

AACDN

Lisboa, 23 de Novembro de 2019

**“A INSERÇÃO de PORTUGAL num MUNDO
em TRANSIÇÃO”**



António Costa Silva
Presidente da Comissão Executiva

PARTEX
OIL AND GAS

SUMÁRIO

- 1. A Geopolítica da Energia e as Mudanças Estratégicas e Estruturais**
- 2. “Energy Game Changers” e a Ameaça Climática**
- 3. A Transição Energética e Desafios para o Futuro**

1. A Geopolítica da Energia e as Mudanças Estratégicas e Estruturais

XXI CENTURY: THE KEY - GEOECONOMIC SPACES

- Cities
- Sea resources
- Mega-cities
- EEZ
- Regions
- South Atlantic
- Hubs
- Indian Ocean
- Ports
- Pacific Rim

THE ROBOTIC REVOLUTION

- Robots just in time to tackle "Ageing" and diminishing work force
- The "Dronization" of society
 - Industrial / Manufacturing
 - Energy
 - Cities
 - Goods transportation
 - War

GEOPOLITICS

- US technological / Military power anchored in Americas and Pacific RIM
- China emergence anchored in Asia Continental Belt, Indian Ocean and South Atlantic
- Russia balance Asia's/China/Europe or running to disaster and chaos?
- Middle East implosion or stabilization?
- Europe reinvention or growing irrelevance

HOW the FUTURE MIGHT EVOLVE?

"The World was always ruled by passion, irrationality and periodic evils"

Kant

WORLD TRANSPORTATION SYSTEM

- The electric car emergence
- TESLA revolution?
- Electric/Hybrids/Fuel Cells
- The Self-driving car
- The car as a center for work, information, analysis, interaction as part of a dynamic network
- ICE motors running on gas with a new dynamics

TECHNOLOGY DISRUPTIONS

- Storage of electricity at grid scale
- Battery-driven world
- Growing electrification of world economy
- Automation / Virtualization
- Artificial Intelligence
- Robotics
- Nano-technologies
- Materials science
- Health science
- Big data
- Internet of things
- Deep ocean mining

WORLD ENERGY MATRIX

- More gas
- More renewables
- More electricity
- The digital revolution
- Smart grids
- Smart consumption
- Negawatt revolution
- The digital utilities

ROBOTS THAT TEACH EACH OTHER





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)

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

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

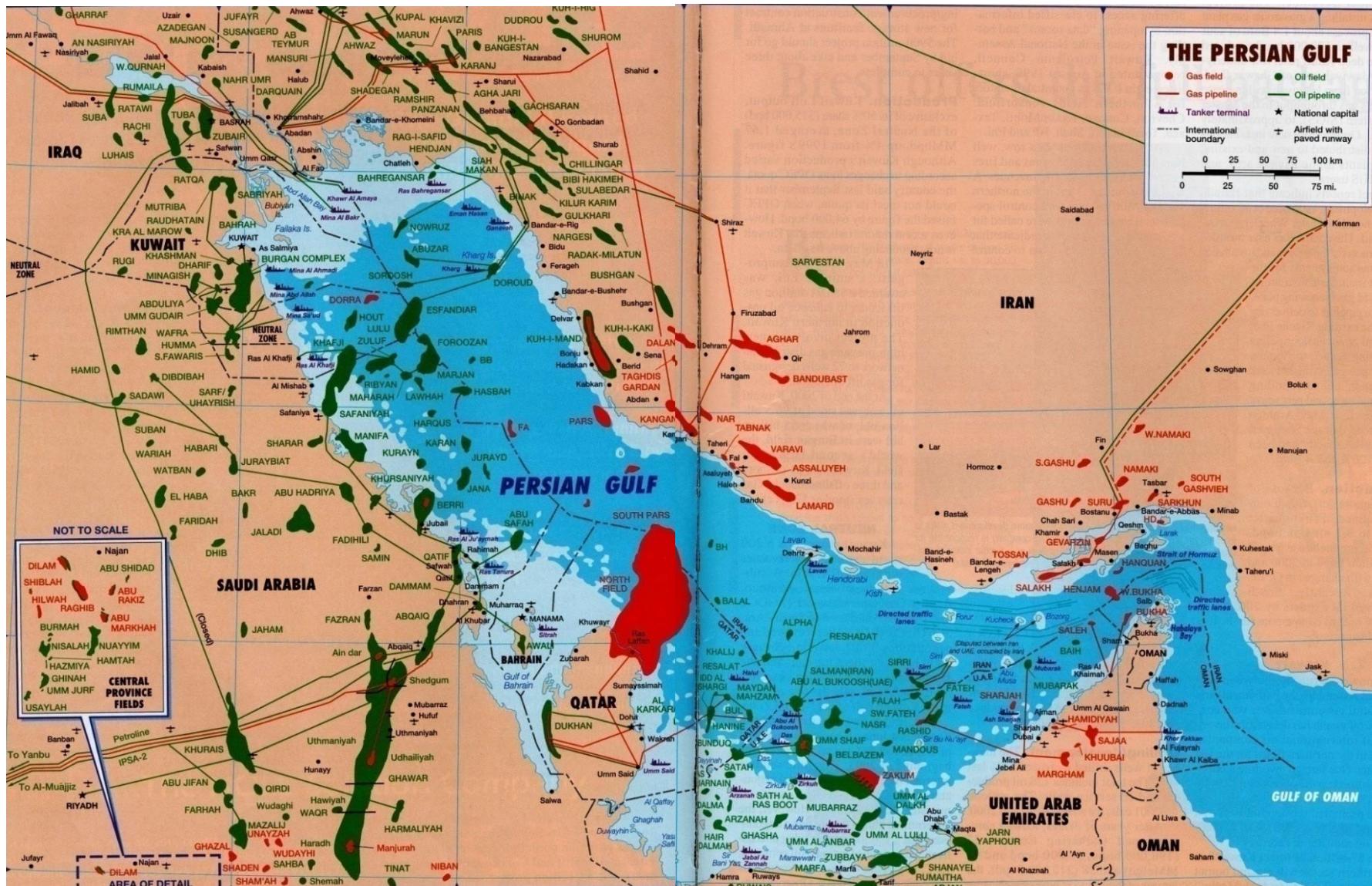
- . Reduction or not water access?

PRODUCTION of SELECTED COMMODITIES, 1950, 1975, and 2000

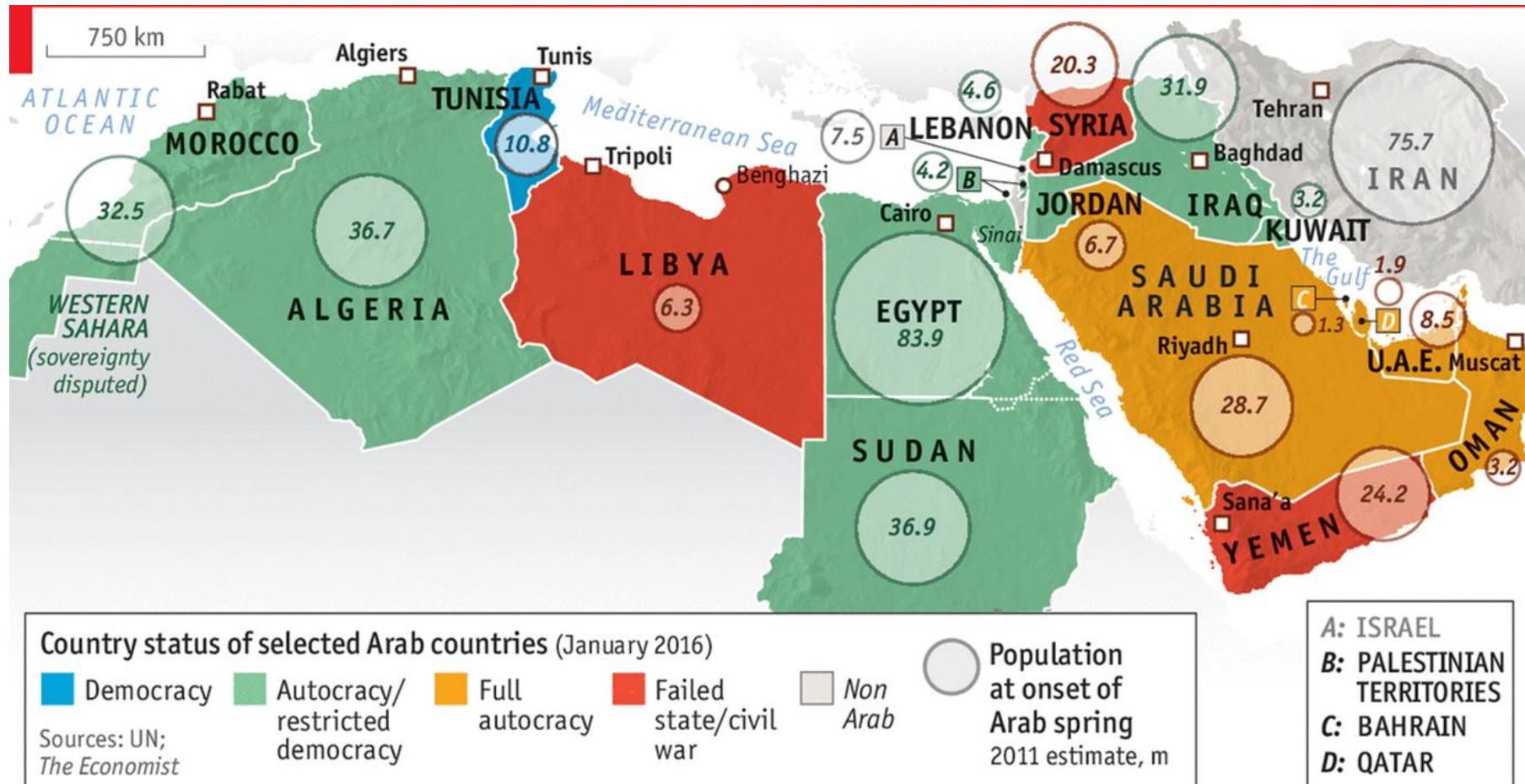
(in thousand metric tons, unless otherwise noted)

	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

CONSTRAINTS ON OIL AND GAS FLOW FROM MIDDLE EAST



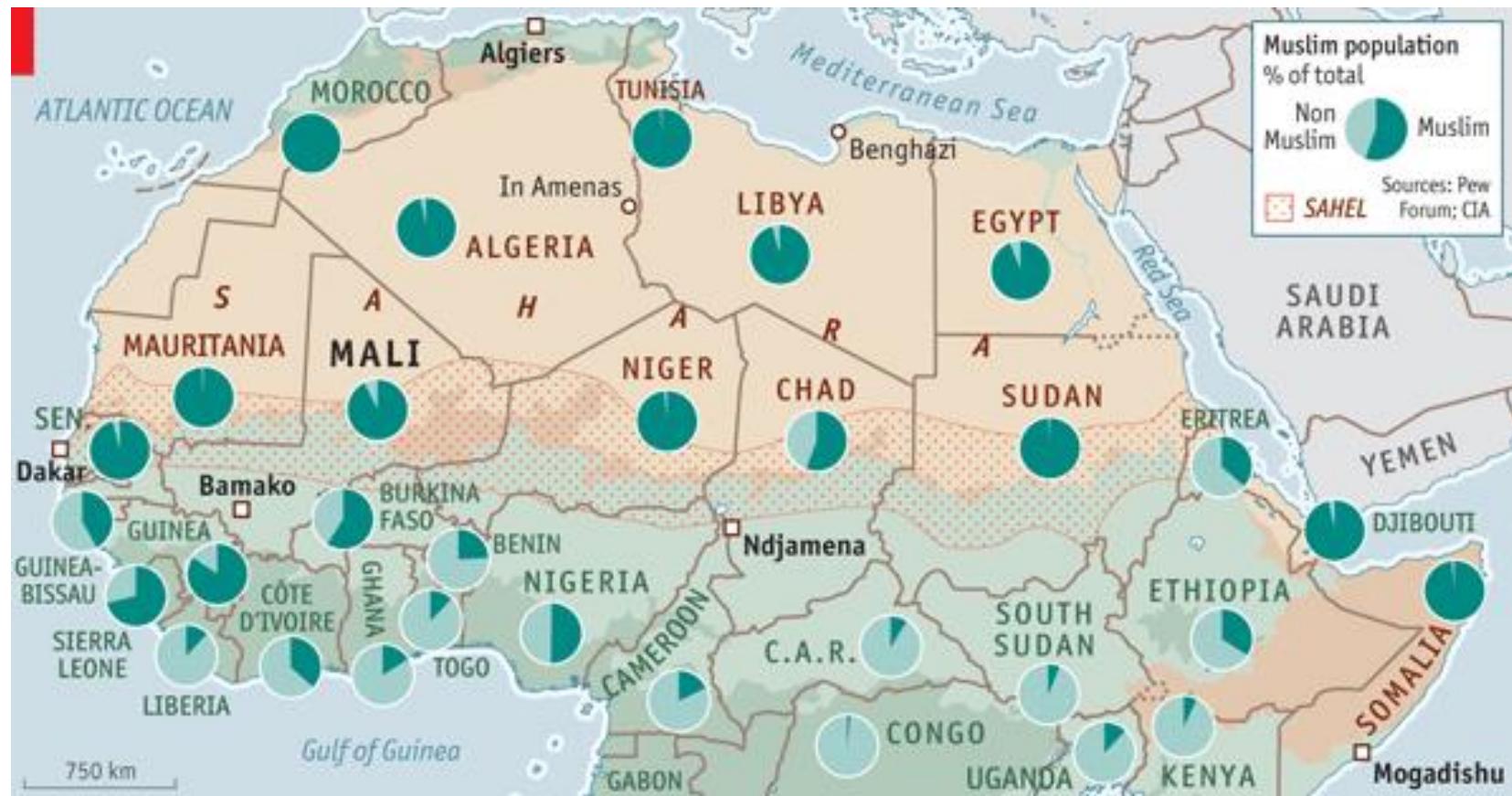
Arab Countries Status



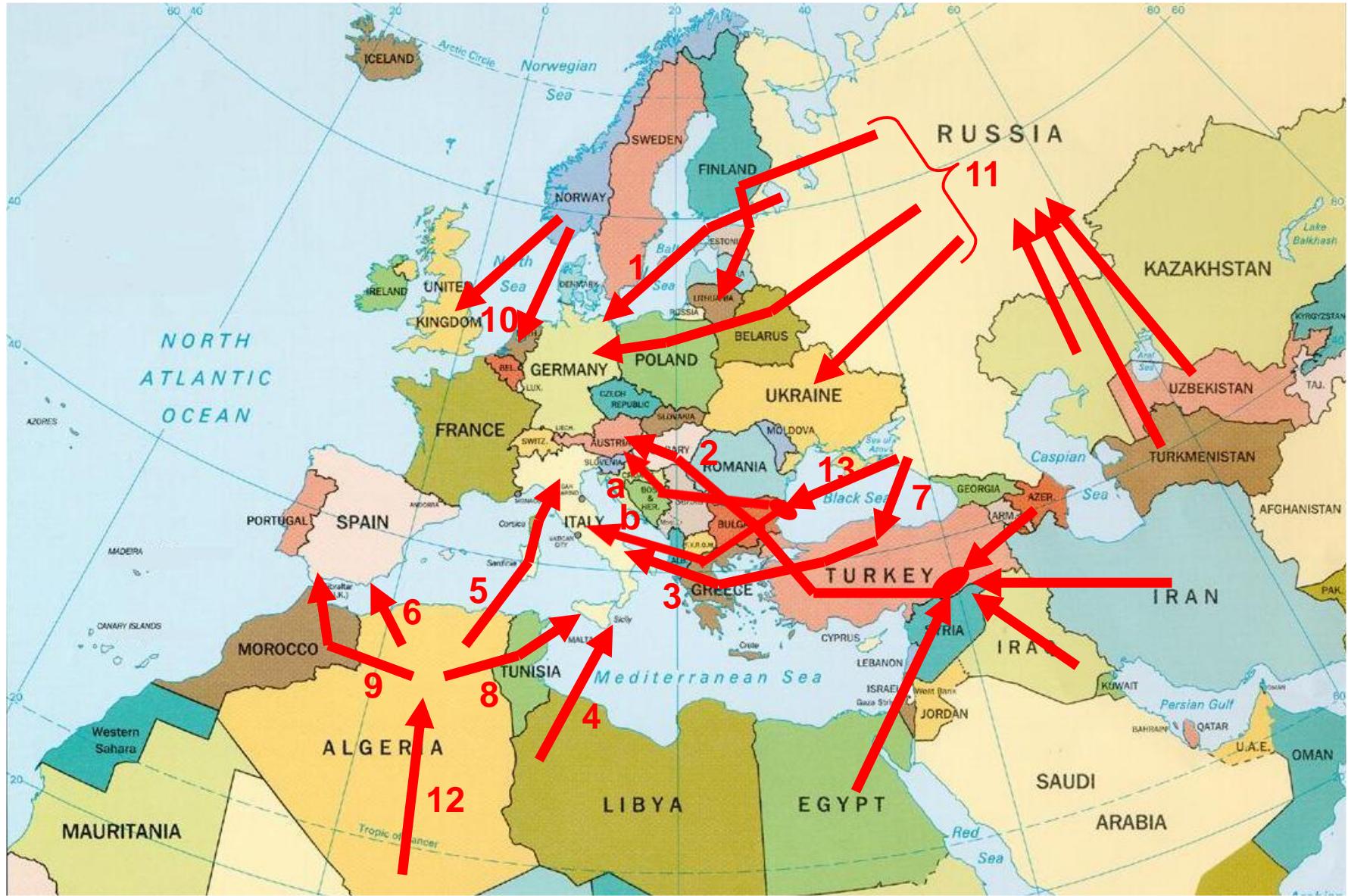
Economist.com

Jihad in AFRICA

The Danger in the Desert



THE GEOPOLITICS OF THE PIPELINES



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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

