

ADFERSIT

Lisboa, 31 de Janeiro de 2013

***TRANSPORTES: AS ENERGIAS e os
COMBUSTÍVEIS DO FUTURO***

António Costa Silva
Presidente da Comissão Executiva

PARTEX
OIL AND GAS

Sumário

- 1. AS MUDANÇAS ESTRUTURAIS e ESTRATÉGICAS em CURSO nos MERCADOS da ENERGIA e o FUTURO**
- 2. “ENERGY GAME CHANGERS” e CONSEQUÊNCIAS**
- 3. A BUSCA de SOLUÇÕES CAPAZES de RESPONDER à ECONOMIA, DEMOGRAFIA, e ALTERAÇÕES CLIMÁTICAS - O CASO do SISTEMA DE TRANSPORTES MUNDIAL**
- 4. O PAPEL das TECNOLOGIAS e a EVOLUÇÃO em CURSO**
- 5. O CASO de PORTUGAL e o QUE FAZER?**

1. AS MUDANÇAS ESTRUTURAIS e ESTRATÉGICAS em CURSO nos MERCADOS da ENERGIA e o FUTURO

Para onde vai PORTUGAL?

PORTUGAL NA ENCRUZILHADA: COMO ACTUAR NO MUNDO DE HOJE?

A GEOPOLÍTICA e a ECONOMIA

- . Efeitos da globalização
- . Declínio do Estado-Nação
- . Emergência de Novos Actores
- . Transferência parcial do poder financeiro
- . Crise global do sistema capitalista

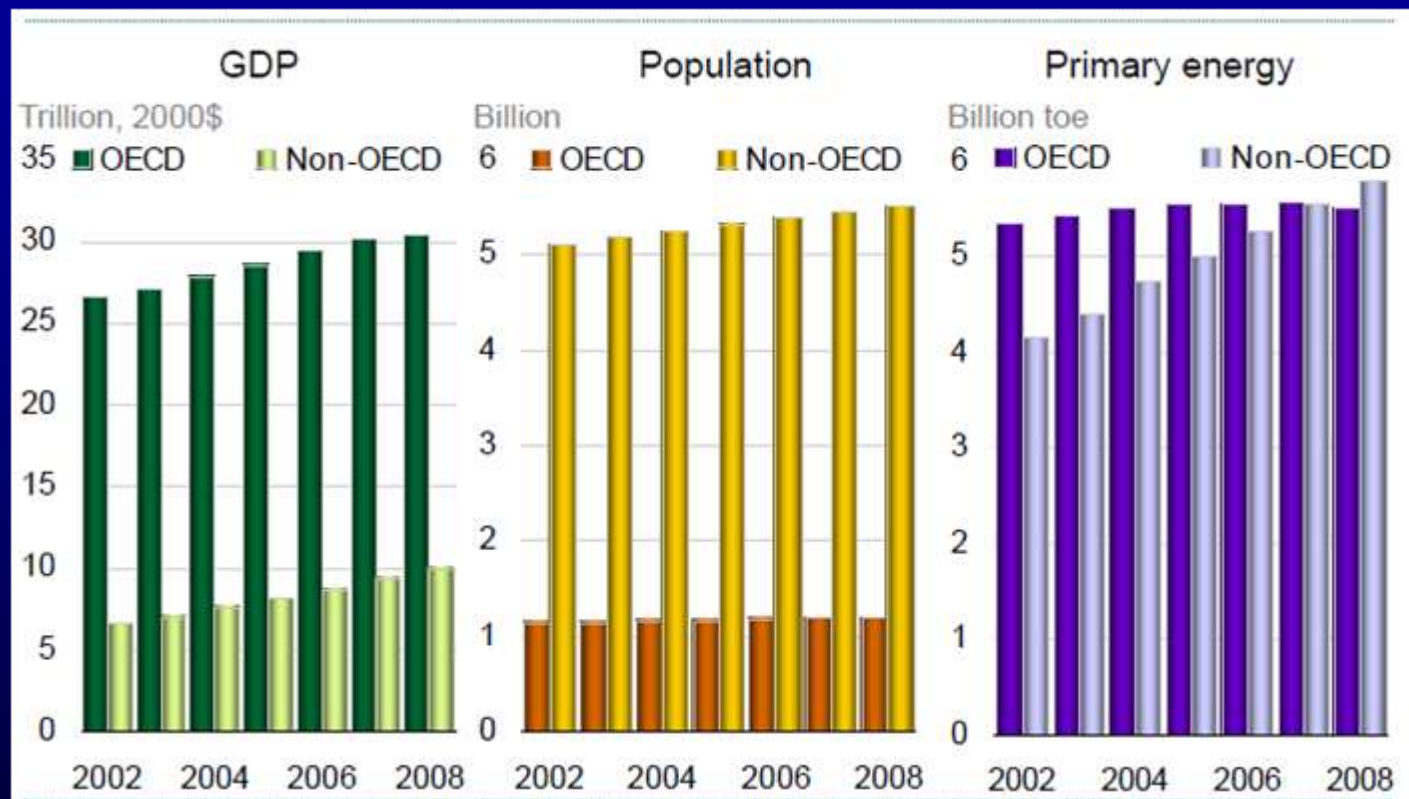
AS AMEAÇAS GLOBAIS

- . Climática (migrações)
- . Terrorismo
- . Pirataria
- . Estados falhados
- . Colapso da ordem em zonas do Globo
- . Proliferação Nuclear
- . Armas de destruição maciça

