

UNIVERSIDADE de VERÃO do PSD 2017

Castelo de Vide, 29 de Agosto 2017

“CLIMA, AMBIENTE e TRANSIÇÕES ENERGÉTICAS”

SUMÁRIO

- 1. A GEOPOLÍTICA da ENERGIA e as MUDANÇAS ESTRATÉGICAS e ESTRUTURAIS**
- 2. “ENERGY GAME CHANGERS”**
- 3. EVOLUÇÃO dos PREÇOS do PETRÓLEO e MERCADOS**
- 4. A TRANSIÇÃO ENERGÉTICA e o PAPEL das ENERGIAS RENOVÁVEIS**
- 5. CONSEQUÊNCIAS para o FUTURO e ESTRATÉGIA**

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

ROBOTS THAT TEACH EACH OTHER





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)

**2ª METADE do SÉCULO XVIII -
1760 a 1840**
Primeira Revolução Industrial

- Máquina a Vapor
- Transição da tracção animal para o poder das máquinas

FIM do Século XIX /Século XX
Segunda Revolução Industrial

- Advento do Motor de Combustão Interna
- Carro / Avião
- Eletricidade
- Fábricas para a produção em massa

HÁ 10 000 ANOS ATRÁS

- A Revolução Agrária e a Domesticação dos Animais

**UMA IDEIA PODE
MUDAR O
MUNDO**

1960 até fim Século XX
Terceira Revolução Industrial: Computadores

- Desenvolvimento dos semi-condutores
- Computação mainframes (1960's)
- Computador pessoal (1970/1980's)
- Internet (1990's)

SÉCULO XXI
**Quarta Revolução Industrial:
Revolução Digital**

- Internet Móvel
- Sensores poderosos
- Inteligência Artificial
- As Máquinas que aprendem ("Machine Learning")
- A Tecnologia Digital combinada com "BIG DATA"

WHICH DIRECTION WE ARE GOING?

THE WORLD AT A CROSSROADS?

The GEOPOLITICS and the ECONOMY

- Globalization effects
- Nation-State decline
- Emergency of new actors
- Partial Transference of financial power
- Global crisis of capitalism

GLOBAL THREATS

- Climatic (migrations)
- Terrorism
- Piracy
- Failed states
- Collapse of Order in areas of the Globe
- Nuclear proliferation
- Weapons of Massive Destruction

THE RESOURCES

- More scarce resources
- Intensification fight by the Resources
 - Minerals
 - Energy
 - Food
 - Water
- Control of strategic Raw Materials

WORLD CHALLENGES

2012

POPULATION

7 billion people

GDP

65 trillion US\$

CAR FLEET

800 million 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?

A GLOBALIZAÇÃO DA PROCURA MUNDIAL DE MATÉRIAS-PRIMAS

- O exemplo do petróleo
- 85% do crescimento da procura mundial vem dos países emergentes

A LUTA GEOPOLÍTICA PELO CONTROLE DAS MATÉRIAS-PRIMAS

- A crise das Terras Raras
China / Japão 2010

OS SUPER CICLOS DE PREÇOS ALTOS DAS “COMMODITIES”

- O choque da procura em 2008
- Repetição em 2012
- Choque da oferta a partir de 2014

O PAPEL DOS PAÍSES EMERGENTES E OS CONSTRANGIMENTOS

- Os recursos necessários para suportar o desenvolvimento económico
- O crescimento demográfico

A VOLATILIDADE DOS PREÇOS

- O balanço cerrado entre a oferta e a procura não explica tudo
- O efeito geopolítico
- O efeito especulativo
- O efeito dos “stocks” estratégicos

UMA NOVA ERA NA DINÂMICA DOS PREÇOS

- Volatilidade elevada
- Papel da “especulação”
- “Players” tradicionais + gama diversa de entidades financeiras

TENDÊNCIAS EMERGENTES NOS MERCADOS DAS MATÉRIAS PRIMAS

A “FINANCEIRIZAÇÃO” DAS MATÉRIAS PRIMAS

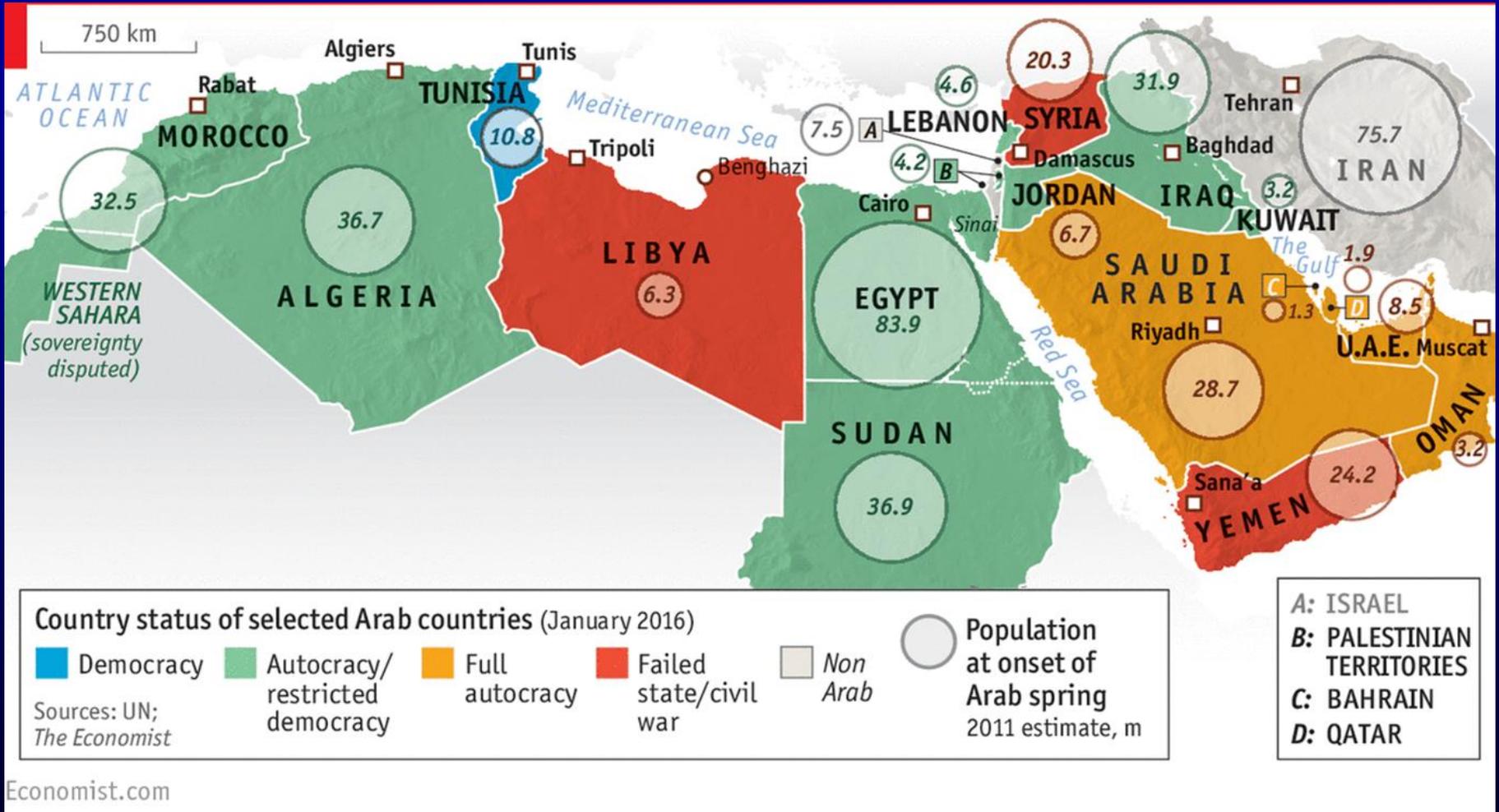
- Personalidade dupla
- Matérias-Primas + Activos financeiros

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

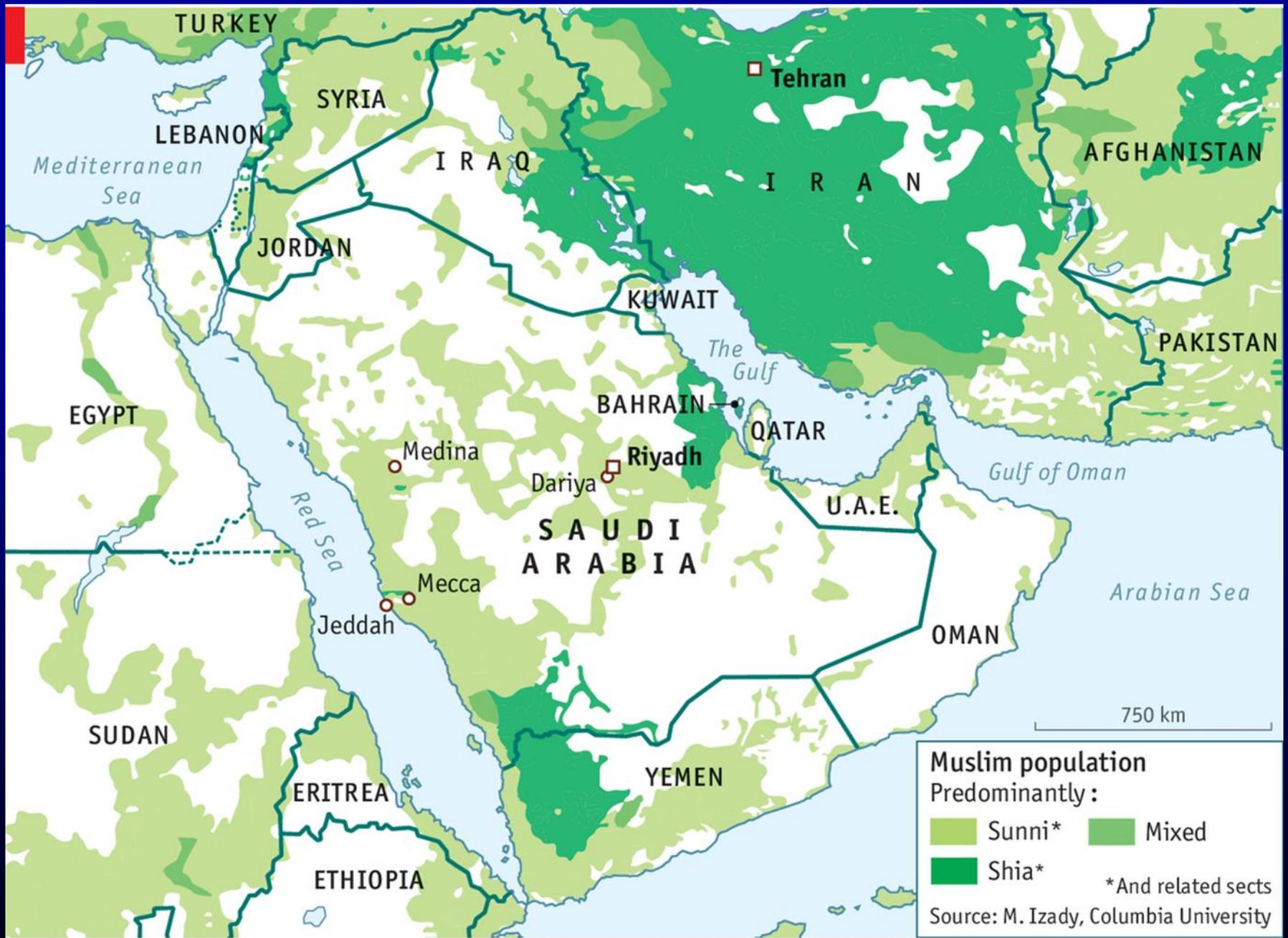
Source: US Geological Survey, Minerals Yearbook; BP, Statistical Review of Weorld Energy

Arab Countries Status



Economist.com

The Economist, 9-15 January 2016



THE GEOPOLITCS OF OIL

Provisions, production and problems

Bahrain

Tiny producer but significant because of proximity to Saudi Arabia's Eastern province, home of the world's largest oil fields. Could become caught up if tensions rise between Saudi Arabia and Iran

0.1

Crude oil proved reserves (bn barrels)

Tunisia

A small oil producer but traders are watching political developments after it was the first Arab government to collapse in 2011

0.4

Syria

Importance in global oil markets has fallen as production dropped in past 10 years. Traders keep an eye on it nonetheless because of political importance in the Arab world

2.5



Yemen

Key to global oil trade because of location on Bab el-Mandeb, mouth of the Red Sea and among the world's most strategic shipping lanes

3.0



Egypt

Suez Canal and Sumed pipeline linking Red Sea and Mediterranean make it critical for global oil trade

3.7



Oman

After years of steady decline in oil production, output has started to creep up with the help of international companies. It is the largest non-Opec Arab oil producer

5.5



Algeria

Proof that oil and natural gas production can continue amid fighting. The hydrocarbons sector did not suffer significantly during a 10-year civil war

12.2



Qatar

Small producer but as the world's largest exporter of liquefied natural gas – the fuel of choice for electricity generation – its role in the global energy market is important

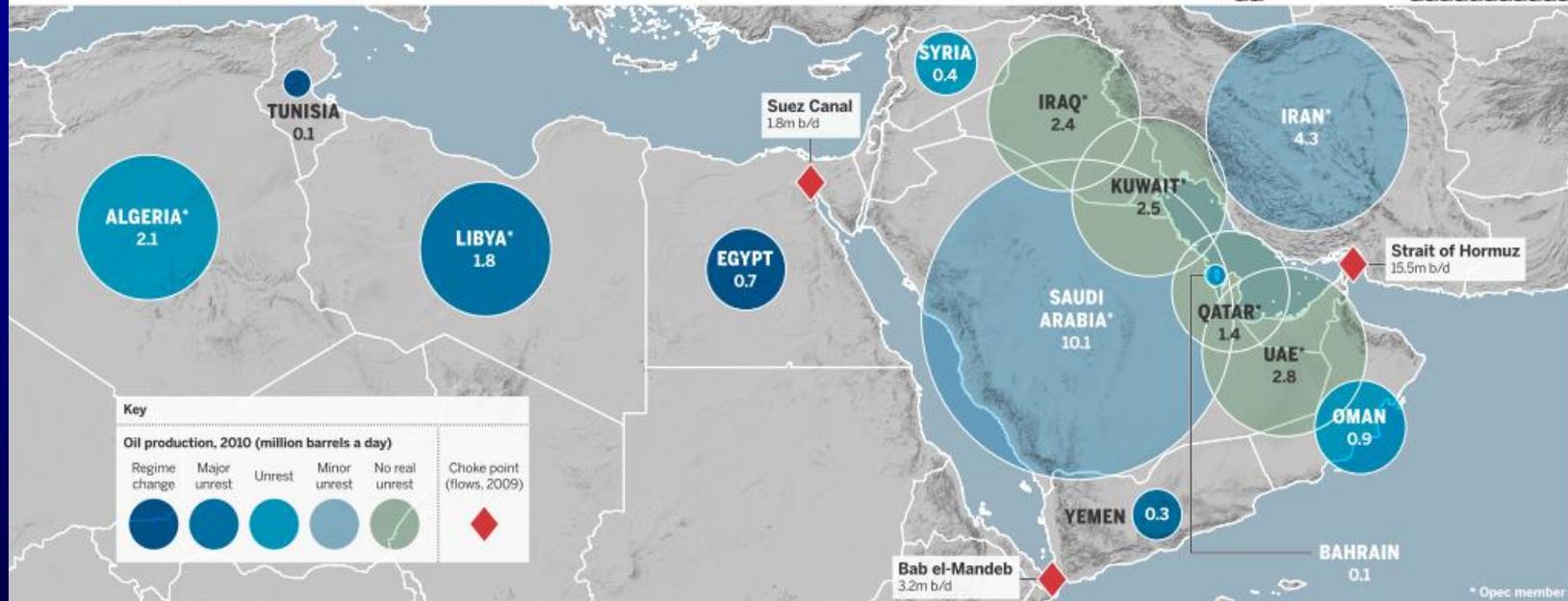
25.4



Libya

Production has dropped to a trickle from pre-crisis levels of 1.6m barrels a day. But rebels are trying to return supplies to the international market with the help of Qatar

44.3



United Arab Emirates

Abu Dhabi, the capital, is the only oil-rich emirate and financially supports poorer members of the seven-state federation. Dubai, Sharjah and Ras al-Khaimah produce small quantities.

98



Kuwait

Struggling to boost production following a decade of fighting off attempts by foreign oil companies to invest

104



Iraq

Plans to boost production from 2.5m b/d to 12m b/d within a decade, but the market is sceptical that it will be able to pump more than 5m-6m b/d

115



Iran

Production never recovered following strikes during the 1979 Islamic revolution that halted output. An important lesson for Libya – currently experiencing outages

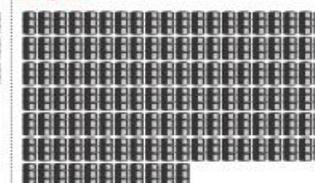
138



Saudi Arabia

The world's largest oil exporter. Also holds the bulk of Opec's idle capacity, giving it a near-unique ability to replace others' outages

262



Jihad in AFRICA

The Danger in the Desert



Source: The Economist, January 26th - February 1st

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

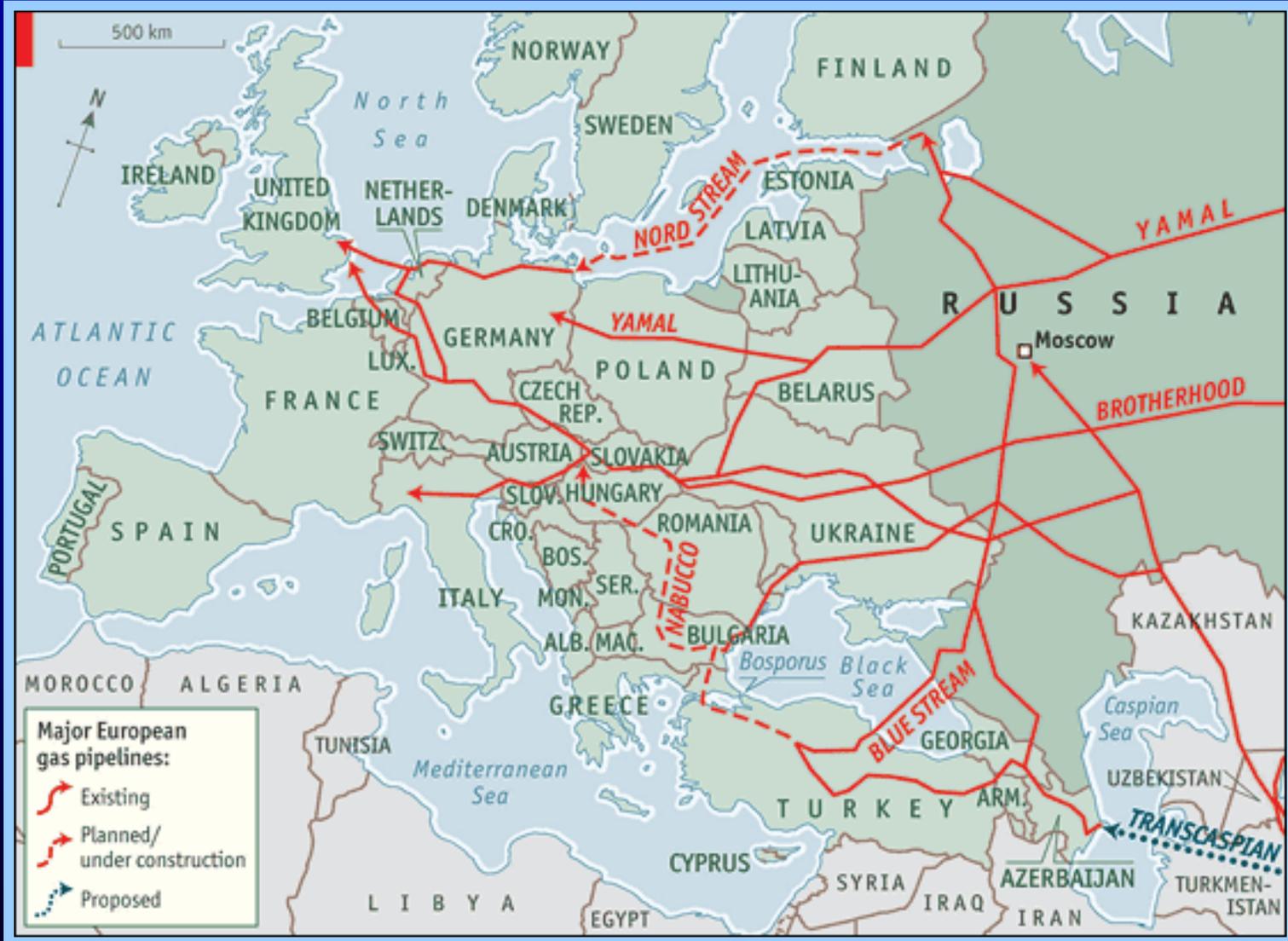
SUSTENTABILIDADE AMBIENTAL

- 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

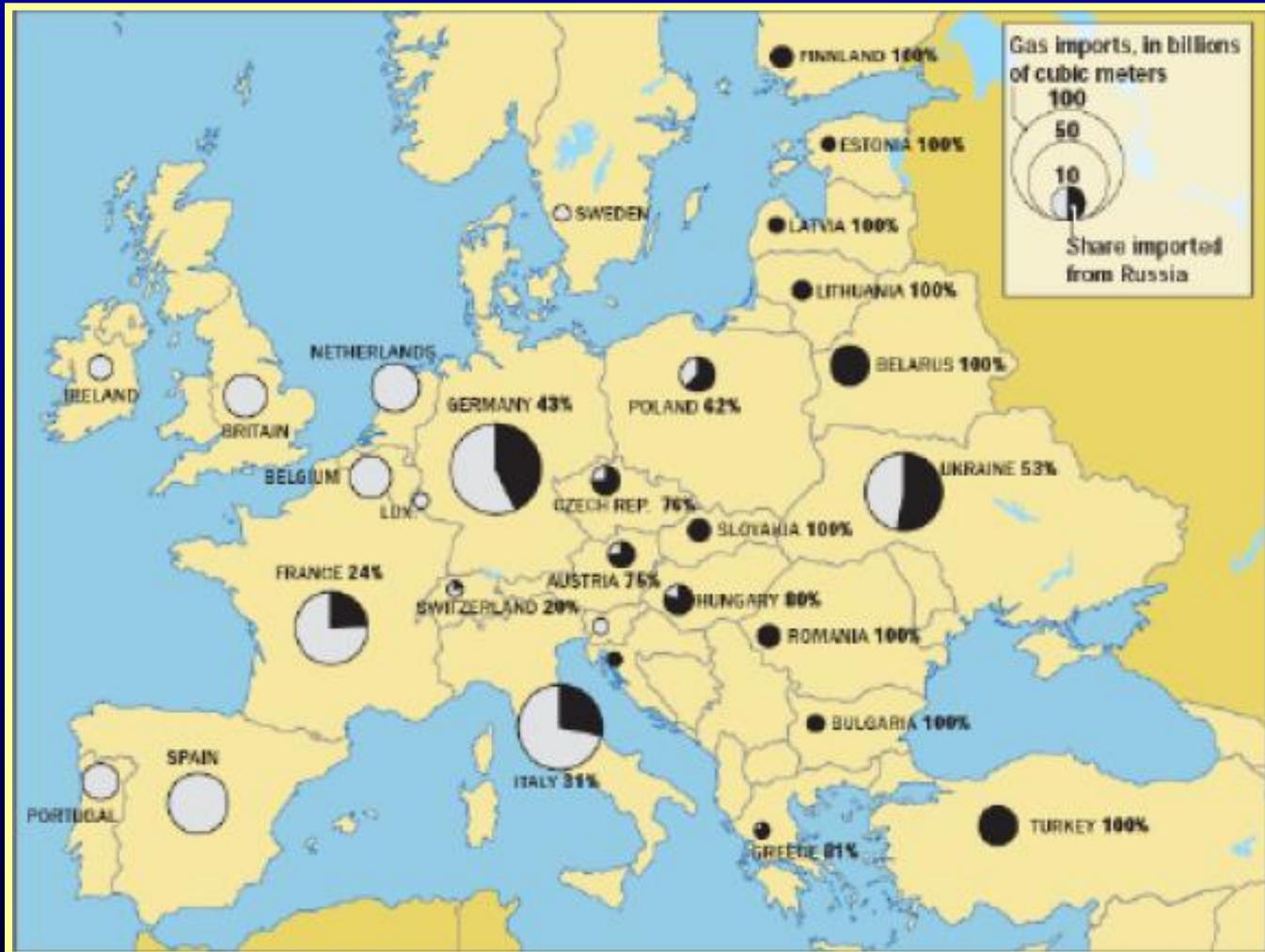
EUROPE ENERGY SECURITY



Source: The Economist - 12 April 2007

An 8% reduction in 2015 global energy investment results from a \$ 200 billion decline in fossil fuels, while the share of renewables, networks and efficiency expands

EUROPE DEPENDENCE ON RUSSIAN GAS



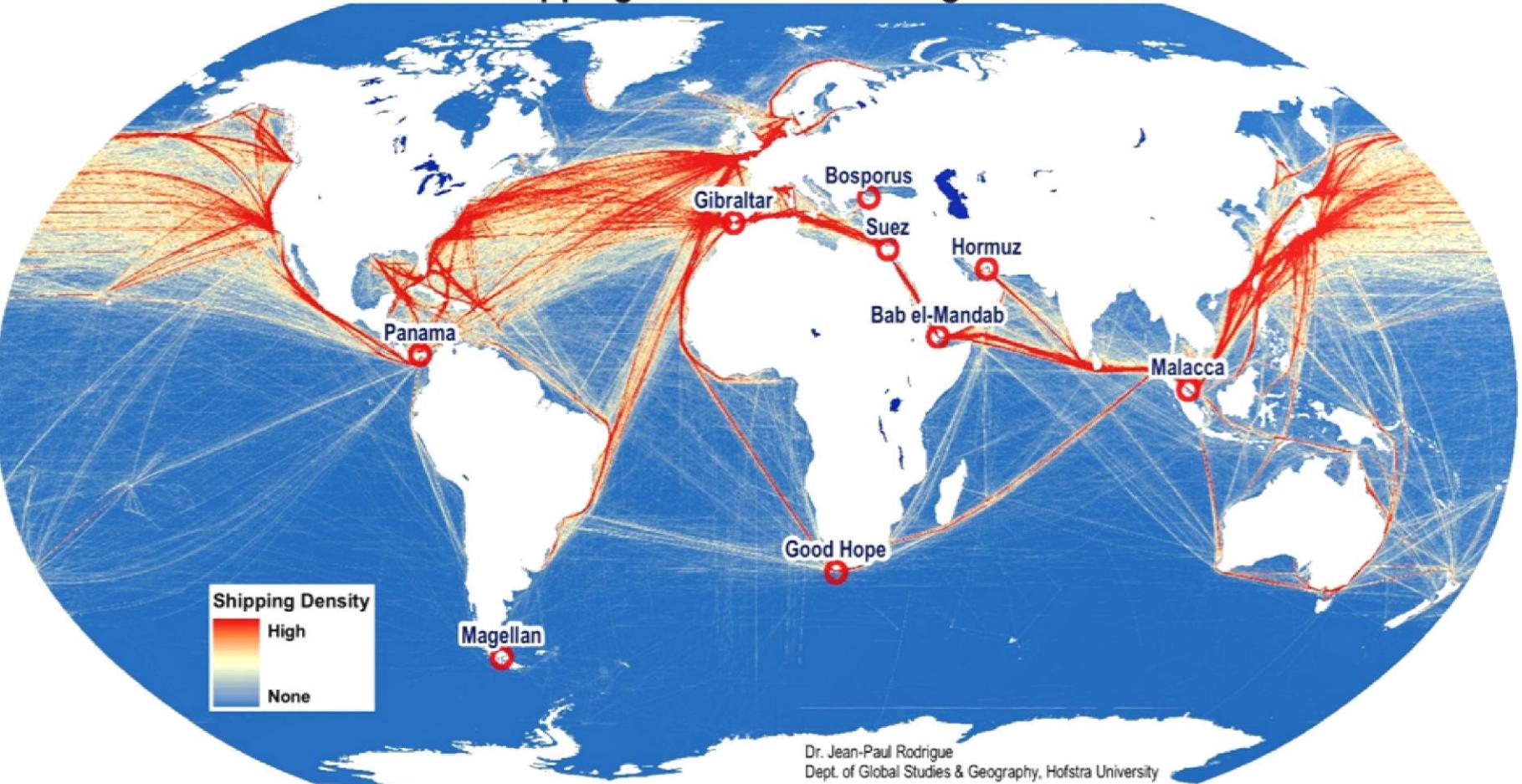
Source: Herald Tribune/IEA

An 8% reduction in 2015 global energy investment results from a \$ 200 billion decline in fossil fuels, while the share of efficiency expands

A SEGURANÇA NA BACIA DO ATLÂNTICO



Maritime Shipping Routes and Strategic Locations



Source: Shipping density data adapted from National Center for Ecological Analysis and Synthesis, A Global Map of Human Impacts to Marine Ecosystems.