A SEGURANÇA NA BACIA DO ATLÂNTICO



Dropped in the ocean

Operational Argo floats

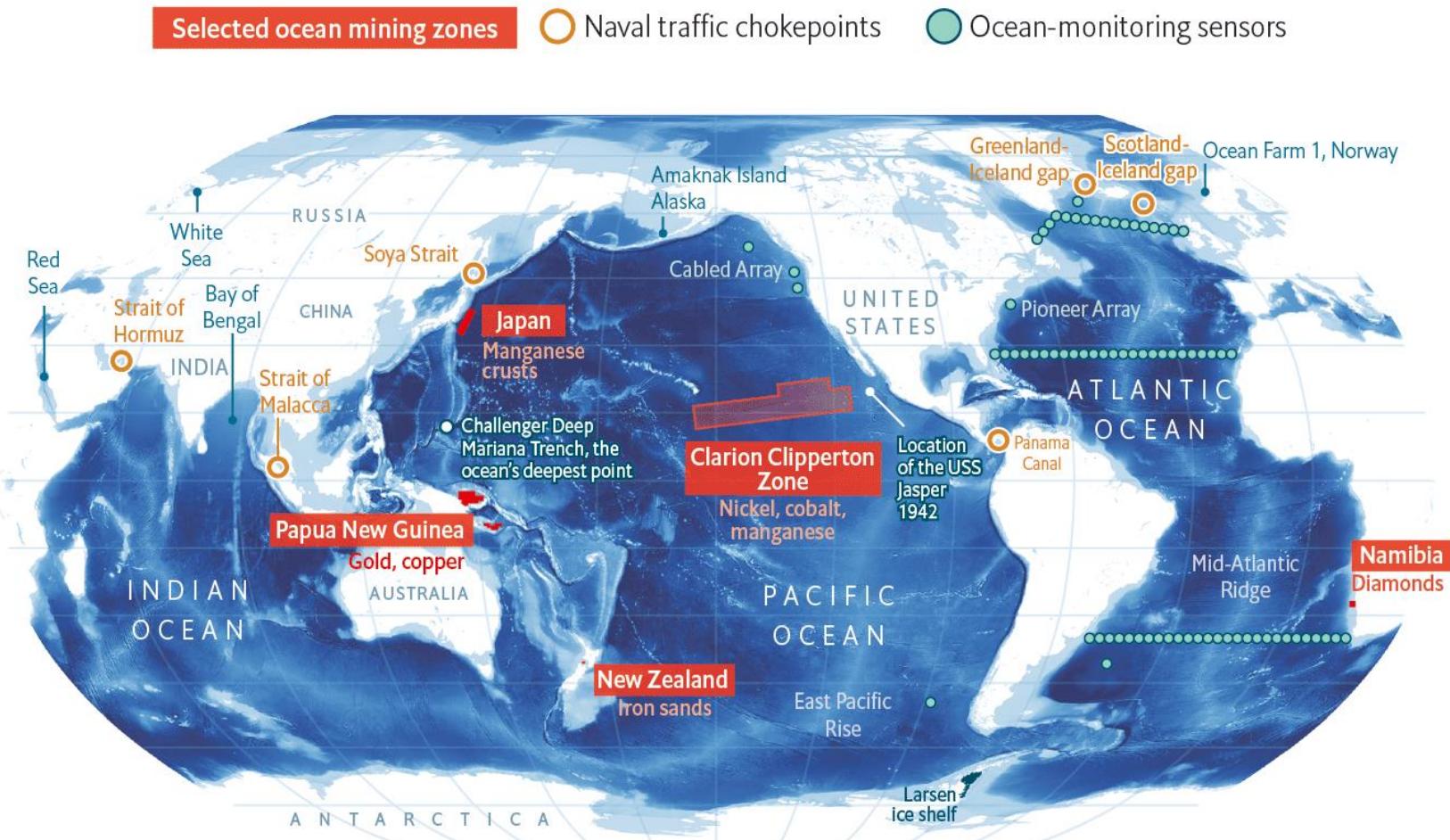
February 12th 2018

Total: 3,887



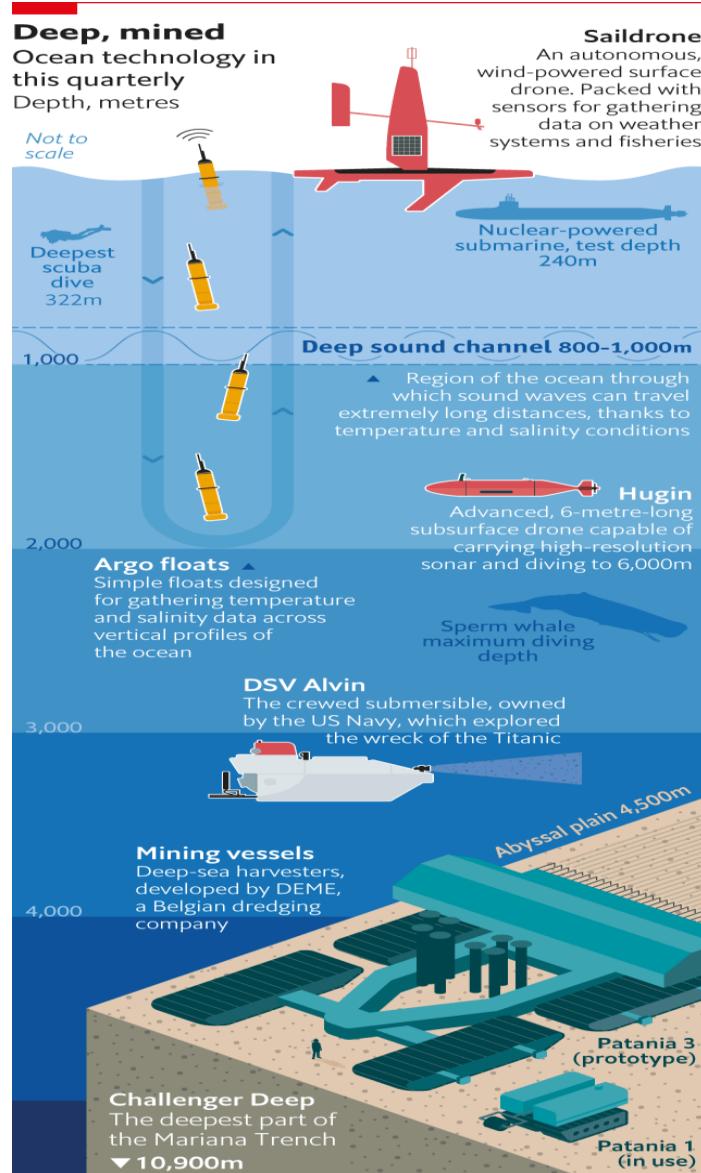
Source: International Argo Project

Sites mentioned in this quarterly



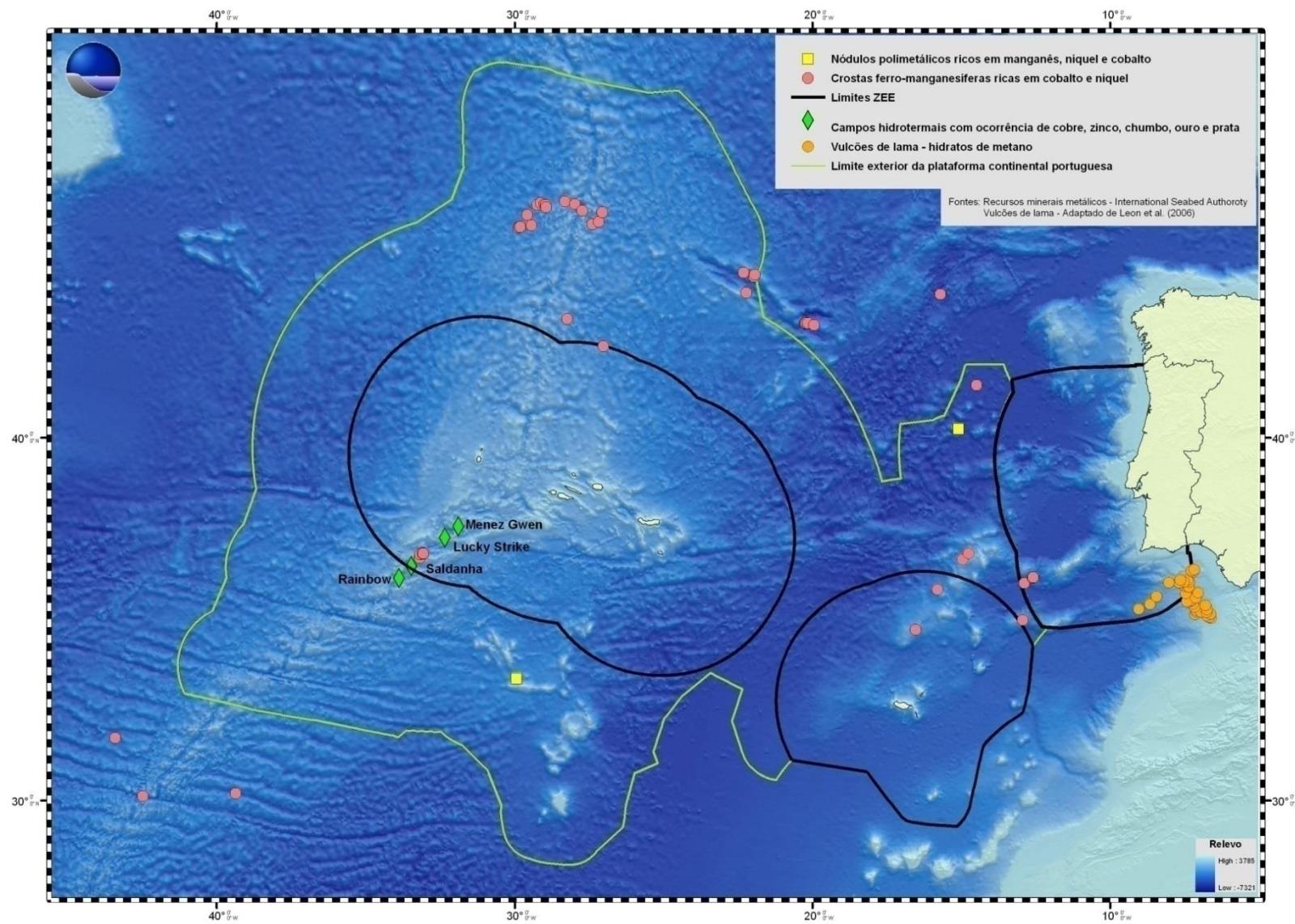
Sources: GEBCO; International Seabed Authority; Nautilus Minerals; *The Economist*

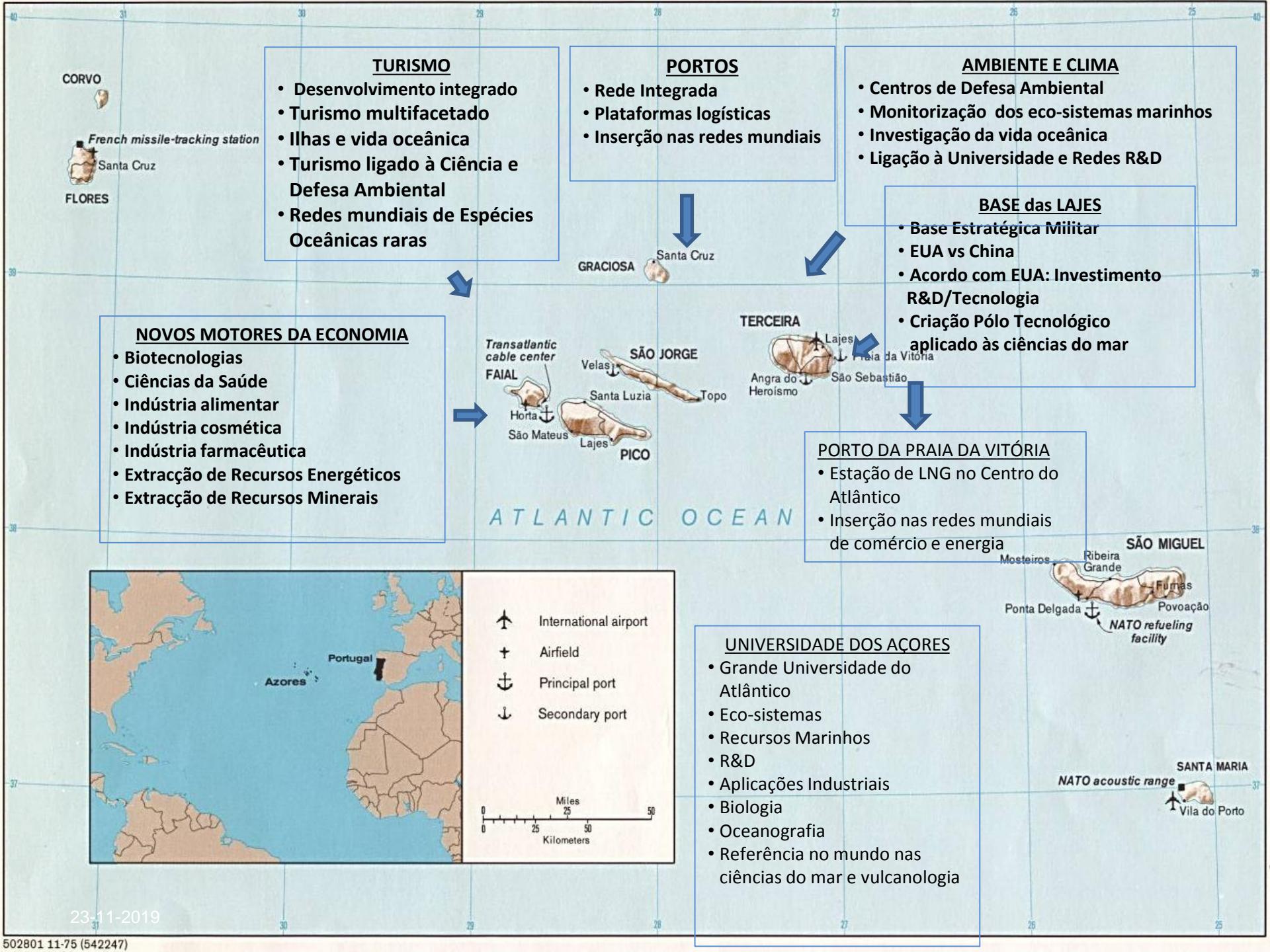
Source: *The Economist*, 10th March 2018

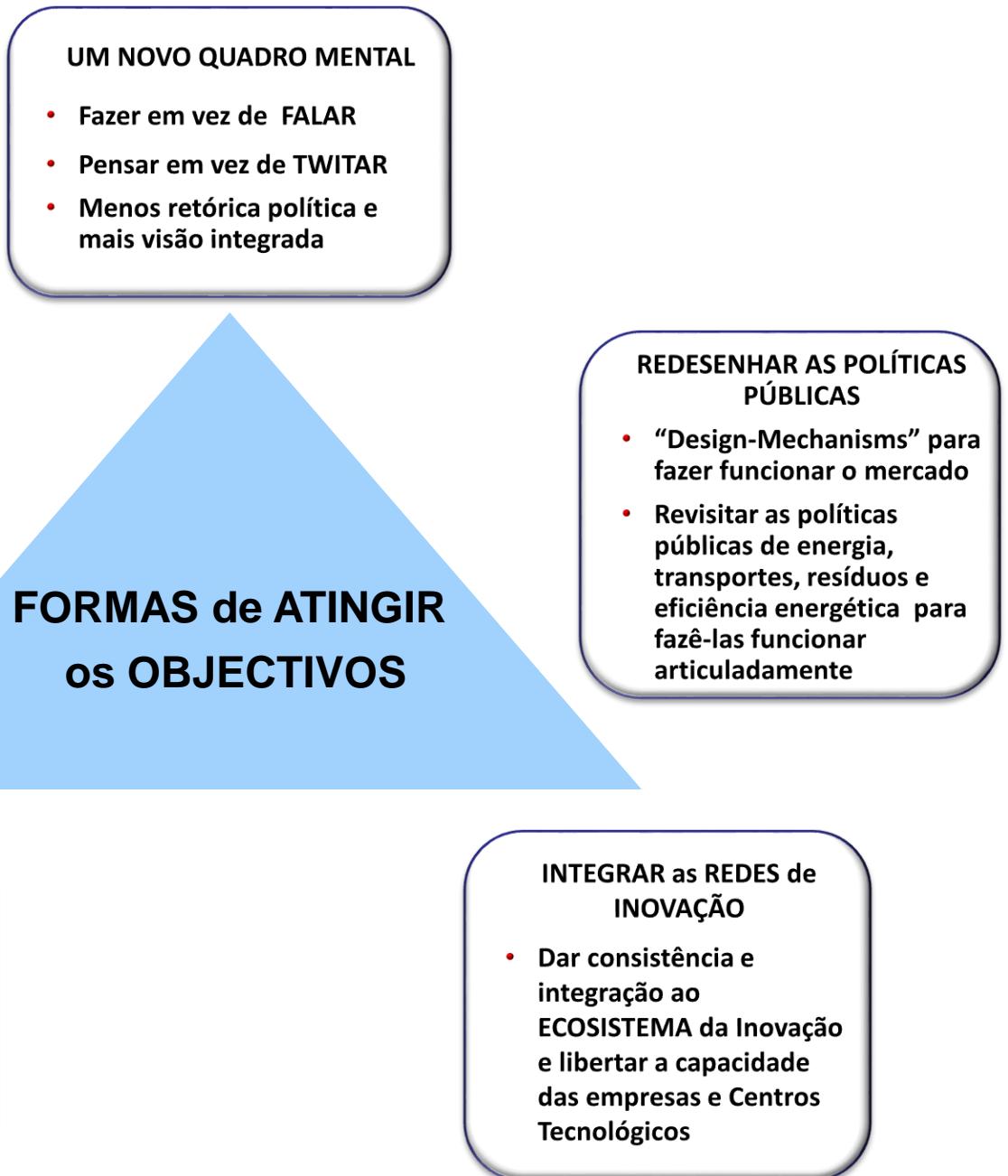


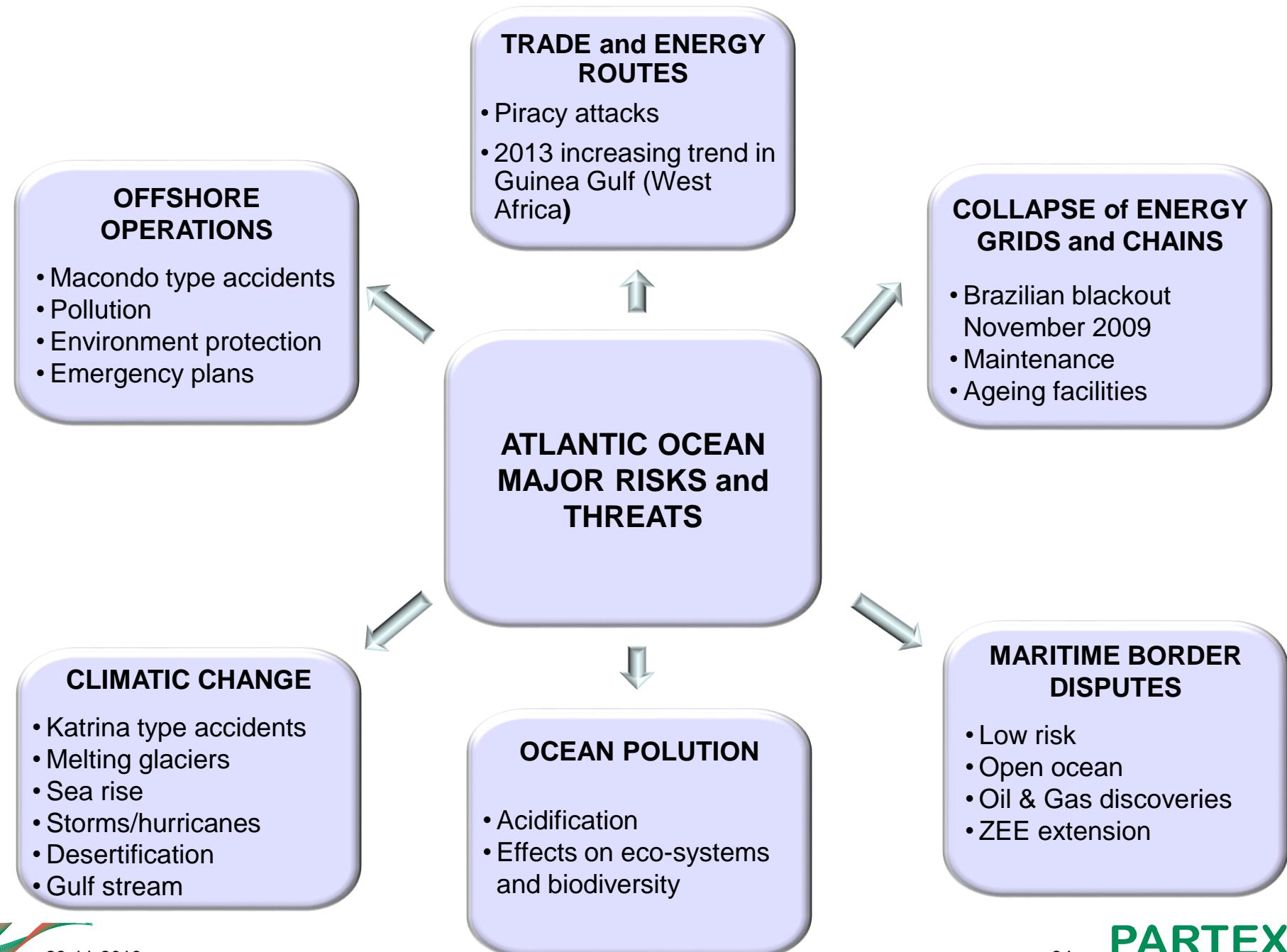
Source: *The Economist*, 10th March 2018