OS RECURSOS

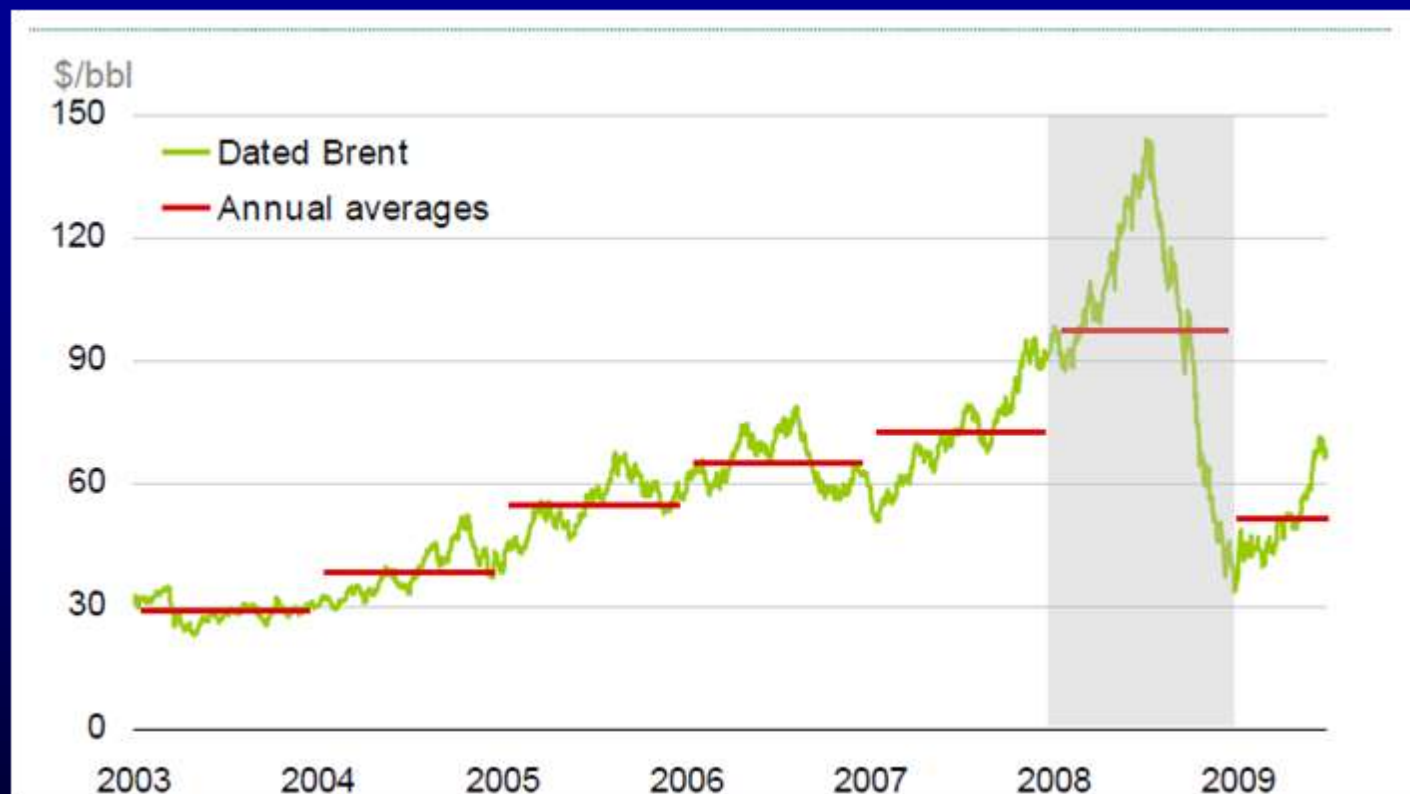
- . Recursos cada vez mais escassos
- . Intensificação da luta pelos recursos:
 - Minerais
 - Energéticos
 - Alimentares
 - Água
- . Controle de matérias-primas estratégicas