**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: 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

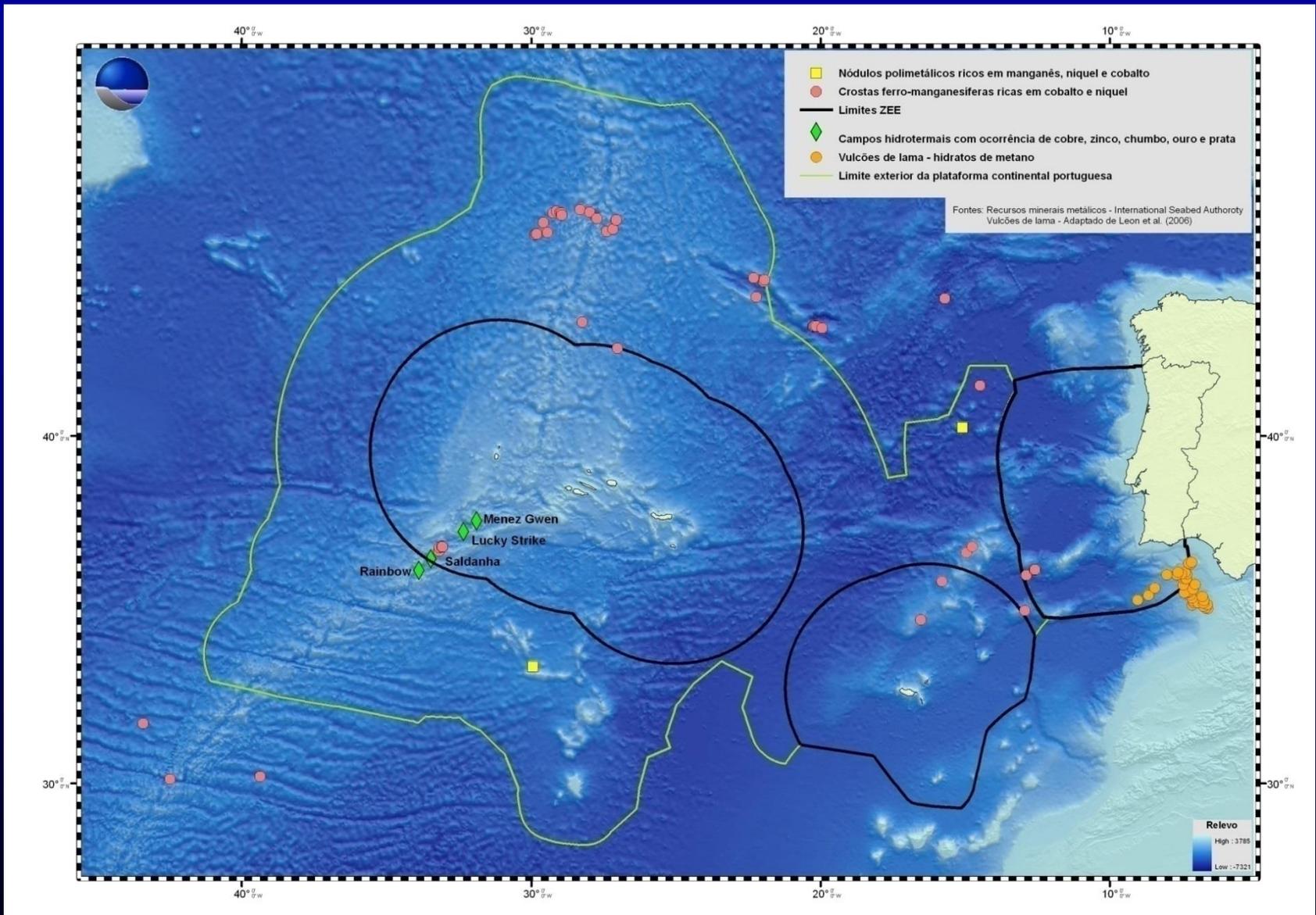
**PORTUGAL: PONTE
GEPOLÍTICA entre EUROPA,
EUA, Ibero-América, África
Norte, Lusofonia, Atlântico
Sul e Ásias**

- TTIP
- CPLP
- Mercosul
- Repensar as Alianças

**PORTUGAL: PLATAFORMA
TECNOLÓGICA INTEGRADA**

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

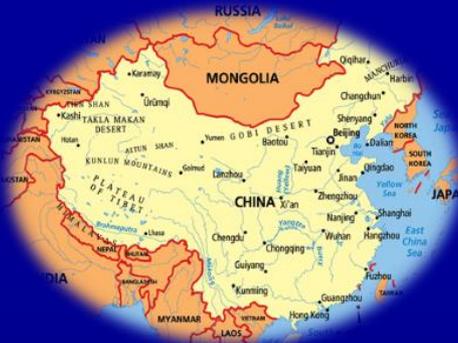
PORTUGAL: ZEE com a Extensão da Plataforma Continental





INDIA GLOBAL ROLE

- Approach to the US
- Contention of China in Indian Ocean and North border
- Access to Raw Materials and Energy
- Potential economic and population growth



US GLOBAL ROLE

- Energy Independence
- Western Hemisphere
- North-South Americas geopolitical axis
- Economic integration with Canada and Mexico
- Role of Latin American
- The “Cuba” détente
- The Transpacific relationships
- Weakening of Transatlantic relationship?



RUSSIA GLOBAL ROLE

- Serious recession
- Collapse of energy prices
- Domestic insecurity, leading to belligerence
- Growing nationalists and export of troubles (Crimea/Ukraine/Syria)
- Severe economic problems
- Pharaonic network of energy pipelines
- Military adventures
- Absence of strong institutions
- Centralized authoritarian rule over large problematic areas

GEOECONOMICAL RECONFIGURATIONS



EUROPE LOST **in THE STORM**

- Financial crisis undermine confidence
- Refugee crisis undermine core values
- Sovereign debt crisis undermine the European project
- Inability to deal with internal and external problems
- Growing instability in East and Southern borders
- Inability to deal with Russia
- Inability to deal with the Middle East and North Africa issues



CHINA GLOBAL ROLE

- The Silk Road Economic Belt
- The Central Asia connections and Platform for energy, trade and commerce
- The role of China national policy: the strategy of 3 chains of islands
- The South and East China seas
- The link to Indian ocean, Persian Gulf, East and West Africa
- The growing pressure of China in South Atlantic Ocean



PERSIAN GULF

- Growing instability / disintegration
- Civil / Religions Wars
- Collapse of energy prices
- Erosion of OPEC
- Readjustment to US policy and presence
- Growing connections of Persian Gulf with China and India

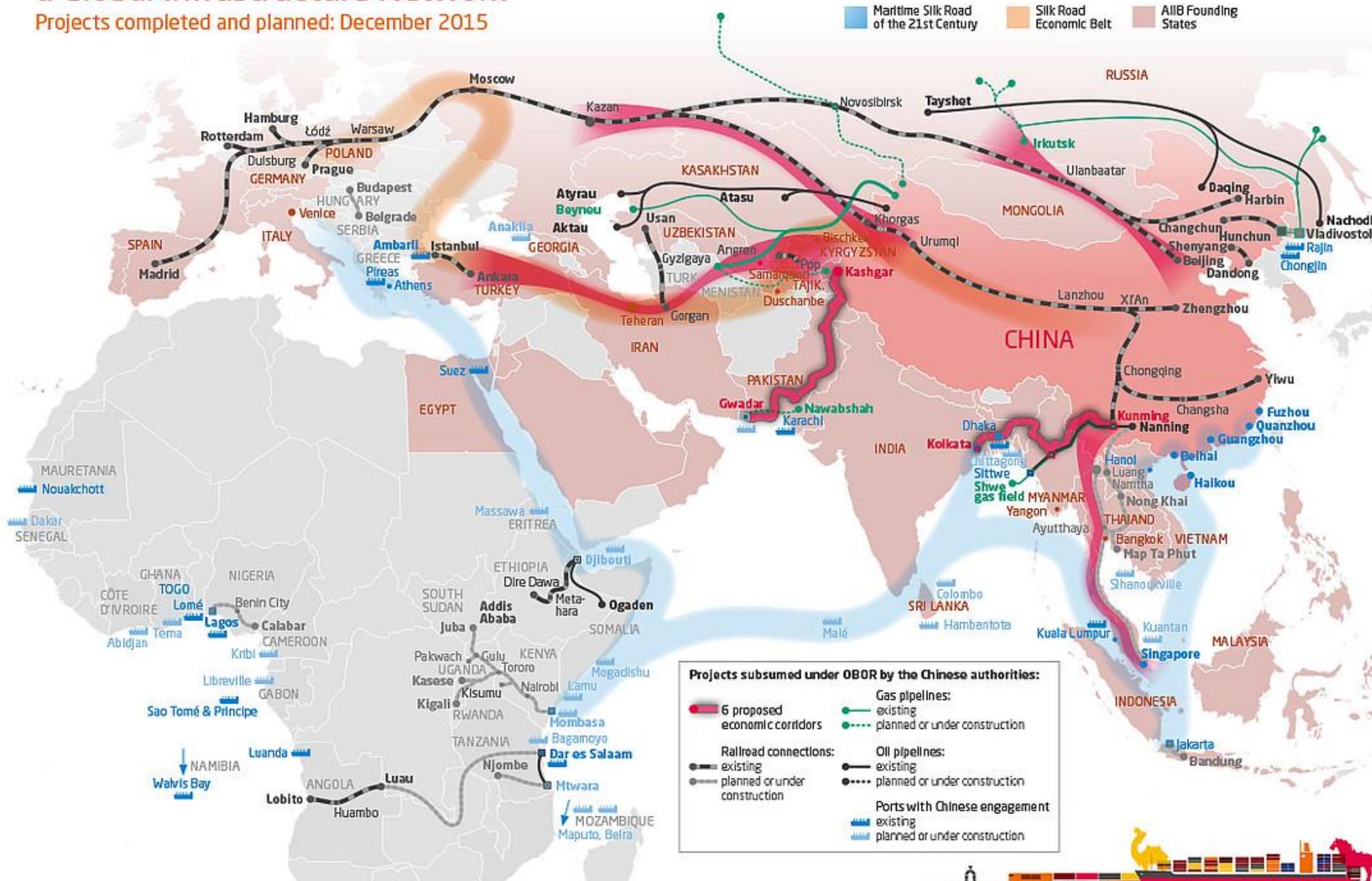
GEOECONOMICAL RECONFIGURATIONS



MERICs China Mapping

One Belt, One Road: With the Silk Road Initiative, China Aims to Build a Global Infrastructure Network

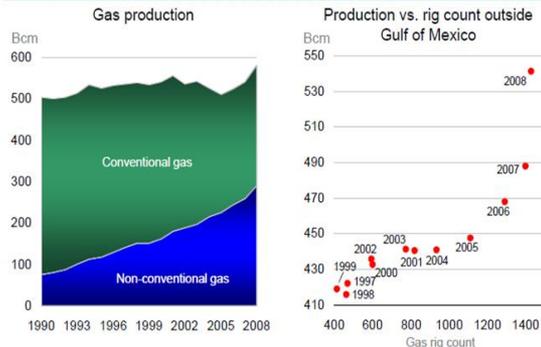
Projects completed and planned: December 2015



2. “ENERGY GAME CHANGERS”

ENERGY GAME CHANGERS in XXI CENTURY

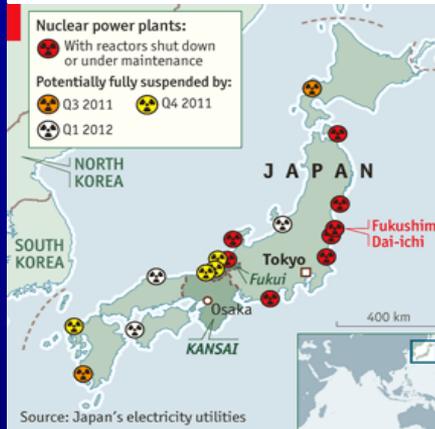
UNCONVENTIONAL GAS



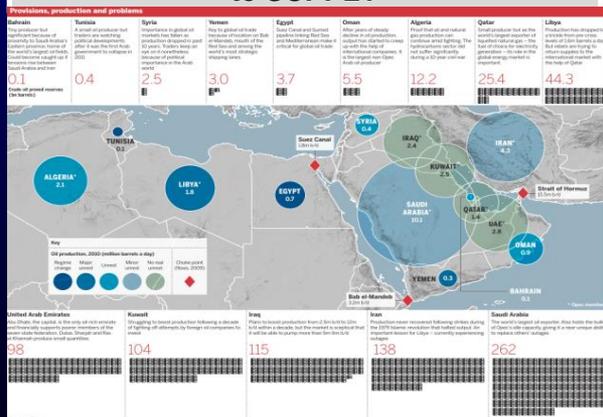
INDUSTRY CATASTROPHIC ACCIDENTS (e.g. OFFSHORE OIL Spills) and PUBLIC IMAGE



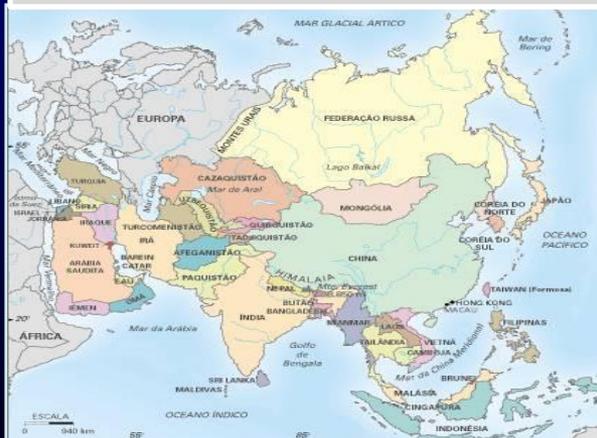
FUKUSHIMA NUCLEAR ACCIDENT



INSTABILITY in PRODUCING COUNTRIES and THREATS to SUPPLY



EMERGENCE of PACIFIC BASIN as TOP ENERGY CONSUMER



CLIMATE CHANGE and ENVIRONMENTAL REVOLUTION

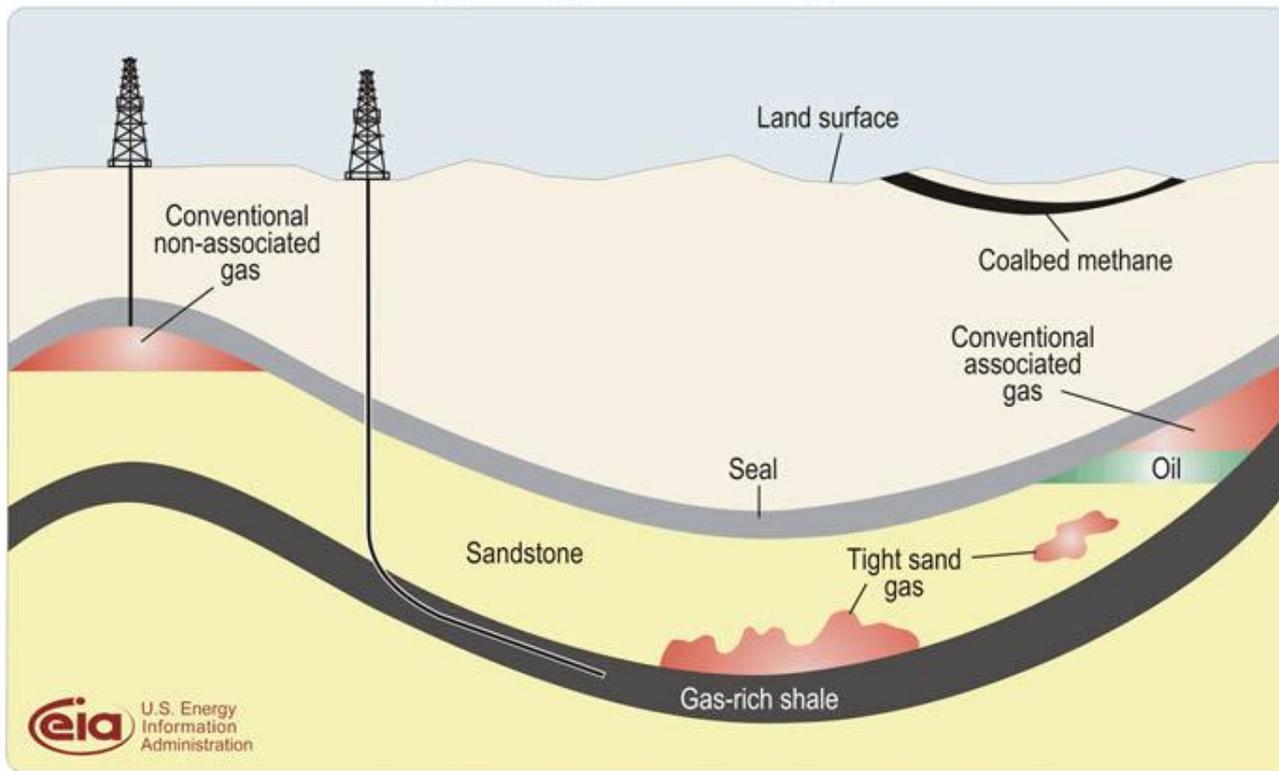


- The Revolution of the SHALE GAS
- The Conceptual Innovation for Shale Production
- US Learning Curve
 - Footprint Concerns
 - Induced Seismicity
- Knowledge of Rocks and Evaluation of the Potential
- Can the US Shale Model be exported?



What is the SHALE GAS?

Schematic geology of natural gas resources



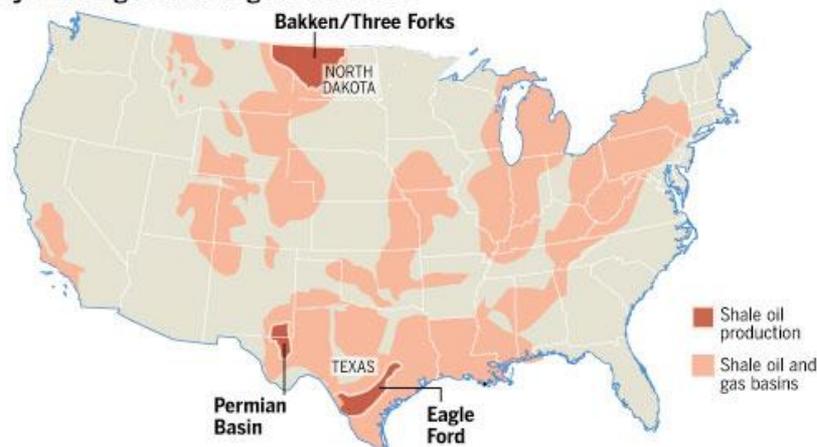
A world class source rock and a potential shale gas reservoir – the Devonian-Mississippian Woodford Shale

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

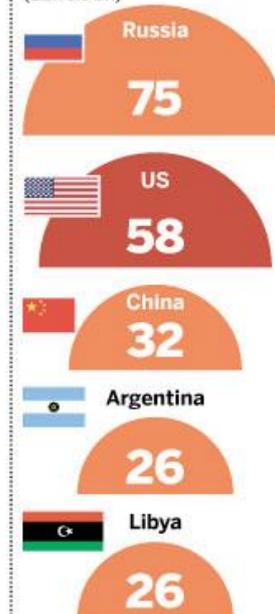
Continental Resources	ExxonMobil
Whiting Petroleum	Marathon Oil
Hess Corporation	Petro-Hunt
Statoil	Slawson Exploration
EOG Resources	Kodiak Oil & Gas

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

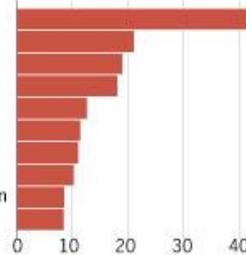
Technically recoverable (Barrels bn)



Top 10 Permian Basin operators, 2012

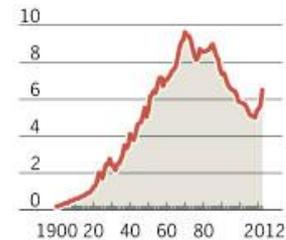
Oil production (Barrels m)

Occidental Permian	~42
Pioneer Natural Resources USA	~28
Apache Corporation	~22
Kinder Morgan Production Co	~18
XTO Energy	~15
Cog Operating	~12
Chevron USA	~10
Oxy USA WTP	~8
Sandridge Exploration and Production	~6
Endeavour Energy Resources	~4



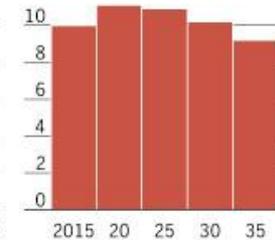
US oil production

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

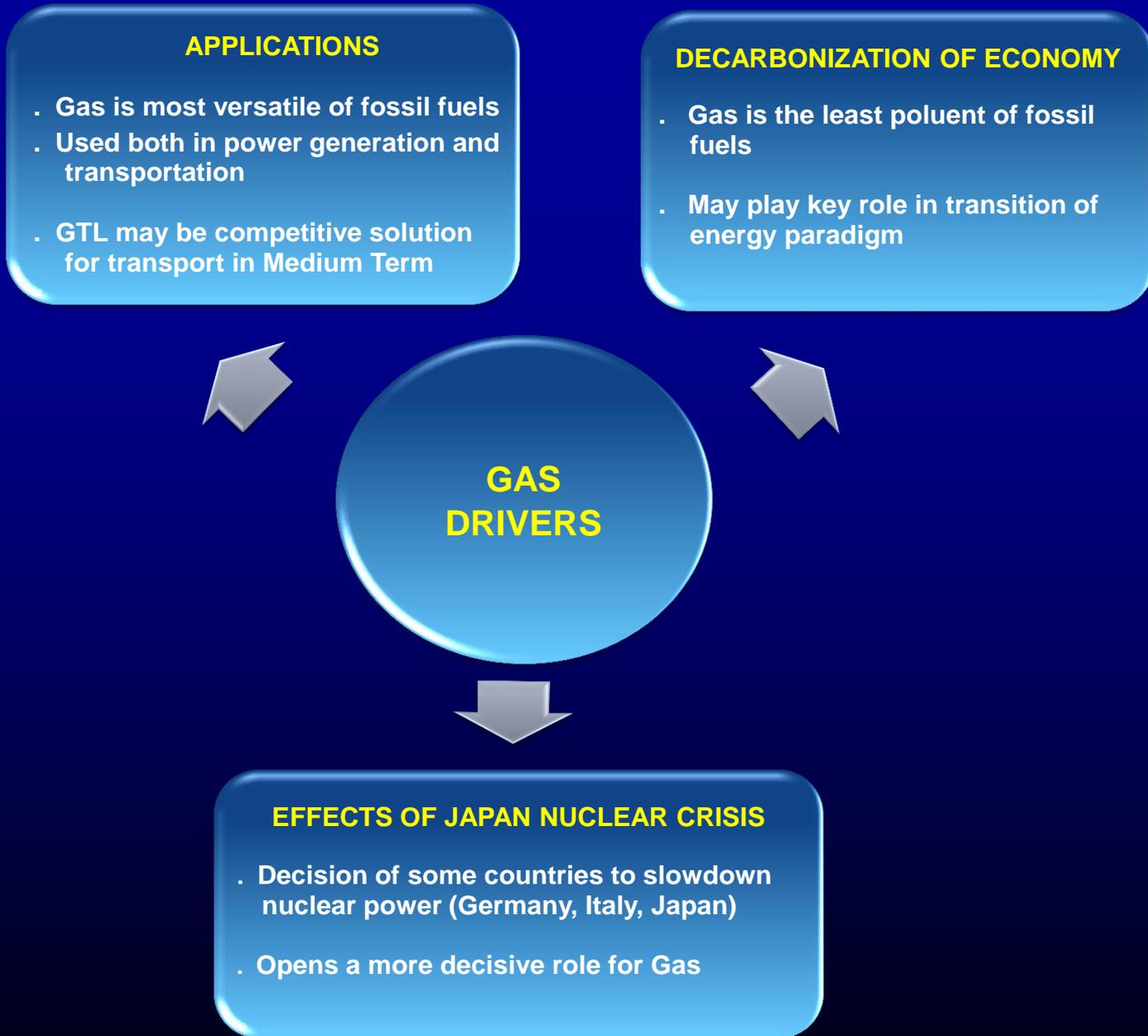


Source: *The Economist*, 6th August 2011

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



Fonte: The Economist, 14th June 2014



ECONOMIC

- Economic growth and productivity
- Creation of wealth to be distributed
- Long Term Approach
- Attraction of investment
- Innovation/Creativity/R&D spending
- Focus on the drivers of growth including the enterprisers



ENERGY SUSTAINABILITY



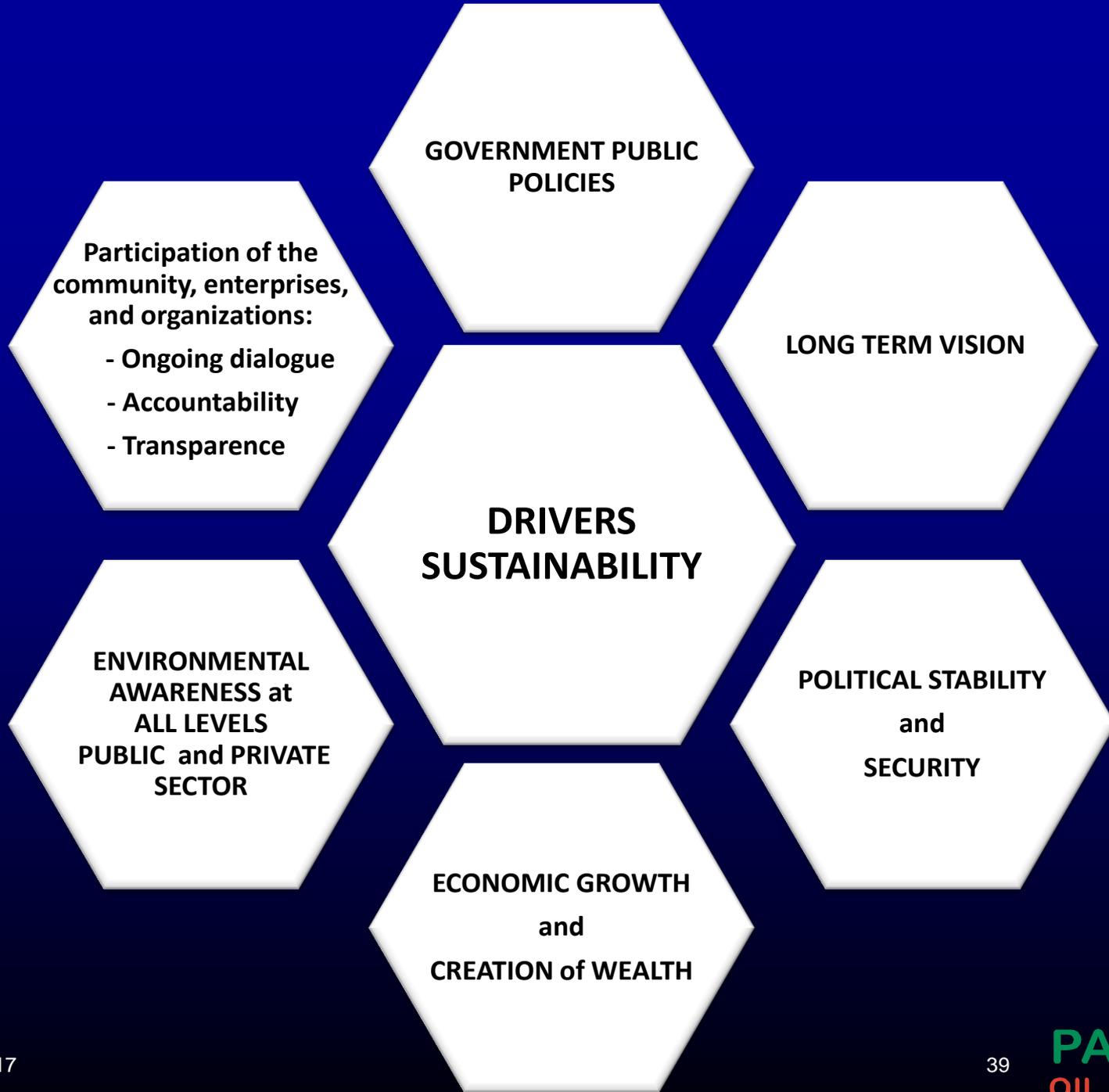
SOCIAL

- Distribution of wealth generated by the economic development
- Quality of Life
- Community Development
- Govern of law & ethics
- Education and Scientific Development
- Public Policies and Involvement



ENVIRONMENTAL

- Energy Efficiency
- Shift in the Energy Mix
- Bid on Gas and Renewables
- Resource management
- Environmental Protection
- Preservation of eco-systems



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:

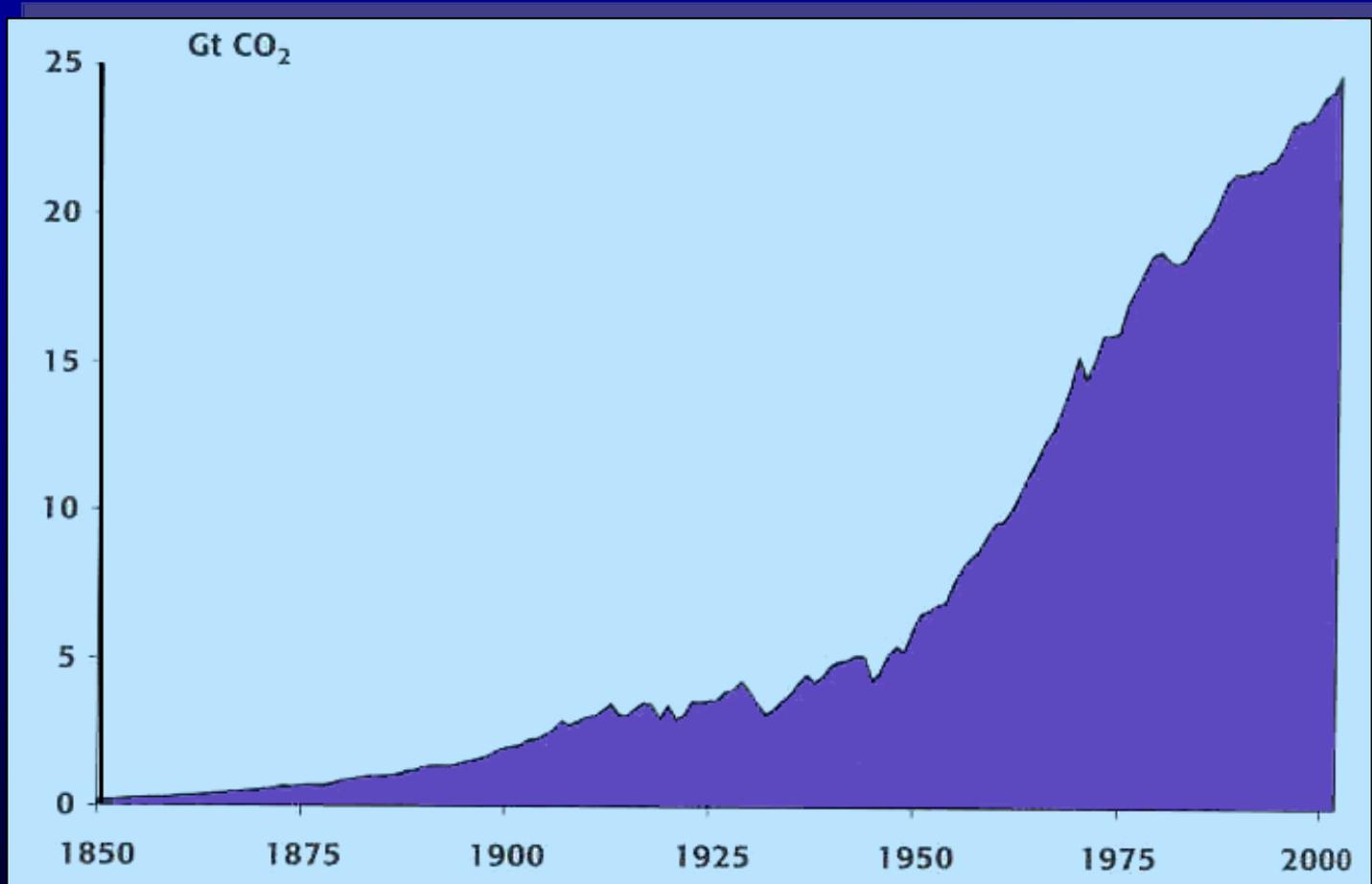
- Power stations
- Electricity System
- Transport System