PORTUGAL: ZEE com a Extensão da Plataforma Continental









PORTUGAL: ECONOMIA ATLÂNTICA no CRUZAMENTO das REDES da GLOBALIZAÇÃO

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

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

- TTIP
- CPLP
- Mercosul
- Repensar as Alianças

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: 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: DO HINTERLAND PARA O EXTERIOR

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



CRESCIMENTO dos GRANDES HUBS PORTUÁRIOS

- Portos asiáticos de Shangai e Singapura
- Taxas crescimento anuais de dois dígitos
- 11 portos chineses entre os 15 maiores do mundo (tonelagem movimentada)

ALONGAMENTO da CADEIA LOGÍSTICA de TRANPORTE

- 2020: 80% dos produtos produzidos num país diferente do consumidor
- Crescimento da Competição

PAPEL da LOGÍSTICA

- Determinante na gestão
- Ajustamento da oferta às exigências da procura

O QUE ESTÁ A MUDAR no TRÁFEGO MARÍTIMO MUNDIAL?

ALTERAÇÃO das ROTAS MARÍTIMAS MUNDIAIS

- Concentração dos principais fluxos de tráfego
- Rotas Extremo Oriente e América do Norte
- Rotas entre o Extremo Oriente e Europa (abre oportunidade a Portugal)
- Canal do Panamá (2016)
- Canal da Nicarágua
- Alianças entre armadores

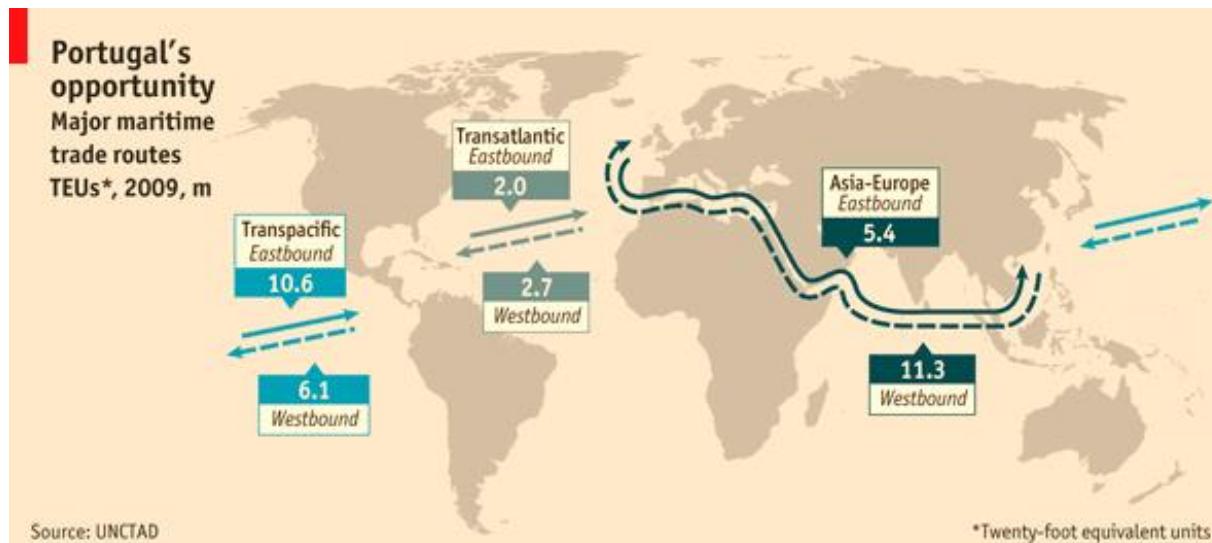
AUMENTO da DIMENSÃO dos NAVIOS

- Navios porta-contentores passam do máximo de 305 m de comprimento e capacidade de carga de 5 000 TEU para 397 m e 15 000 TEU (Post-Panamax) ou 18 000 TEU (os Triple E)
- 2016: entrada no mercado de navios de 20 000 TEU
- As potencialidades do Porto de águas profundas de Sines
- Estudo das zonas costeiras portuguesas

REFORÇO da CONCENTRAÇÃO NO SECTOR

- 20 maiores armadores controlam o tráfego marítimo mundial

“PORTUGAL PORTS AT THE CROSS-ROADS OF TRADING AND ENERGY ROUTES”



VISÃO ESTRATÉGICA

- Portos de águas profundas em zonas costeiras é a escolha certa
- Frotas de navios gigantes com unidades de 300 m de comprimento e 20 m calado
- Barreiro-CUF (7 metros fundo) é má escolha
- Dragagens dispendiosas
- O Mercado não são os pequenos navios de 500 ou 1 000 TEU's
- Os portos em estuários não são escolha interessante

INTEGRAÇÃO E ESPECIALIZAÇÃO

- Pensamento Estratégico
- Portos interiores têm perdido capacidade de movimento de movimentação de cargas
- Séc. XIX: Porto do Douro transferido para Leixões (navios 100 m de comprimento e 10 m calado)

PORTOS

- PRODUZEM RIQUEZA
- DÃO LUCROS

ESTRATÉGIA de DESENVOLVIMENTO

- Inserção nas redes globais
- Explorar as cadeias de valor
- Equipamentos
- Instalações para receber grandes navios
- Zonas costeiras de águas profundas
- Ter em conta as novas exigências operacionais dos navios

POLÍTICA de TRANSPORTE MARÍTIMO

- Deslocar operações portuárias das águas interiores com fundos baixos, assoreamentos contínuos e reduzidos espaços para manobras
- Foco nas águas profundas, próximas das margens oceânicas abertas onde não existam impedimentos e as operações são menos onerosas e mais seguras

CONSTRUÇÃO de TERMINAL de MINÉRIOS para EXPORTAÇÃO

- Desenvolvimento da ZEE
- Sulfuretos Polimetálicos
- Crostas de níquel e manganês
- Minérios do offshore e onshore
- Navios mineiros têm em media 200 m comprimento e 15 de calado
- Não é boa escolha os estuários do Douro, Vouga ou Lima
- Praia de Matosinhos ou Leça?

AÇORES

- Porto da Praia da Vitória
- Estação LNG no Atlântico

PORTOS DESAFIOS PARA O FUTURO

PORTO de LISBOA

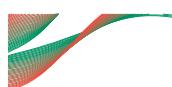
- Como vai ser desenvolvido?
- Minimizar 12 milhões m³ de areias retiradas da Golada do Tejo para se construir a norte a Doca de Pedrouços
- Mais docas em Dafundo e Cruz Quebrada significa mais degradação da Caparica
- Não ao desenvolvimento do Porto de Lisboa pela margem norte saturando a cidade
- Terminal de cruzeiros em Santa Apolónia é erro (locais de visita na parte oposta)
- Porto Lisboa: escolha certa é o desenvolvimento a jusante para junto da costa, mais fundo, evita a degradação da Barra do porto e atrai os grandes navios

FUTURO PORTUÁRIO do ALGARVE

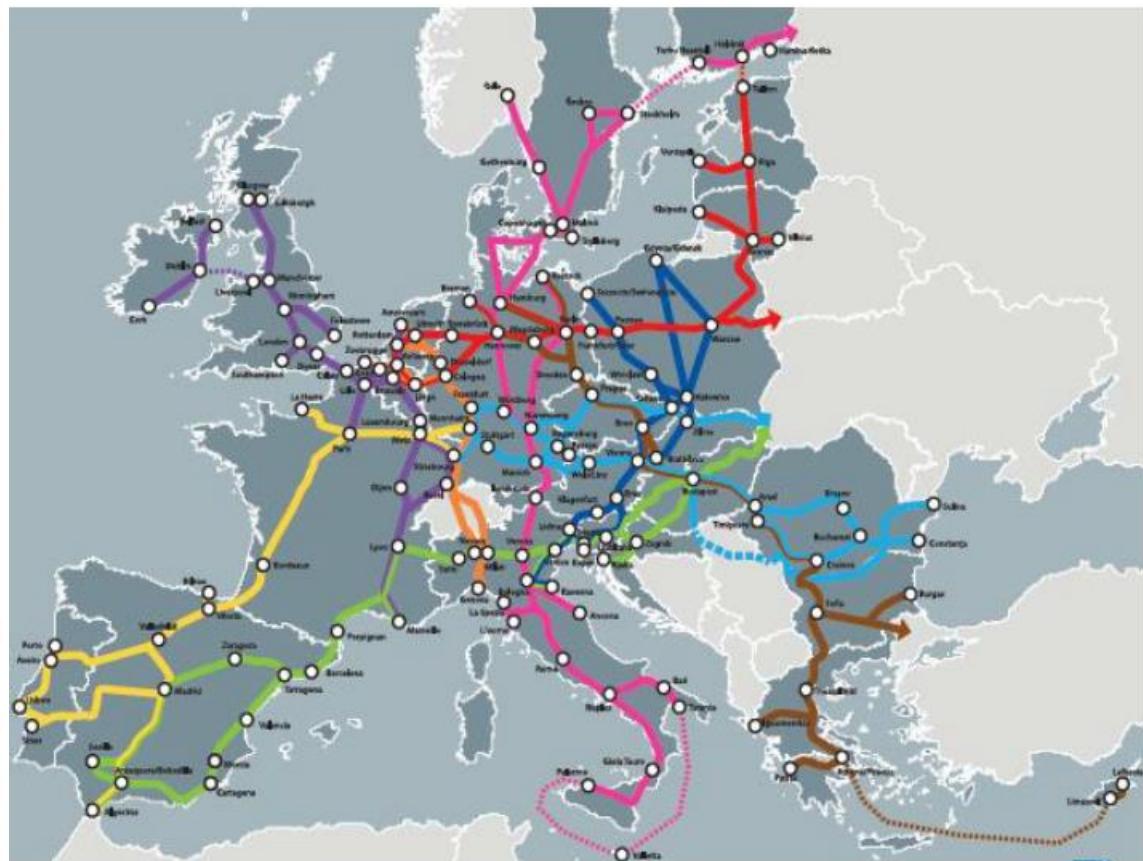
- Gás
- Hidrocarbonetos
- Ligação à Rede Ibérica de Pipelines?

PORTOS e SEGURANÇA

- Protecção contra acidentes de navios
- Poluição marítima
- Protecção ambiental
- Acordos internacionais
- EMSA



REDE TRANSEUROPEIA DE TRANSPORTES (RTE-T)



Rede Principal (Core Network) – 9 Corredores Multimodais

PROPOSTA de PORTUGAL ACORDO de PARCERIA 2014/2020

- Aprovada pela CE 30/07/2014
- Necessidade de articular financiamento nacional e comunitário
- Competitividade e valorização da produção nacional
- Explorar a cadeia de valor
- Reforço das Exportações
- Valorização dos recursos endógenos
- Investimento em I&D

NÓS das MALHAS ESTABELECIDAS

- Aeroportos (82 principais)
- Portos Marítimos (90 principais)
- 88 nós urbanos da Rede principal
- Portos Fluviais
- Portos Ferroviários
- Terminais Ferroviários

INVESTIMENTO nas REDES TRANSPORTES

- Rede Principal: 15.2 mil milhões Euros
- Países da coesão: mais 11.1 mil milhões de Euros
- Redes de transportes, energia e telecomunicações
- Financiamento articulado de instrumentos financeiros com subvenções reservadas à rede principal e contribuições nas secções transfronteiriças
- Só 10% das necessidades (Rede Principal precisa de 250 mil milhões Euros)
- Concorrência pelos fundos

CORREDOR MEDITERRÂNICO

- Parte Sudoeste
- Ligação com o Sul de França, Norte de Itália e Europa Central

REDE TRANSEUROPEIA DE TRANSPORTES

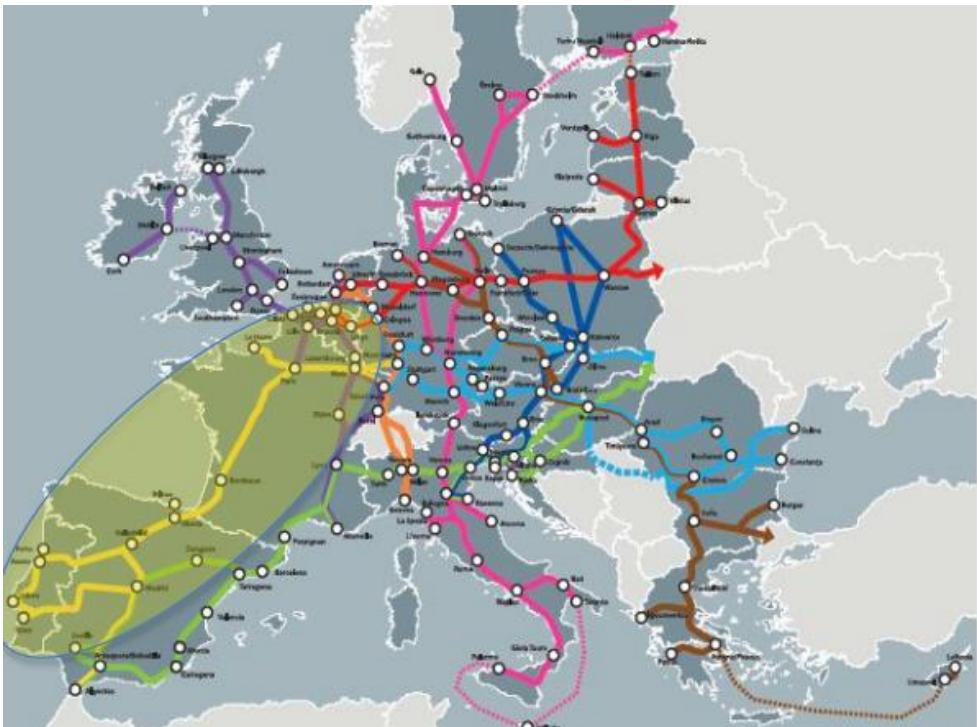
- 2013: aprovação EU/1315/2012
- Criação do “**MECANISMO INTERLIGAR a Europa**”
- Sistema de 9 EIXOS ou “**CORREDORES**” que **ATRAVESSAM a EUROPA**
- **Rede TEM CARÁCTER MULTIMODAL e COMEÇA e ACABA em PORTOS**

O CORREDOR ATLÂNTICO e a OPORTUNIDADE para PORTUGAL

Quatro alinhamentos:

- Algeciras-Bobadilla-Madrid
- Sines/Lisboa-Madrid-Valladolid
- Lisboa-Aveiro-Leixões/Porto
- Aveiro-Valladolid-Vitória-Begoña-Bilbau/Bordeaux-Paris-Le Havre-Metz-Mannheim-Strasbourg
- Portugal: 3 portos – Leixões, Lisboa e Sines - todos ligados ao Corredor Atlântico
- Redução dos custos das exportações

CORREDOR ATLÂNTICO



Estados Membros Envolvidos:

- Portugal
- Espanha
- França
- Alemanha

Alinhamento:

- ✓ Algeciras – Bobadilla – Madrid
- ✓ Sines / Lisboa – Madrid – Valladolid
- ✓ Lisboa – Aveiro – Leixões/Porto
- ✓ Aveiro – Valladolid – Vitoria – Bilbao/Bordeaux – Paris – Le Havre/Metz – Mannheim/Strasbourg