GDP, Population and Primary Energy Consumption



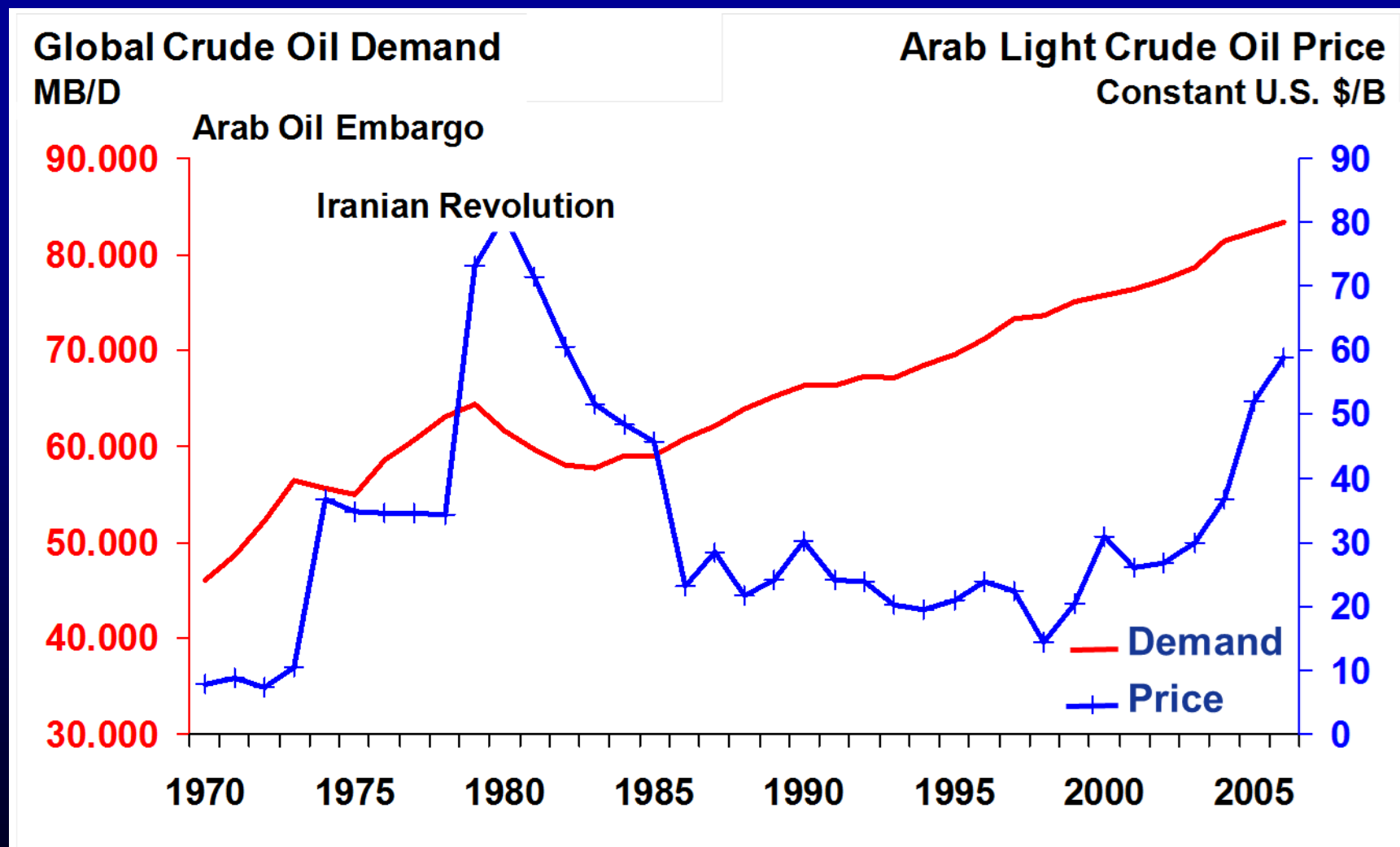
Source: BP Statistical Review of World Energy June 2009

Crude Prices: What Happened?