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

NEED BUILD a Low-Carbon ECONOMY

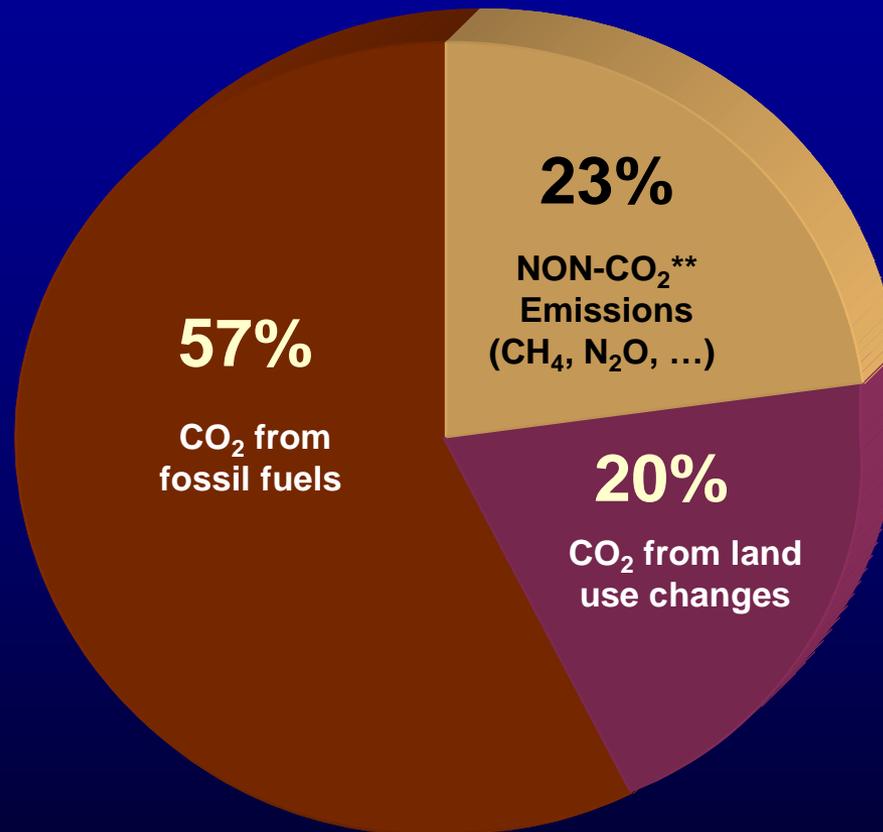
- Till today action led to poor results
- New Action Plans

Global Co₂ Emissions from Fossil-Fuel



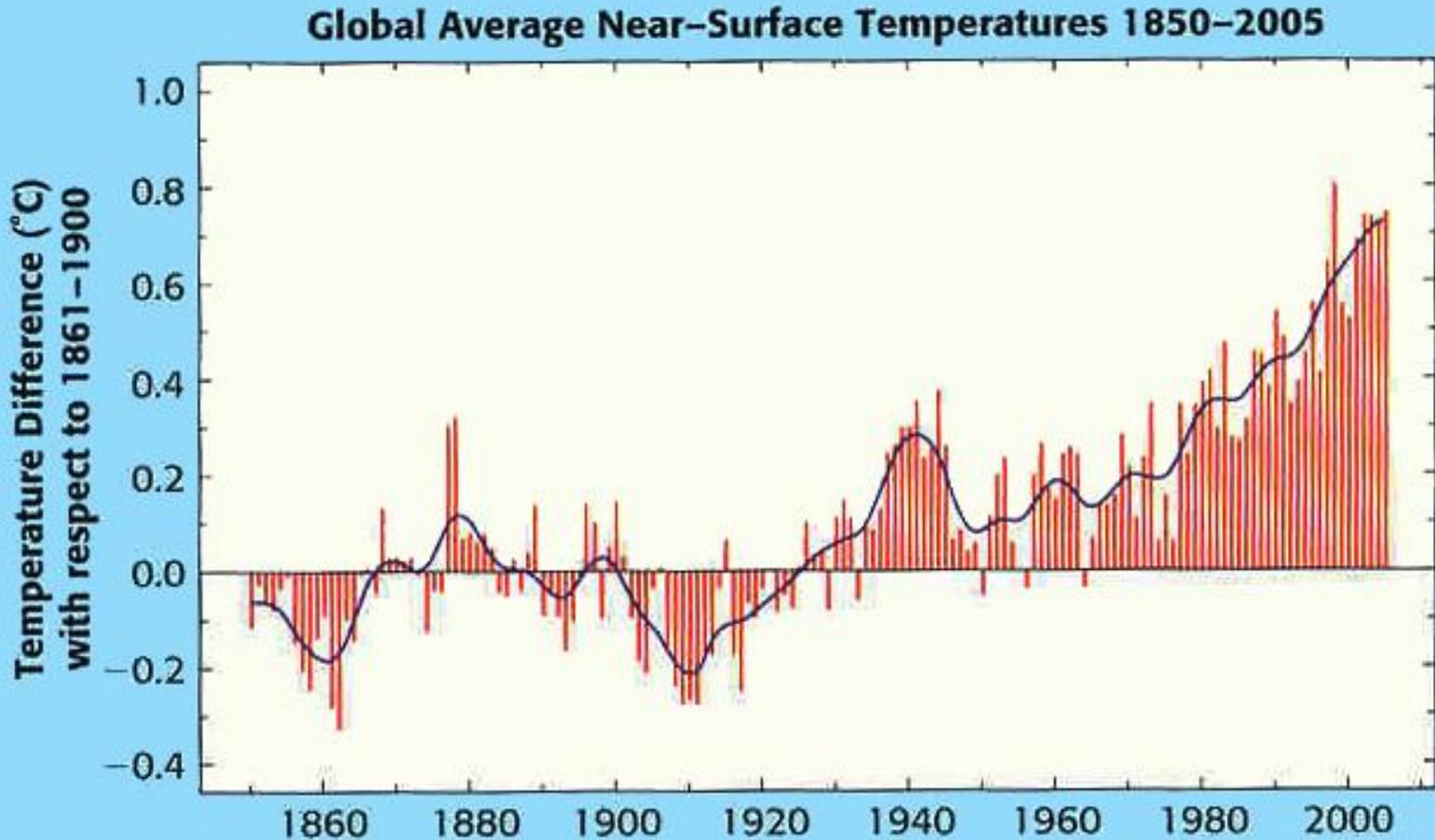
Source: Nicholas Stern / Brohan et al (2006)

Rough Breakdown of Global Greenhouse Gas Emissions in 2004



Fonte: IPCC, 2007

The Earth has warmed 0.7°C since around 1900



Met Office

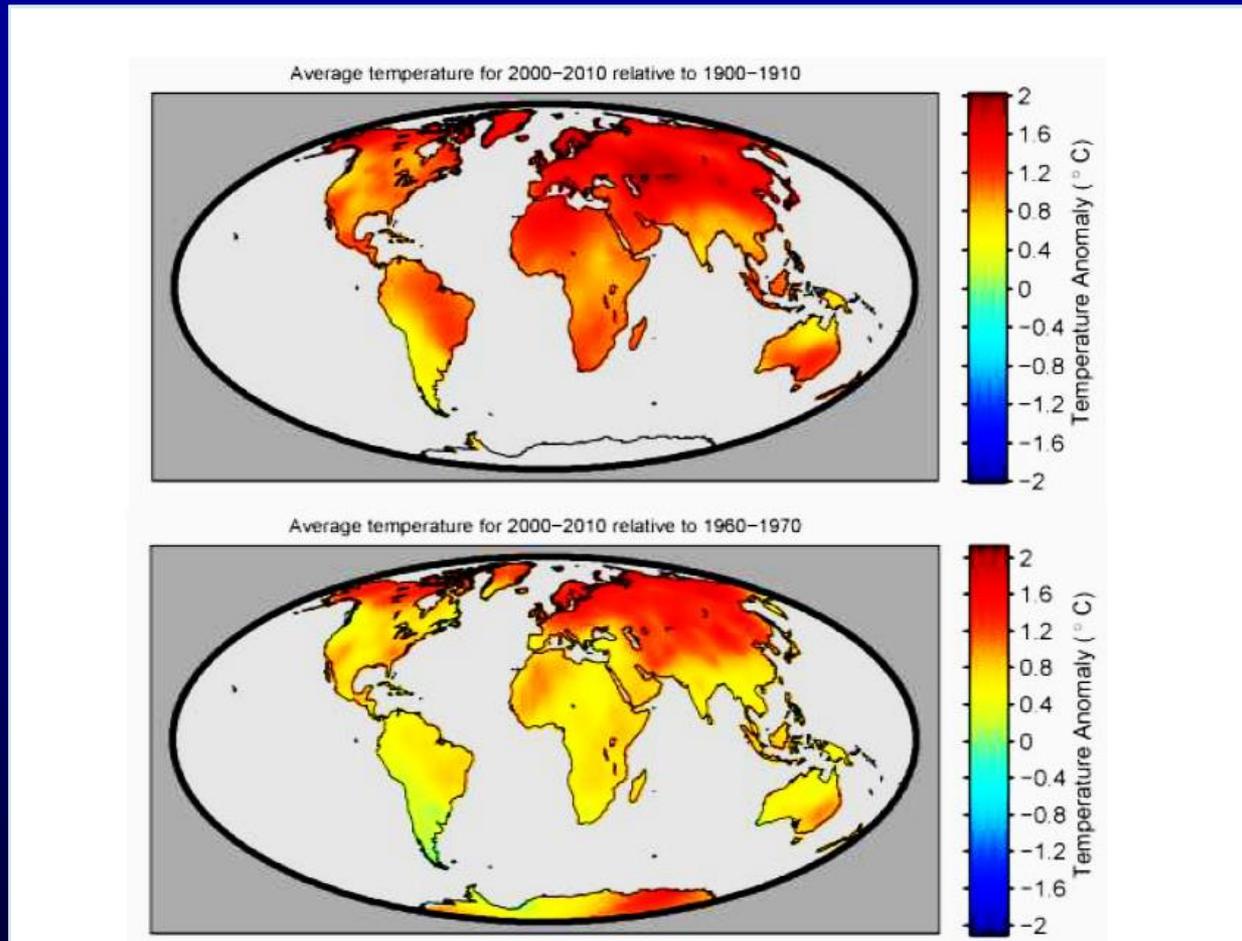
Hadley Centre for Climate Prediction and Research and CRU, University of East Anglia

ii 24/04/2006 1547

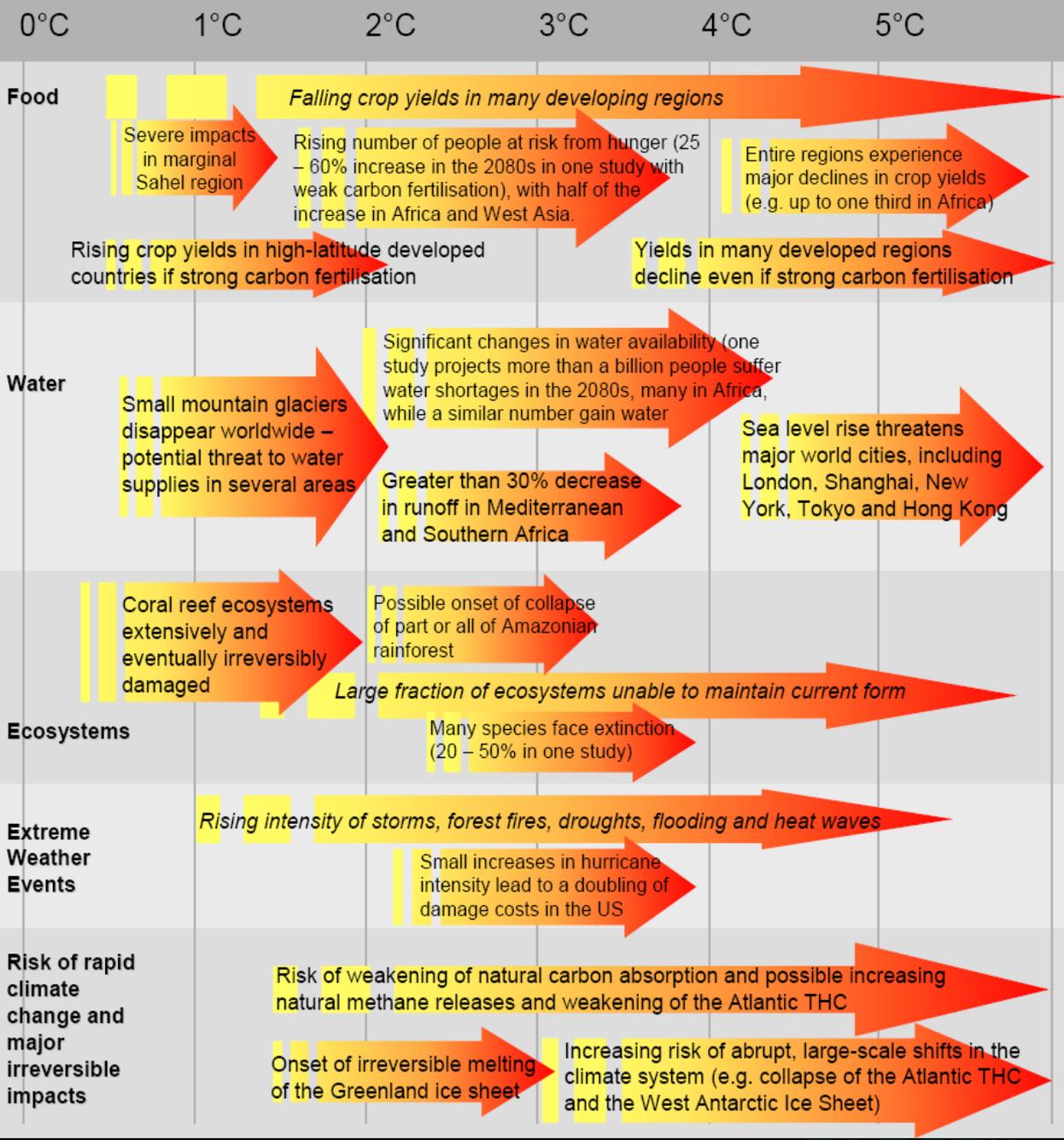
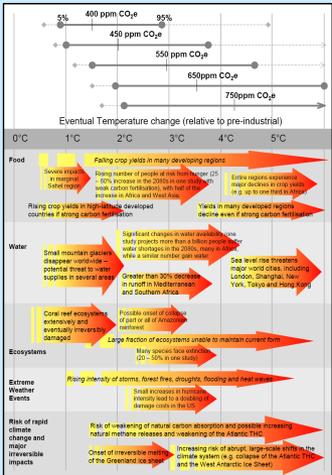
Fonte: Nicholas Stern / Brohan et al (2006)

BERKELEY EARTH TEMPERATURE STUDY

Prof. Richard A. Muller Team, November 2011



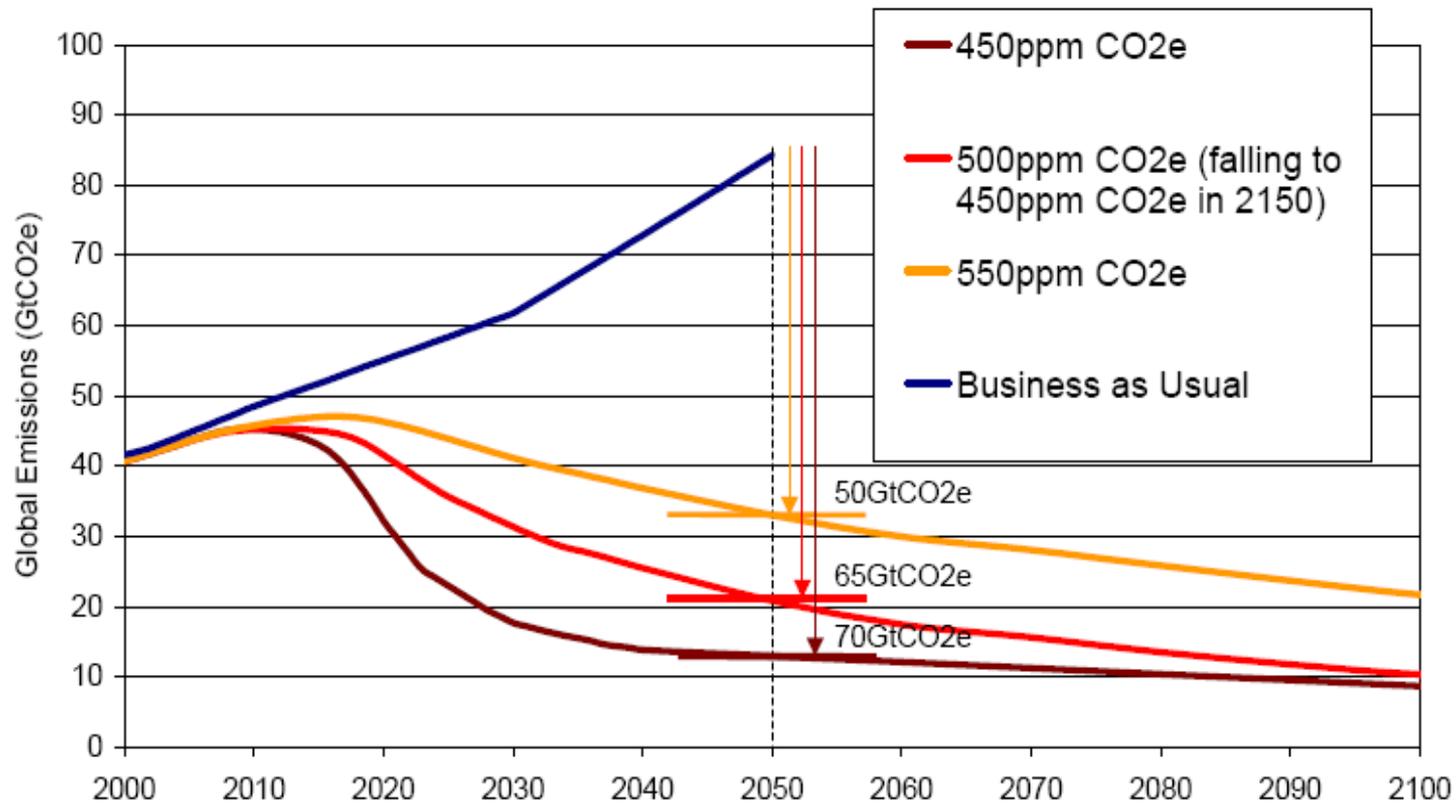
Maps showing the decadal average changes in land temperature field. In the upper plot, the comparison is drawn between the average temperature in 1900 to 1910 and the average temperature in 2000 to 2010. In the lower plot, the same comparison is made but using the interval 1960 to 1970 as the starting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



Effects of Temperature Rise

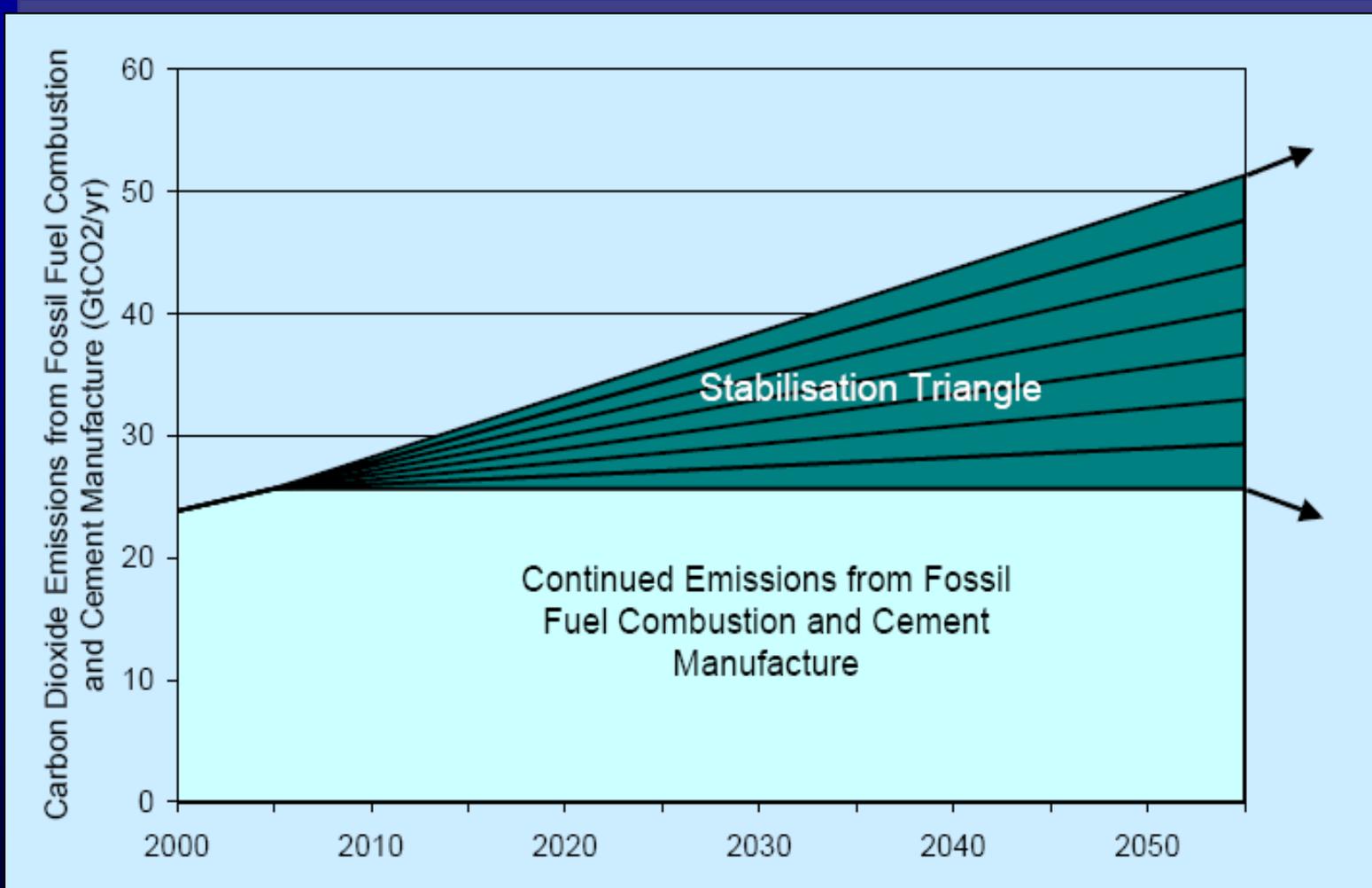
Fonte: Nicholas Stern / Stern Review web site

Socolow and Pacala's "wedges"



Fonte: Nicholas Stern

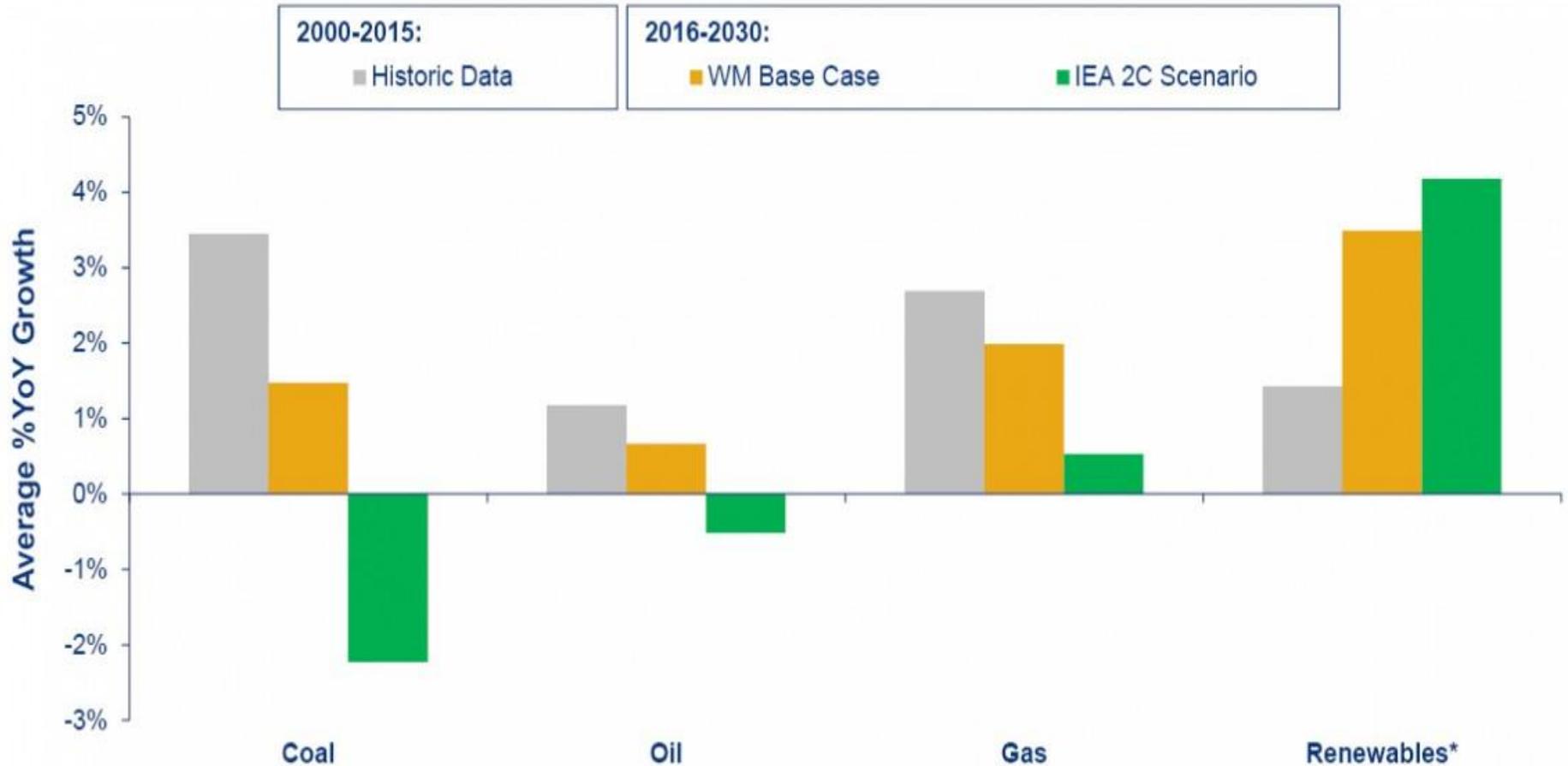
Socolow and Pacala's "wedges"



Source: Pacala and Socolow (2004)

Paris COP 21 and Future Scenarios

Global Energy Demand Growth: 2000-2015 vs 2016-2030



Source: Wood Mackenzie; *Note: "renewables" is defined as wind, solar, hydro and nuclear