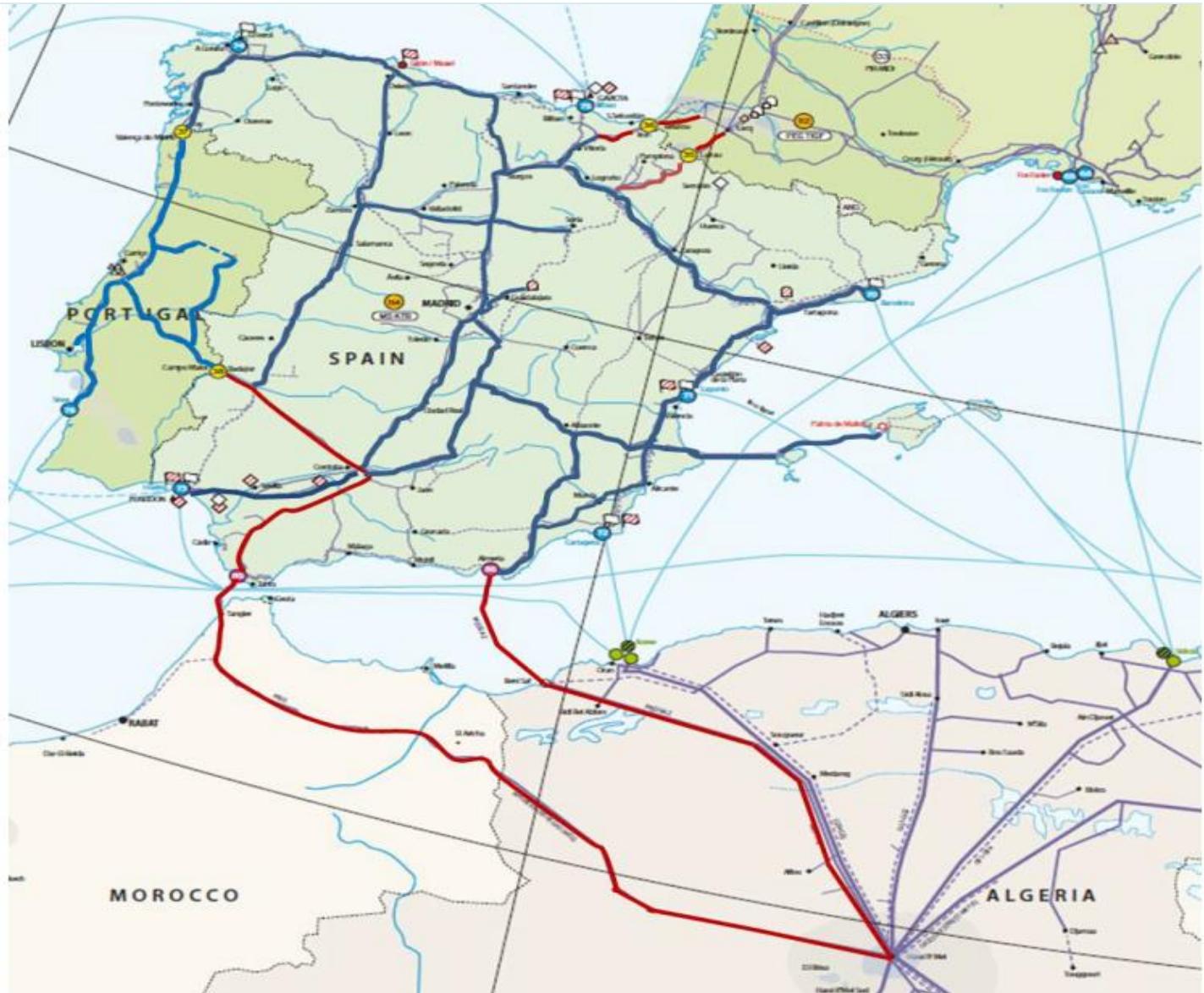
THE FUTURE OF NATURAL GAS



AFP

Source: The Economist, 6th August 2011

INTERLIGAÇÕES DA REDE DE GASODUTOS



Fonte: GIE – Gas
Infrastructure Europe

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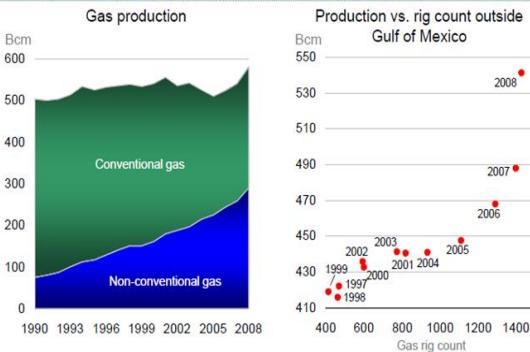
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PARTEX
OIL AND GAS

2. “Energy Game Changers” e a Ameaça Climática

ENERGY GAME CHANGERS in XXI CENTURY

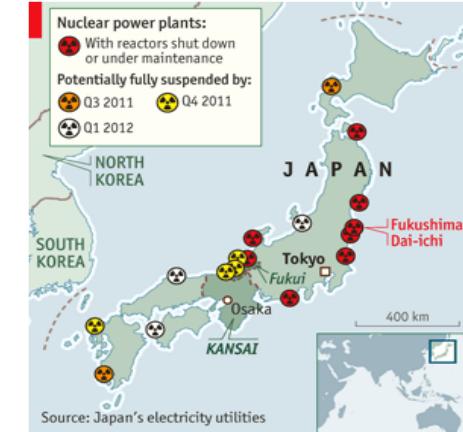
UNCONVENTIONAL GAS



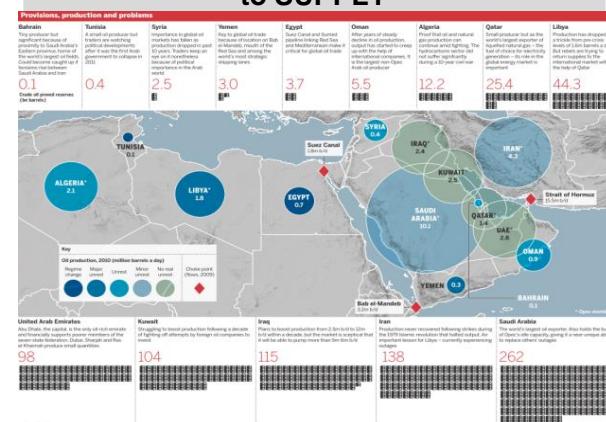
INDUSTRY CATASTROPHIC ACCIDENTS (e.g. OFFSHORE OIL Spills) and PUBLIC IMAGE



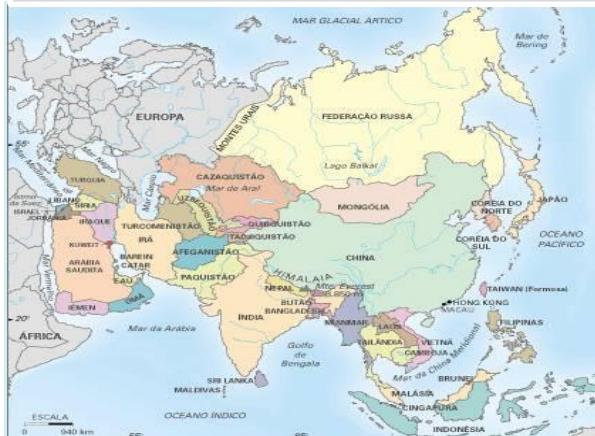
FUKUSHIMA NUCLEAR ACCIDENT



INSTABILITY in PRODUCING COUNTRIES and THREATS to SUPPLY



EMERGENCE of PACIFIC BASIN as TOP ENERGY CONSUMER



CLIMATE CHANGE and ENVIRONMENTAL REVOLUTION

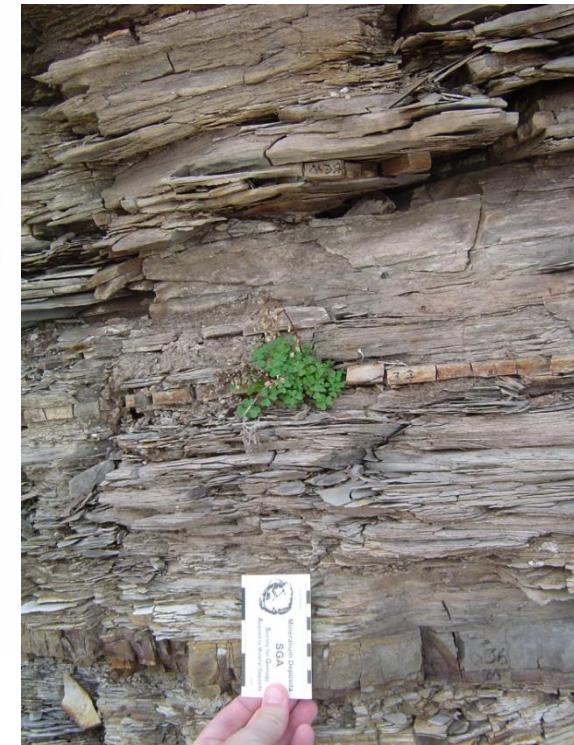
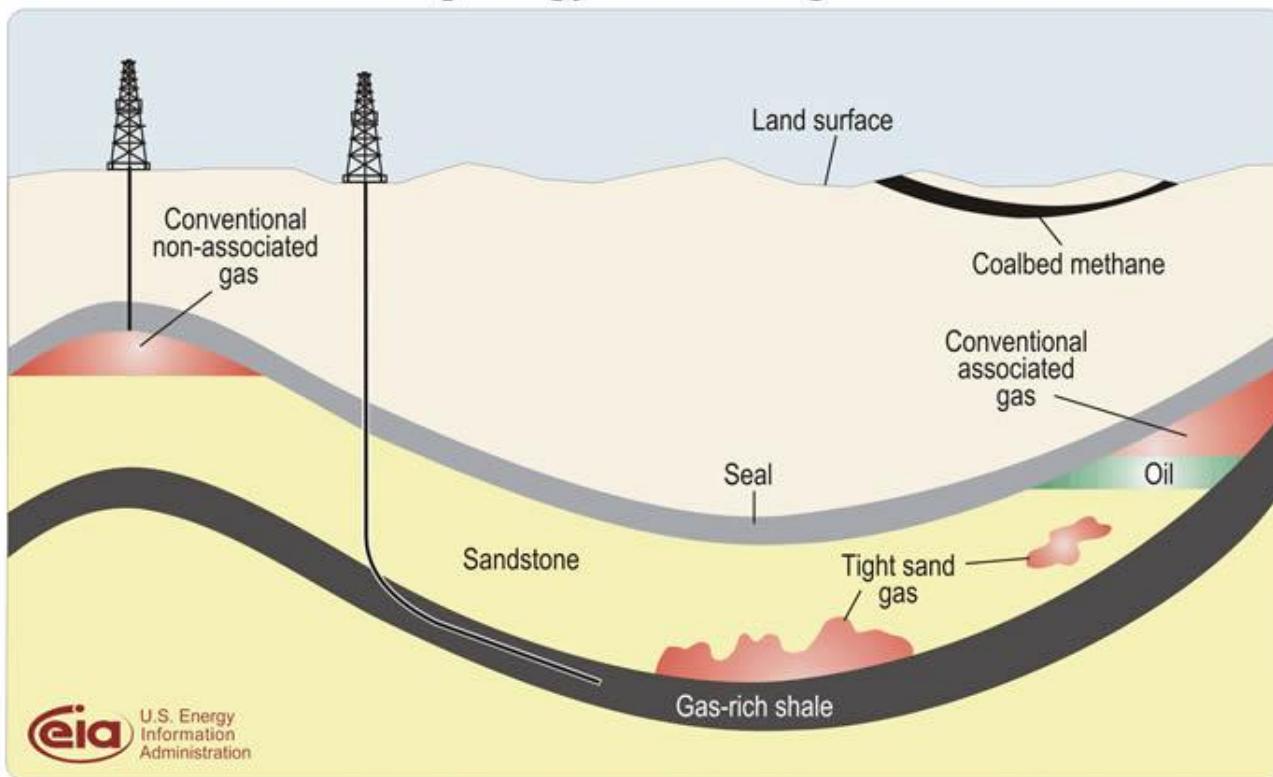


- The Revolution of the SHALE GAS
- The Conceptual Innovation for Shale Production
- US Learning Curve
 - Footprint Concerns
 - Induced Seismicity
- Knowledge of Rocks and Evaluation of the Potential
- Can the US Shale Model be exported?



What is the SHALE GAS?

Schematic geology of natural gas resources



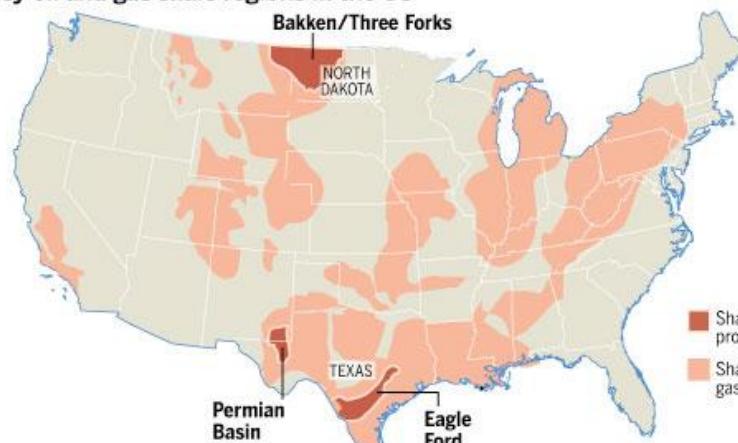
A world class source rock and a potential shale gas reservoir – the Devonian-Mississippian Woodford Shale

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
Whiting Petroleum
Hess Corporation
Statoil
EOG Resources

Eagle Ford

ExxonMobil
Marathon Oil
Petro-Hunt
Slawson Exploration
Kodiak Oil & Gas

Eagle Ford

EOG Resources
ConocoPhillips
Chesapeake Energy
GeoSouthern Energy
Anadarko
Plains Exploration & Production

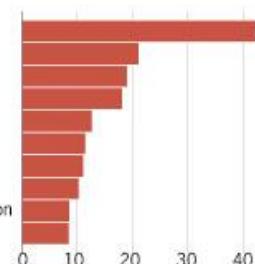
EP Energy
Marathon Oil
Murphy Oil
Pioneer Natural Resources

Top 10 Permian Basin operators, 2012

Oil production (Barrels m)

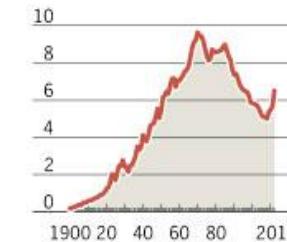
Occidental Perman
Pioneer Natural Resources USA
Apache Corporation
Kinder Morgan Production Co
XTO Energy
Cog Operating
Chevron USA
Oxy USA WTP
Sandridge Exploration and Production
Endeavour Energy Resources

Sources: EIA; IEA



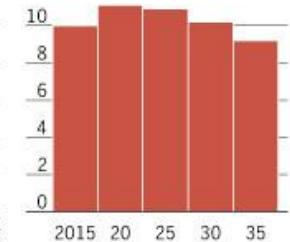
US oil production

Million barrels per day



US oil production forecasts

Million barrels per day



FT graphic Photo: Bloomberg

Source: FT, 8th July 2013

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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

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:

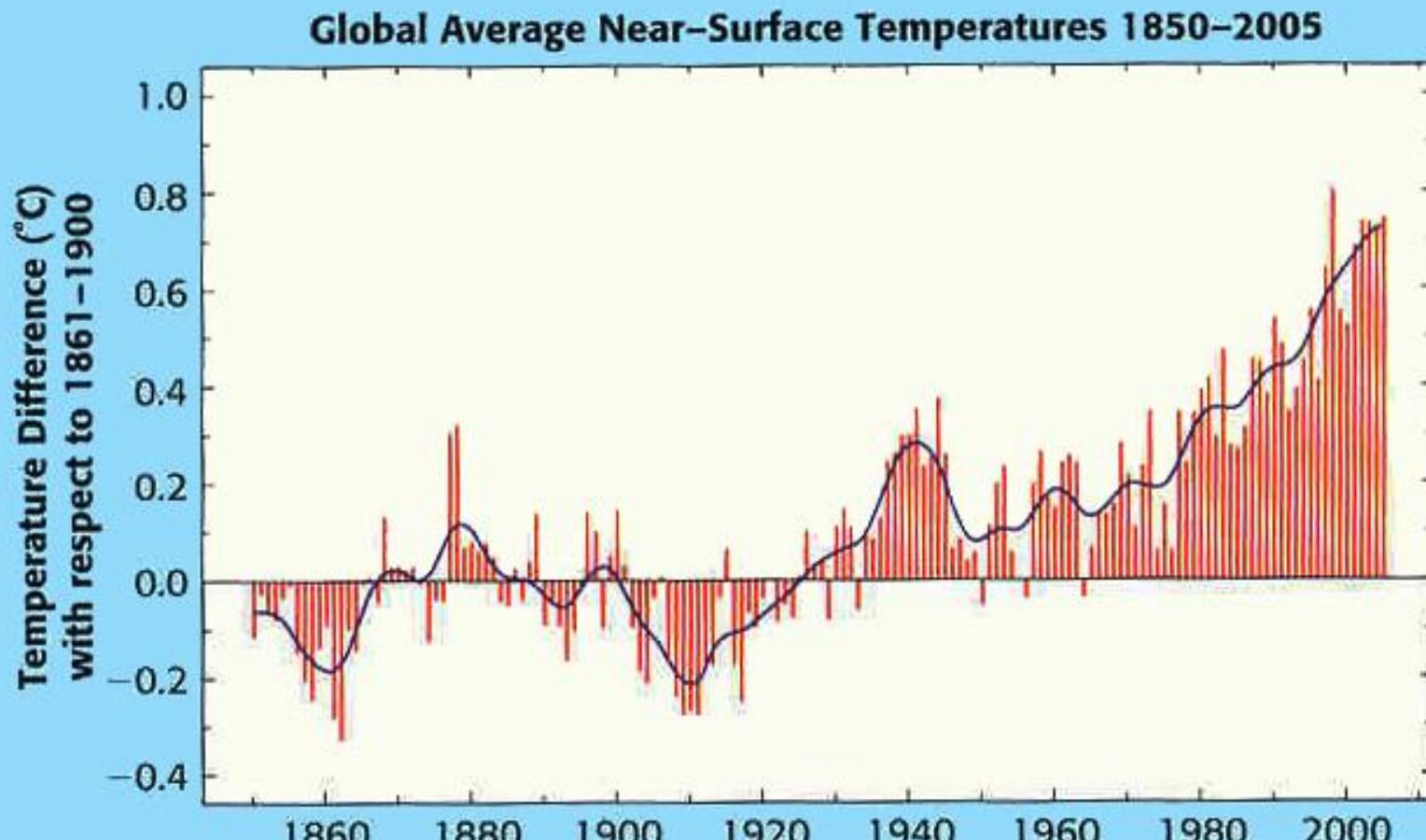
- Power stations
- Electricity System
- Transport System