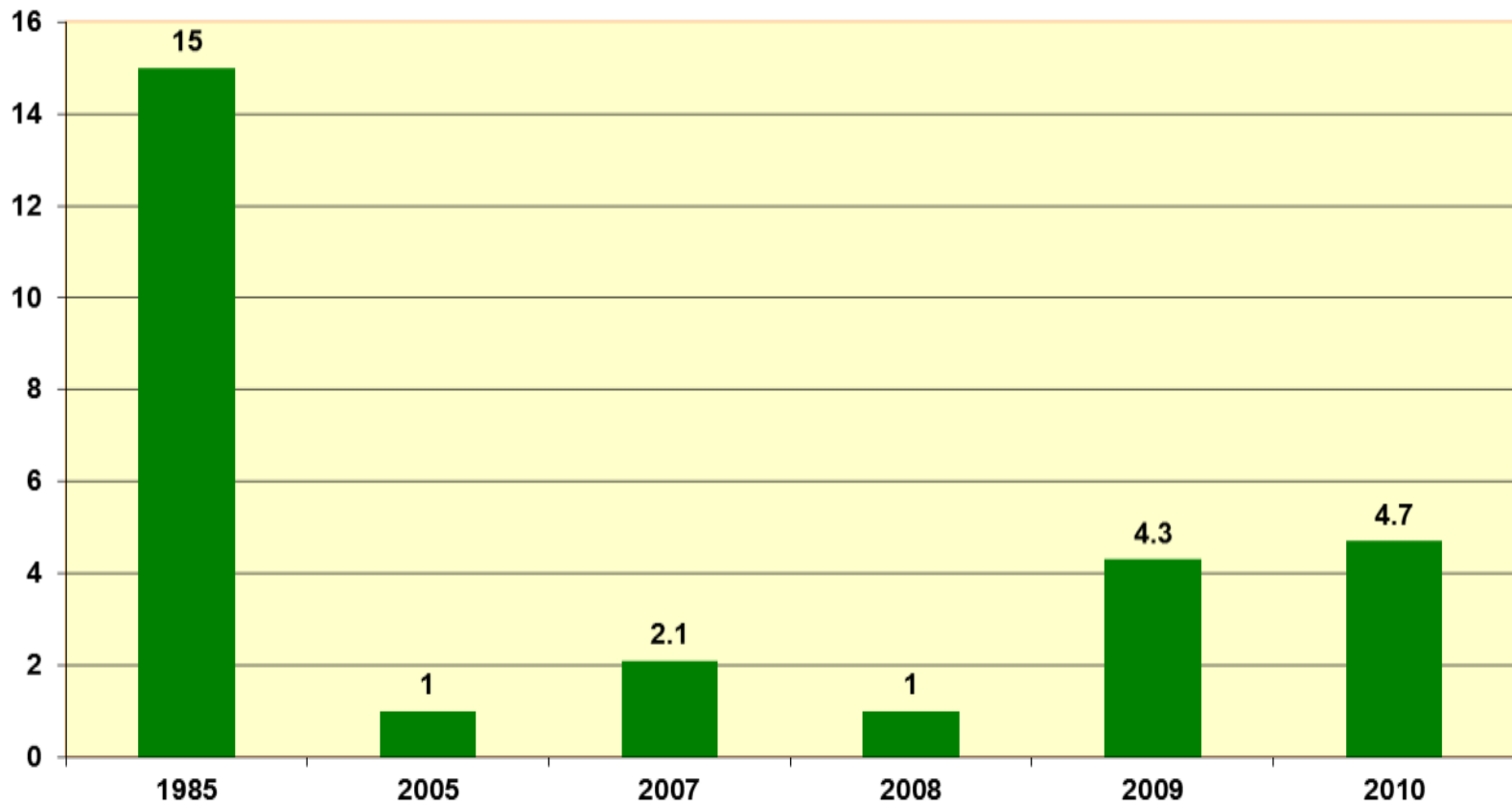
Source: BP Statistical Review of World Energy June 2009

DEMAND HAS FALLEN BEFORE ON HIGH PRICE BUT NOT THIS TIME



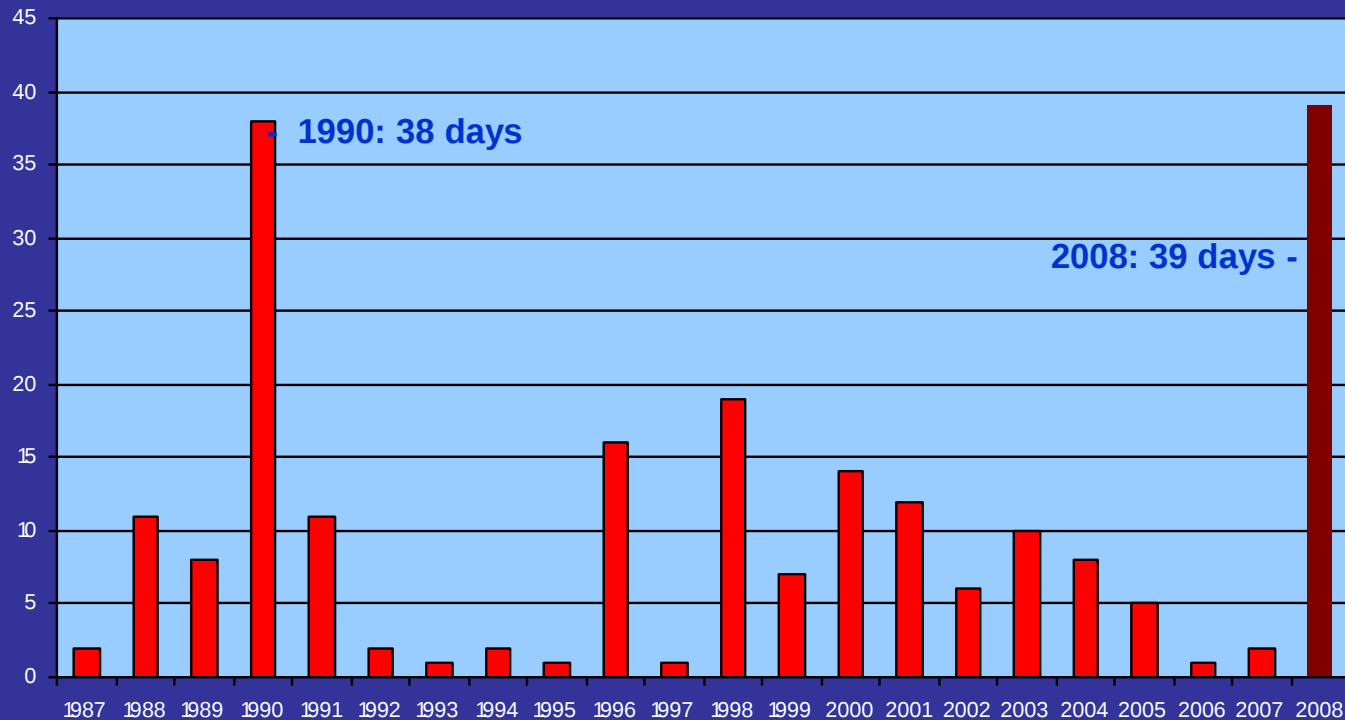
OPEC EXTRA-CAPACITY

M Barrels per Day



Source: IEA

VOLATILE OIL MARKET



In 2008 the price of oil changed 5% or more from its previous close on 39 days. The most recent year with comparable volatility was 1990