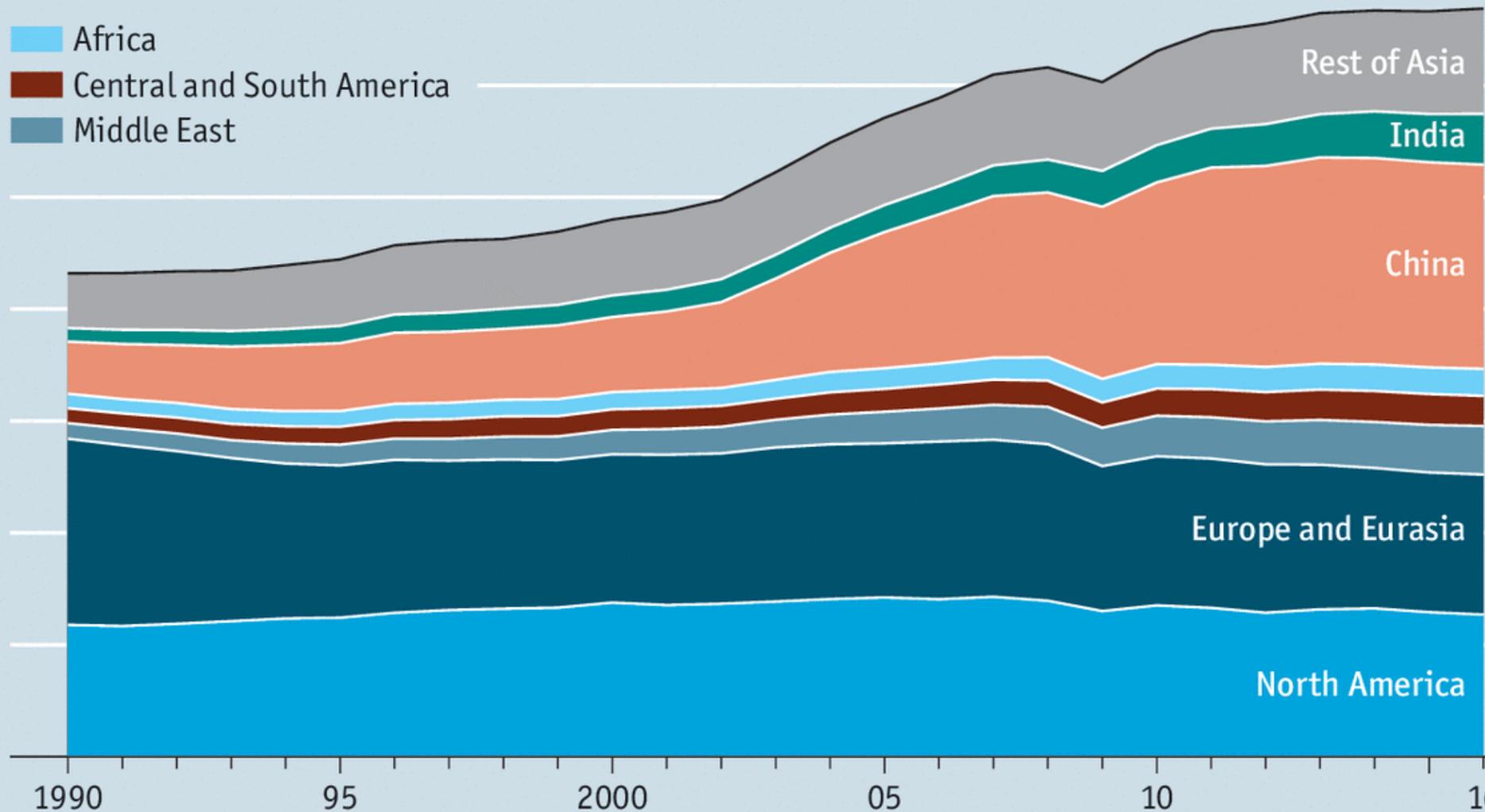
CO₂ emissions

Tonnes, bn

Africa

Central and South America

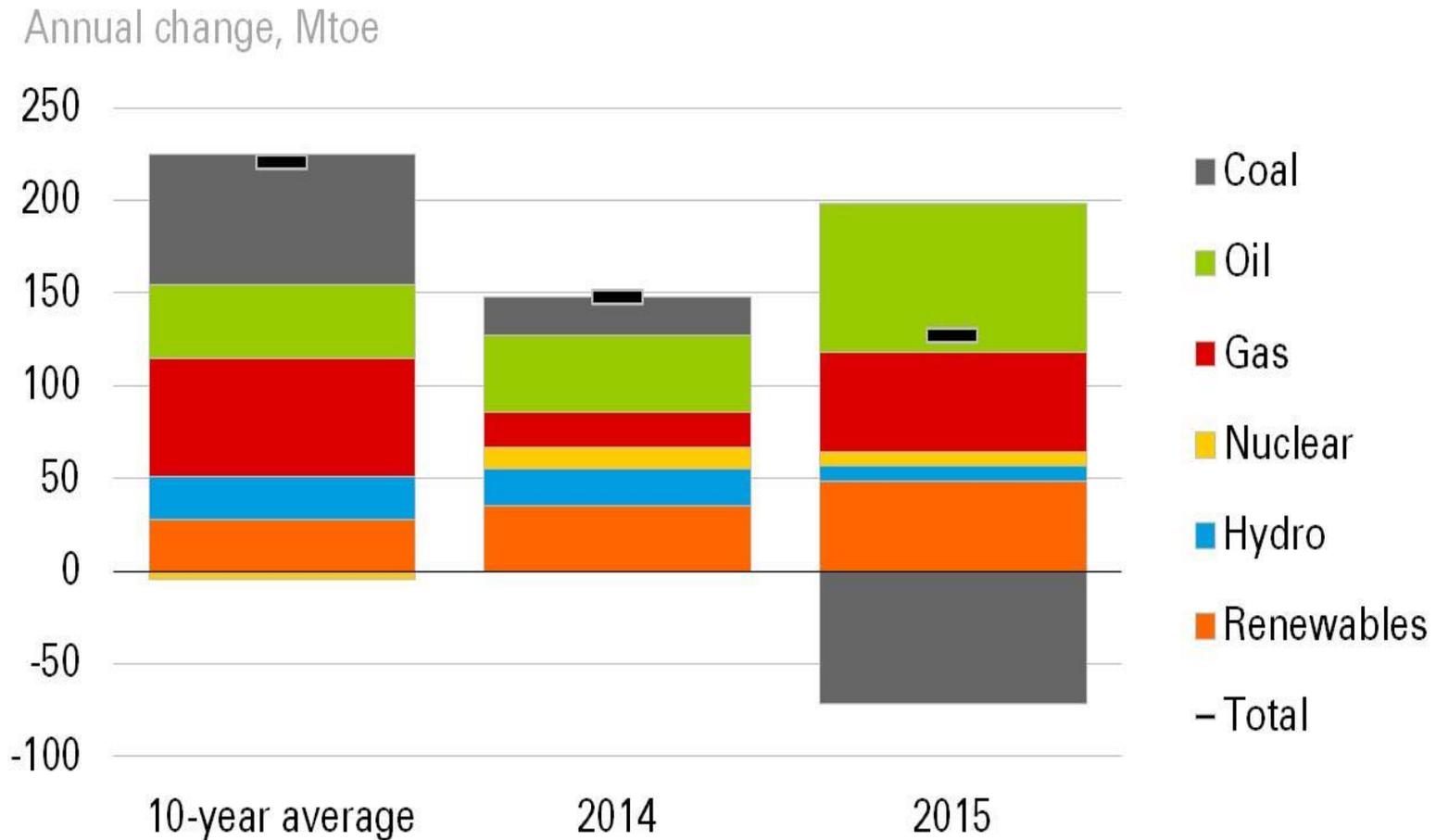
Middle East



Source: BP

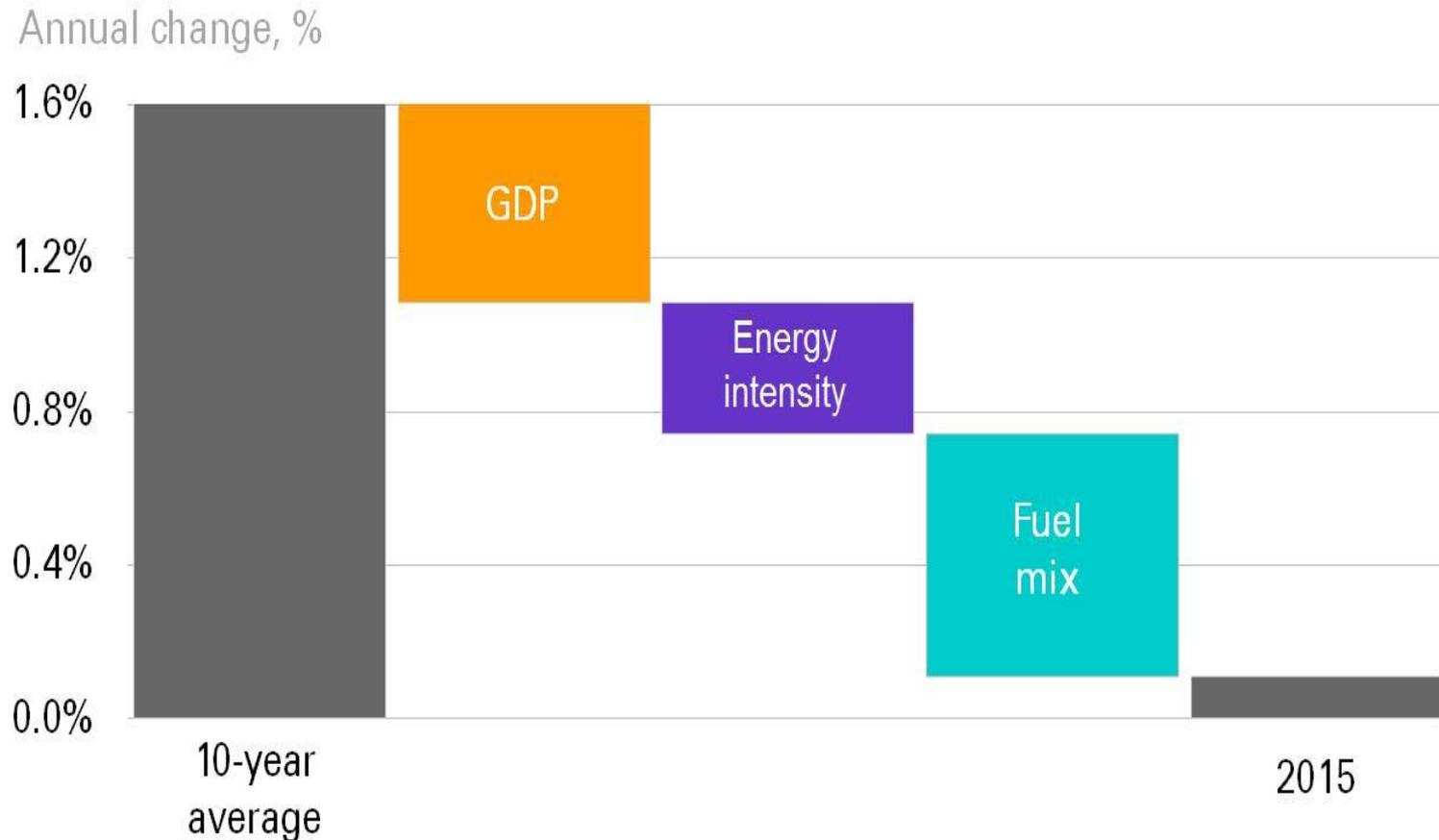
Primary energy growth

Fuel increments

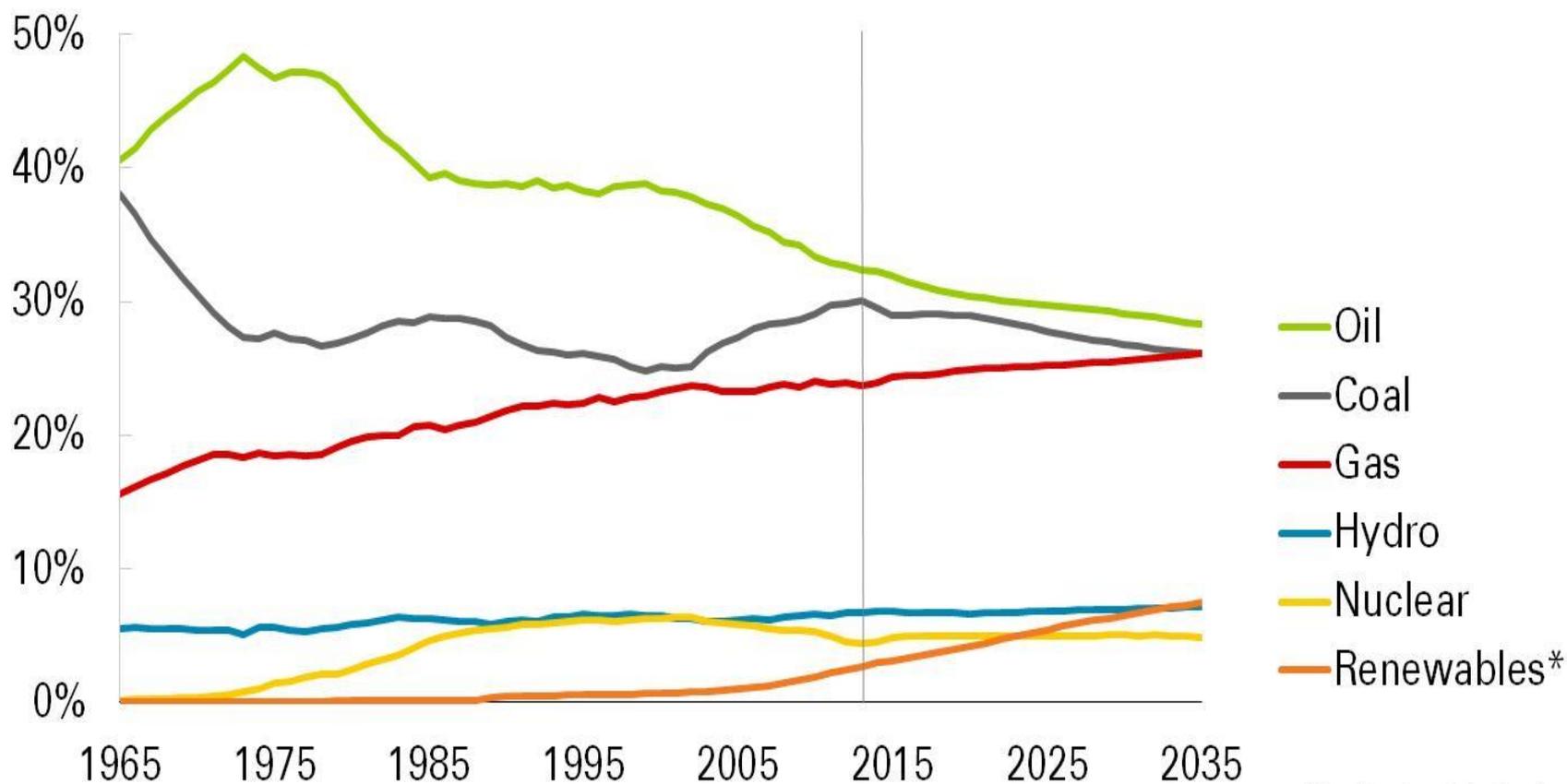


Factors driving slower growth of carbon emissions

Contributions to slowdown in 2015 growth vs trend



Shares of primary energy



*Includes biofuels

ENERGY

Total global energy investment in 2015

\$1.8 trillion

-8%

lower than in 2014, mostly because of cuts in upstream oil and gas spending as well as declining costs across the energy sector

Top 5 markets



Oil & gas still number one, despite investment drop



\$583 billion
Upstream oil & gas investment in 2015

25%
less than 2014

mainly a result of cost reductions triggered by lower oil prices



Further **24%** drop expected in 2016

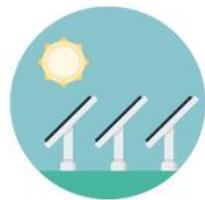
Source: IEA, 2016

ENERGY

A major shift in investment towards low carbon sources of energy



\$221 billion
invested in energy
efficiency



\$313 billion
invested in all renewable
energy sources



\$21 billion
invested in new nuclear
plants

+33% more energy

Renewable power spending was flat from 2011-2015 but produced one third more electricity thanks to smarter deployment of improved wind and solar technology

Electricity sector



\$420 billion
invested in electricity
generation



\$262 billion
invested in networks

Are we on track?

420
kg/Mwh

The carbon intensity of power generation that came online in 2015, a 20% improvement on the existing fleet

100
kg/Mwh

Where we need to be to reach climate stabilisation in the next two decades

Source: IEA, 2016

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

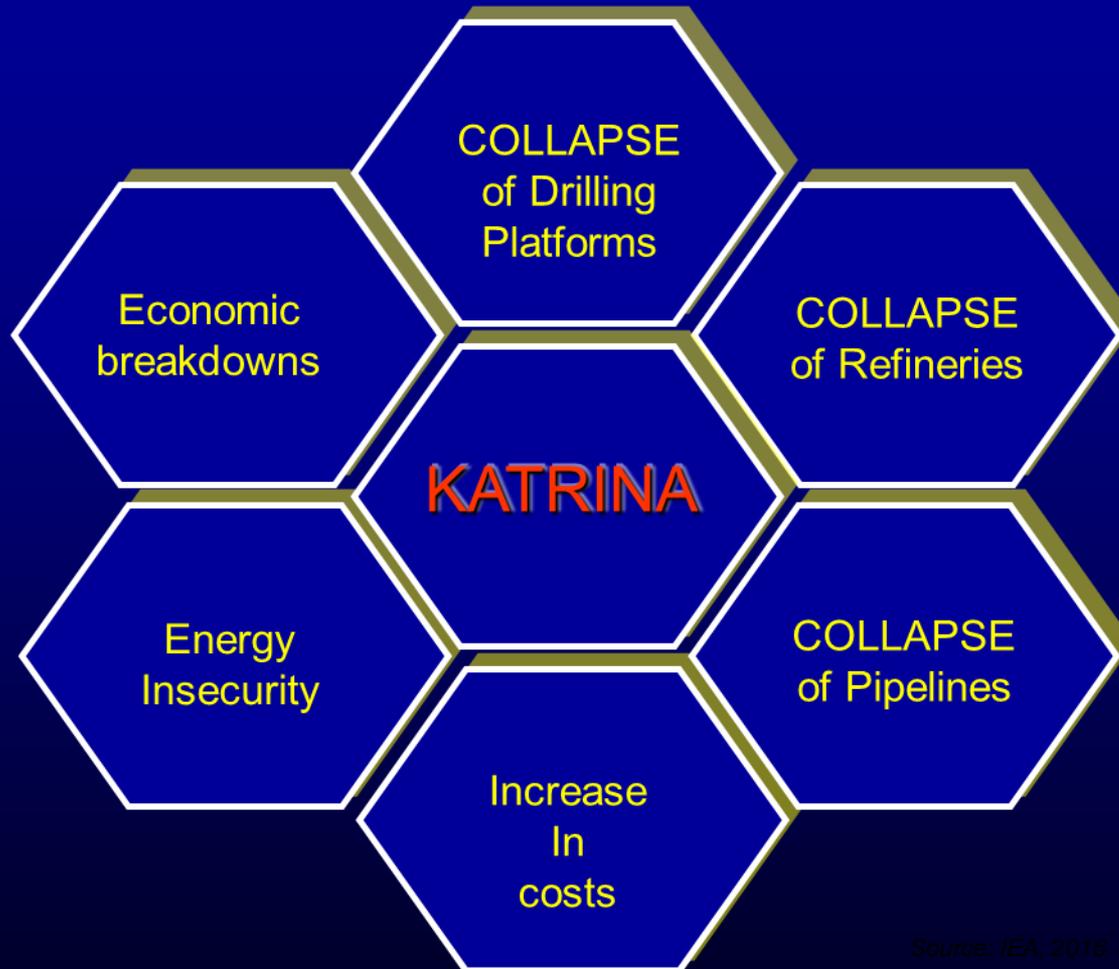
OIL & GAS INDUSTRY PUBLIC IMAGE

- 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

O CONCEITO DE SEGURANÇA ENERGÉTICA

	AMEAÇAS	RESPOSTAS ESTRATÉGICAS
SÉCULO XX	<ul style="list-style-type: none"> • Ruptura do abastecimento nos países produtores • Repetição do embargo político de 1973 • Volatilidade dos preços no mercado 	<ul style="list-style-type: none"> • Criação das reservas estratégicas de emergência de petróleo (SPR) • Criação da Agência Internacional de Energia • Redução da dependência: Standards para a indústria automóvel (CAFE/USA) • Utilização da “spare capacity” da Arábia Saudita
SÉCULO XXI	<ul style="list-style-type: none"> • Terrorismo • Desestabilização interna nos países produtores por grupos extremistas • Erosão da “Spare Capacity” • Dependência crescente da OPEP • Furacões como o Katrina e Rita • Paralisação da rede de Produção e Distribuição de energia • Black-out's • Volatilidade extrema dos preços • Ameaça climática • Factor demográfico • Insustentabilidade do modelo energético actual 	<ul style="list-style-type: none"> • Redução da dependência da OPEP • Mudança do Modelo Energético • Aposta nas energias renováveis, nos biocombustíveis, na energia hidro-eléctrica, nuclear, biomassa, micro-geração • Nova política para as Reservas Estratégicas de Petróleo • Criação de Reservas Estratégicas de Gás • Diversificação das fontes de abastecimento (eixo Mediterraneo/Atlântico/Ásia Central) • Integração de China e Índia na Agência Internacional de Energia • Construção do MERCADO Unico Integrado Europeu de Energia

The integrated shock



Source: IEA, 2016

An 8% reduction in 2015 global energy investment results from a \$ 200 billion decline in fossil fuels, while the share of efficiency expands

O Problema é que a Europa é um Anão político e falha na LIDERANÇA

Um MERCADO ABERTO e COMPETITIVO é hoje uma questão de Segurança energética

A Europa não está a conseguir construir o Mercado Europeu Integrado de Energia

MERCADO ENERGÉTICO EUROPEU

- Mercado do Carvão e do Aço em 1956
- Tratado EURATOM em 1956
- Energia inscrita na Matriz Energética da Europa
- Não há uma Política integrada e um Mercado Único de Energia

A Europa da Energia está prisioneira dos Monopólios e a liberalização MARCA PASSO

Regresso dos proteccionismos nacionais

- França
- Espanha

O Domínio dos monopólios em alguns países é ESMAGADOR

- E.on e Ruhr-60%
- GdF – 70%

O reforço dos monopólios distorce o Mercado

An 8% reduction in 2015 global energy investment results from a \$ 200 billion decline in fossil fuels, while the share of renewables, networks and efficiency expands

GOOGLE / HIGH-TECH

- 12th January 2010: attack by Chinese hackers
- Web is not a safe place
- Flame in 2012 rendered Iranian computers useless

2012/2013 CYBER ATTACKS

- Saudi Aramco: 15th August 30,000 computers paralyzed
- Exxon/Shell/Rosneft/Gasprom/ attacks in July by Group Anonymous
- E-Bay in 2013 told its users to change passwords after services being crashed

CYBER ATTACKS

- One of the most potent and deadly problems of XXI century
- Oil & gas investments one of most exposed
- Heterogeneity of geographic threats

CYBER SECURITY BUSINESS

- Growing fast: 12 billion \$ in US
- Snowden effect
- Credibility test

MANDIANT STUDY 2013

- State-sponsored hacking
- Dozens of US oil & gas companies and facilities attacked
- Tracking to a Chinese military unit in Xangai

MASK ATTACK 2014

- Internal security company Kaspersky Lab uncovered
- From Spanish-speaking
- Target oil & gas companies
- Dormant since 2007
- Heartbleed, detected in 2014, has been on web services stealing passwords and personal information
- Numerous flaws in complex softwares

FUTURE

- Targets will be even wider
- Natural computer process on watches, thermostats, cars
- Internet of things
- Potential consequences: stolen data, crash of communications, crash of cars
- The car is becoming a more connected device could be next victim
- Need of a New Security model
- DARPA initiative on automate-cybersecurity (sensors on computer systems)
- Role of information takes new forms

COMO LIDAR COM A INFORMAÇÃO DILUVIANA CARACTERÍSTICA DO NOSSO TEMPO?



CONSEQUÊNCIAS

- Espécie de Lei de Moore acelerada para a informação
- A informação passou da escassez à super-abundância em pouco tempo
- A gestão da informação é crucial para o exercício da Engenharia moderna
- Transformar informação em conhecimento
- Minas digitais e campos digitais de petróleo e gás
- As implicações para a compreensão dos sistemas complexos e para o processo de decisão

CYBER SECURITY TODAY

- Not only to stop spies and hackers
- Protect IT systems
- Protect/Safeguard information
- Need of MORE PREDICTIVE approach to Computer Network Protection
- Credibility/loyalty issues
- Links to Intelligence Services

CYBERSECURITY IN ORGANIZATIONS

CHANGE OF PARADIGM

- Most markets of commercial security software focused on fast-spreading viruses (worms)
- Today more advanced, sophisticated, silent attacks
- Hackers download malware in stages, often leaving it dormant for months eluding detection systems

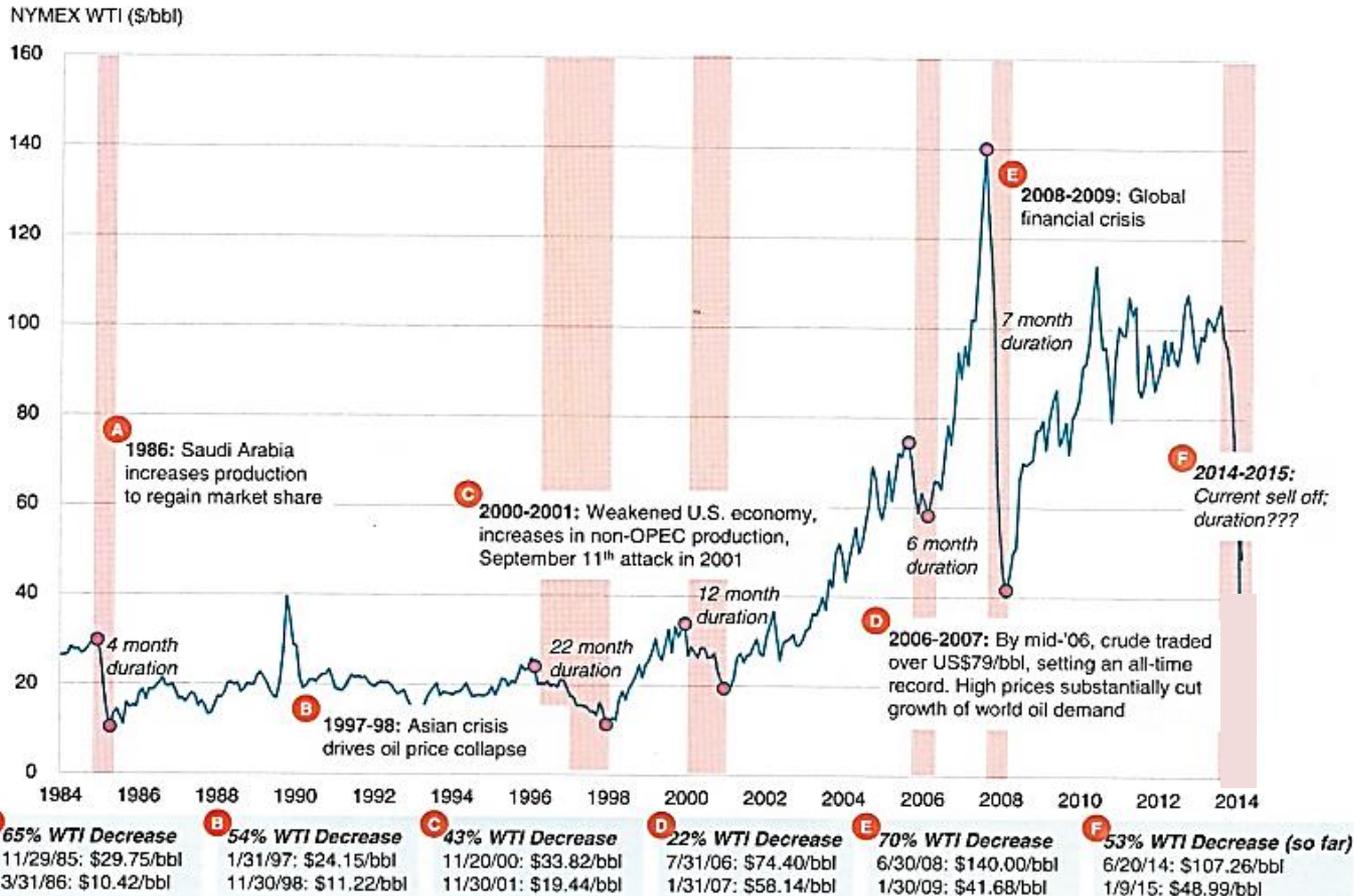
NEW PARADIGM (Fire Eye approach)

- A system that replicates a client's network on a series of virtual machines
- When malware attacks, the virtual machines speed up computer time to show in microseconds the effects on short/medium/long time
- Quickly a counter attack is determined to beat malware

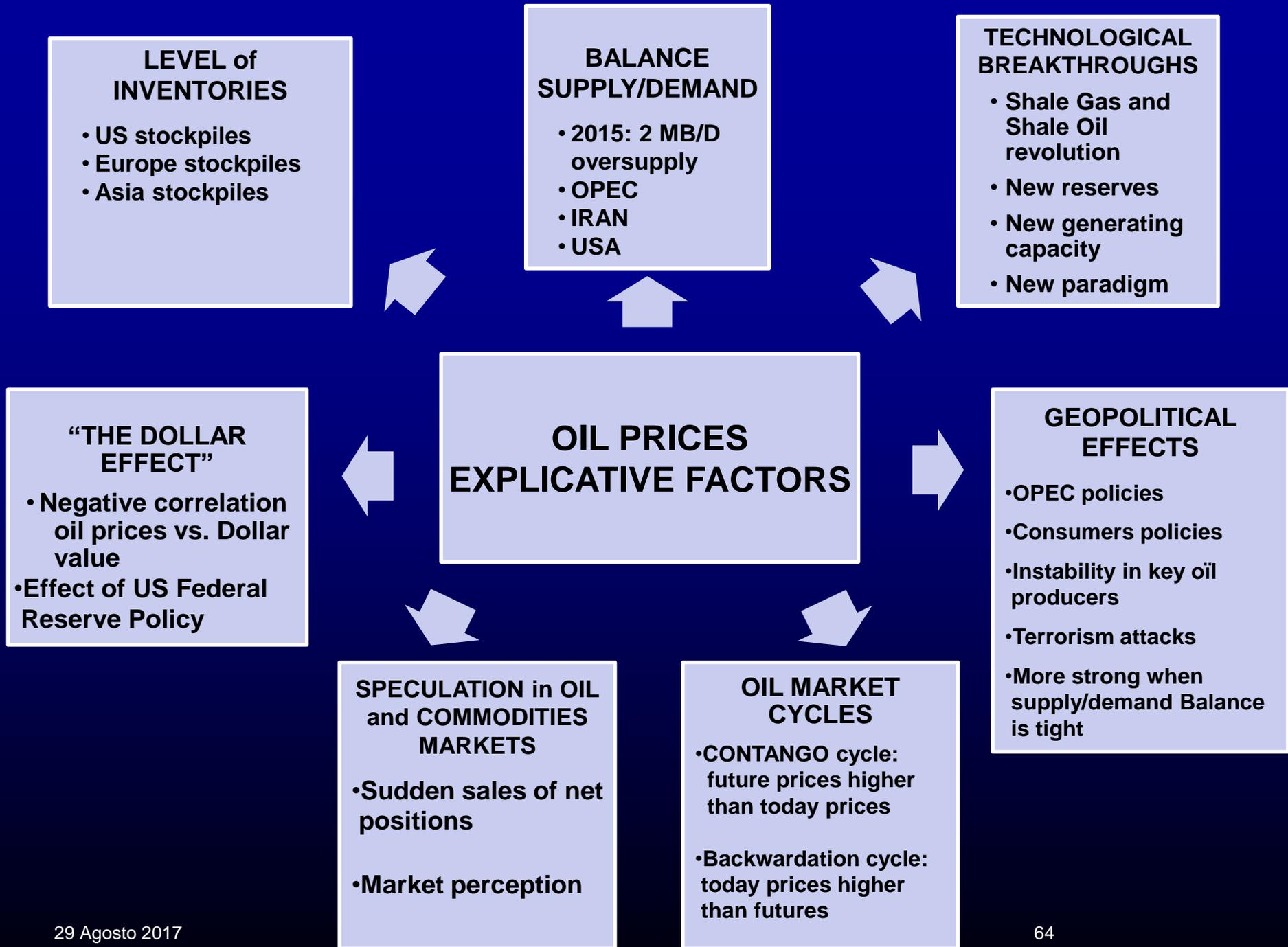
3. EVOLUÇÃO dos PREÇOS do PETRÓLEO e MERCADOS

Resulting in the 2nd Largest Oil Price Crash in History

30-Year Monthly History of WTI Prices

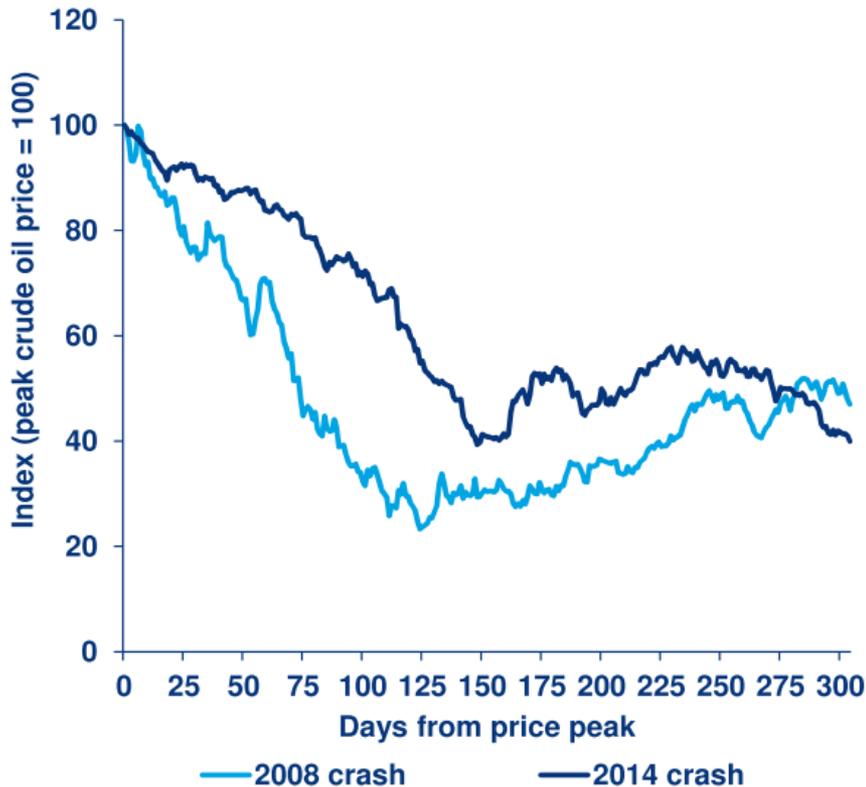


Source Bloomberg as of January 9, 2014



“2008 and 2014 CRASHES and DEMAND CHANGE”

Comparison of relative price declines



GDP and oil demand changes



Source: Argus

Source: Wood Mackenzie

Analysis

- More complex situation
- Saudi Arabia Role
- Erosion of OPEC influence
- No control on Non-OPEC production
- Iran in difficulties
- Russia, Iran, Venezuela and Nigeria need oil above 100 US\$/bbl to avoid huge fiscal deficits
- Undermine competitor advantages including alternative energies
- But economics of shale oil is very flexible
- Break-even: 57 to 65 US\$/bbl
- Based on wells
- Investment one well: 1.5 M US\$
- Gain in productivity:
 - US economic pragmatism
- In the long-term shale industry may prevail

Sheikhs v shale



Source: *The Economist*, 06-12 December 2014

O “ACUMULADO HISTÓRICO”

- O crash de preços em 1986 e a política saudita de ampliar a sua “share” no mercado
- A OPEP levou 20 anos a recuperar a sua quota-parte do mercado
- A síndrome de Jacarta de 1998
- A resposta à queda dos preços de 2008

A REVOLUÇÃO do “SHALE” e as IMPLICAÇÕES

- EUA a disputar com Arábia Saudita o 1º lugar de produtor mundial
- A flexibilidade do “Shale Model”
- O novo paradigma de projecto com pouca intensidade de capital à cabeça e mais custos variáveis
- O “rig count” é ilusório: 70% dos poços são responsáveis por 30% da produção
- Existem 2 000 poços de óleo e 2 500 de gás em “stand-by”