NEED BUILD a Low-Carbon ECONOMY

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

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

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

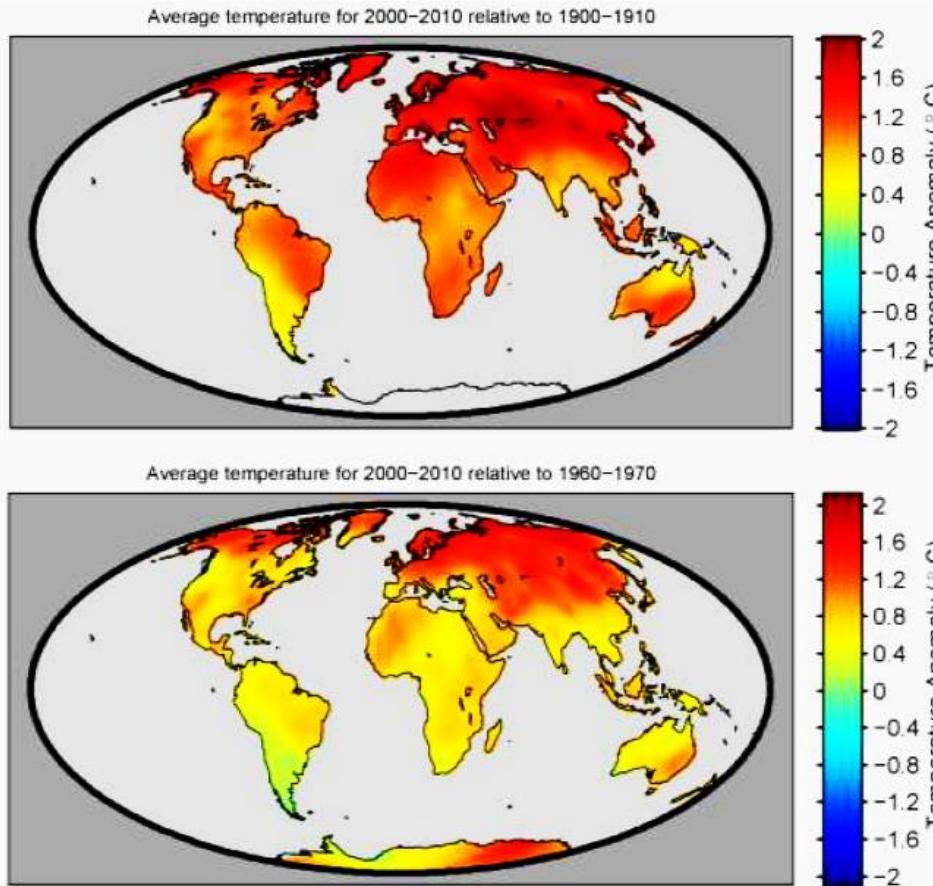
ii 24/04/2006 15:47

Fonte: Nicholas Stern / Brohan et al (2006)

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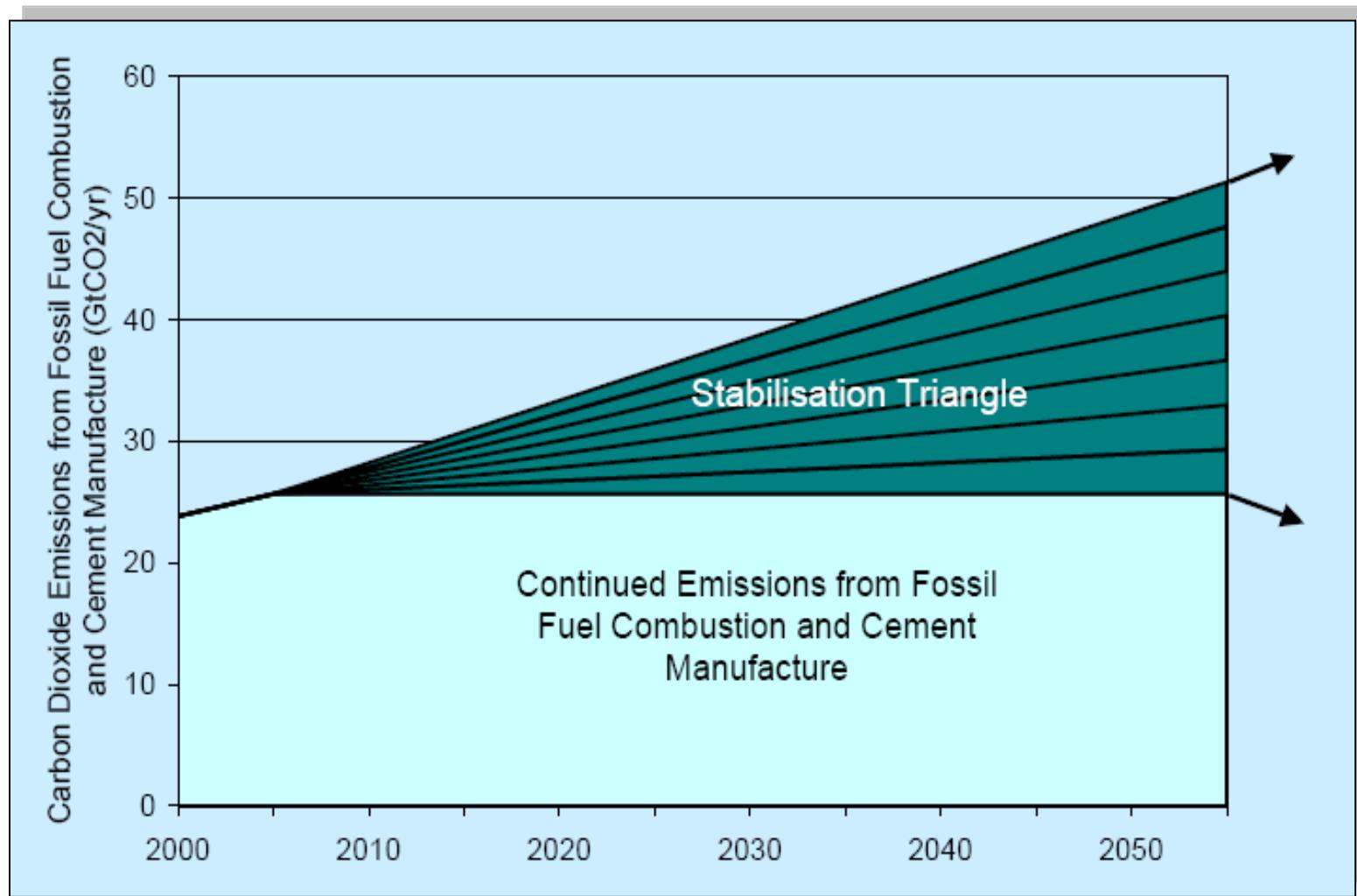
BERKELEY EARTH TEMPERATURE STUDY

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

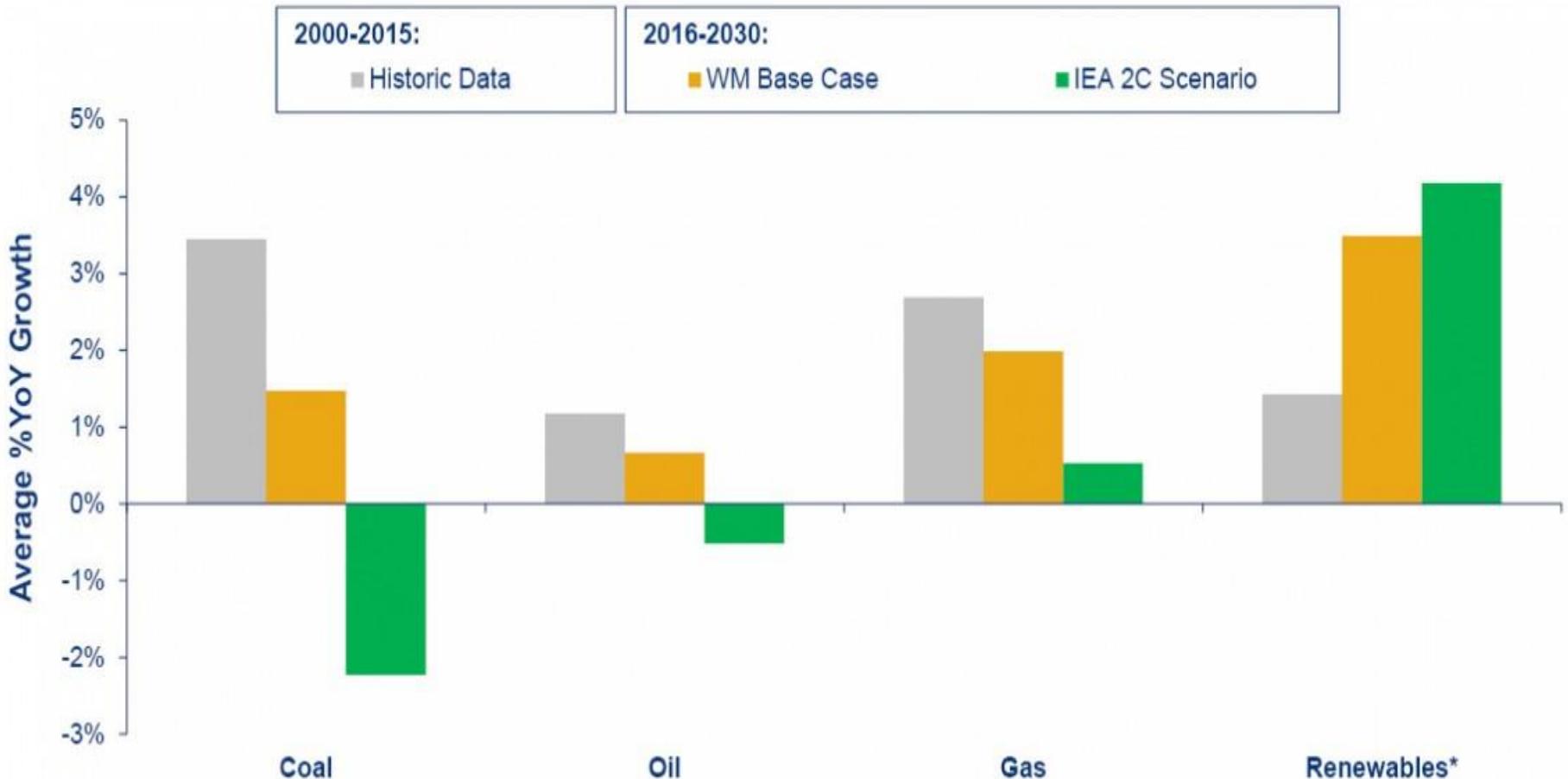
Socolow and Pacala's "wedges"



Source: Pacala and Socolow (2004)

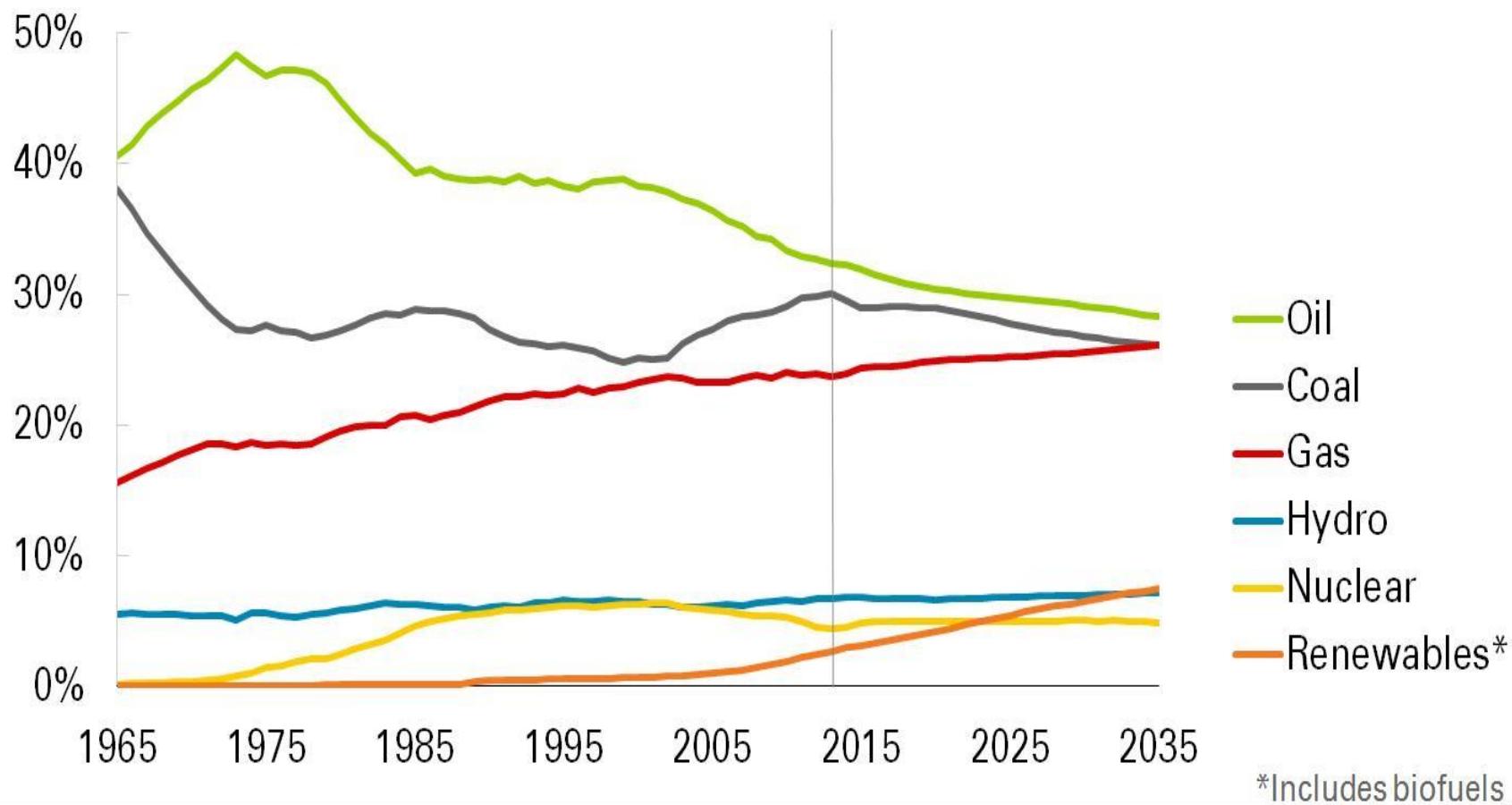
Paris COP 21 and Future Scenarios

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



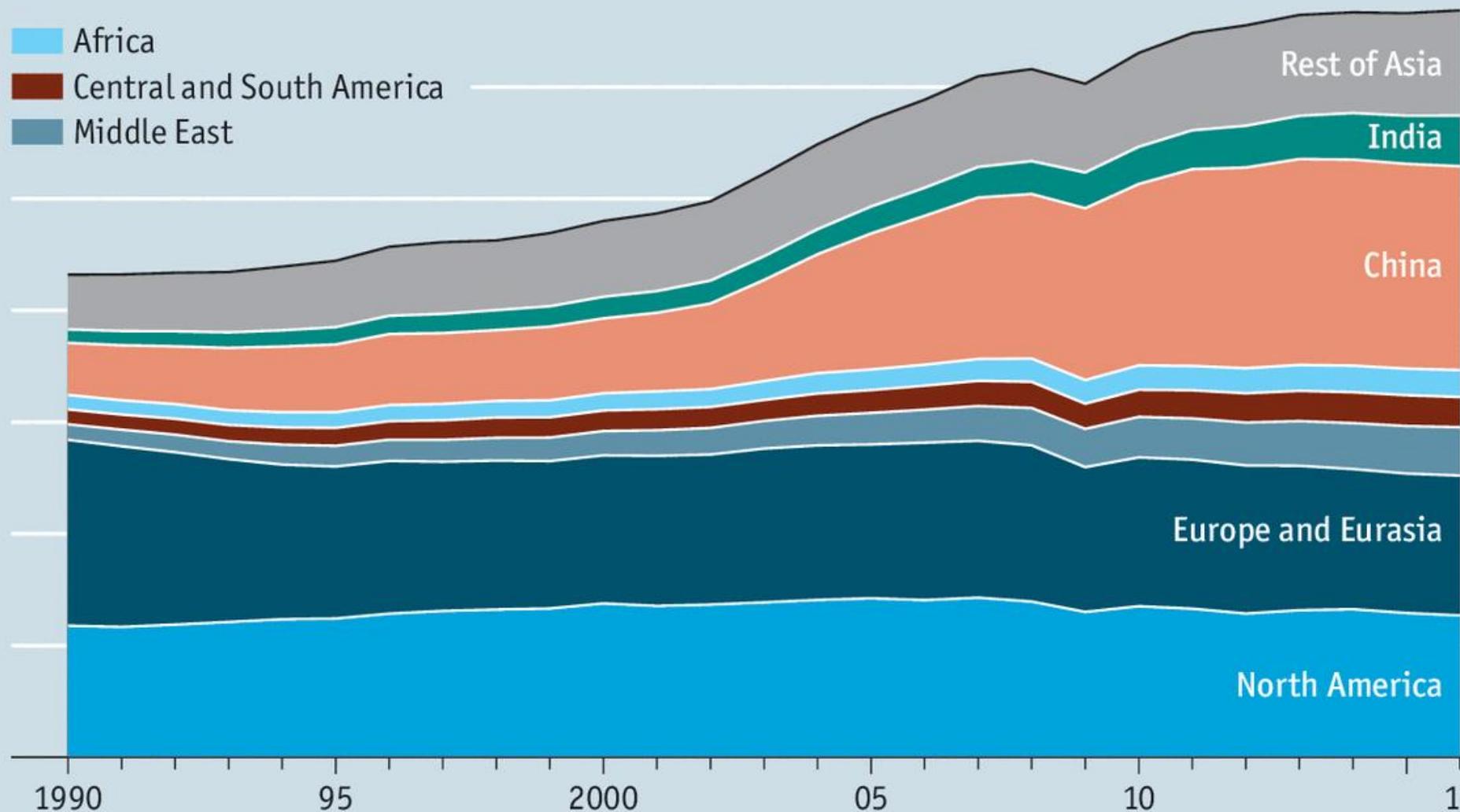
Source: Wood Mackenzie; *Note: "renewables" is defined as wind, solar, hydro and nuclear

Shares of primary energy



CO₂ emissions

Tonnes, bn



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 polluting
- 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