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 World Energy*

WORLD DAILY CONSUMPTION

- 85 Million Barrels of Oil
- 306 Billion Cubic Feet of Natural Gas
- 14 Million Tons of Coal

85 MB/D – Means
One Olympic-sized swimming pool of Oil CONSUMED
in 15 SECONDS

ONE DAY OF CONSUMPTION = 5500 swimming pools

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

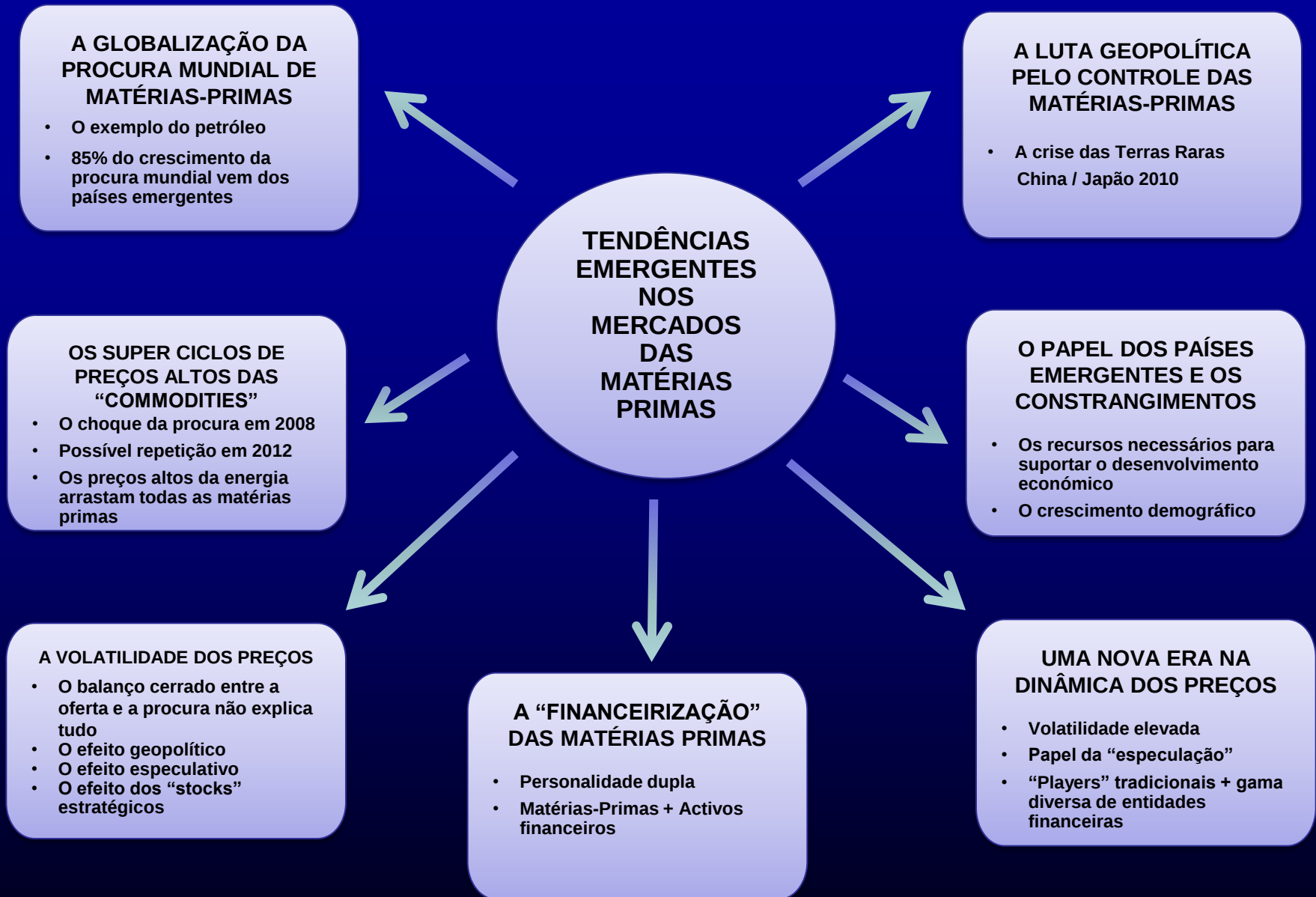
- . Dominance of Natural Gas?
- . Consolidation of Renewables
- . Solution for the transport system: (electric/biofuels/GTL/fuel-cells)?