EVITAR A EROSÃO e as FRACTURAS

- Coesão
- Disciplina
- Unidade de propósito
- Barreiras de entrada

O PAPEL da OPEP e da ARÁBIA SAUDITA

AS MUDANÇAS OCORRIDAS

- Arábia Saudita já não é o único “swing producer”, o Banco Mundial do Petróleo
- O paradigma da crise de 2003 na Venezuela é passado
- Novos “players” no mercado fora da OPEP
- Produção OPEP e não-OPEP estão hoje no patamar máximo

A POLÍTICA SAUDITA de AUMENTO da PRODUÇÃO e AMPLIAÇÃO de SHARE do MERCADO TEM CONSEQUÊNCIAS

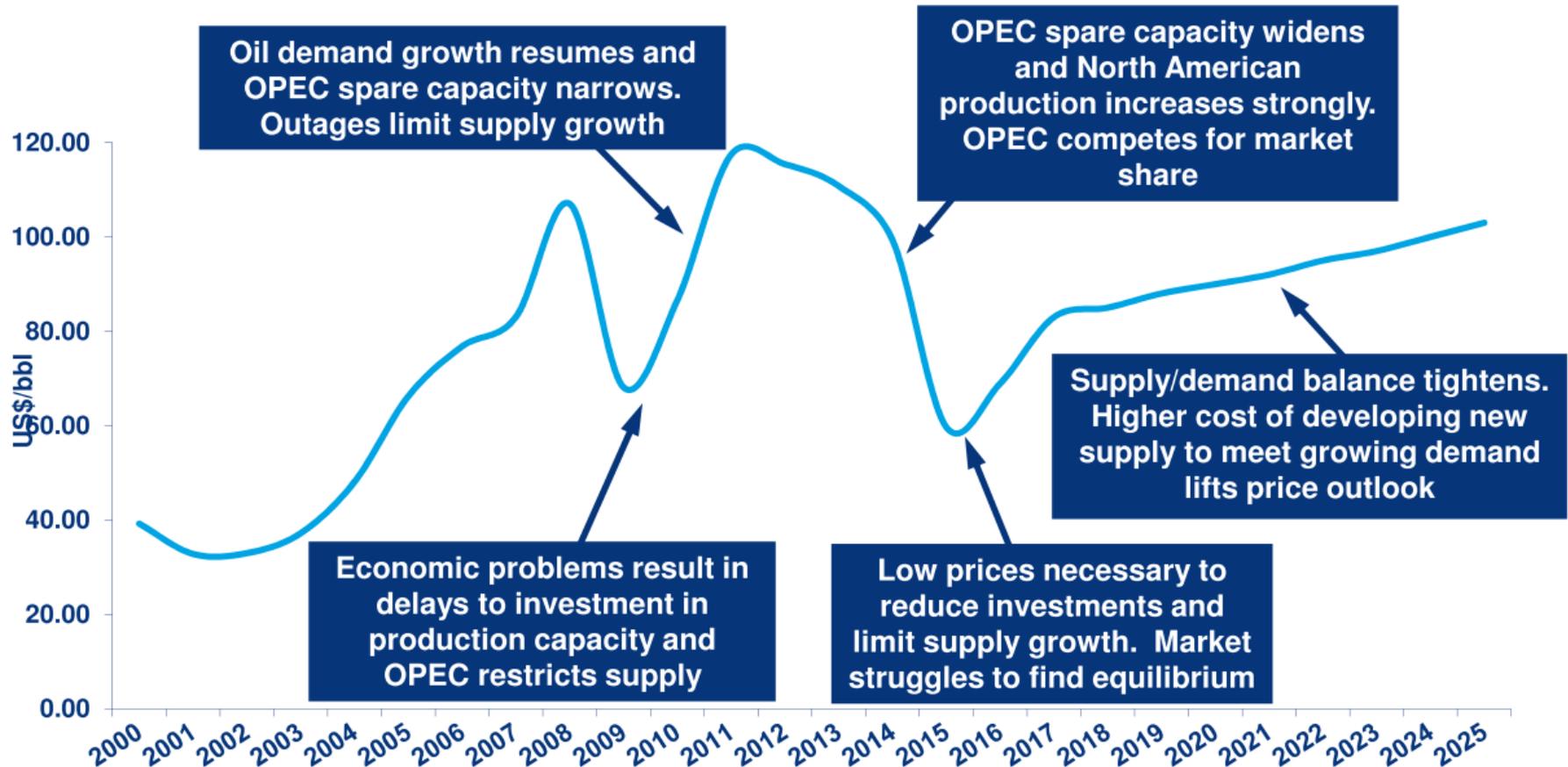
- A flexibilidade do “Shale Model” retarda um equilíbrio do mercado
- O “oversupply” de 2 MB/D mantém-se há 16 meses consecutivos
- Deslocação do custo marginal do deep-offshore para o shale (Angola/Brasil/ /Nigéria afectados)
- Situação difícil de muitos países da OPEP com perda de receitas
- Dificuldades orçamentais na Venezuela, Nigéria, Argélia, Iraque, Irão
- Ameaça à coesão da OPEP
- A Arábia Saudita e outros países do Golfo também estão a sofrer erosão das reservas monetárias

ATÉ QUANDO?

- Sauditas tinham 800 billion US\$ de reservas monetárias
- Só em 2015 a erosão chega aos 85 billion US\$
- Sauditas estão a retirar investimentos em activos no Ocidente
- Sauditas têm muitos críticos dentro e fora da OPEP
- Se o “oversupply” se mantiver até finais de 2015 e início de 2016 os sauditas podem reconsiderar
- Vai ser difícil assumir política diferente sem uma roupagem que defenda o orgulho

“FUTURE EVOLUTION of OIL PRICES”

Crude prices strengthen sharply from 2017 due to lower investments in the short term reduces supply growth

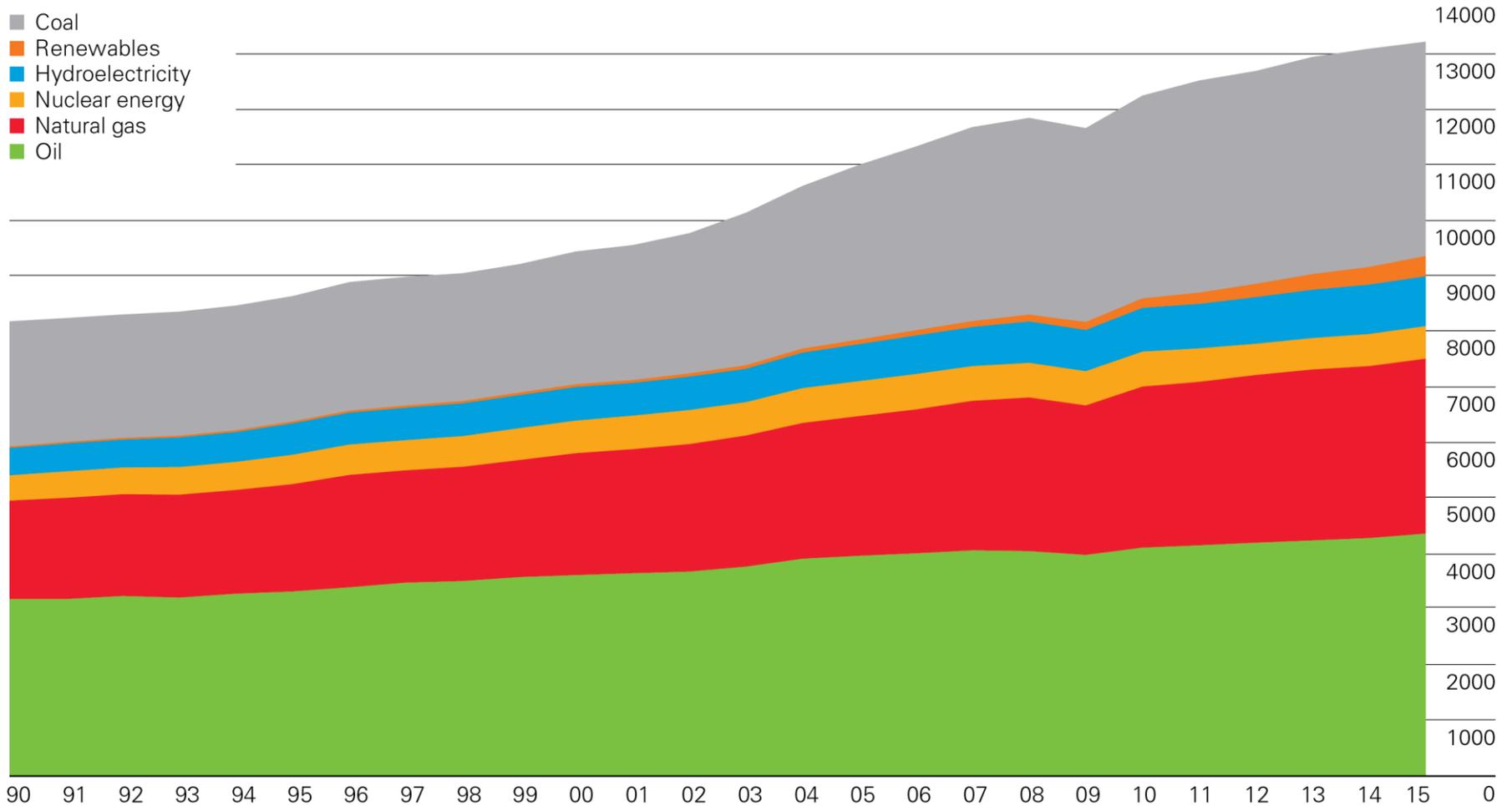


Source: History Argus, Forecast - Wood Mackenzie

4. A TRANSIÇÃO ENERGÉTICA e o PAPEL das ENERGIAS RENOVÁVEIS

Primary energy world consumption

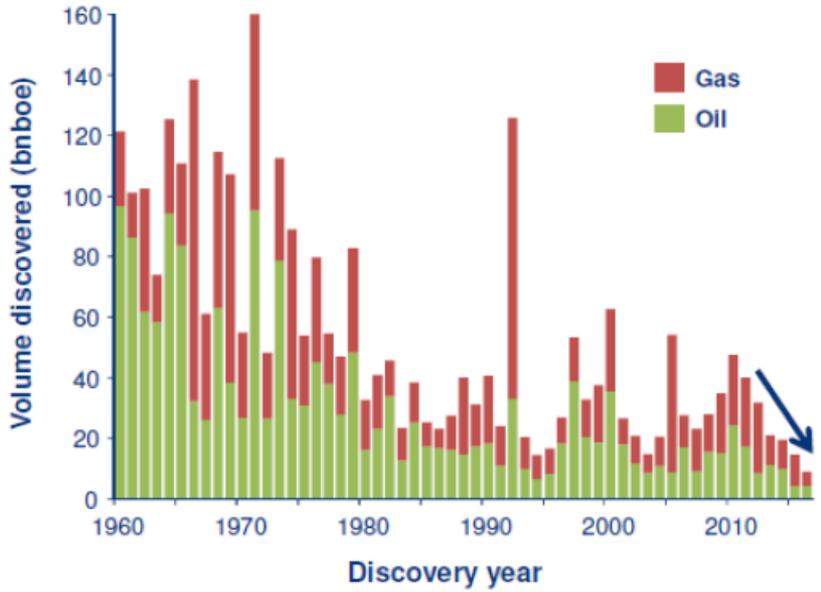
Million tonnes oil equivalent



BP Statistical Review of World Energy 2016
© BP p.l.c. 2016

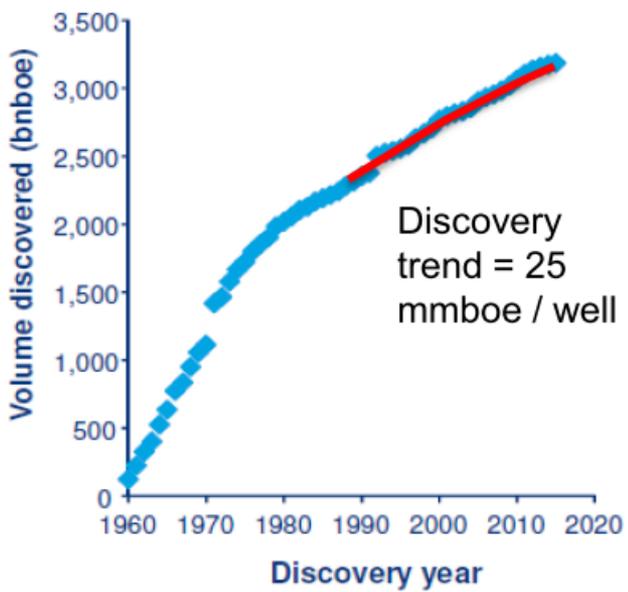
Key Conventional Exploration Trends

- Global Discovered Volumes



Source: Wood Mackenzie. Conventional volumes only by year of discovery well completion

- Global Creaming Curve

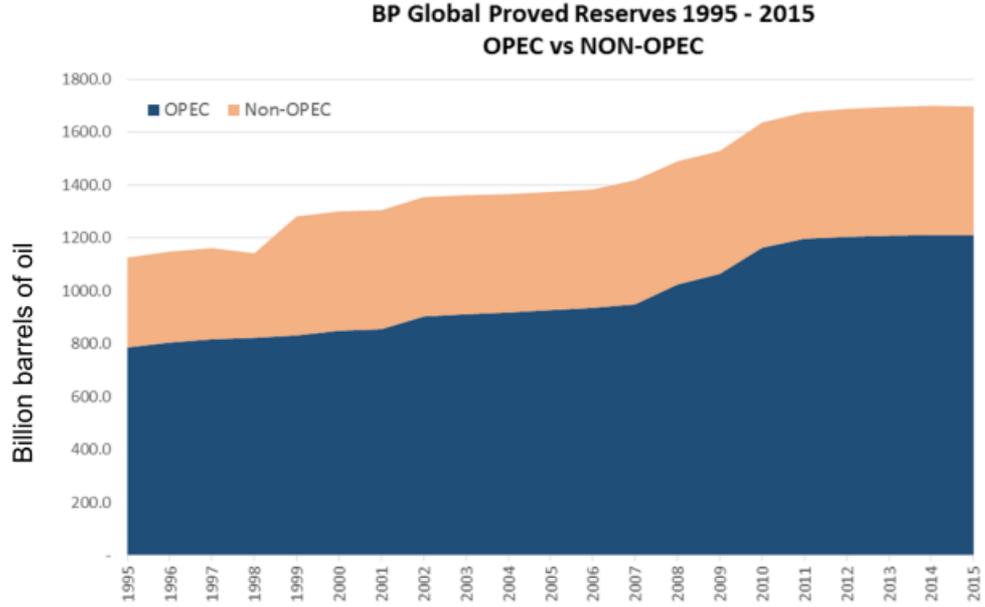


Source : Wood Mackenzie 2017

- Global discovered volumes at an all time low
- 2016 saw the lowest volume of oil and gas discoveries since 1947
- On a per well basis, discovered volumes are consistent
- Exploration Inventories are being threshed

Global Exploration CAPEX has dropped 60% from \$100bn (2014) to \$40bn

Global Proved Reserves : Over- Abundance ?



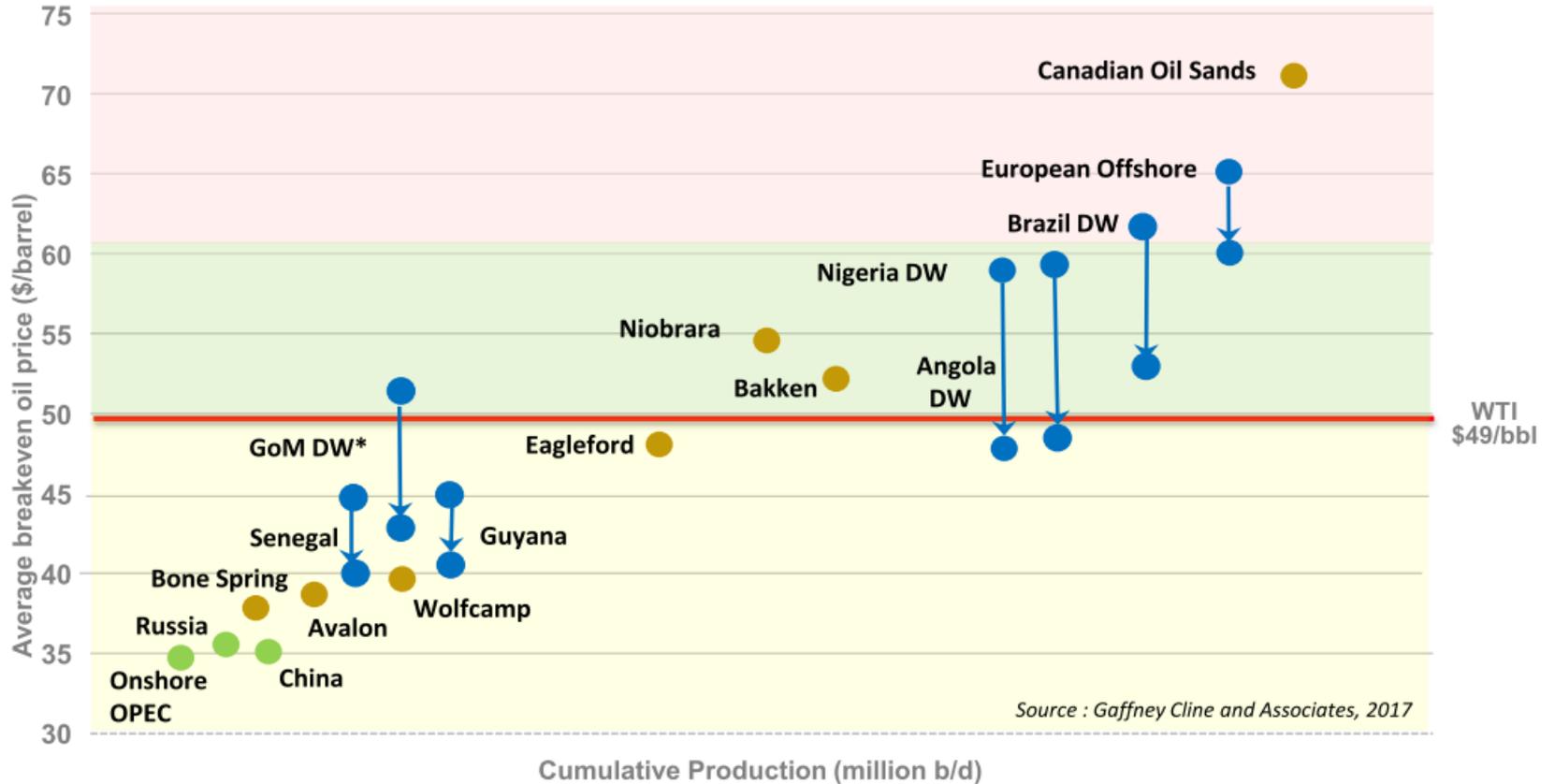
Source : Gaffney Cline and Associates, 2017

- ❑ Global Proved Reserves : 1.7 Trillion barrels
- ❑ Cumulative Oil Demand to 2040* 1.01 Trillion barrels

* (2% growth in production to 2020 and 1% thereafter)
 **(97MMBbl/day)

Current proved reserves will last until 2063**

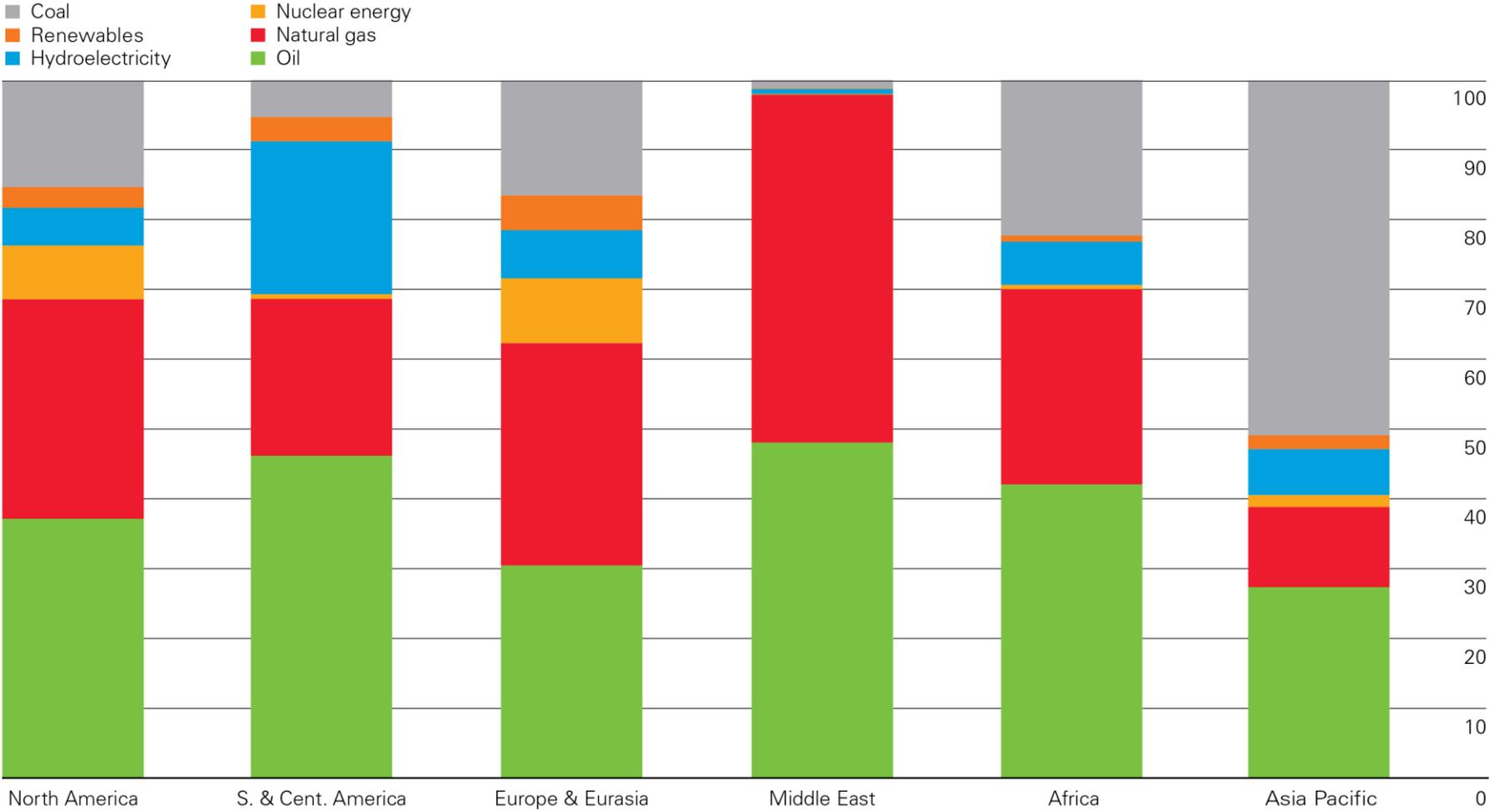
Global Break Evens : \$/boe



Breakevens have been squeezed : Fight to the bottom

Primary energy regional consumption by fuel 2015

Percentage

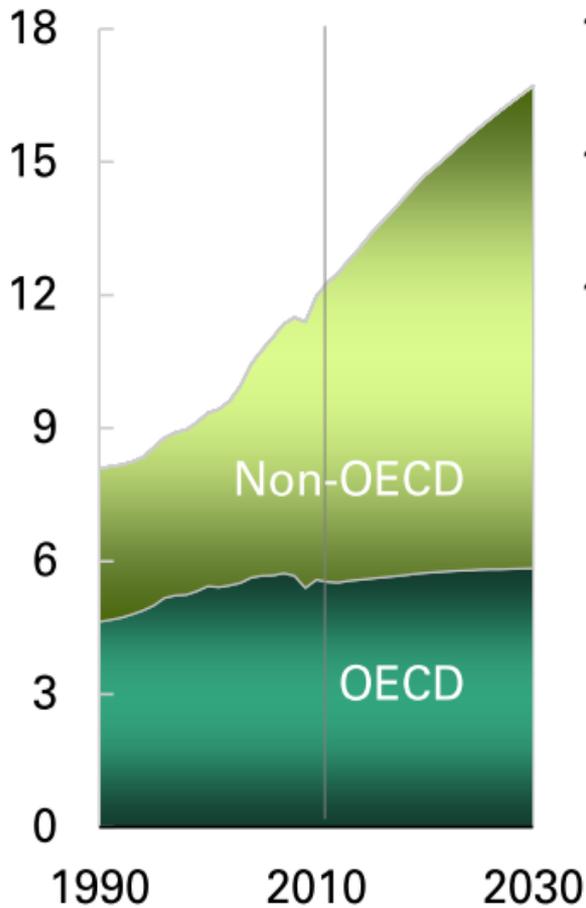


BP Statistical Review of World Energy 2016
© BP p.l.c. 2016

Industrialisation and growing power demand...

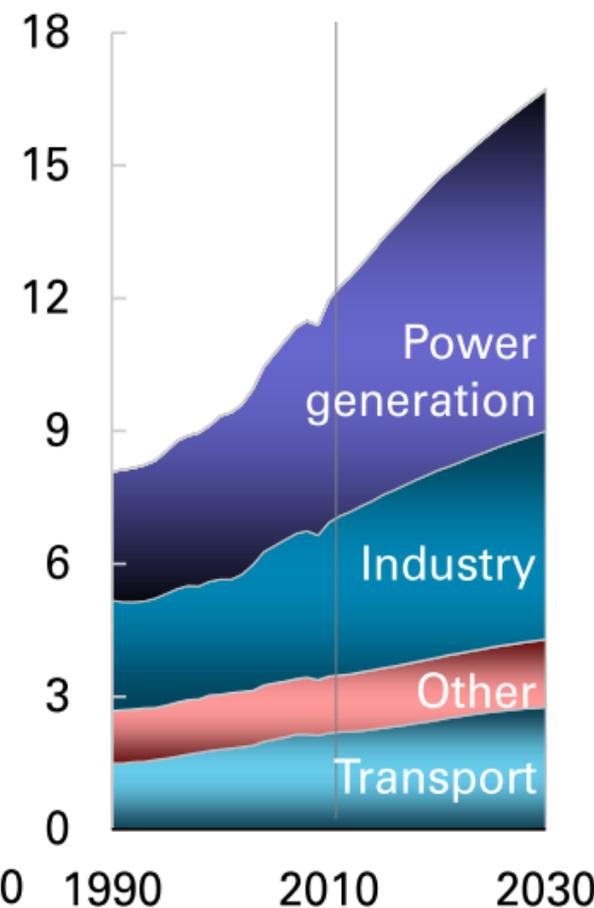
By region

Billion toe



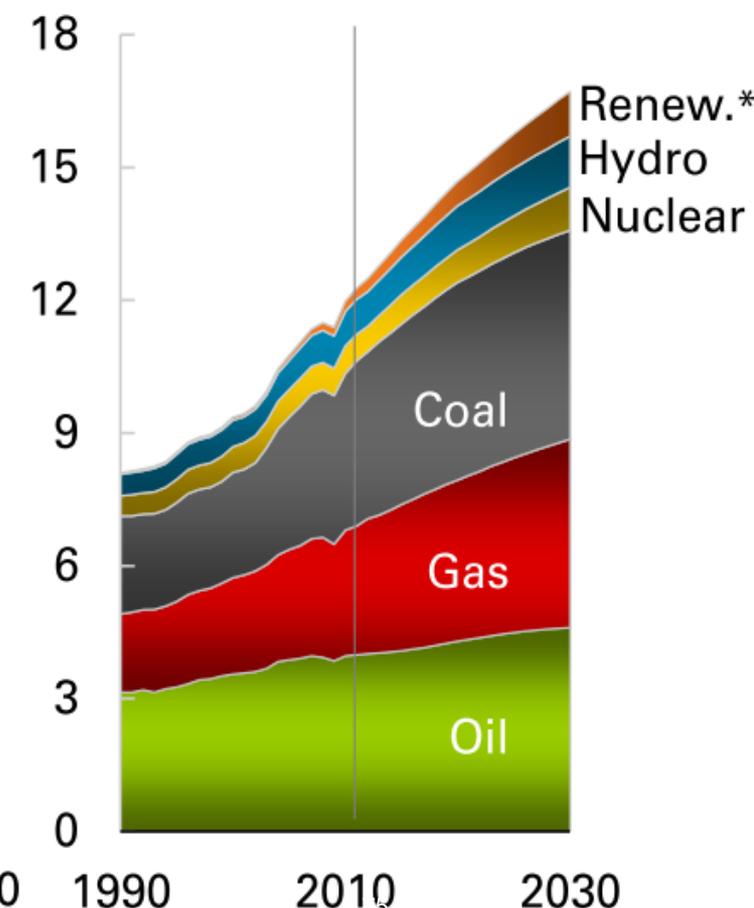
By primary use

Billion toe



By fuel

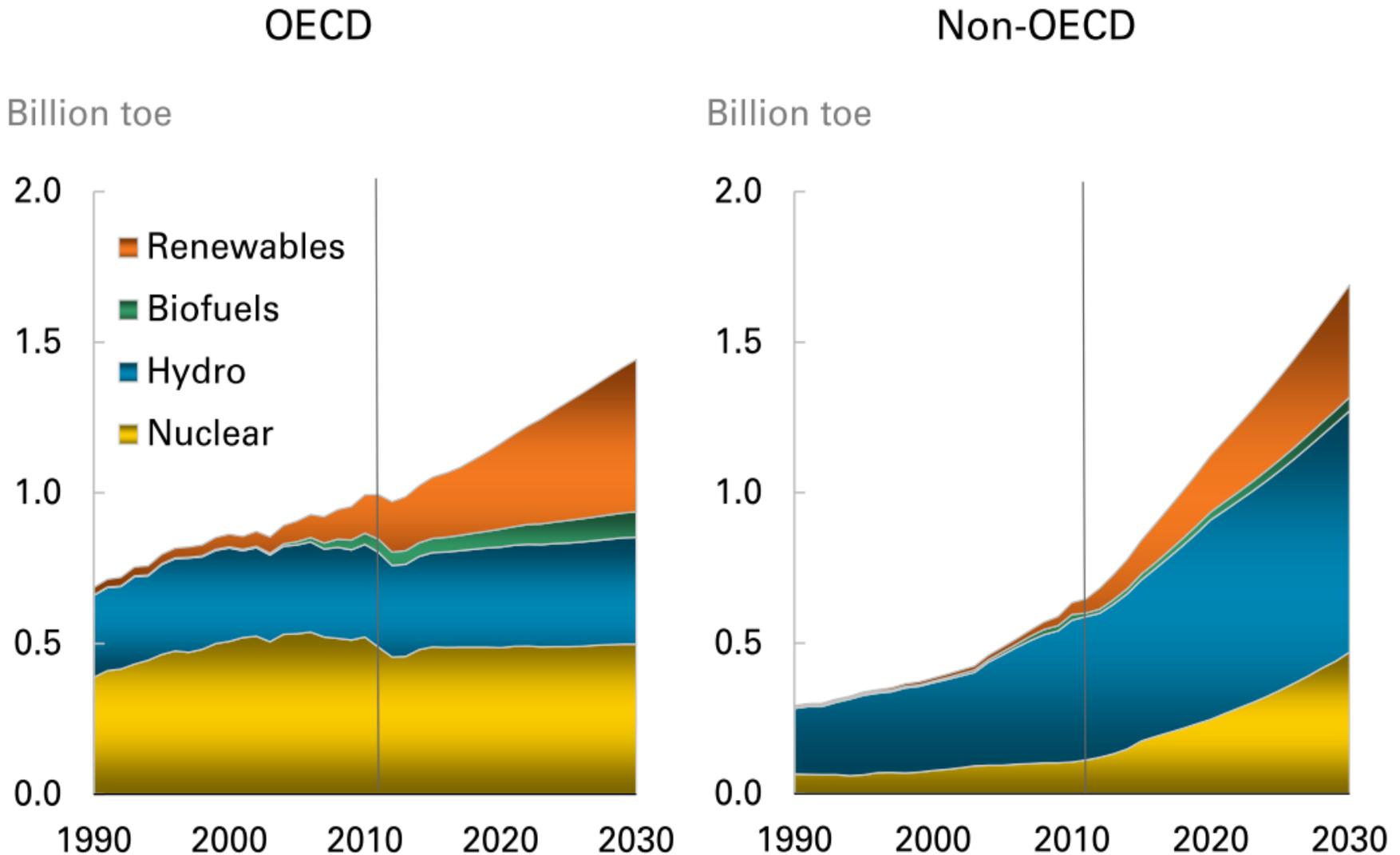
Billion toe



Source: BP Statistical Review 2016

*Includes biofuels

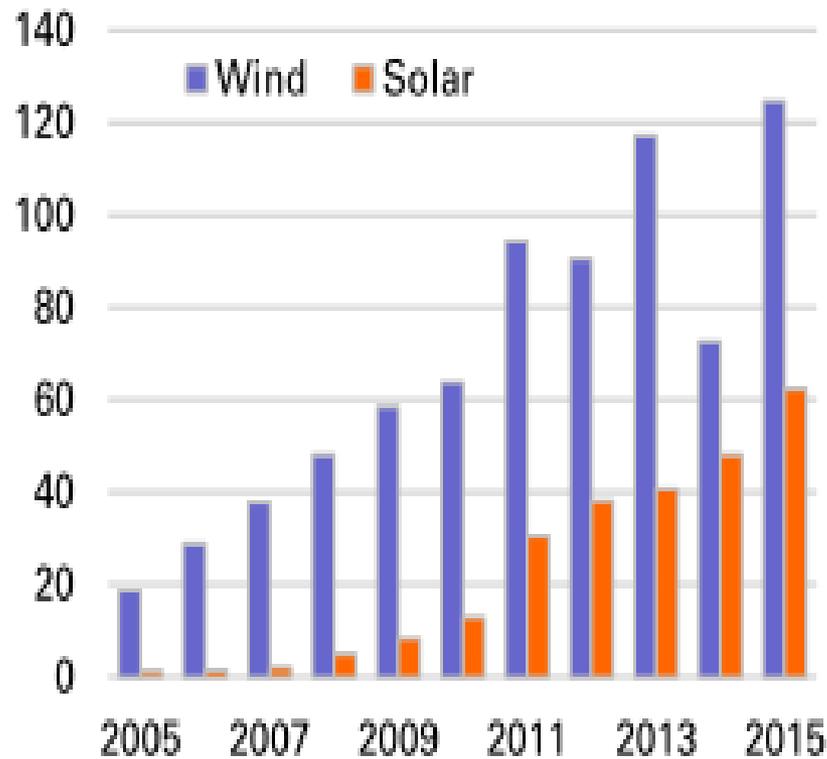
Non-fossil fuels growth is led by renewables in the OECD...