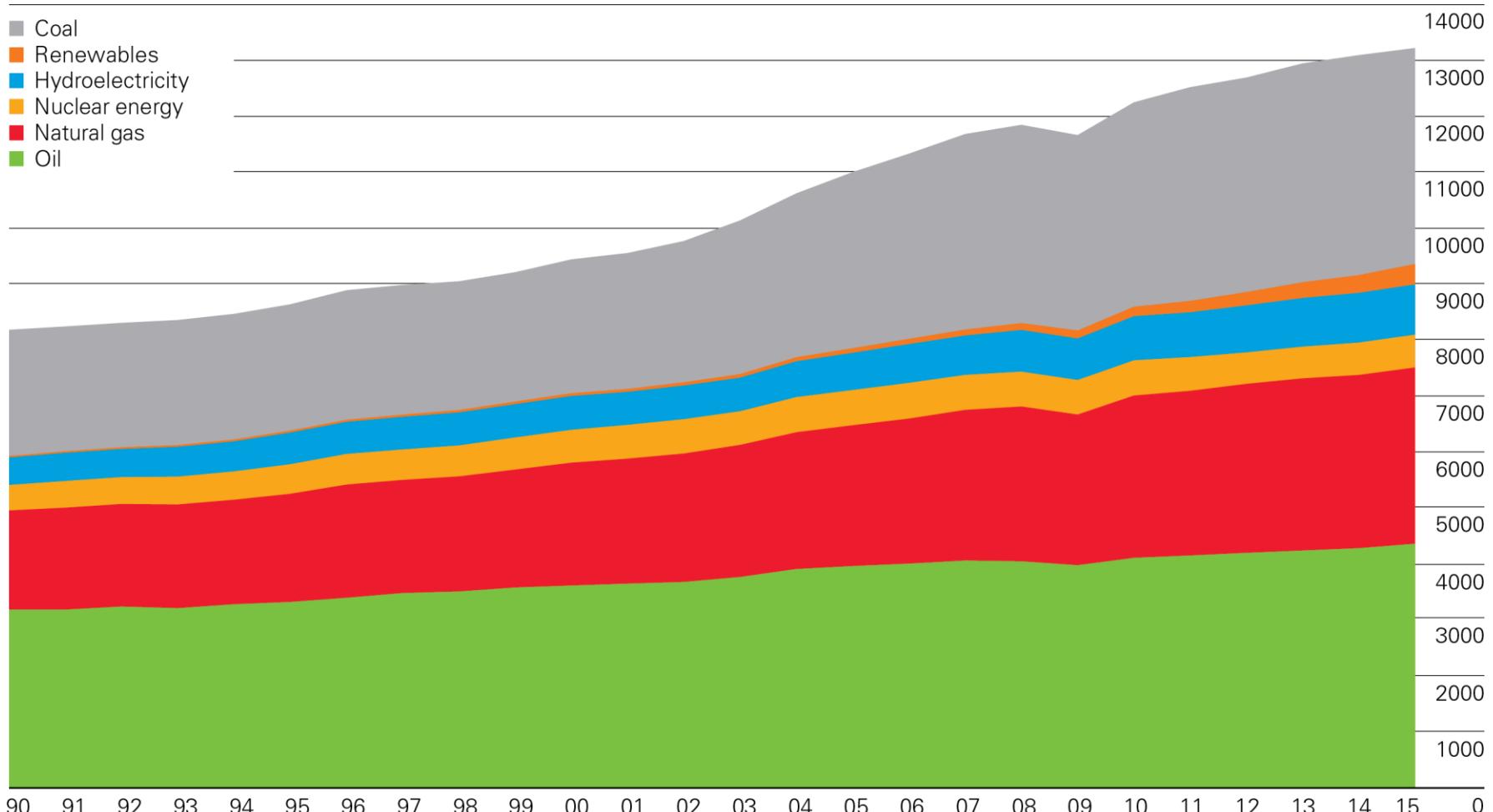
OIL & GAS INDUSTRY PUBLIC IMAGE

- 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

3. A Transição Energética e Desafios para o Futuro

Primary energy world consumption

Million tonnes oil equivalent



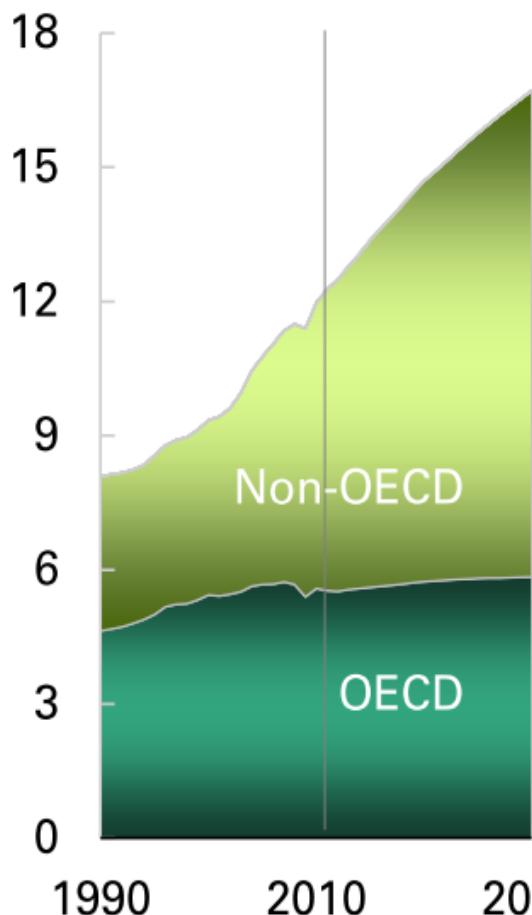
Conferências do Chiado
António Costa Silva – Presidente da Comissão Executiva

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Industrialisation and growing power demand...

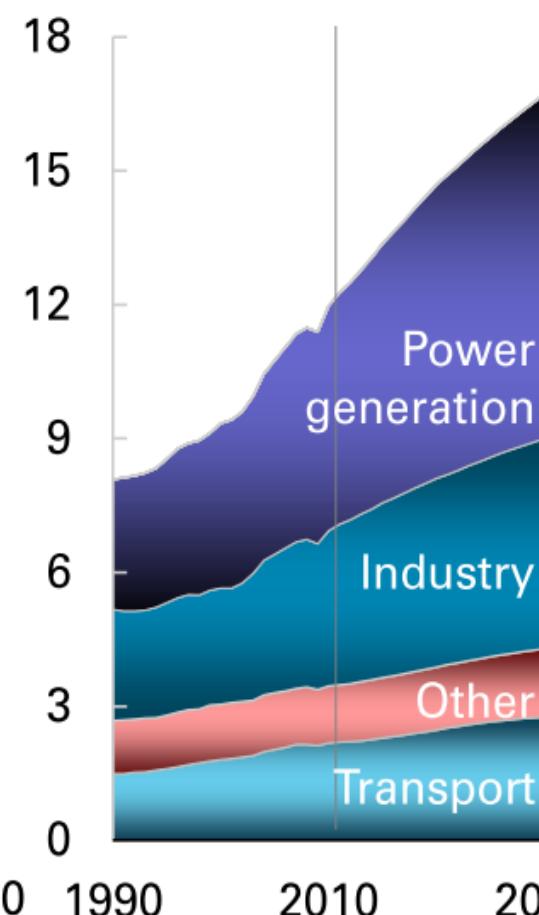
By region

Billion toe



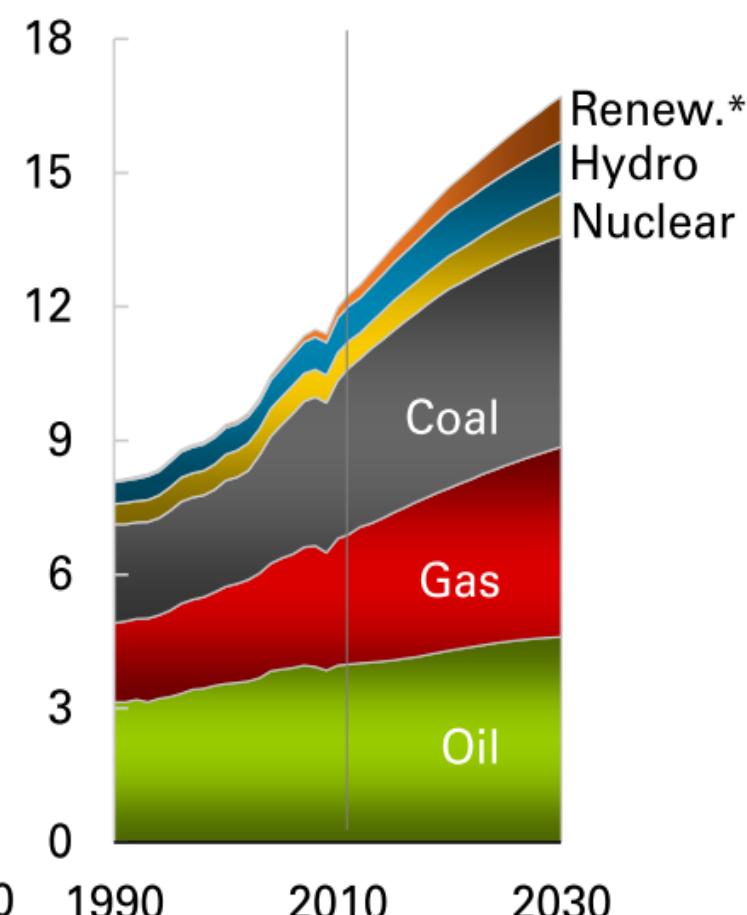
By primary use

Billion toe



By fuel

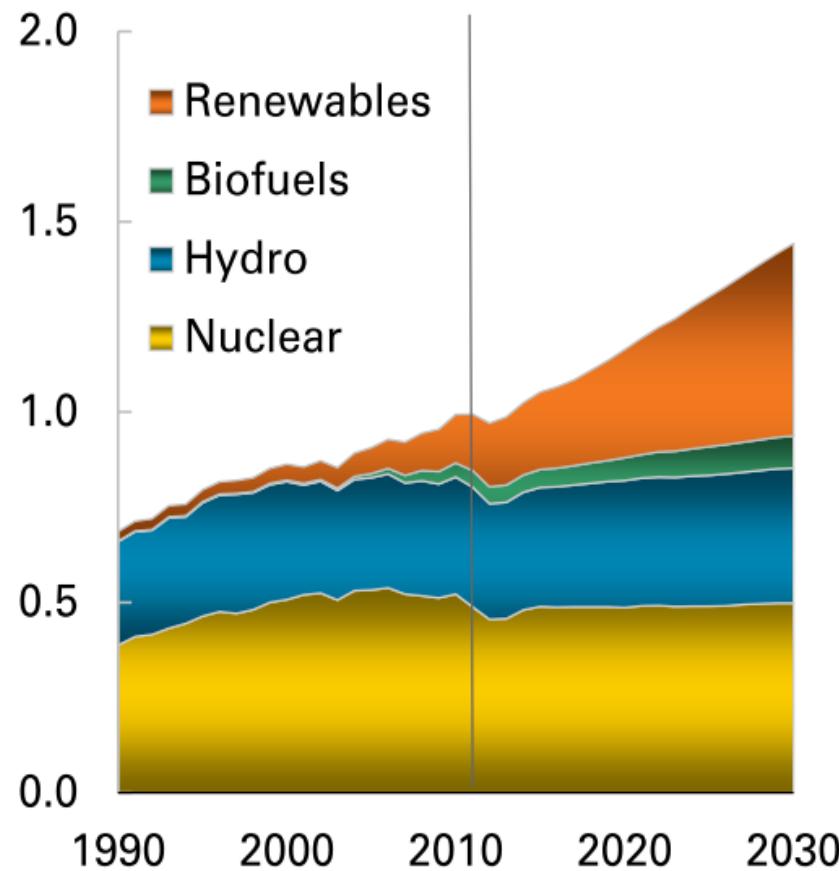
Billion toe



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

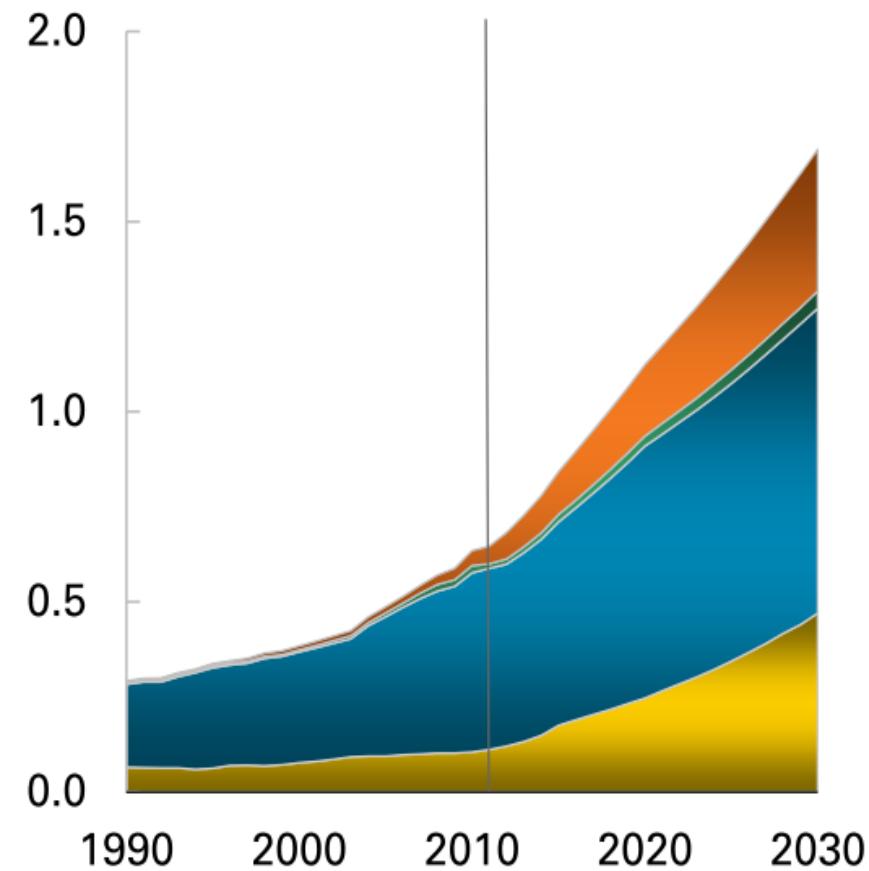
OECD

Billion toe



Non-OECD

Billion toe

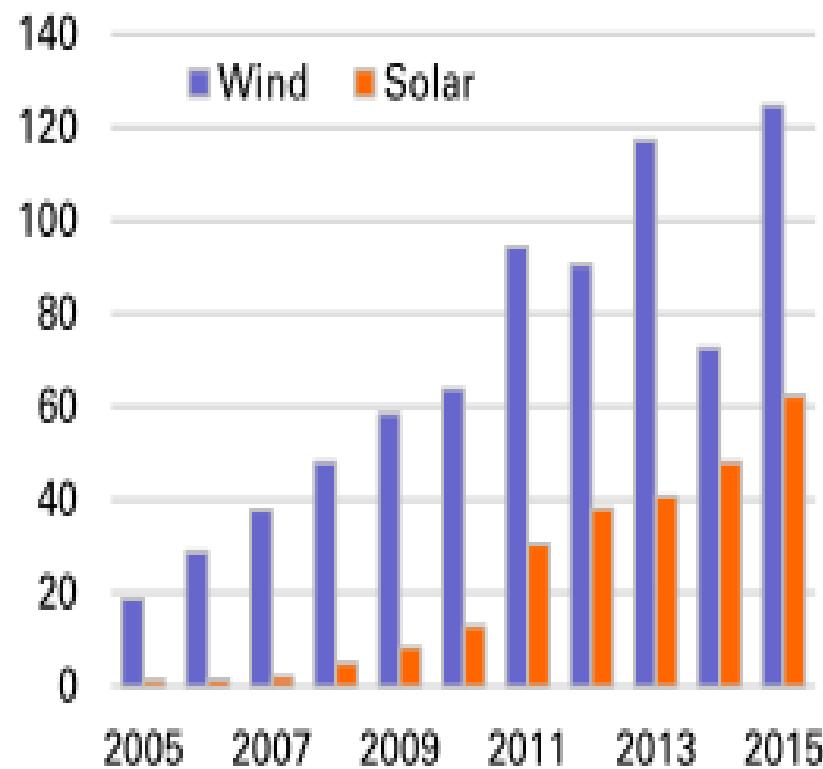


Source: BP Statistical Review 2016

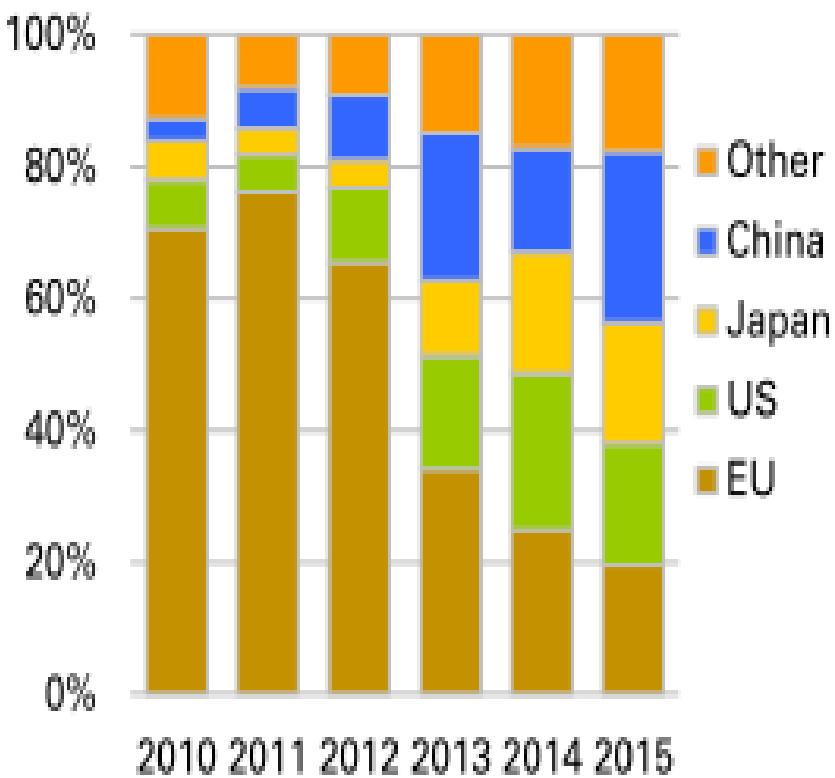
Renewables growth

Wind and solar growth

Annual change, TWh



Shares of solar growth



Source: BP Statistical Review 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