ELECTRICITY

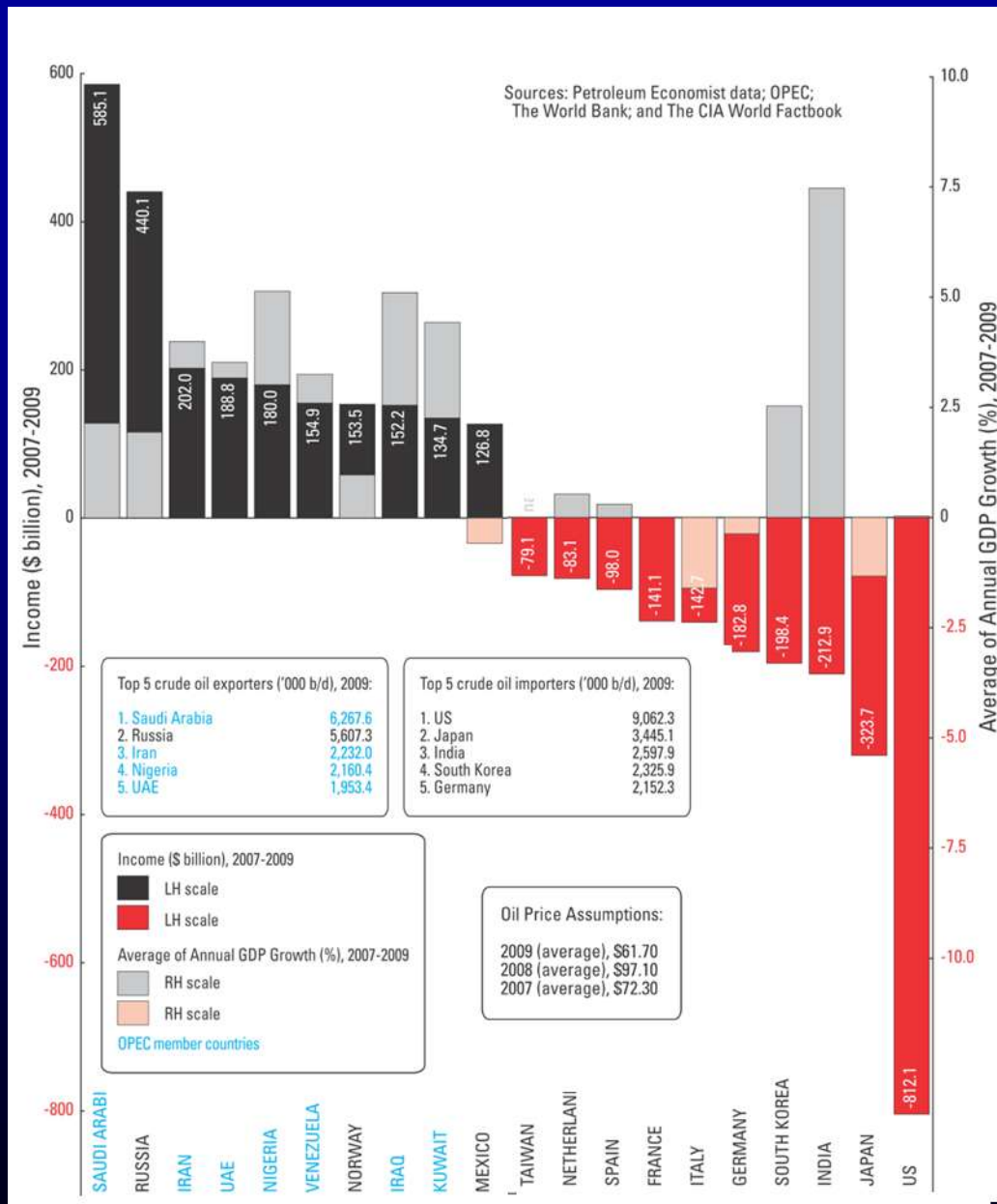
. Wide access and needs

WATER

. How to lift restrictions?



PETRO-DOLLARS: who's rich who's not



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:

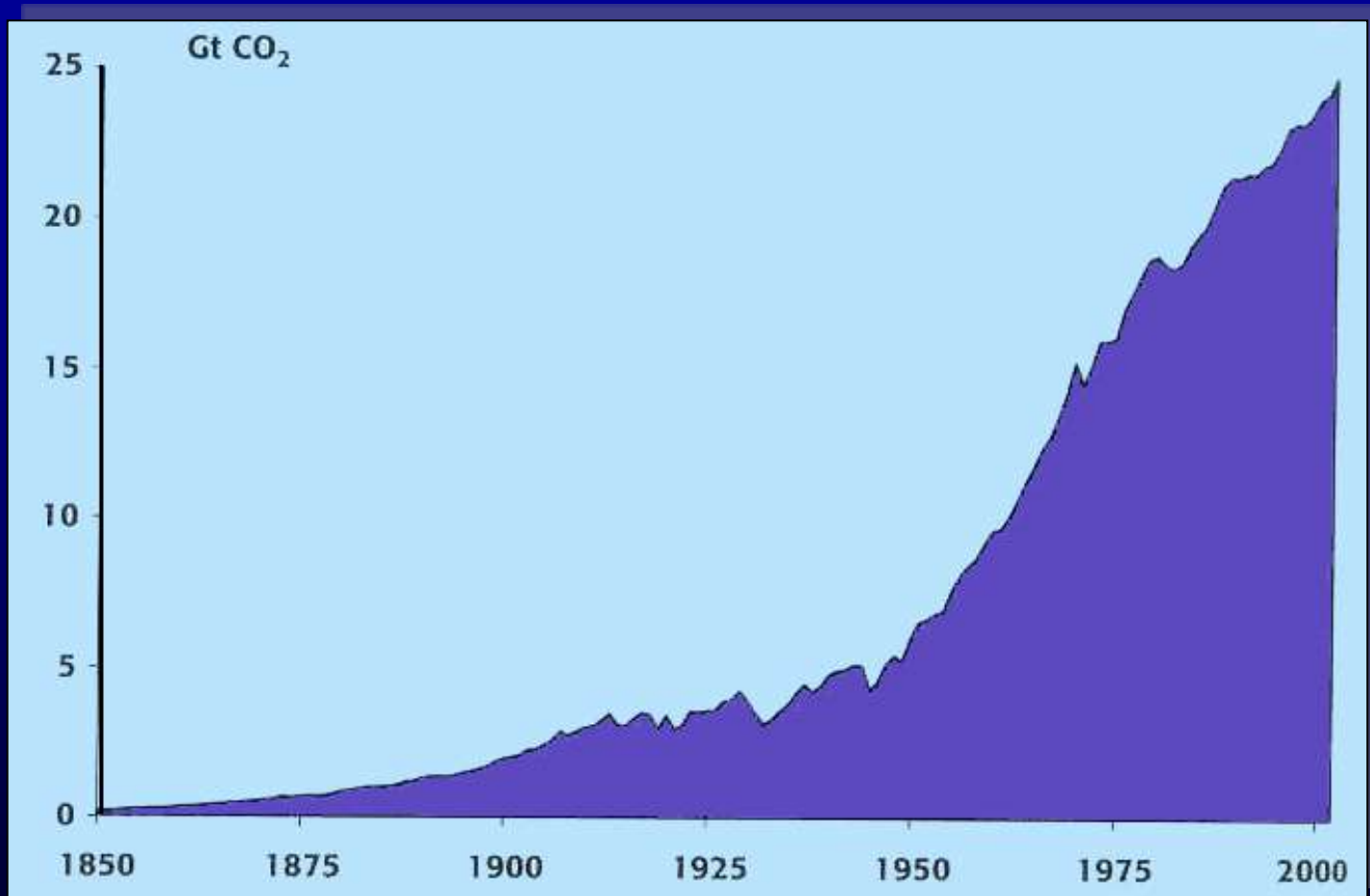
- Power stations
- Electricity System
- Transport System