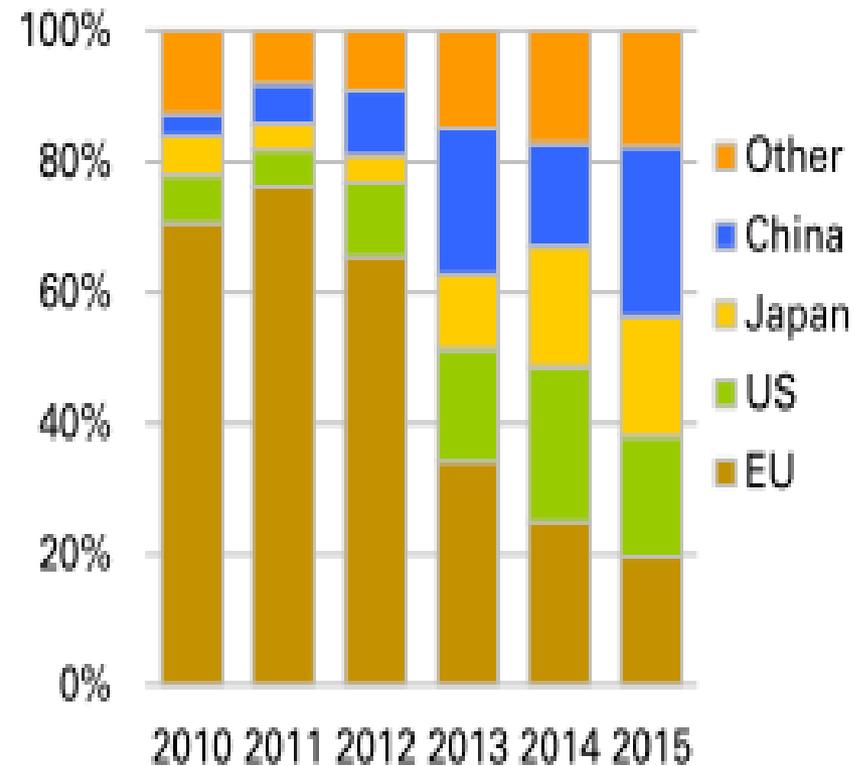
Renewables growth

Wind and solar growth

Annual change, TWh



Shares of solar growth





SOLAR CITY'S GIGAFACTORY in BUFALLO / USA



Source: MIT Technology Review
Special Edition, 10 December 2016

OFFSHORE WIND

- Emerging Market
- Explosive growth in Investment
- 8 GW installed in Europe and 12.7 GW globally (shallow water)
- 5 GW expected next 18 months
- 74 offshore wind farms in 11 countries
- Picking-up also in US and Japan
- Even larger potential in deep water

OFFSHORE WIND POTENTIAL (depths greater 40 meters)

Europe	1 000 GW
Japan	500 GW
USA	3 000 GW

HOW TO TAP THIS POTENTIAL



- High capital intensive
- Regulatory uncertainties
- Need to reduce costs
- Become competitive and commercial (demonstration and development projects)

OFFSHORE RENEWABLES



CHALLENGES

- Technologies to be successful proven
- Can innovation bring technologies to commercial development?
- Need of further full-scale demonstrations (ex. wave and tidal devices)
- Projects are capital intensive and need to attract private sector
- Need to reduce costs to become competitive
- Public policies driven by low carbon technologies may help
- Need to sufficient development in the whole supply chain
- Development of electrical grid to accommodate marine resources (remote locations)
- Decarbonisation
- Job creation
- Complement to other renewables



OCEAN WAVE ENERGY

- Resource potential of ocean huge
- Ocean waves, Tidal currents, Tidal range, Deep Currents, Thermal Gradients, Changes in Salinity
- Infancy of marine technologies
- Need strong costs reductions
- Option viable if constraints on Nuclear Energy and CCS confirmed
- US wave energy potential amounts to 2 640 Twh/year
- US total recoverable resource along US shelf is 1 170 Twh/year
- 1 170 Twh/year is 1/3 of 4 000 Twh of electricity used in US each year

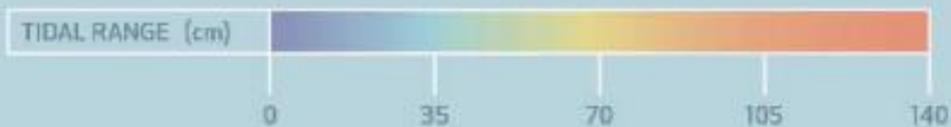
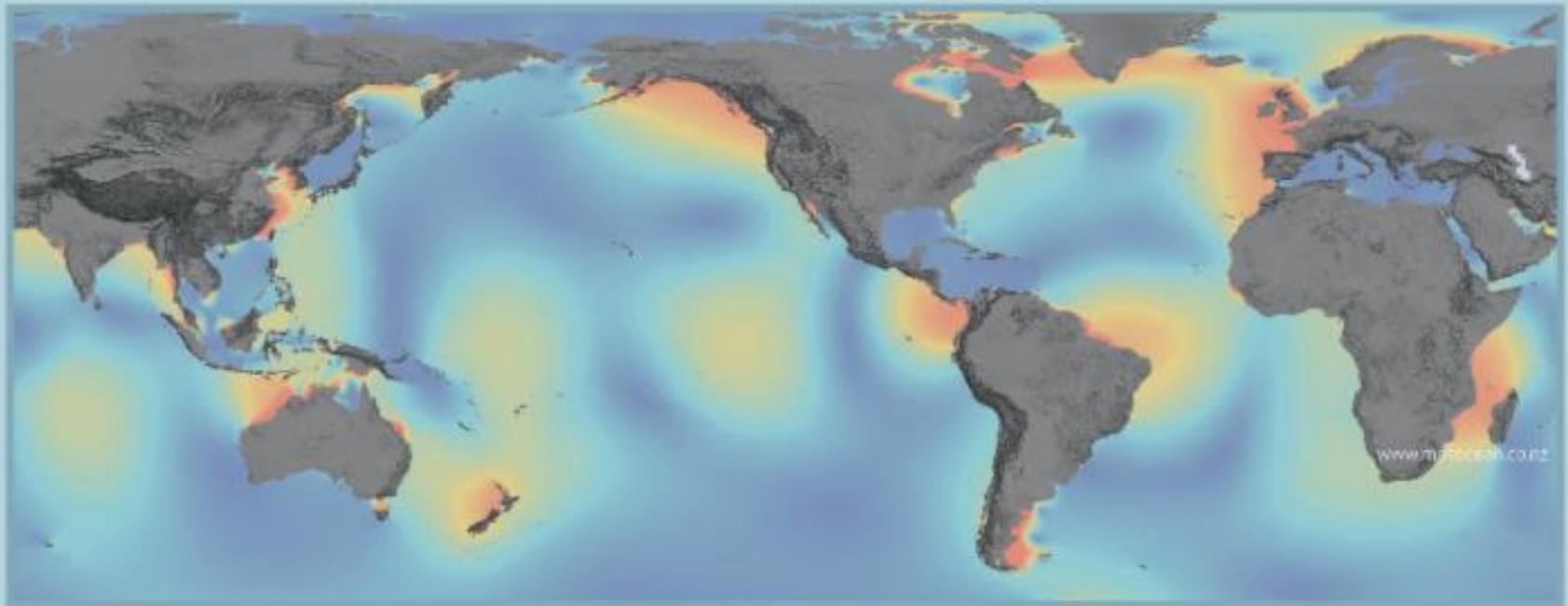
OCEAN WAVE ENERGY POTENTIAL

- Estimates range from 20 000 Twh to 80 000 Twh
- This represents between 100% to 400% of current global demand for electricity

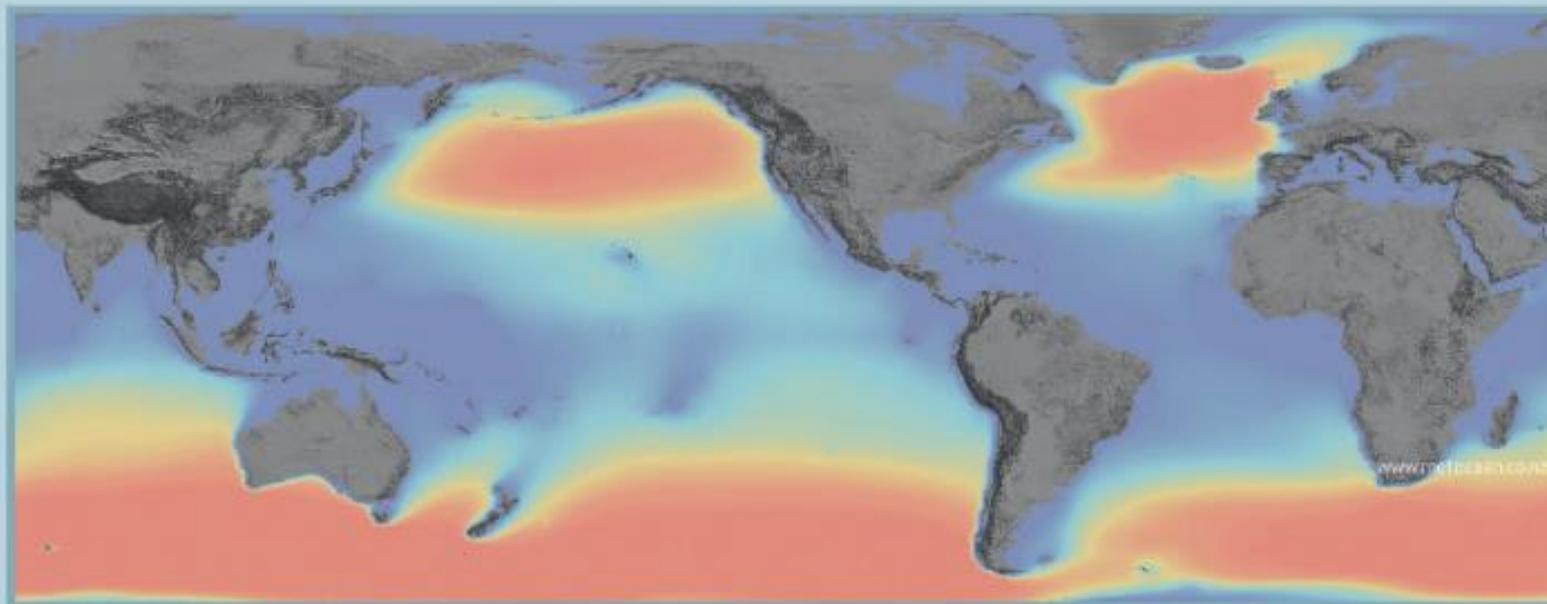
TECHNOLOGIES

- Highly diverse / variety
- Differences near-shore, offshore and far-offshore
- 4 basic applications: terminator devices, attenuators, point absorber, overtopping

Tidal Range

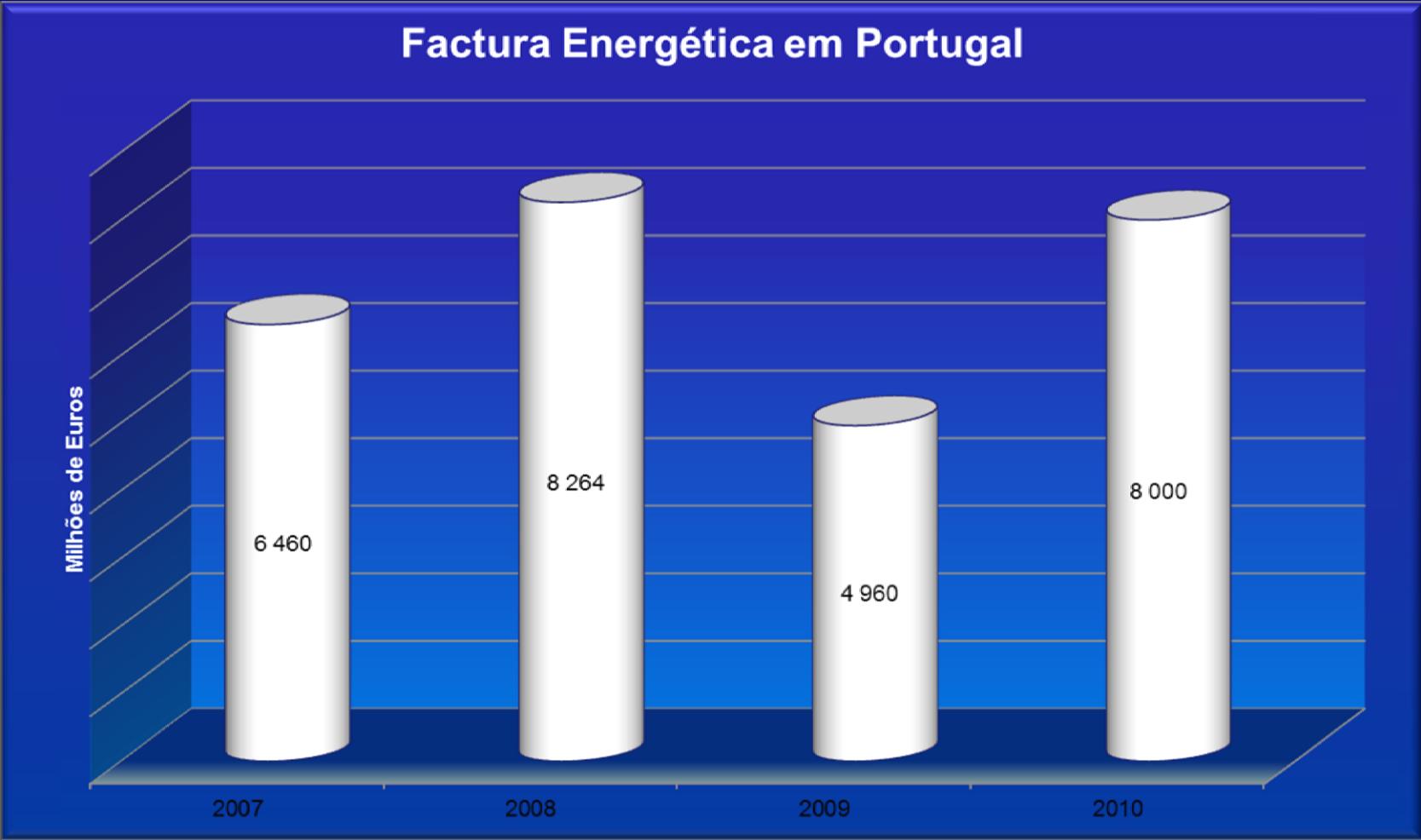


Wave Power



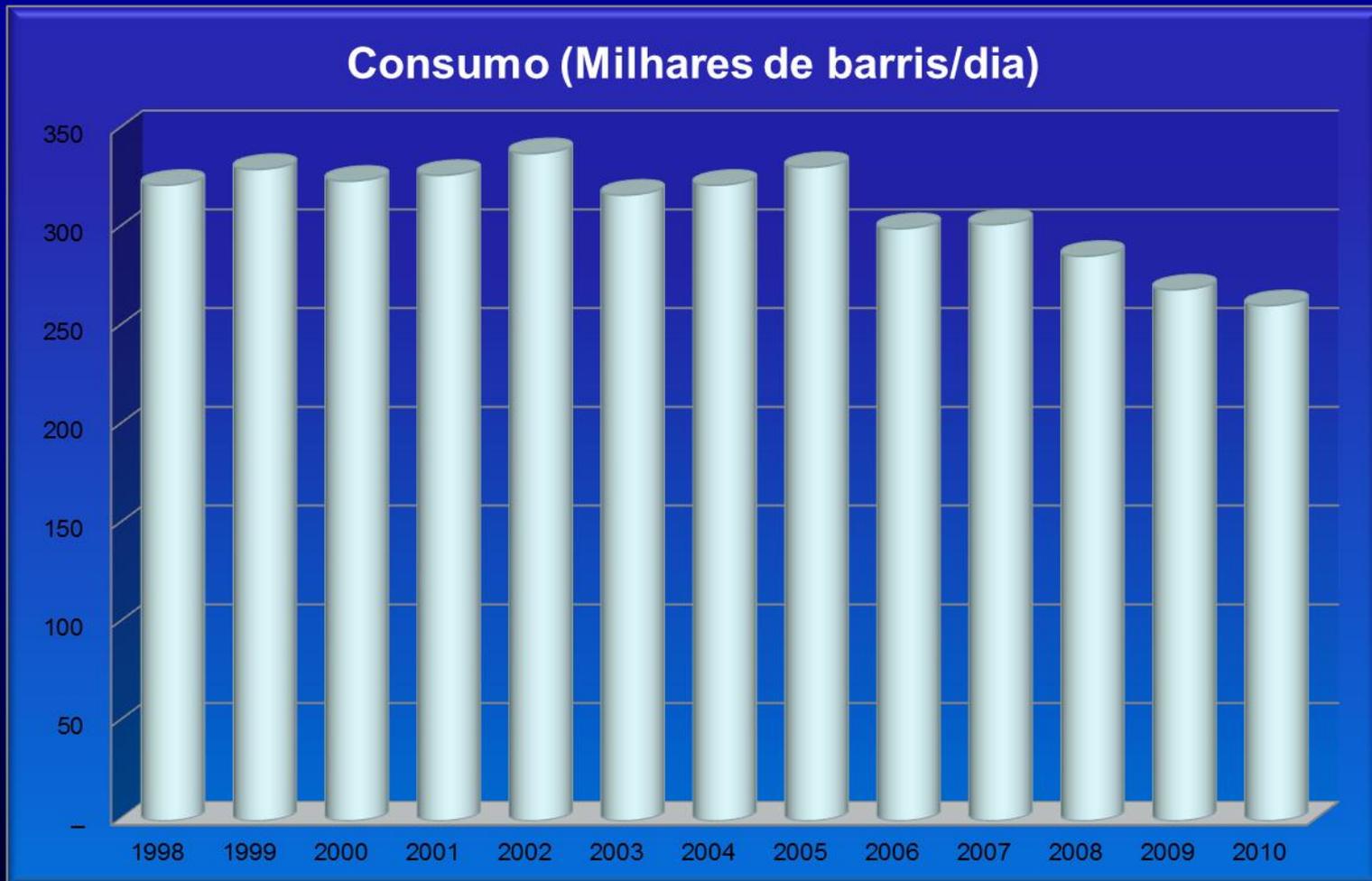
Source: Huckerby *et al.* (2011). Note: Provided with print permission by IEA-OES

Impacto Económico da Dependência Excessiva de Combustíveis Fósseis



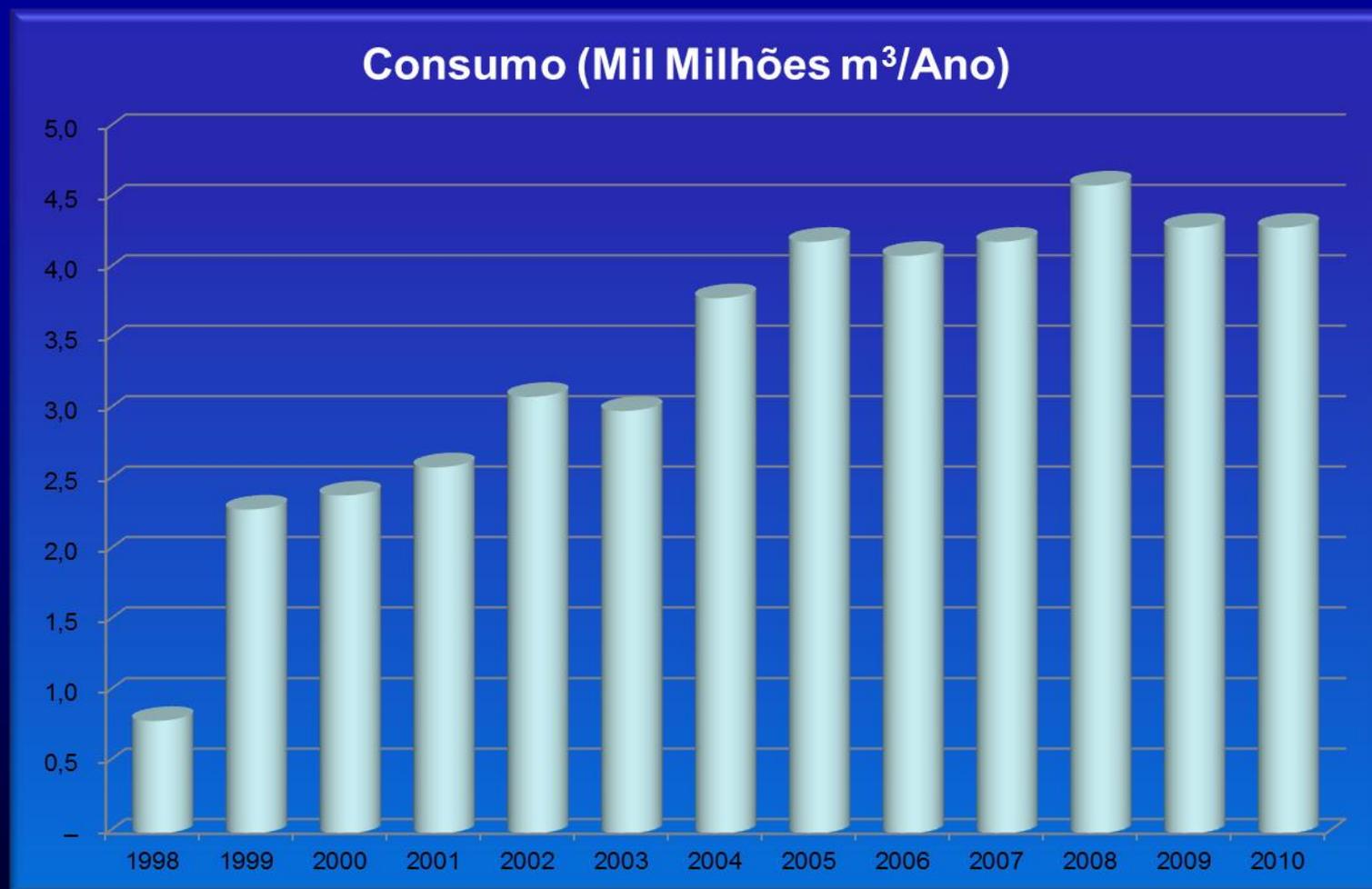
Fonte: DGEG

Evolução do Consumo de Petróleo em Portugal



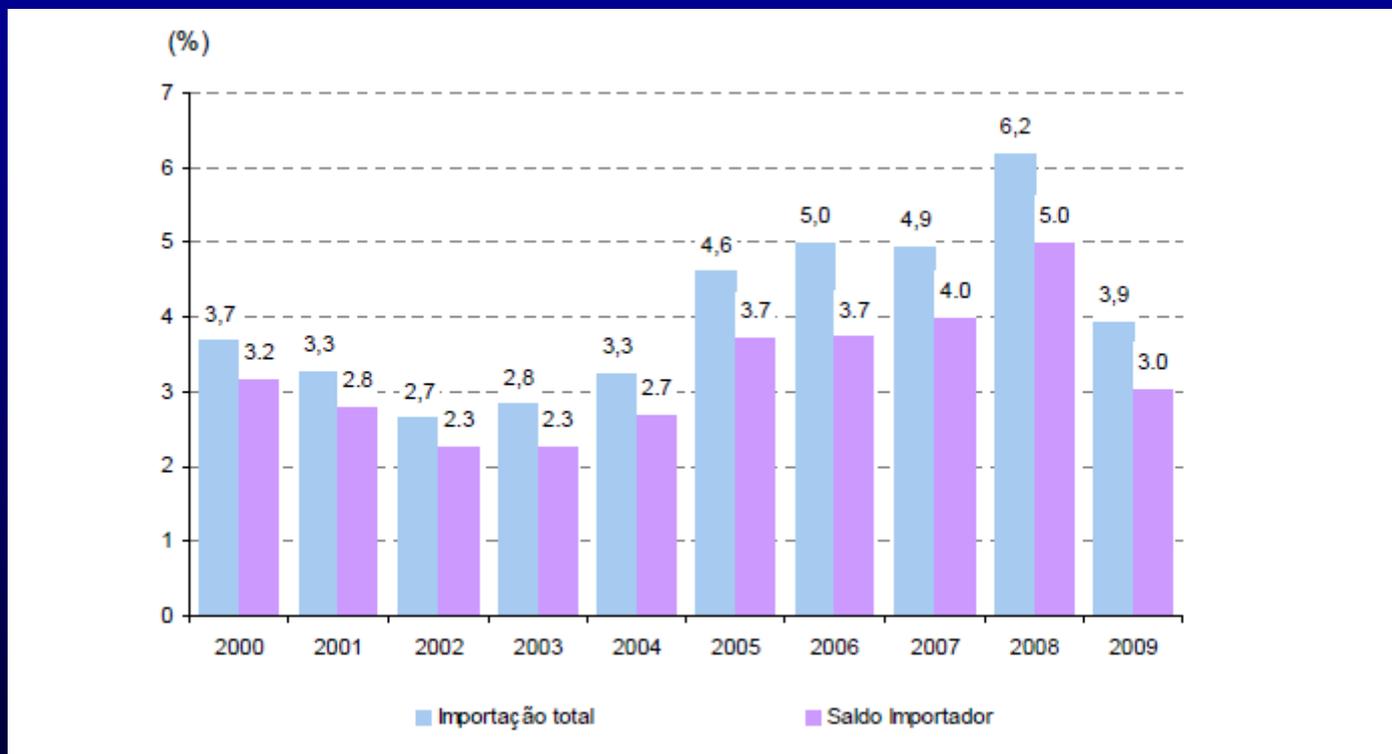
Fonte: BP Statistical Review of World Energy – Junho 2011

Evolução do Consumo de Gás Natural em Portugal



Fonte: BP Statistical Review of World Energy – Junho 2011

Peso da Importação dos Produtos Energéticos no PIBpm (€)