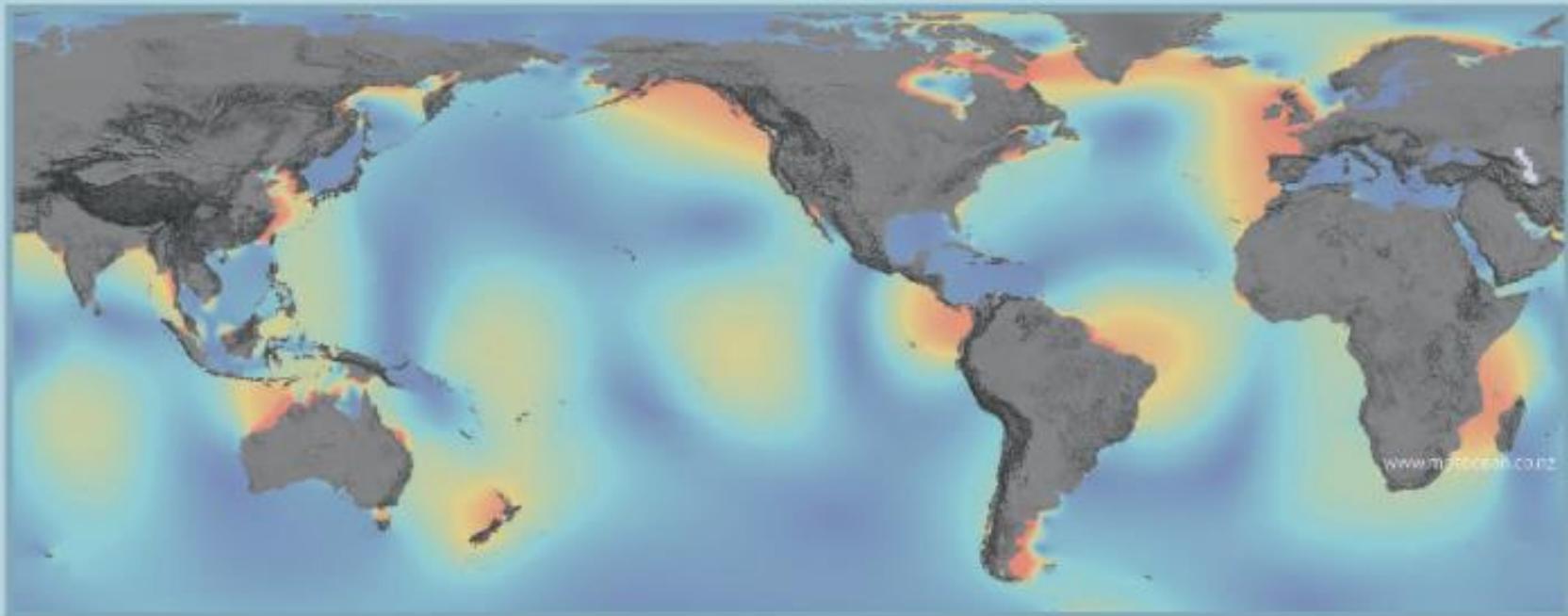
OCEAN WAVE ENERGY POTENTIAL

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

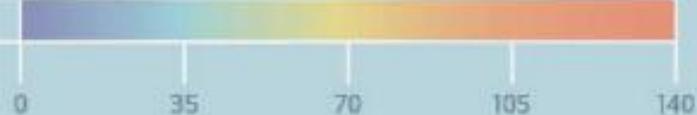
TECHNOLOGIES

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

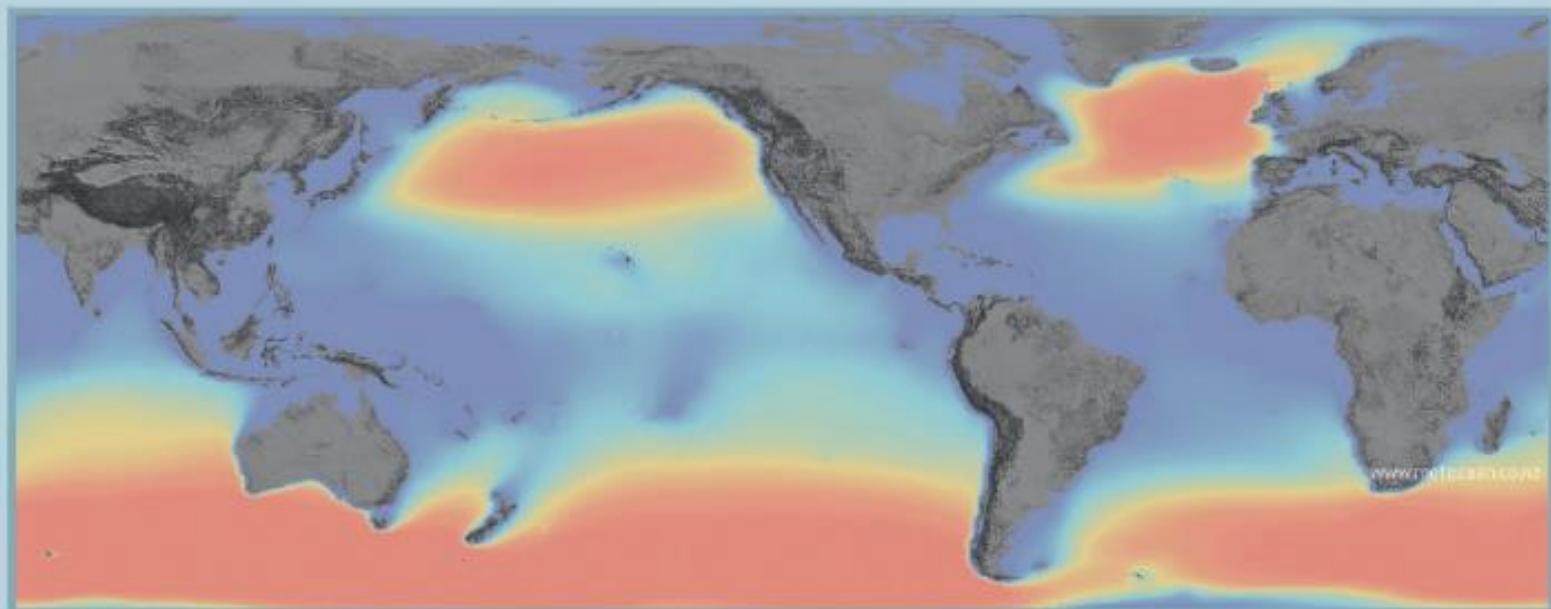
Tidal Range



TIDAL RANGE (cm)



Wave Power



WAVE POWER (kW/m)

0 25 50 75 100 125



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

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António Costa Silva – Presidente da Comissão Executiva

TRANSPORTATION

- Penetration of gas in boats (LNG), trucks and taxi fleets (US)
- Growing share of electric cars
- Internal combustion engines fighting for survival
- Similar to telecommunications revolution
- Self-driving cars with technologies of information

WORLD ENERGY MATRIX

- More gas
- More renewables
- Less coal

OIL MARKET

- Declining oil share
- Ability to reduce and control costs
- How to compete in a low oil price world

POWER GENERATION

- Innovation and Emerging Technologies
- Distributed Generation
- Evolving power business models
- New services on demand response, supply, storage, energy efficiency
- Competition based on algorithms, sensors, processing power – the internet model

ENERGY 2030

- A VISION of the 2030 WORLD from the MANY “POSSIBLE WORLDS” CONTAINED in TODAY’s REALITY
- 4 MAJOR TRENDS:
 - Electrification
 - Decarbonization
 - Optimization
 - Localization

GAS MARKET

- Ascension of gas
- LNG as a driving force of gas market globalization
- Gas less polluent of fossil fuels

RENEWABLES

- Growing share of world energy mix
- 5% in 2015 to 20/25% in 2050
- Solar costs reduced : 75% in 6 years
- Role of venture capital
- Ocean power: “a hidden” energy machine

TECHNOLOGIES and RISKS

- Disruptive technologies on storage, intelligent consumption, energy efficiency
- Batteries
- Cyber and Energy Infrastructure Security
- A New Face of Risks

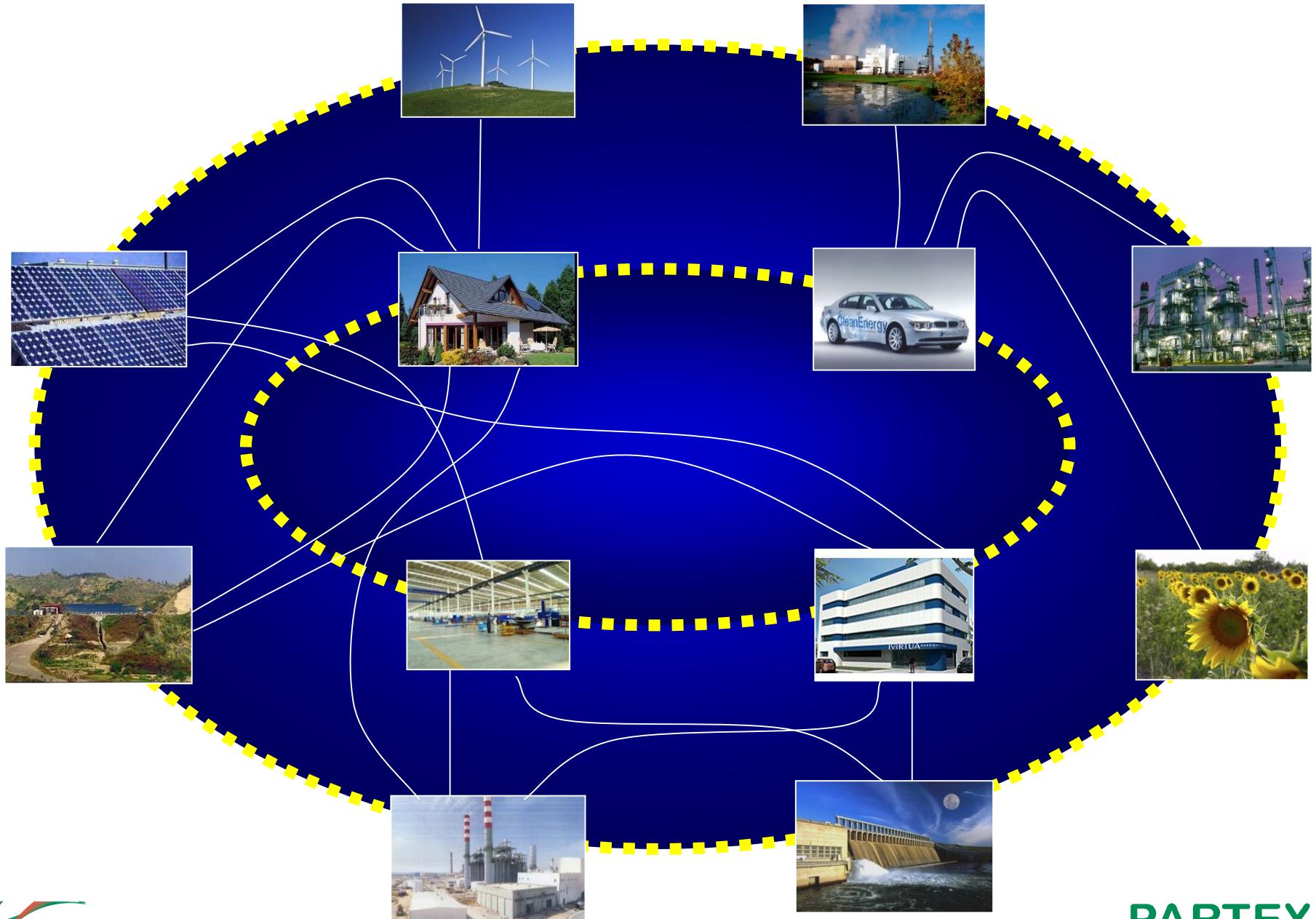
CLIMATE CHANGE

- Decarbonization
- Clean technologies
- Role of China
- Post-Paris
- Strategic responses to low carbon agenda

MARKETS and BUSINESS MODELS

- Globalization of gas market
- Improve capital efficiency
- Capital markets and Energy Investment

O NOVO PARADIGMA ENERGÉTICO



PIVOTAL ROLE of GAS in the ENERGY MIX

- The less pollutant of fossil fuels
- Win / win with renewables

STRONG CLUSTER of RENEWABLE ENERGIES

- Wind onshore and offshore
- Solar
- More and more competitive prices

BIOFUELS/BIOENERGY

- Conversion of biomass into fuels
- Reverse of paradigm
- Waste to resources
- Cellulosic algae
- Not compete with food crops

OTHER POWERFUL SOLUTIONS

- Natural carbon sinks
- Reforestation/Agriculture soils
- Carbon capture and sequestration
- Direct air capture
- Carbon mineralization

MULTIDIMENSIONAL RESPONSE to ENERGY TRANSITION

HYDROGEN REVOLUTION

- Hydrogen from Natural Gas
- Competitive costs vs. water electrolysis
- Application in Fuel-cells and Batteries

ELECTRICAL MOBILITY

- Change of the transportation system
- EV's for cities
- Plug-in's
- Hybrid fleet

DIGITALIZATION and OPERATIONAL EFFICIENCY

- Internet of Energy
- Streamlining of operations
- AI and ML for BIG Data processing
- Reduce emissions
- Reduce waste

STORAGE

- Batteries at grid scale
- Invention of the Century
- Foster electrification of the economy

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

NANOTECHNOLOGIES

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

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

"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



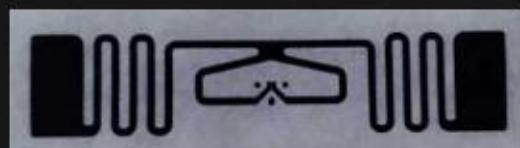
Composites and coatings



Energy



Biomedical

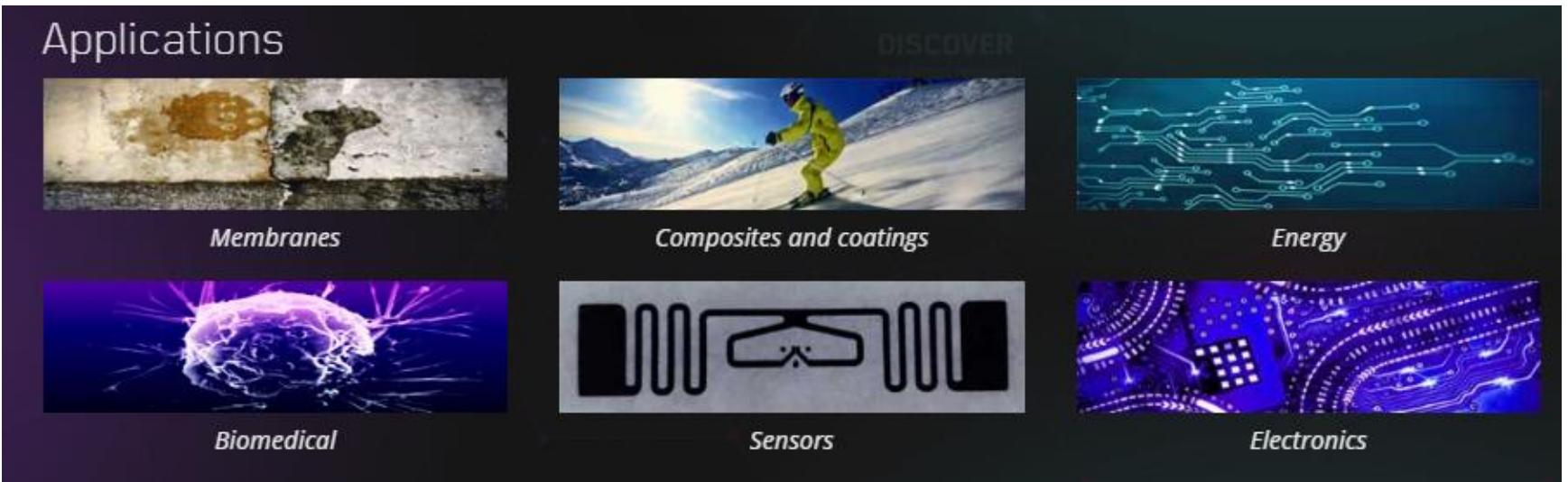


Sensors



Electronics

DISCOVER



AVIÕES COMERCIAIS

Novas Configurações, com novos materiais



VOO SUPERSÓNICO
Com novos sistemas de propulsão –
ramjet e scramjet?

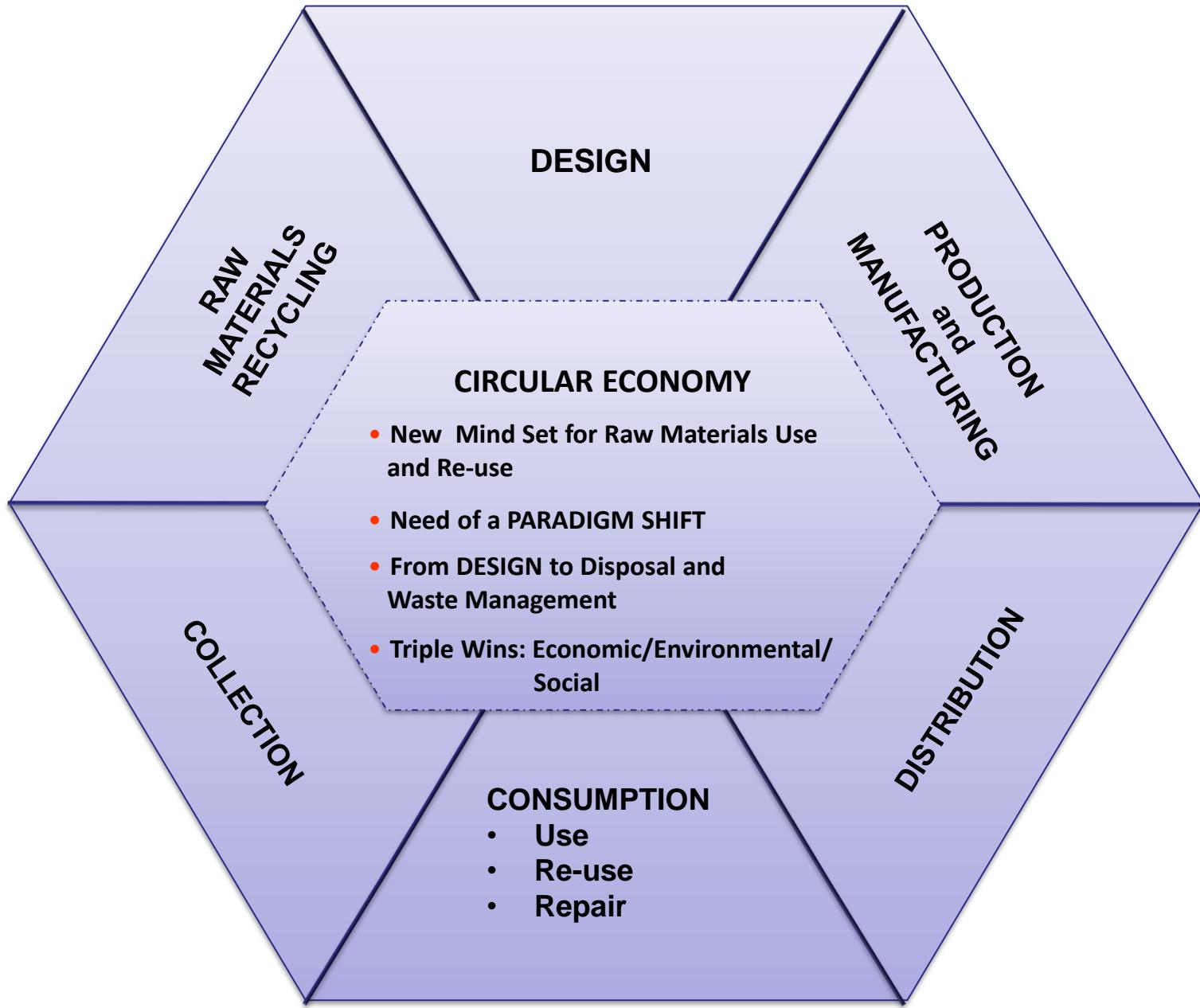
LOCAL MOTORS

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](#).



