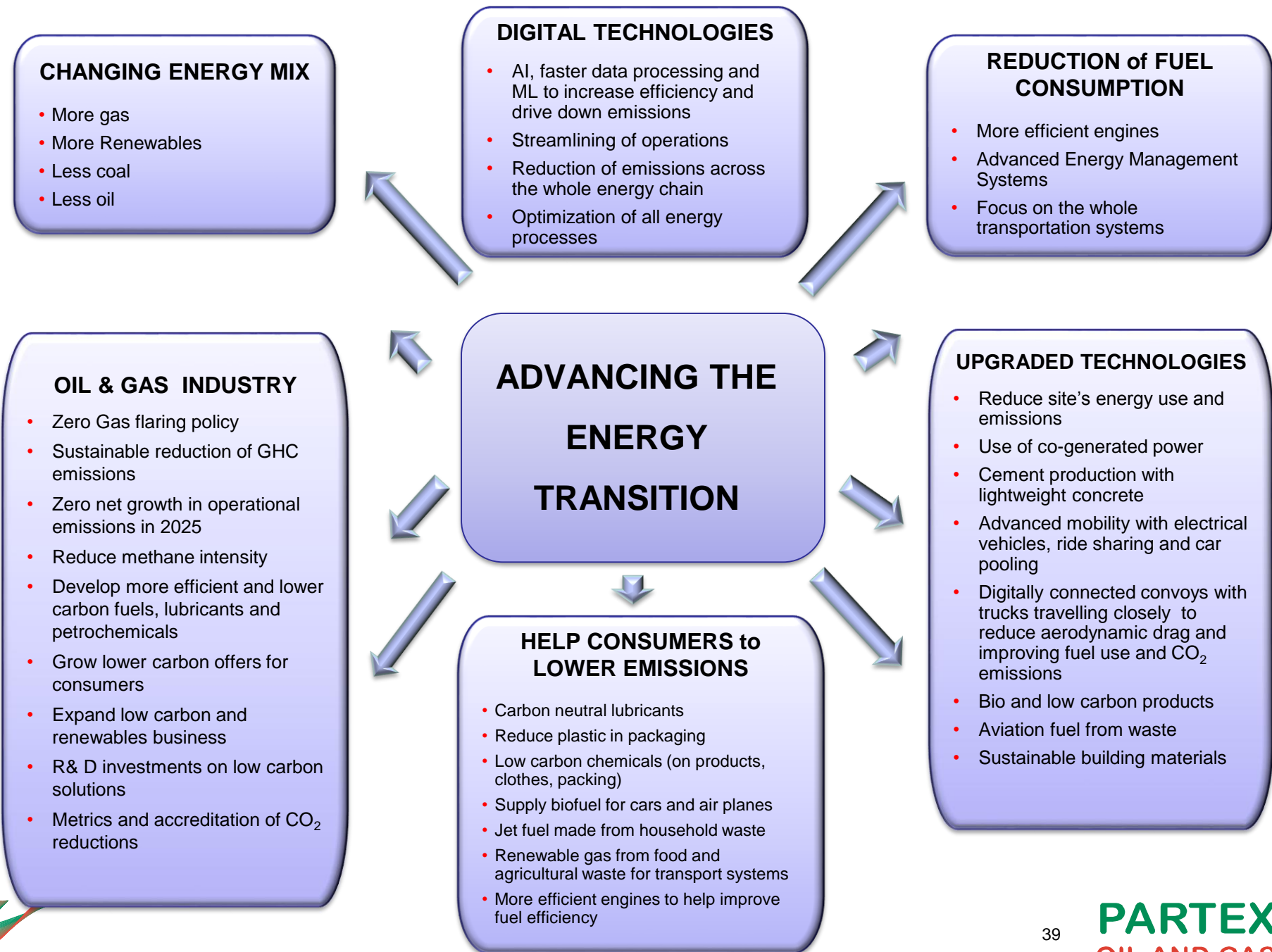


O NOVO PARADIGMA ENERGÉTICO



Energy Road Map and Solutions: Many Possible Paths Leading to Same “Destination”





OBRIGADO