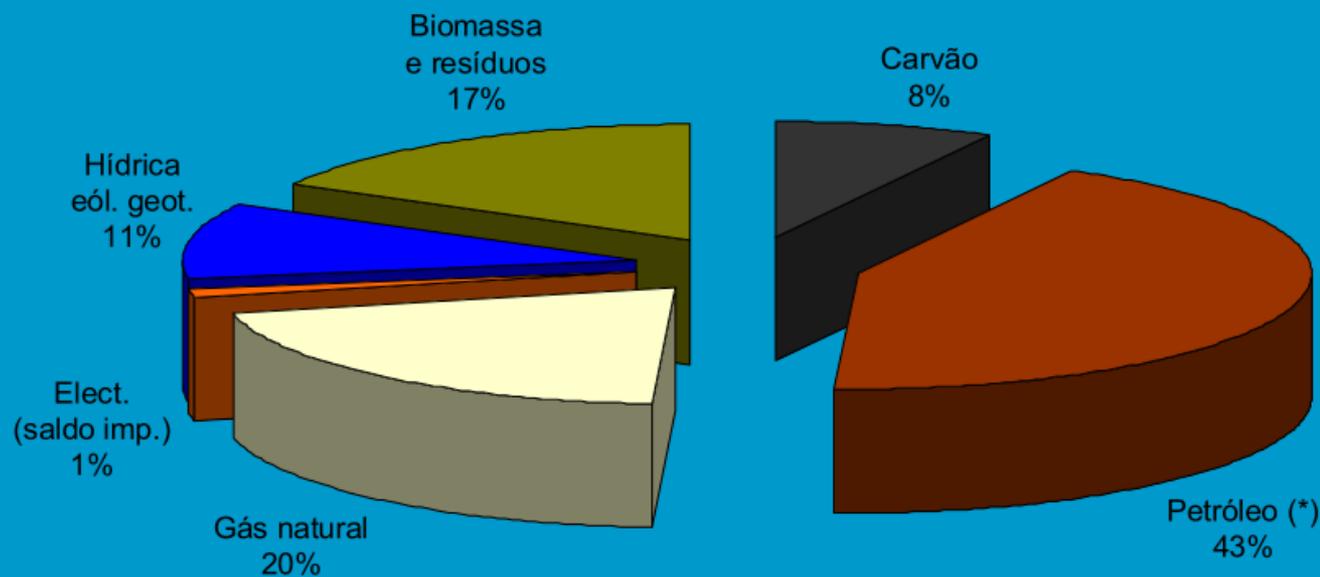


Fonte: DGEG

Fontes de Energia Primária Portugal, 2010

Renováveis: 28%

2010



(*) Excluindo utilizações não energéticas

Fonte: Prof. José Sucena Paiva

O que fazer em Portugal



MATRIZ ENERGÉTICA: PORTUGAL e MUNDO

ENERGIAS	SITUAÇÃO ACTUAL	VANTAGENS	DESvantagens	FUTURO
PETRÓLEO	<ul style="list-style-type: none"> • 43% do consumo de energia primária do país • Dominante no sistema de transportes 	<ul style="list-style-type: none"> • Competitivo mas preços a subirem • Versatilidade 	<ul style="list-style-type: none"> • Poluente • Preço a subir • Dependência de países instáveis 	<ul style="list-style-type: none"> • Declínio da sua dominação • 11 anos seguidos a perder "Share"
GÁS NATURAL	<ul style="list-style-type: none"> • 20% do consumo de energia primária do país • Importante para a geração eléctrica e térmica 	<ul style="list-style-type: none"> • Procura estável ou em ascensão • Reservas abundantes • Preço competitivo • 30% mais eficiente que o carvão 	<ul style="list-style-type: none"> • Menos poluente dos combustíveis fósseis 	<ul style="list-style-type: none"> • Idade dourada do gás • Combustível de transição e destino
CARVÃO	<ul style="list-style-type: none"> • 8% do consumo de energia primária do país • Importante para a geração eléctrica e térmica 	<ul style="list-style-type: none"> • Reservas grandes nos EUA, China, etc. • Competitivo 	<ul style="list-style-type: none"> • Muito poluente 	<ul style="list-style-type: none"> • Em declínio
NUCLEAR	<ul style="list-style-type: none"> • Não existe em Portugal • Arrefecimento na sua utilização depois do desastre de Fukushima • Há 440 centrais nucleares no mundo; França 75% da electricidade 	<ul style="list-style-type: none"> • Energia limpa, sem emissões de CO₂ • Competitividade do ponto de vista económico 	<ul style="list-style-type: none"> • Gestão dos resíduos radioactivos • Preocupação com a segurança • Integração na rede eléctrica nacional 	<ul style="list-style-type: none"> • Reactores de 4ª Geração mais seguros mas ainda não comerciais • ITER/Fusão Nuclear (2050)

ENERGIAS	SITUAÇÃO ACTUAL	VANTAGENS	DESVANTAGENS	FUTURO
ENERGIAS RENOVÁVEIS	<ul style="list-style-type: none"> A produção doméstica renovável representa 28% do consumo da energia primária 	<ul style="list-style-type: none"> Recursos endógenos Diversificação da matriz energética Menor dependência do exterior 	<ul style="list-style-type: none"> Preocupação com a competitividade económica de algumas energias renováveis Intermitência 	<ul style="list-style-type: none"> Maior papel das energias renováveis Uso das redes inteligentes para lidar com a intermitência
EÓLICA	<ul style="list-style-type: none"> 4081 MW de potência instalada em Portugal Contribuição importante para a geração eléctrica 	<ul style="list-style-type: none"> Recursos endógenos Energia limpa Redução dos custos de produção Já é competitiva com gás natural e carvão 	<ul style="list-style-type: none"> Intermitência Necessidade de back-up das centrais convencionais 	<ul style="list-style-type: none"> O seu papel está em ascensão Preço do petróleo mais elevado viabiliza a sua utilização
HÍDRICA (incluindo a PRE)	<ul style="list-style-type: none"> 5390 MW de potência instalada (Mini-hídrica 410 MW) 	<ul style="list-style-type: none"> Competitividade do ponto de vista económico Energia limpa 		<ul style="list-style-type: none"> Apenas 50% da capacidade hídrica nacional é utilizada
SOLAR TÉRMICA	<ul style="list-style-type: none"> Pouca penetração no país 250 000 m² de painéis solares 	<ul style="list-style-type: none"> Potencial do país elevado (3 000 horas de exposição solar) Redução custos de produção nos últimos anos 	<ul style="list-style-type: none"> Competitividade económica Intermitência 	<ul style="list-style-type: none"> Em ascensão
FOTOVOLTAICA	<ul style="list-style-type: none"> Progresso lento e hesitante Opção grandes centrais de Moura e Serpa não é correcta Objectivo do PNAEE de 164 MW até 2015 	<ul style="list-style-type: none"> Opção só é aceitável no âmbito da produção descentralizada de energia em regime de micro-produção 	<ul style="list-style-type: none"> Produção fotovoltaica centralizada não melhora eficiência do sistema electro- produtor Desperdício no transporte e distribuição de energia 	<ul style="list-style-type: none"> Em ascensão Mais I & D

ENERGIAS	SITUAÇÃO ACTUAL	VANTAGENS	DESVANTAGENS	FUTURO
BIOMASSA	<ul style="list-style-type: none"> • Necessidade ampliar a sua utilização • País coberto 35% por floresta • Produção 7 Mt resíduos por ano • Potência instalada insuficiente 	<ul style="list-style-type: none"> • Recurso endógeno • Aproveitamento biomassa fixa populações no interior e cria emprego • Permite tratar a floresta e prevenir incêndios 	<ul style="list-style-type: none"> • Falta de quantificação da biomassa florestal • Competitividade económica 	<ul style="list-style-type: none"> • Em ascensão
BIOCOMBUSTÍVEIS	<ul style="list-style-type: none"> • Necessidade ampliar a sua utilização • País tem terrenos em pousio subsidiados que podem ser aproveitados • Atenção que o país é fortemente deficitário em cereais 	<ul style="list-style-type: none"> • Recurso endógeno • Oferta de mais uma solução para o problema dos transportes • Diminuir a necessidade de importação de petróleo • Baixa emissões de CO₂ 	<ul style="list-style-type: none"> • A selecção das culturas é crítica • Evitar competição com culturas alimentares 	<ul style="list-style-type: none"> • INETI tem experiência de 25 anos no aproveitamento de micro-algas para fabrico de biodiesel • Mais I & D
ENERGIA das ONDAS	<ul style="list-style-type: none"> • Criação de zonas piloto com potencial de exploração até 250 MW • Central piloto onshore do Pico (Açores) com 400 KW • Tecnologia Pelamis em teste na Póvoa do Varzim 	<ul style="list-style-type: none"> • Portugal tem das melhores zonas costeiras para o aproveitamento deste recurso • Energia limpa 	<ul style="list-style-type: none"> • As tecnologias conhecidas estão ainda a nível experimental • Competitividade económica 	<ul style="list-style-type: none"> • Mais I & D

PORTUGAL: O PROBLEMA-CHAVE DOS TRANSPORTES

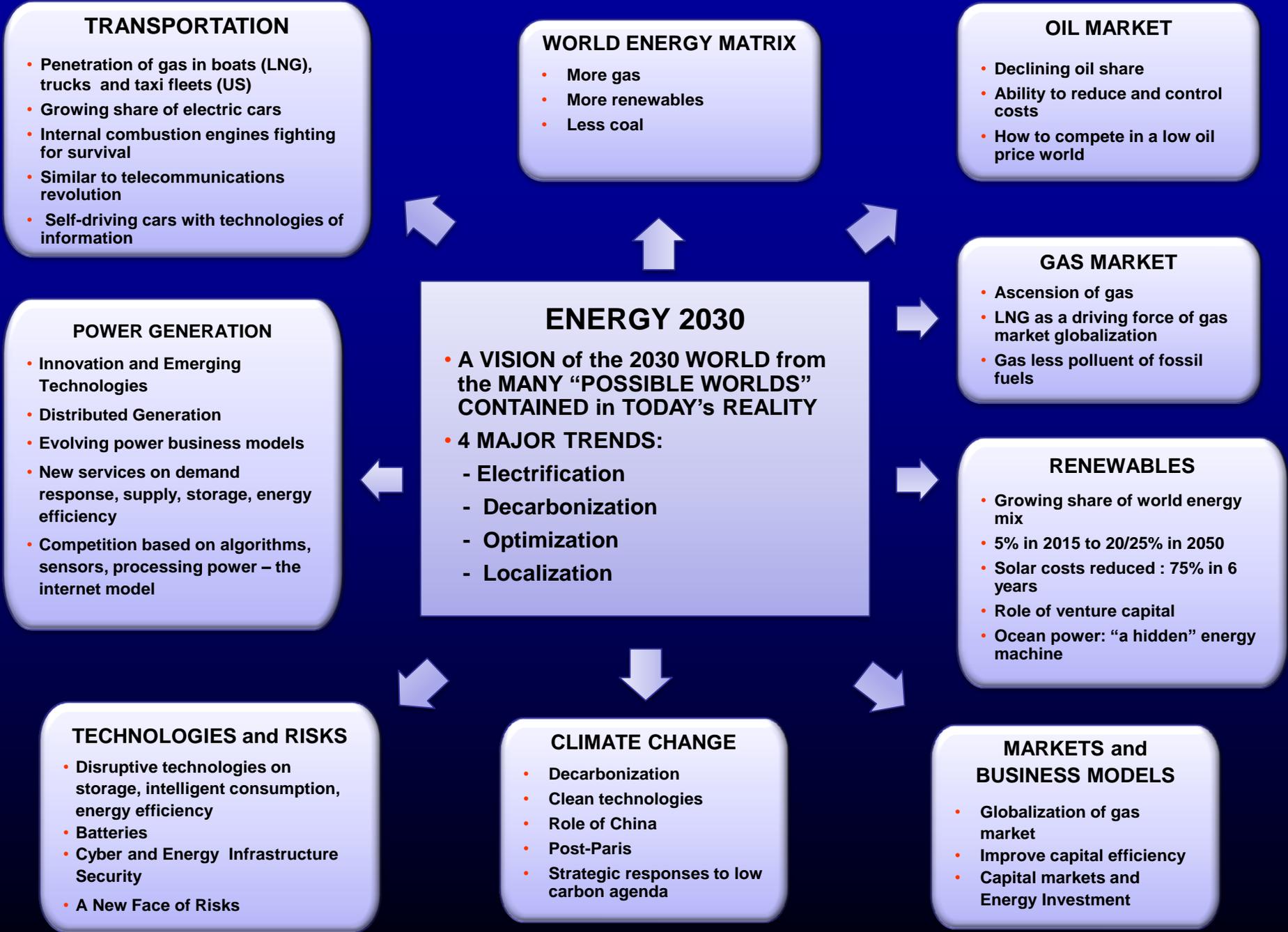
- Sector dos transportes consome 36% do total da energia final;
- Transportes rodoviários concentram 33% deste consumo e correspondem a um Consumo Energético Intensivo fortemente dependente dos combustíveis fósseis;
- Geram um desperdício colossal;



TRANSPORTES SÃO O PRINCIPAL PROBLEMA ENERGÉTICO DO PAÍS

- O problema agravou-se entre 1990 e 2004: aumento de consumo de 4.5% ao ano com a expansão do parque automóvel;
- Nos últimos anos verificou-se tendência ligeira para a redução do consumo devido aos aumentos dos preços dos combustíveis: necessidade de consolidação desta tendência.

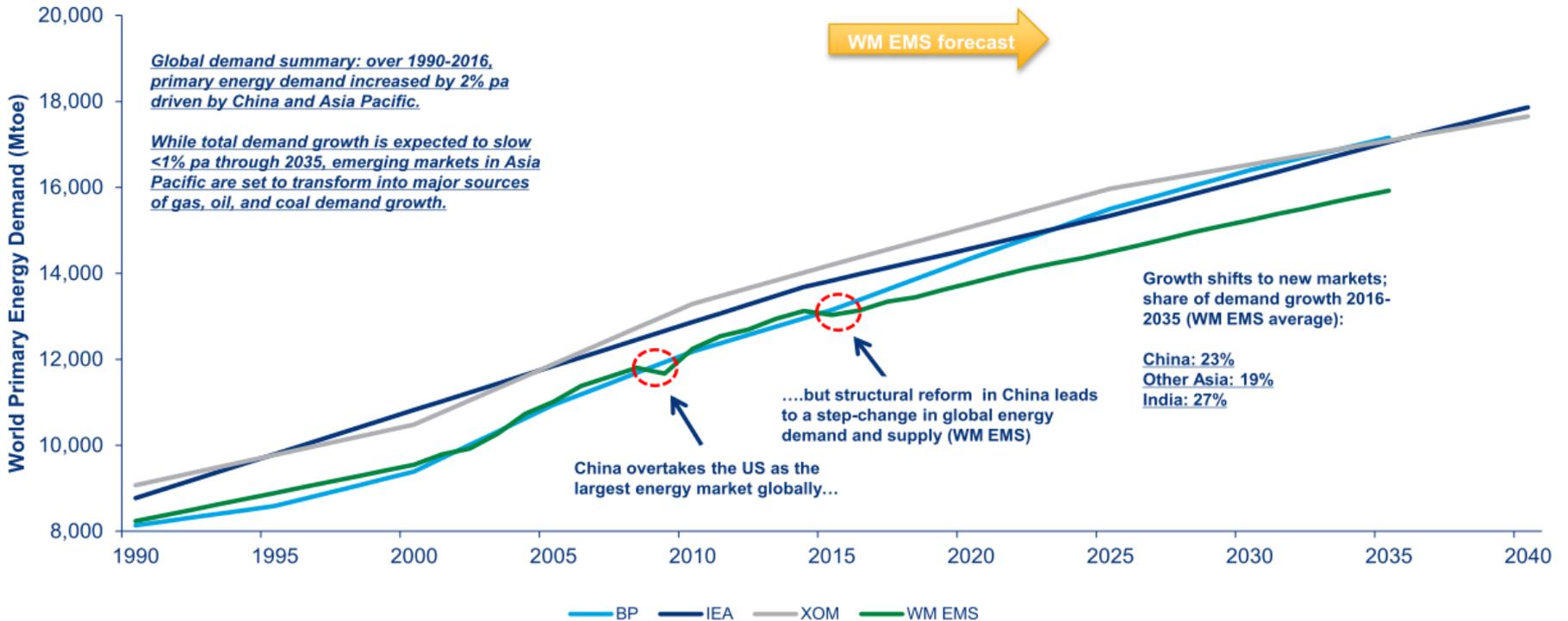
5. CONSEQUÊNCIAS para o FUTURO e ESTRATÉGIA



Global energy summary: demand expected to slow across outlooks

Asia Pacific still expected to drive demand growth, but focus shifts to India and Other Asia

Global primary energy demand 1990-2040

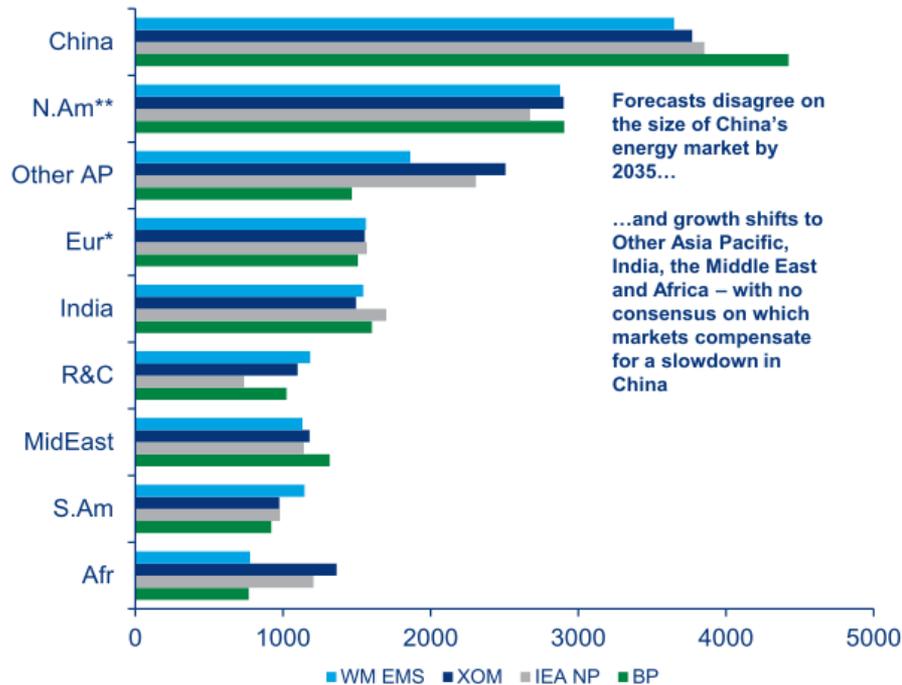


Source: Wood Mackenzie / IEA / BP / XOM

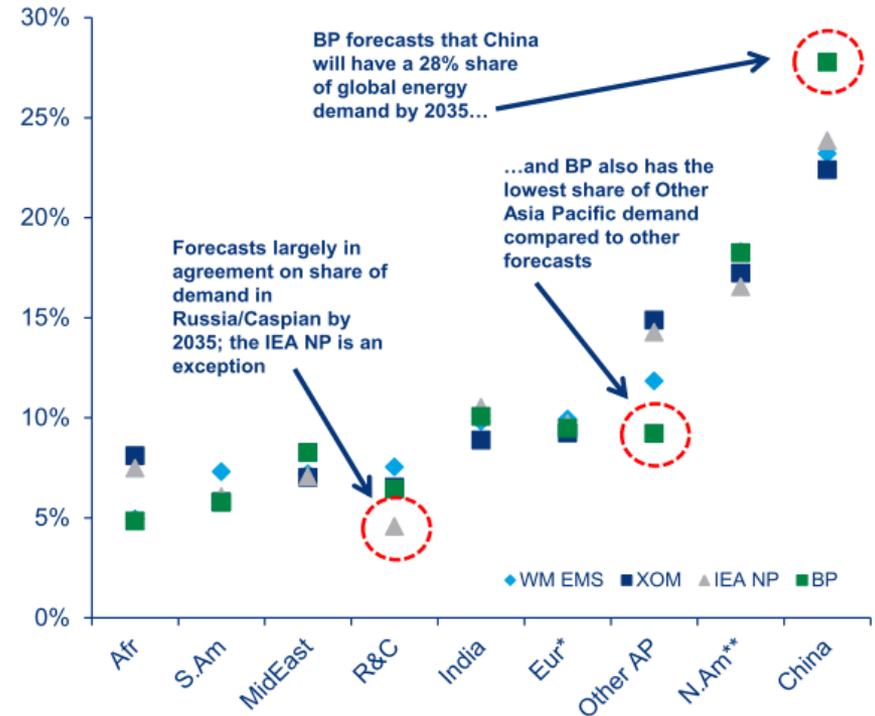
It's no longer just about China: Other AP, India, and the Middle East emerge as future growth drivers

But, forecasts disagree on the ultimate size of growth markets

2035 Total Primary Energy Demand (TPED) by region



2035 TPED by region and country



Source: Wood Mackenzie / IEA / BP / XOM. *IEA data for Europe OECD; WM EMS / XOM EU-28; **N. America IEA, Americas OECD. Other AP derived by deducting China, India demand from Asia Pacific.

O NOVO PARADIGMA ENERGÉTICO



BUILDINGS

- Lighting 20% of world electricity
- LED / SSL
- Buildings: context
- Energetic Performance
- "Zero-Energy Homes"
- Micro-generation

Emerging Technologies: Decarbonisation Economy

- Energy Efficiency
- Economic Competitiveness
- Security
- Environmental Sustainability

TRANSPORTATION SYSTEMS

- Batteries and plug-in cars
- Electric vehicles
- Advanced biofuels
- Natural gas vehicles
- Evolving smart grids
- Advances in internal combustion
- Increasing fuel efficiency
- Advanced diesels
- New lighter materials
- Chemical Propulsion:
- Space Industry

ELECTRICAL AND THERMAL GENERATION

- Sequestration and storage of CO₂:
 - Post-Combustion
 - Pre-Combustion
 - Oxy-Fuel
- Electricity 30% plus expensive
"CLEAN COAL" FutureGen (USA):
1st Integrated Central
 - Electricity Production
- + Hydrogen with CO₂ sequestration
- Coal Gasification: Conversion in gas (H + OC)
- Hydrogen Production
- Renewables: Wind / Solar / Waves/ Geothermal / Biomass/
Nuclear Energy: 3rd and 4th Generation

NANOTECHNOLOGIES

- Production / Storage of Energy
- Energy Efficiency
- New techniques to process hydrocarbons

"SMART GRIDS"

- Producer / Consumer
- Decentralized and distributed networks

- Send high voltages over long-distances to passive customers
- Main concerns: supply electricity and meet peaks in demand
- Vertical Integrated
- Big
- Centralized
- Regulated
- High Costs
- Deal with the most inefficient part of the power industry: the generating capacity that is held in reserves to meet Peak Demand
- Old Business Model of delivering through the grid over long-distances is in retreat
- Need to take a long view
- Model under pressure: new entrants and new forms of STORAGE and GENERATION are “eating” the OLD Business Model
- Analogy to computing industry: switch from main frames and terminals to CLOUD STORAGE and the Internet
- Need to do new things and respond to COMPETITION



NEW ENERGY LANDSCAPE

- Era of abundance in Energy
- Revolution of shale gas and shale oil
- Abundant gas reserves (2 to 3 x conventional)
- Renewables playing an increasing role
- Solar energy impressive cost reduction (75% decline last 6 years)
- The “Hawaii” core example
- Technological breakthroughs in Storage, Energy Efficiency, Management of Demand, Intelligent Consumption
- The revolution of “NegaWatts”: the unused electricity
- Clever technology with increased efficiency is shaping the future
- Capital markets more tilted in financing solar, storage, energy efficiency
- Costs of pollution: “decarbonisation”
- Demand for energy: increase 37% over next 25 years (“Internet of the Things” ; new devices to be connected)



New Entrants

Services provided:

- Demand response
- Supply
- Storage
- Energy efficiency

Competitive Advantages (the Internet Model”

- Algorithms
- Sensors
- Processing power
- Good Marketing
- Cheaper power + better storage + increased resilience: shape the grid of the future
- Transmission costs for electricity are declining
- Energy efficiency + Renewables + shale gas provide abundance of energy, accessible with new technologies
- More effective management of supply and demand: sensors, computer power and algorithms
- Pressure and changes on Business Models: Management of demand response; microgrids; “Prosumers”
- Storage business is booming: biggest advantage avoids need of generating capacity held in reserves to meet peak demand
- 1 Mw of storage replaces 10 Mw of such generating capacity
- Batteries approaching crucial benchmark: cost of storage 100 US\$/Kwh

Nanotechnologies: Building Nanostructures to fabricate very Tiny Shapes



Using a macroscale model, Zhang shows off his clever trick for making complex nanostructures.

*Source: MIT Technology Review
Special Edition, 10 December 2016*

GRAPHENE

Applications



Membranes



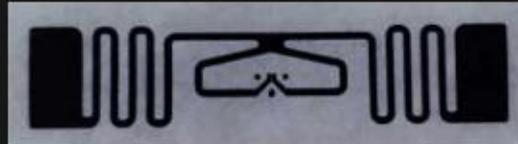
Composites and coatings



Energy



Biomedical



Sensors



Electronics

DISCOVER

AVIÕES COMERCIAIS

Novas Configurações, com novos materiais



VOO SUPERSÔNICO
Com novos sistemas de propulsão –
ramjet e cramjet?

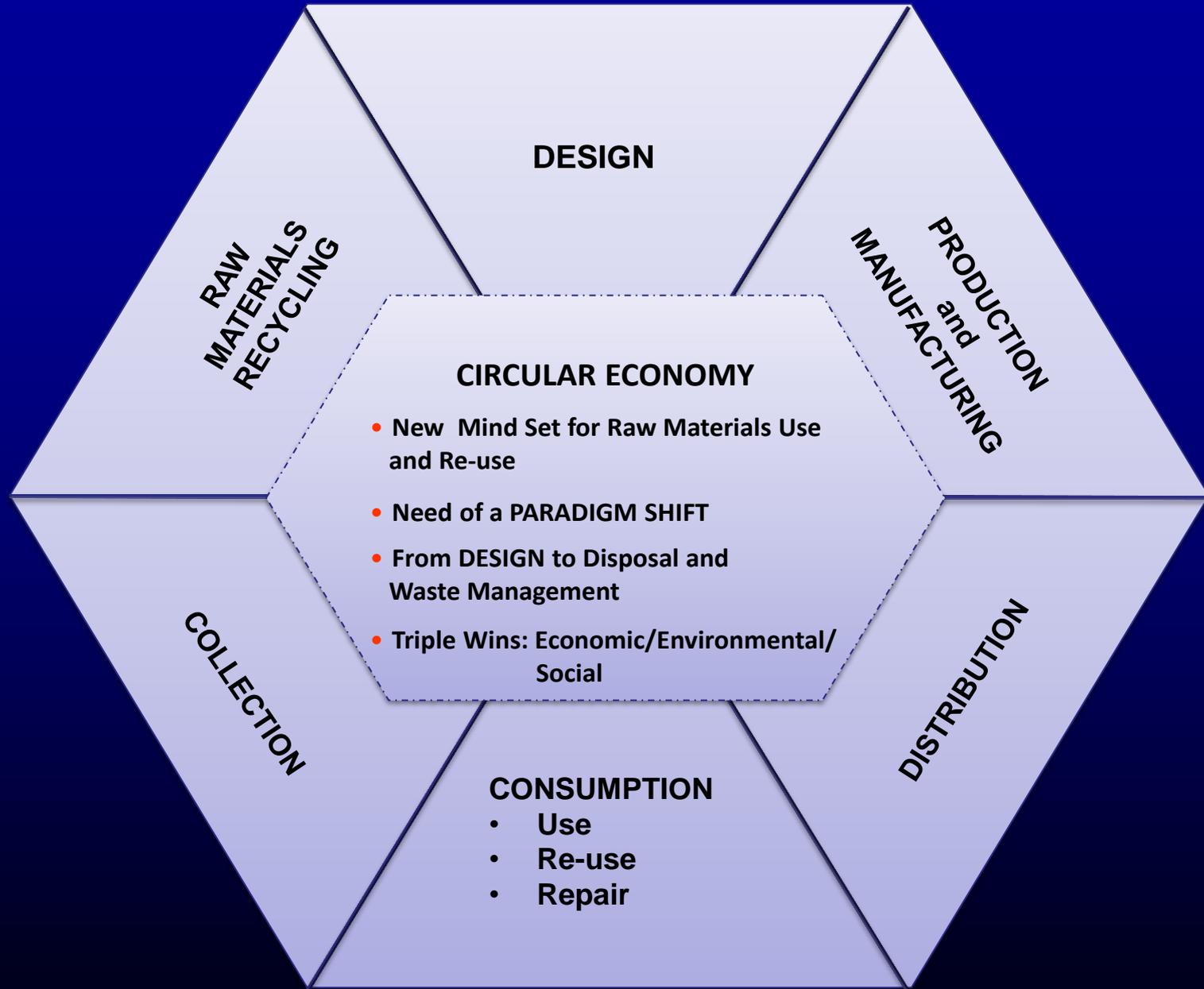
LOCAL MOTORS

Meet the World's First 3D-Printed Car

The world's first 3D-printed car, the Local Motors Strati, demonstrates the power of using direct digital manufacturing (DDM) + the Factory of the Future to disrupt the manufacturing and auto world as we know it.



STARTI is an [electric car](#) developed by [Local Motors](#) and manufactured in collaboration with [Cincinnati Incorporated](#) and [Oak Ridge National Laboratory](#).^[2] It is the world's first 3D-printed electric car.^[3] The car was manufactured using a Large Scale 3D Printer developed by [ORNL](#) and Cincinnati Inc. The car took just 44 hours to print during the 2014 [International Manufacturing Technology Show](#) in [Chicago, Illinois](#).