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



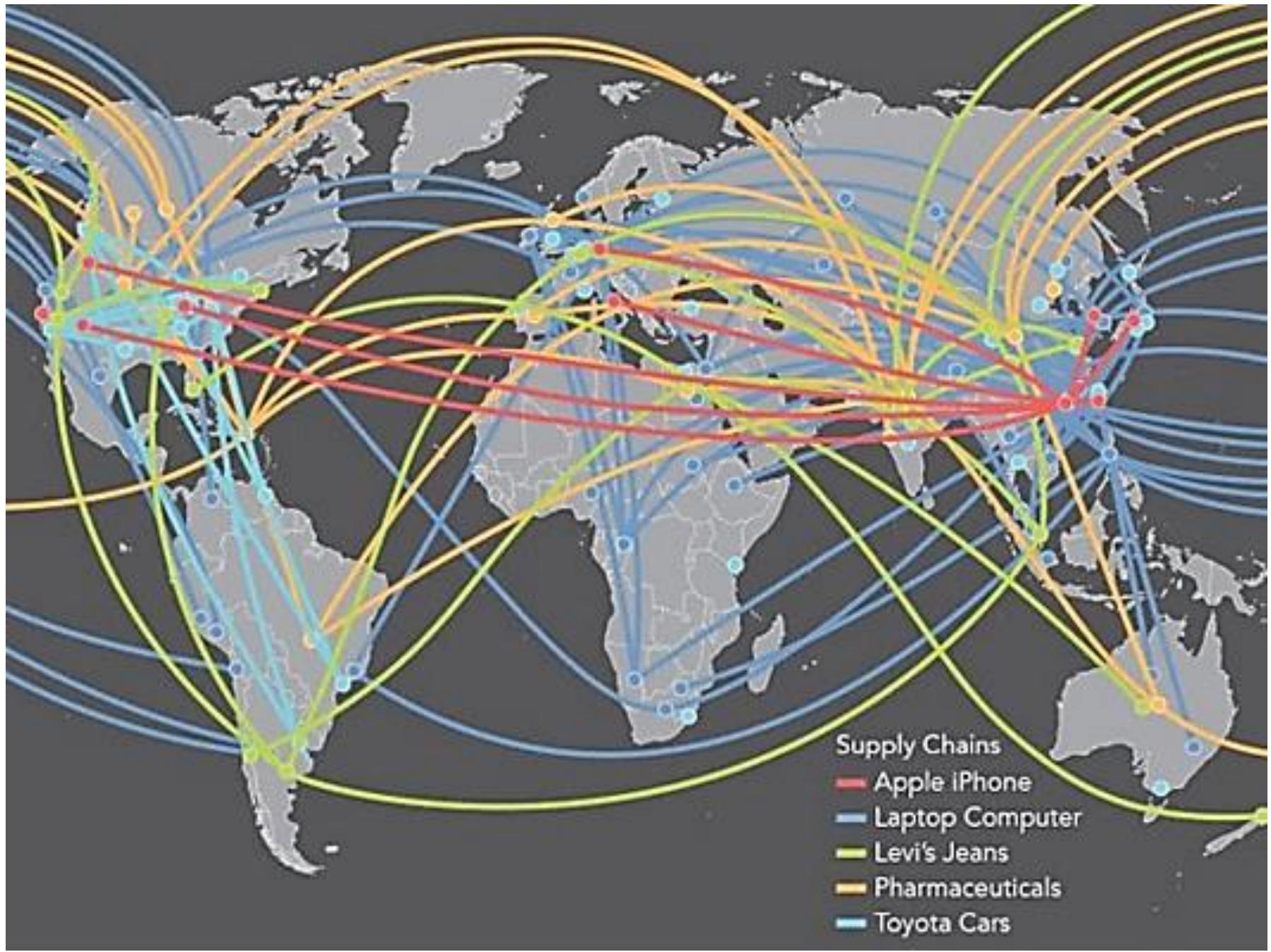
CITIES with CURRENT LANDSCAPE IMPLY HUGE RISKS

- 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

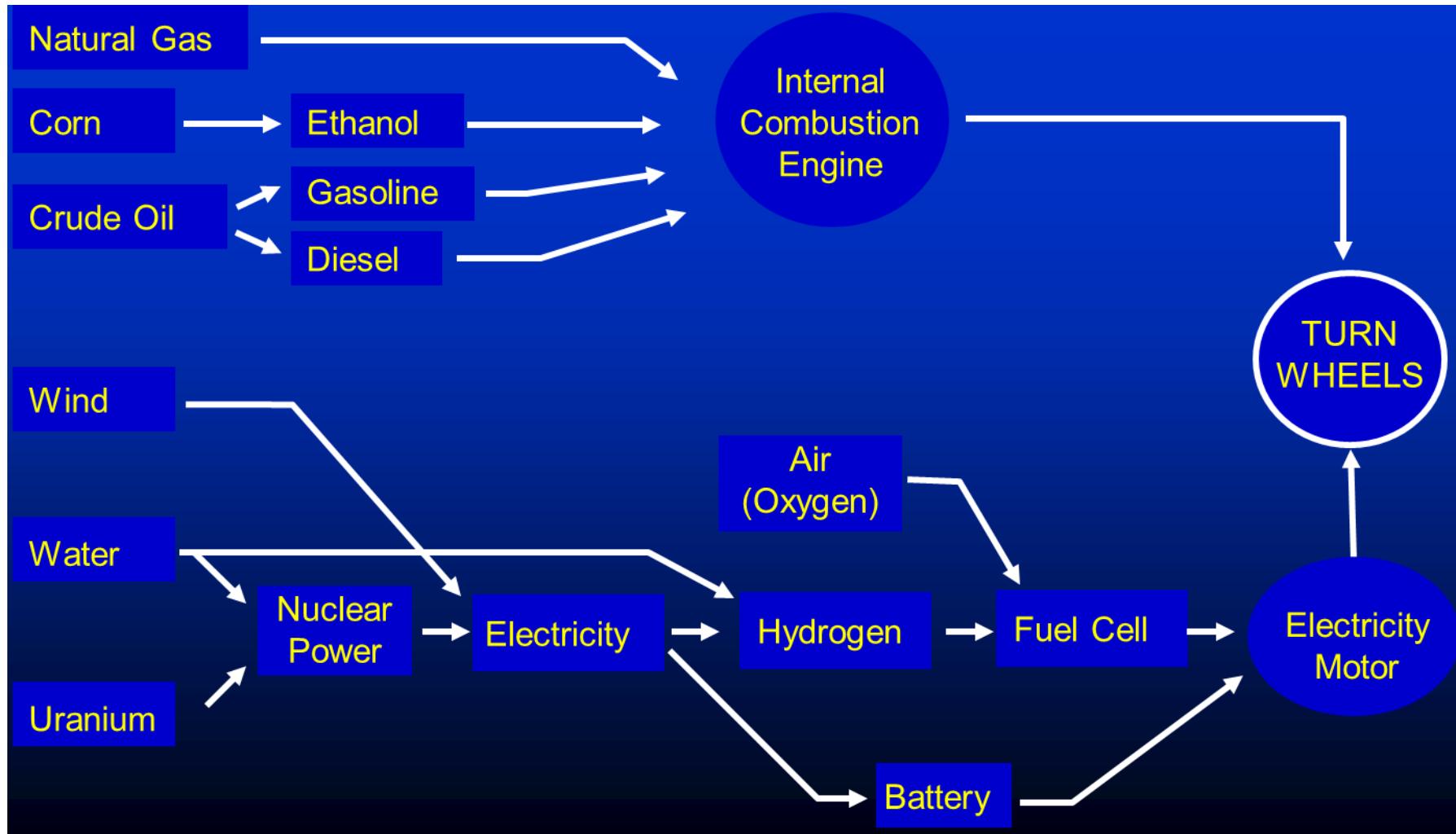
- Water management
- Energy management
- Residuals treatment
- New role of transport system based on public transport + electric cars + evaporation of traffic jams
- New modes of access and distribution of resources



Supply Chains

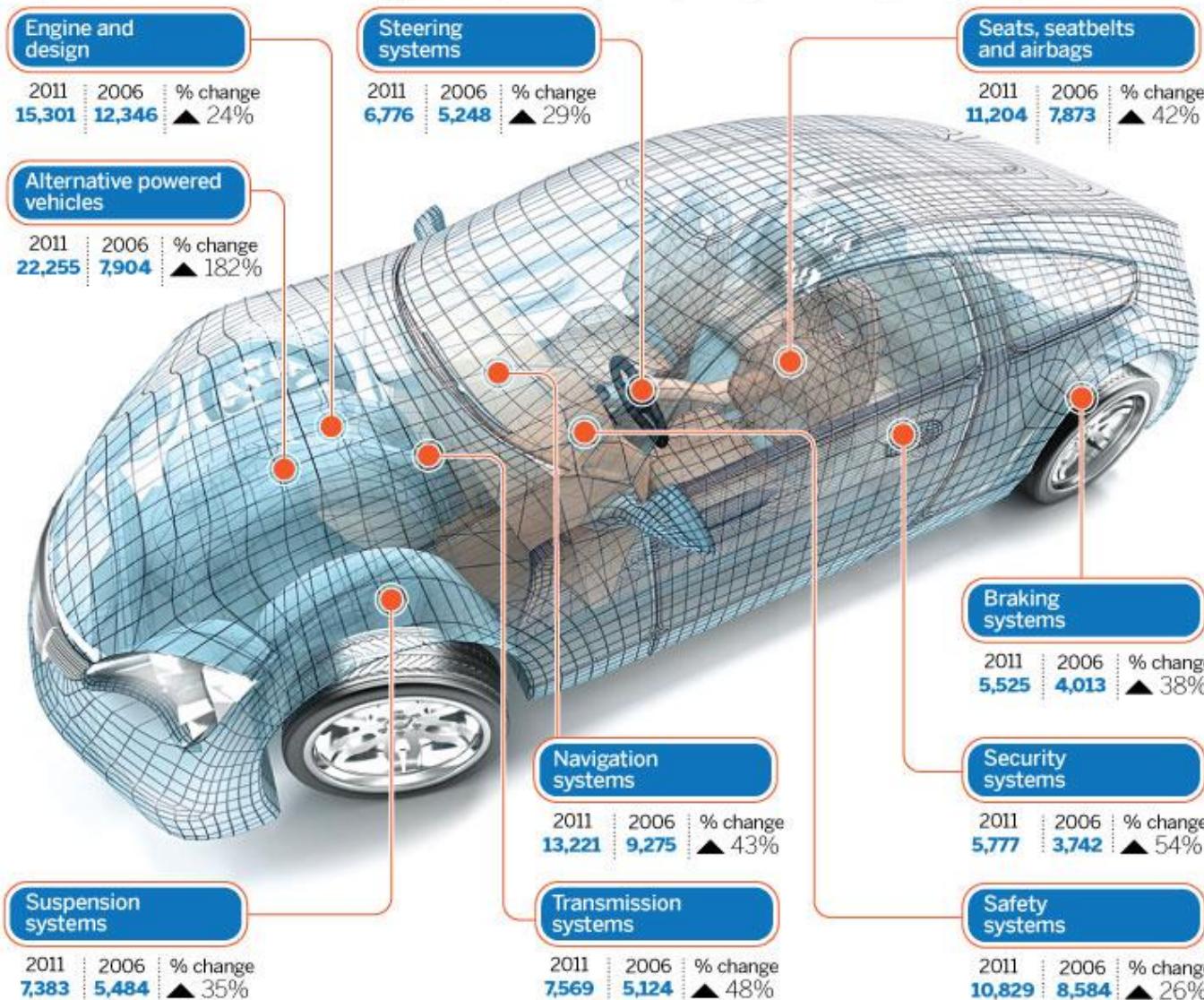
- Apple iPhone
- Laptop Computer
- Levi's Jeans
- Pharmaceuticals
- Toyota Cars

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

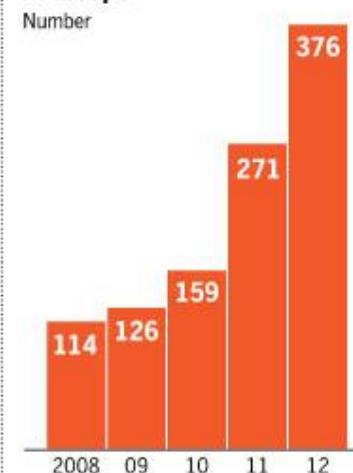


RISE OF THE AUTOMOTIVE PATENT TECH WARS

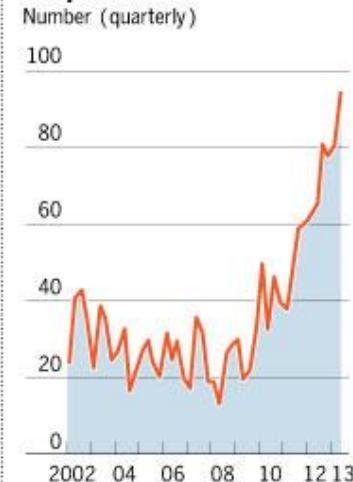
Top automotive-related technology areas (Number of published patent applications and granted patents)



Electric car patents in Europe



US hybrid or electric car patents



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

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

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

CONSEQUENCES for the FUTURE

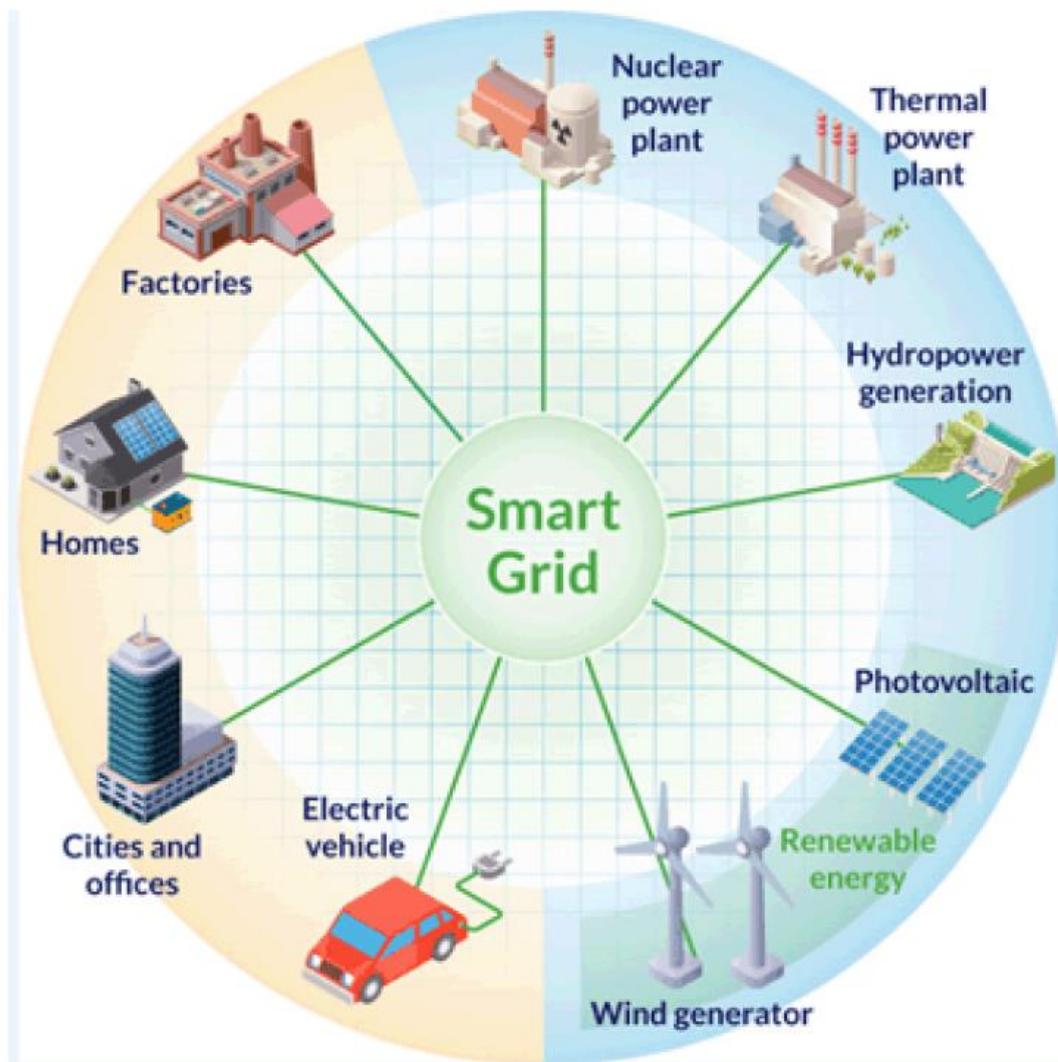
- Disruptive business model
- Shaking-up the 100 billion US\$ a year taxi business
- But using SELF-DRIVING CARS may shaken world personal transport market worth 10 trillion US\$

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)

Widespread Infrastructure Connectivity

Simplified Smart Grid Diagram



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 nascente?

A Interconectividade Global

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

SÉCULO XXI AS IDEIAS QUE PODEM MUDAR O MUNDO

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

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

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OBRIGADO

António Costa Silva
Presidente da Comissão Executiva