ECONOMIC GAINS

- Efficient use of raw materials
- Products design to faster re-use of materials
- More efficiency in all segments of industrial chain

CIRCULAR ECONOMY TRIPLE WINS

ENVIRONMENTAL GAINS

- Repair and recycling of products
- Change paradigm of “exponential” depletion of resources
- Change habits
- Avoid deterioration of earth’s climatic system
- Convert garbage into resources

SOCIAL GAINS

- Prevent waste
- Improve waste management
- Build citizen mindset more sensitive to sustainable depletion of resources

CITIES are BEST INVENTION of MAN

- Mark death of distance
- Rotating platform for markets and cultures
- Connect human capital
- Cities are main drivers of innovation

CHALLENGES for FUTURE CITIES

- More sustainable models
- Address energy security
- Smart grids
- New model for mobility
- There is no sustainability for future without a new vision for the development of more intelligent cities
- Sustainability is a multidimensional concept and needs to question the excess of the constant growth logic and fight the waste of resources

THE NEED of a PARADIGM SHIFT for WORLD CITIES

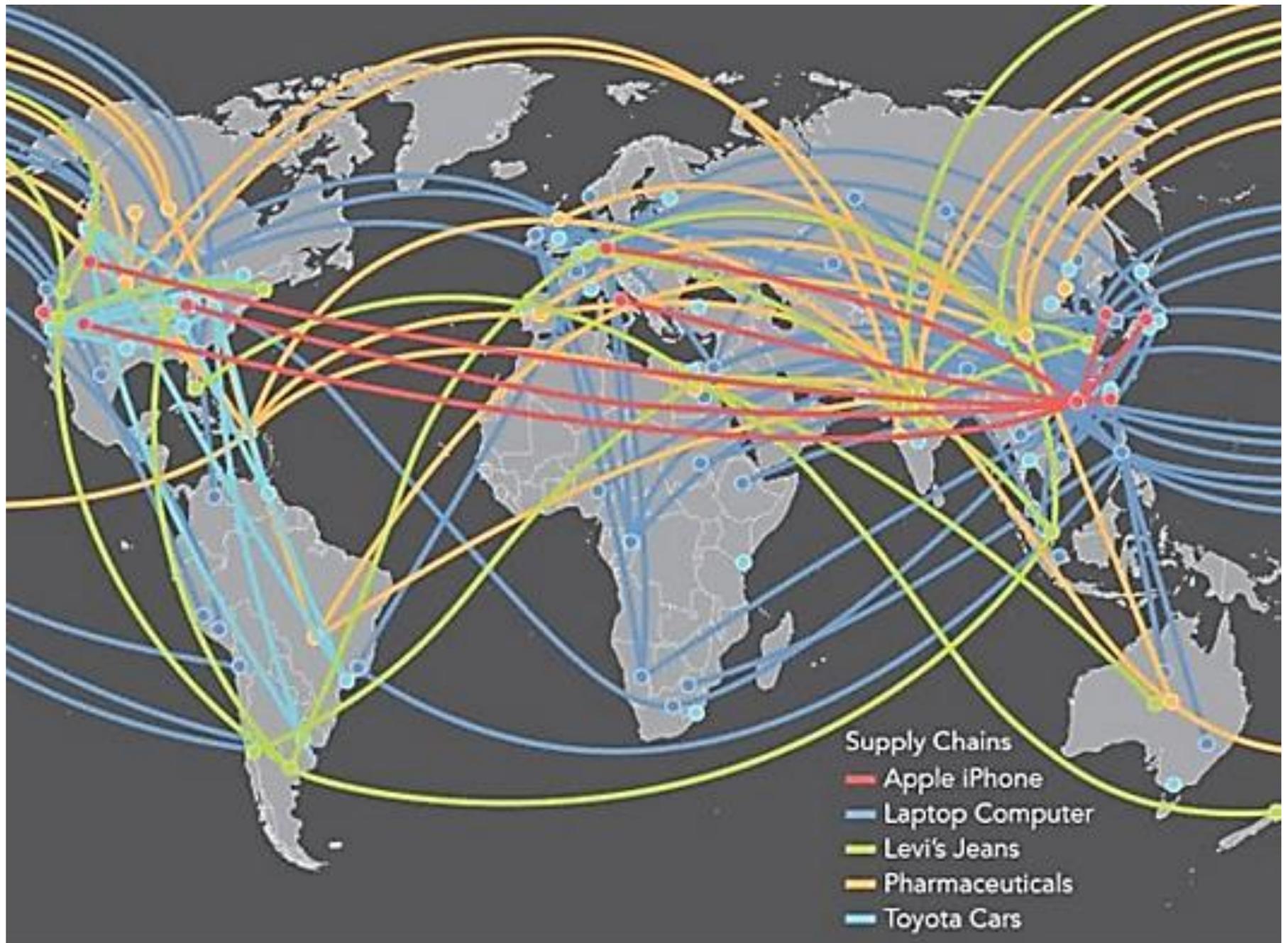
- **Cities occupy 2% of planet surface**
- **50% of world population**
- **Consume 75% of energy produced**
- **Responsible for 80% of CO₂ emissions**

CITIES with CURRENT LANDSCAPE IMPLY HUGE RISKS

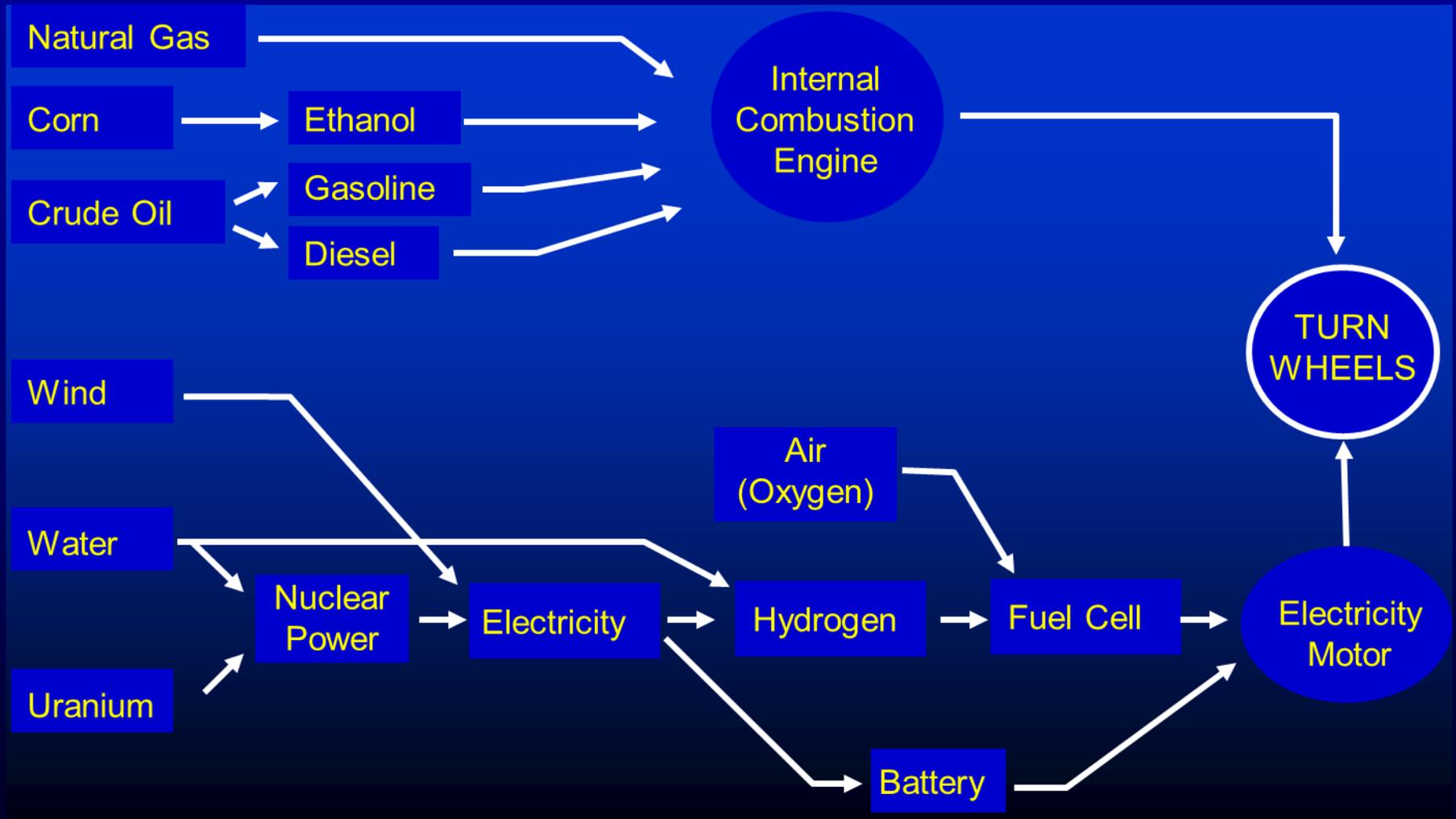
- Frenetic urban growth
- Difficulties in resources management
- Drivers of atmospheric pollution
- “Heat-Islands”
- Negative impact on earth climatic system
- Key issue: transport system

NEW MODEL for CITIES

- Water management
- Energy management
- Residuals treatment
- New role of transport system based on public transport + electric cars + evaporation of traffic jams
- New modes of access and distribution of resources

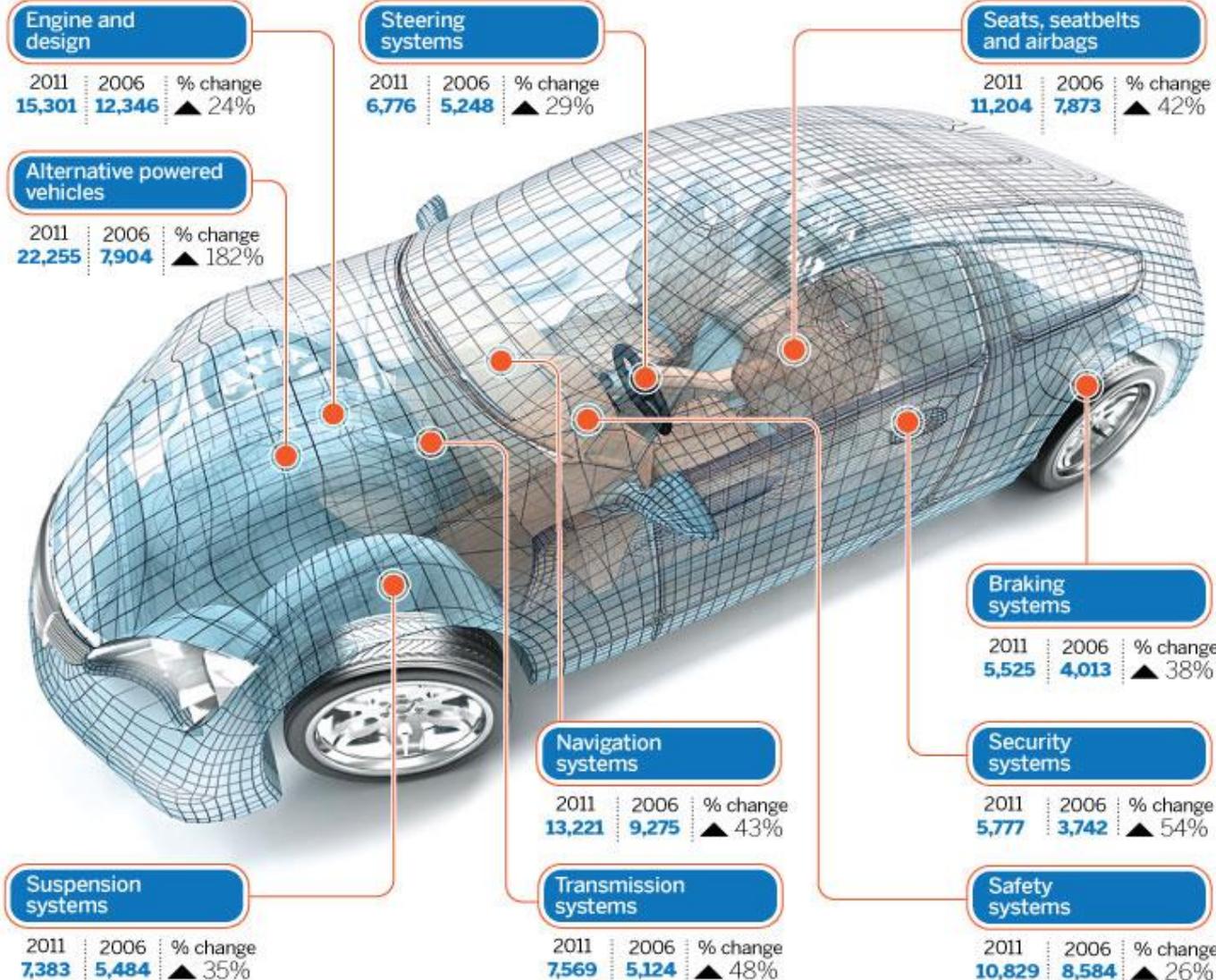


Energy Road Map and Solutions: Many Possible Paths Leading to Same “Destination””

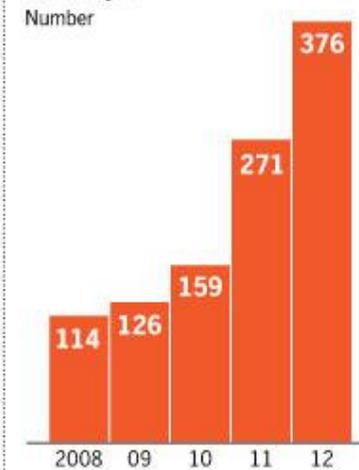


RISE OF THE AUTOMOTIVE PATENT TECH WARS

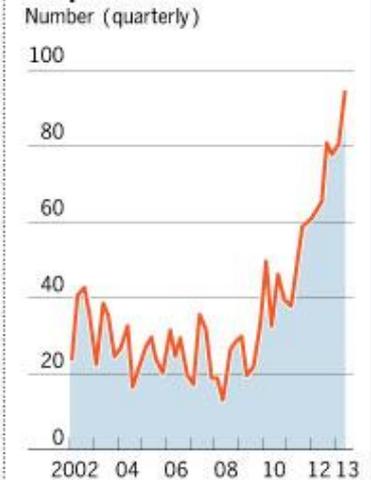
Top automotive-related technology areas (Number of published patent applications and granted patents)



Electric car patents in Europe



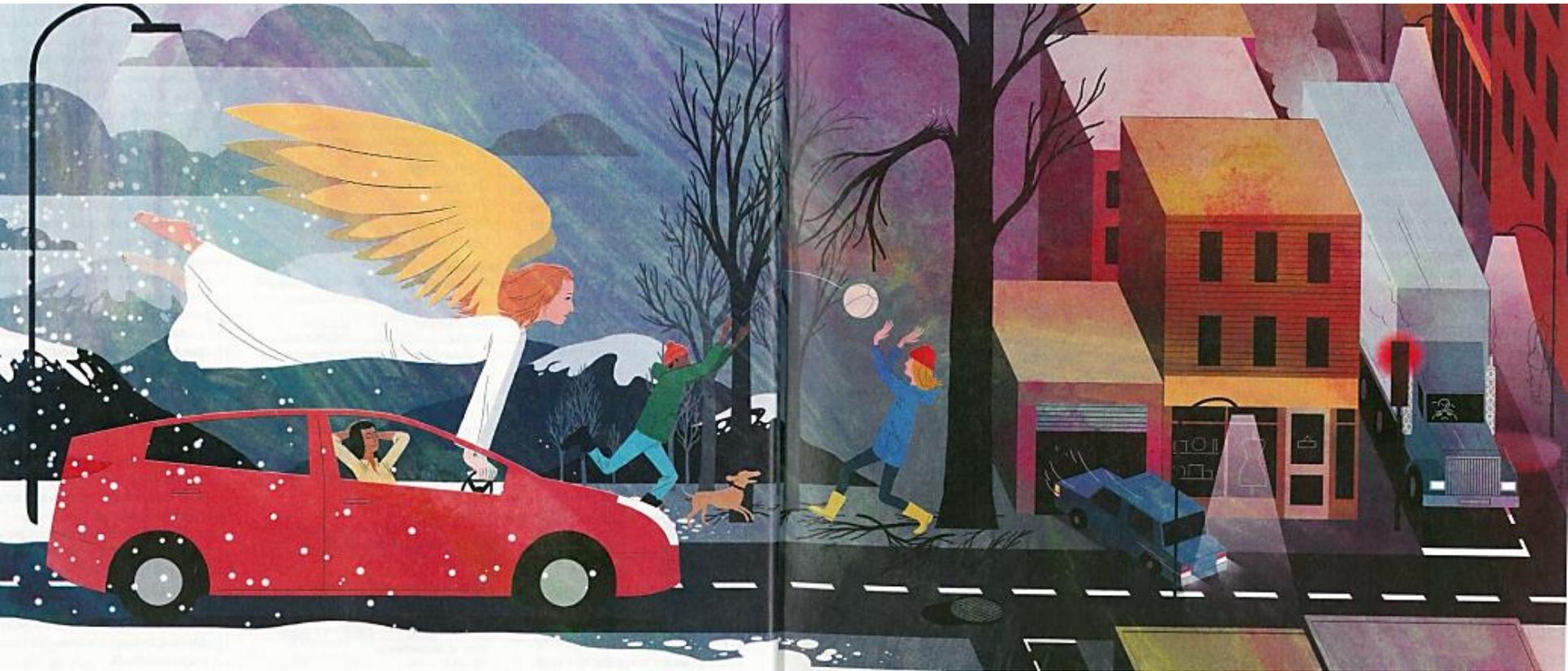
US hybrid or electric car patents



Sources: Thomson Reuters Datastream; Bloomberg; Cleantech Photo: Dreamstime FT graphic

TOYOTA

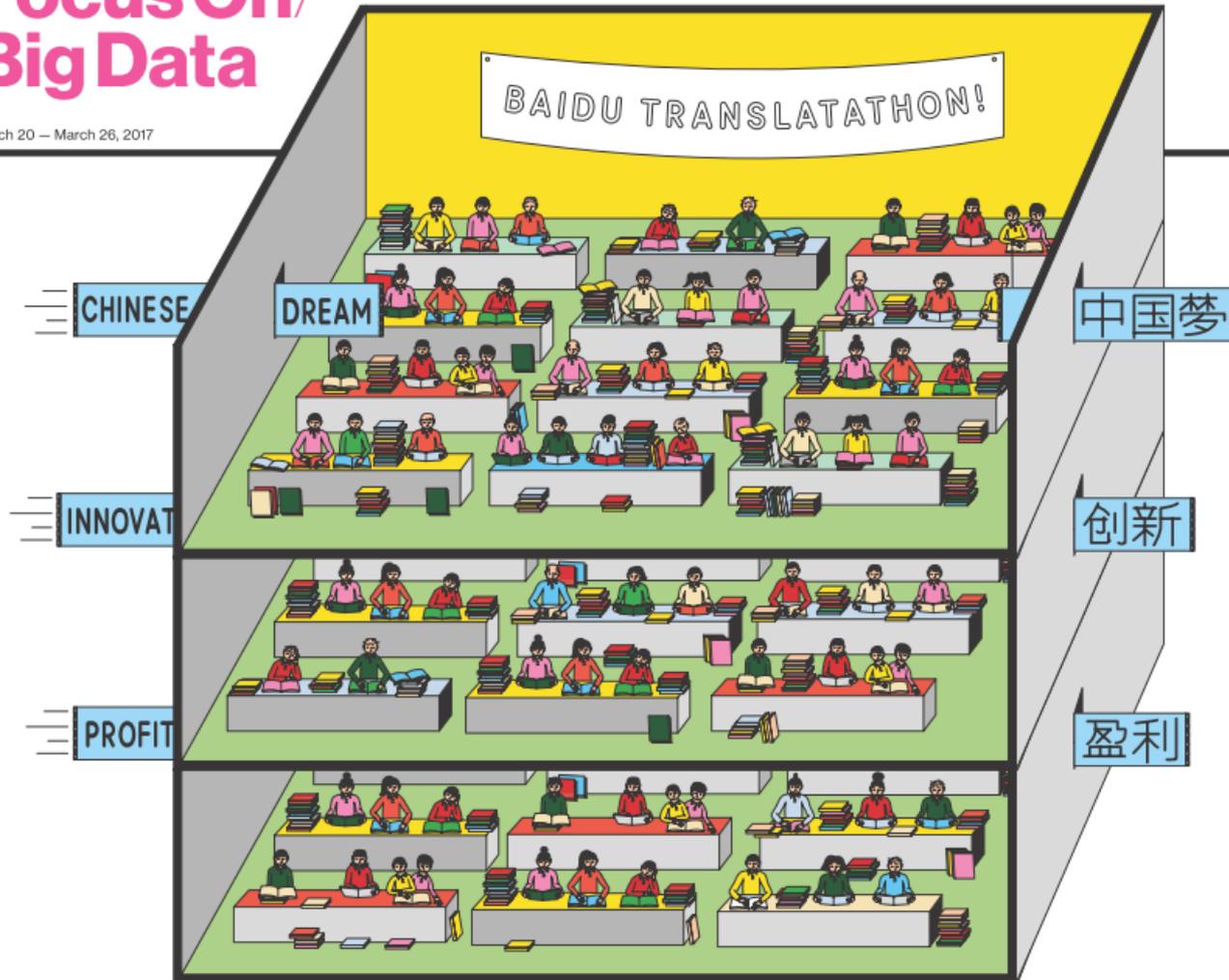
The world's largest automaker is finally getting serious about self-driving technologies



Source: MIT Technology Review Special Edition, 10 December 2016

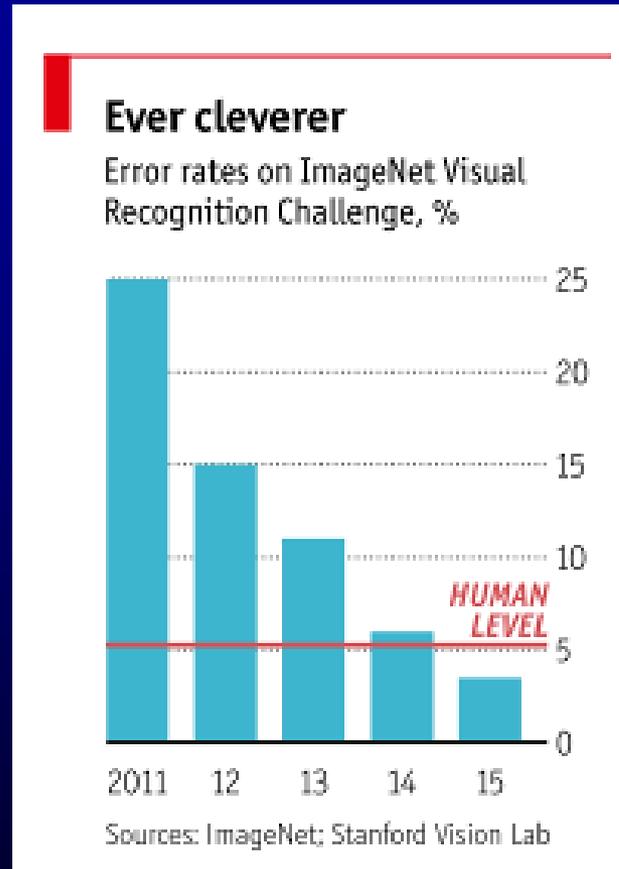
Focus On/ Big Data

March 20 – March 26, 2017



AI With Chinese Characteristics

INTERNET IMAGE CHALLENGE: DEEP-LEARNING APPLIED to MANY DOMAINS



Source: *The Economist*, 25 June 2016

**The
Economist**

SEPTEMBER 2ND - 9TH 2016

Brussels spouts, Apple bruised

How to live with terrorism

Statistics and superstitions in China

Britain's post-Brexit economy

Uberworld

The race to reinvent transport



TRENDS

- Matching riders with drivers
- Offer transport services without owning a single car
- Keep the lion's share of profits
- Cost of expanding is lower because does not own cars
- Success of peer-to-peer services
- Pay access to things

CITIES LANDSCAPE WILL CHANGE

- Self-driving cars will make it cheaper and more accessible
- OECD study model on Lisbon shows autonomous cars reduce number by 80%/90%
- As car ownership declines an enormous amount of space devoted to parking will be released
- "Uber model" risks to transform the future of personal transport and change cities landscape
- Cities with more space, less cars, less pollution

DISRUPTIVE BUSINESS MODEL

UBER at the intersection of 3 linked disruptive trends:

- Emergence of the Asset-light business model
- Shift to the Sharing Economy
- Consumers (young people) apply for access to the things rather than own the things

SHORT-TERM

- Taxi Business

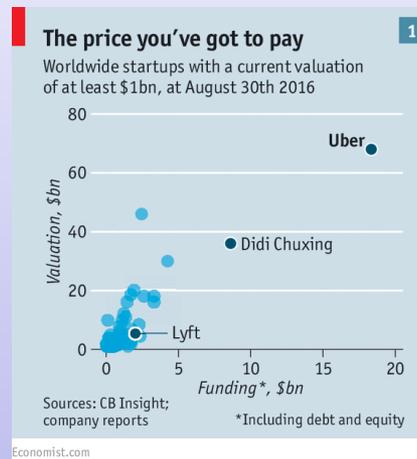
CONSEQUENCES for the FUTURE

- Disruptive business model
- Shaking-up the 100 billion US\$ a year taxi business
- But using SELF-DRIVING CARS may shaken world personal transport market worth 10 trillion US\$

LONG TERM

- Potential of self-driving cars
- Revolution on personal transport
- Boundaries between private and public transport
- Longer term autonomous vehicles will drive the reinvention of transport
- Google test on autonomous cars in Mountain View
- Start-up of NuTonomy in Singapore

UBER BUSINESS MODEL



- Founded in 2009 and today is the most valuable start-up worth 70 billion US\$
- Can summon a car in a few seconds in more than 425 cities

A NEW MOSES COMPANY?

- Never reaching its promised land
- Pioneer of new technological trends do not manage always to stay on top
- Nokia / BlackBerry (smartphones)
- KODAK (digital cameras)
- My Space (social networks)



**The
Economist**

JUNE 25TH-JULY 1ST 2016

Inside China's Ministry of Truth
Trump in trouble
Who are the Niger Delta Avengers?
The flaws in executive pay
Motorcycles that fly

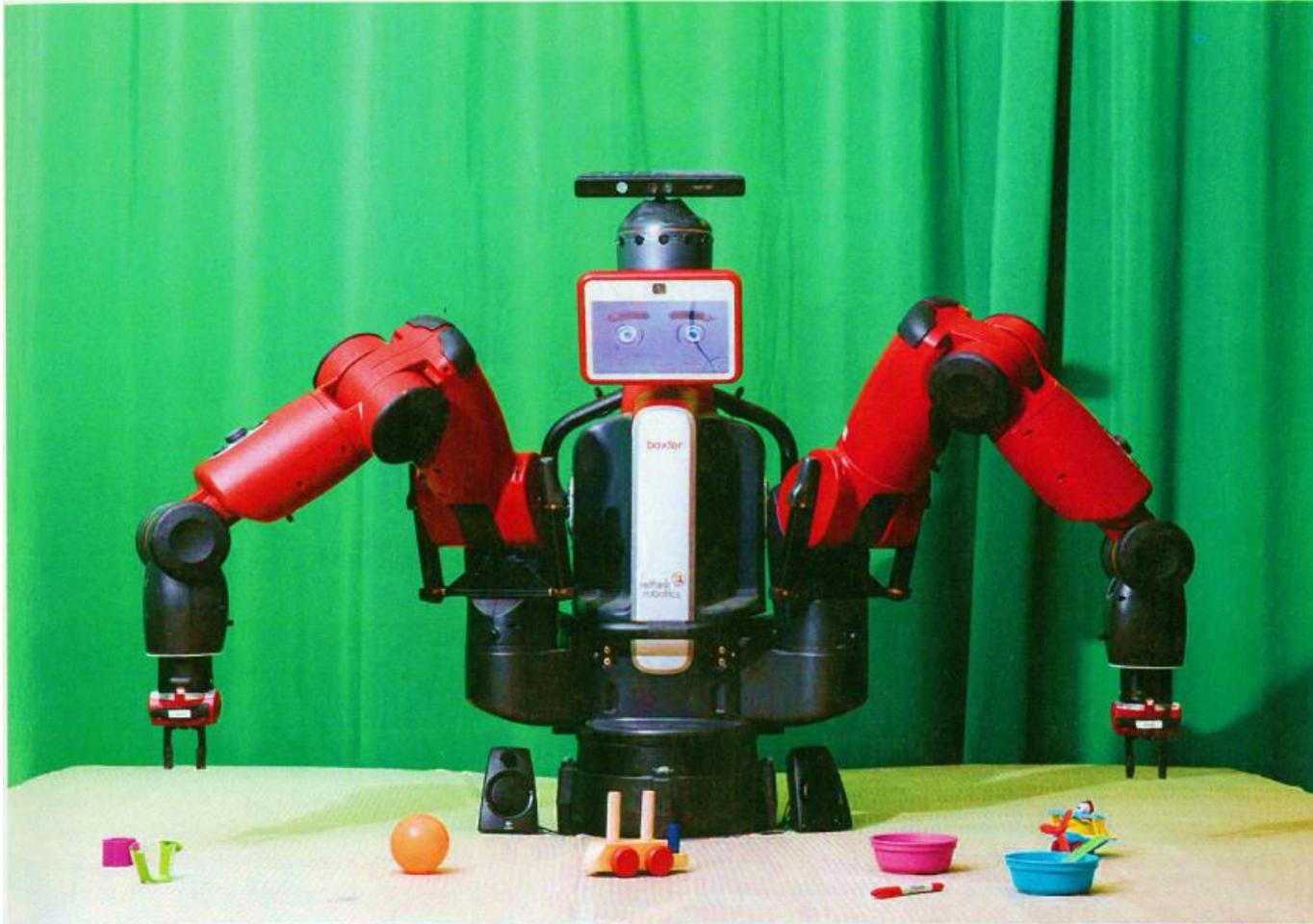
March of the machines

A SPECIAL REPORT ON ARTIFICIAL INTELLIGENCE

A Marcha das Máquinas

. DEMÓNIOS OU FACILITADORES?

Each time the robot determines the best way to grasp and hold something, it files that data away in a format other robots can use



Source: MIT Technology Review Special Edition, 10 December 2016

Widespread Infrastructure Connectivity

Simplified Smart Grid Diagram

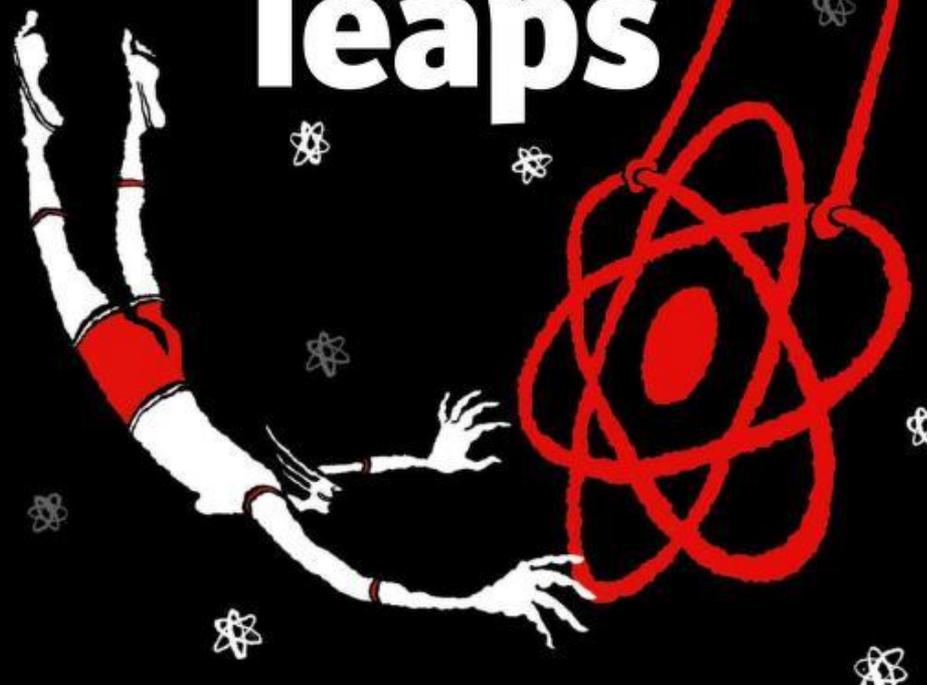


**The
Economist**

MARCH 11TH-17TH 2017

Taiwan and the one-China fiction
IS up against the wall in Mosul
In praise of quinoa, millet and teff
Is there a bubble in the markets?

Quantum leaps



A mind-bending technology goes mainstream

Universidade de Verão PSD 2017
António Costa Silva – Presidente da Comissão Executiva

The Economist, 11-17 March 2017

A ECONOMIA PARTILHADA e NOVOS MODELOS de NEGÓCIO

- O “Asset-light” Model
- Modelo UBER
- A digitalização da Economia

O DINHEIRO DIGITAL

- A confiança digital
- O BITCOIN
- O Blockchain
- Maior inclusão Financeira
- Maior Transparência
- Combate à corrupção

AS CIDADES INTELIGENTES

- Maior eficácia na utilização de recursos
- Novos modelos de gestão dos transportes, água, energia, resíduos

AS NEUROTECNOLOGIAS

- O primeiro ser humano com memória artificial?
- O primeiro ser humano cujo genoma é desenhado e editado à nascença?

A Interconectividade Global

- Telemóveis/Smartphones ao alcance de todos
- A presença digital de grande parte da Humanidade

A INTERNET nos OLHOS DAS PESSOAS

- A visão como nova interface
- Os óculos da Google e o seu impacto nos serviços, indústria, navegação, educação, lazer, namoro

AS ROUPAS LIGADAS À INTERNET

- A tecnologia cada vez mais pessoal
- Cuidados de Saúde
- Tomar melhores decisões

UM SUPER-COMPUTADOR NO BOLSO de CADA PESSOA

- Participação económica dos mais desfavorecidos
- Acesso à Educação/Skills
- Expansão do mercado / e-commerce
- Participação Cívica

BIG DATA

- Armazenamento e processamento da informação
- A mudança das profissões: Jornalistas/Médicos/Advogados
- As Bases de dados
- A extensão da memória pessoal
- A AI na pesquisa e na tomada de decisões

A INTERNET das COISAS

- A conectividade do carro, escritório, casa, fábricas, aparelhos
- Maior eficiência na utilização dos recursos
- Aumento da produtividade
- Criação de novos negócios

SÉCULO XXI AS IDEIAS QUE PODEM MUDAR O MUNDO

OBRIGADO