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

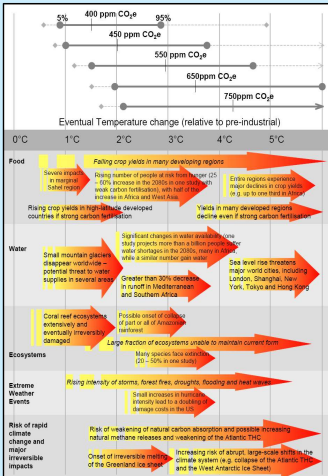
NEED BUILD a Low-Carbon ECONOMY

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

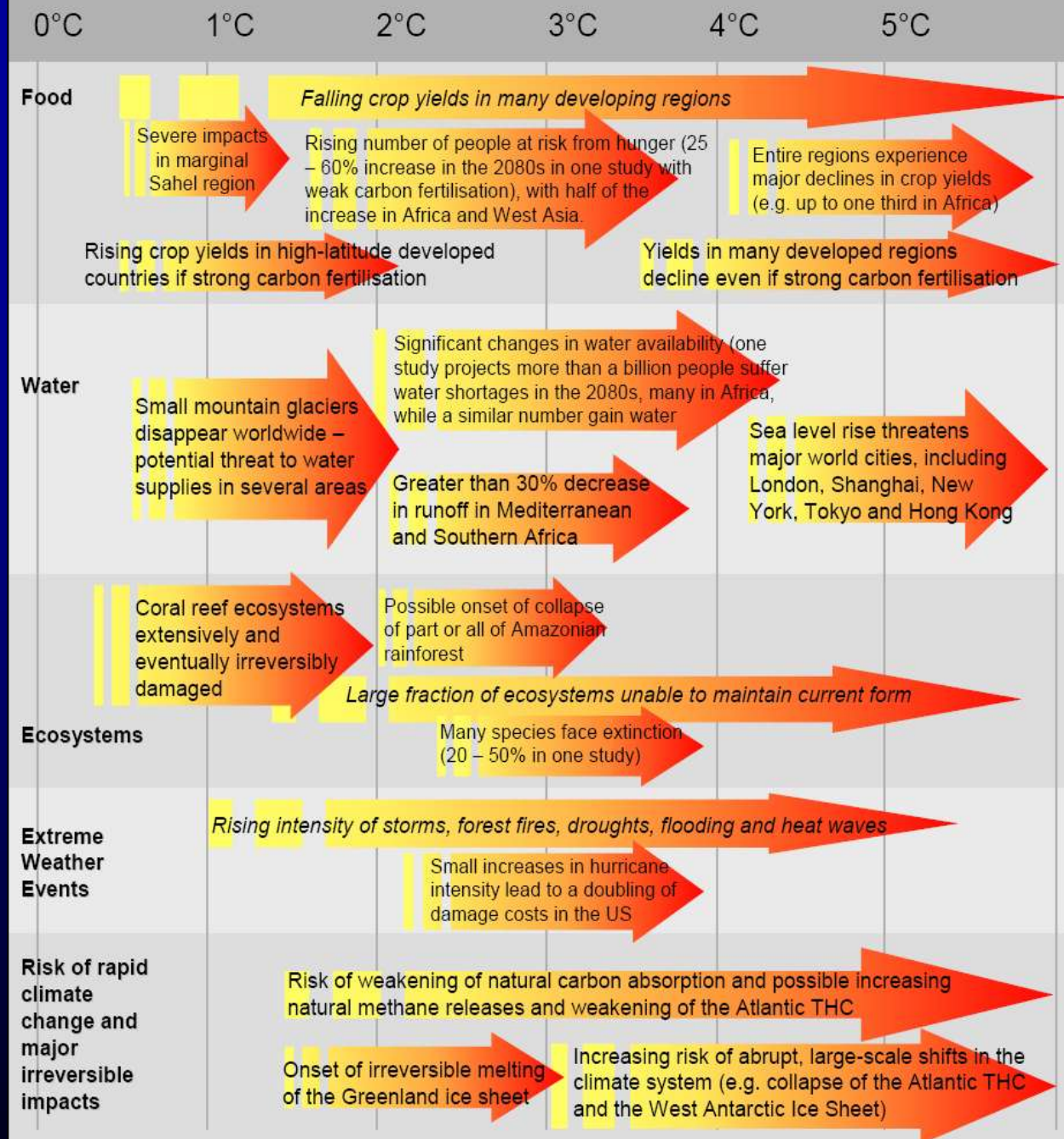
Global Co₂ Emissions from Fossil-Fuel



Source: Nicholas Stern / Brohan et al (2006)



Effects of Temperature Rise



Fonte: Nicholas Stern / Stern Review web site

CO₂ EMISSIONS

YEAR	CO ₂ EMISSIONS (Million Tons)	RATE OF INCREASE (%)
2000	22 000	
2030	38 000	Transport 27% Power-Generation 48%

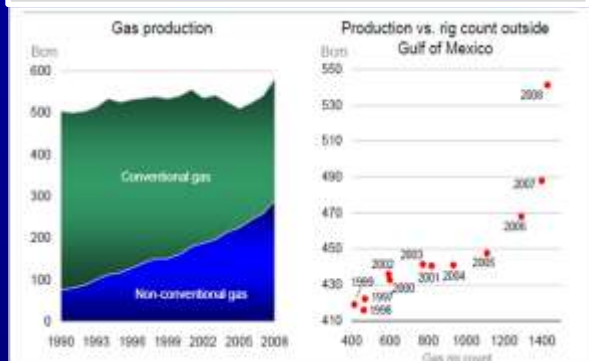
EVOLUTION of WORLD CAR FLEET FUEL CONSUMPTION

YEAR	Consumption (Million tons)
1985	950
2005	2500

2. “ENERGY GAME CHANGERS” e CONSEQUÊNCIAS

ENERGY GAME CHANGERS in XXI CENTURY

UNCONVENTIONAL GAS



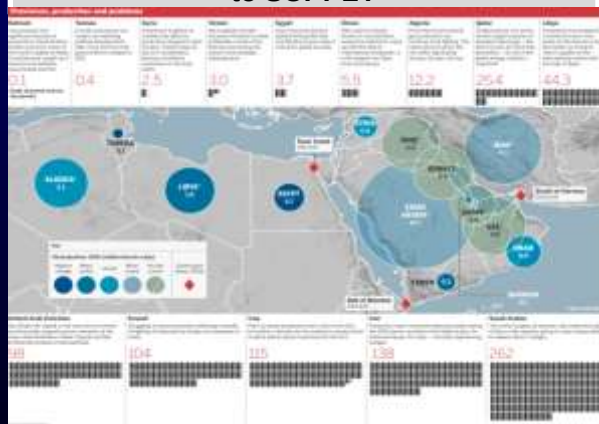
INDUSTRY CATASTROPHIC ACCIDENTS (e.g. OFFSHORE OIL Spills) and PUBLIC IMAGE



FUKUSHIMA NUCLEAR ACCIDENT



INSTABILITY in PRODUCING COUNTRIES and THREATS to SUPPLY



EMERGENCE of PACIFIC BASIN as TOP ENERGY CONSUMER



CLIMATE CHANGE and ENVIRONMENTAL REVOLUTION



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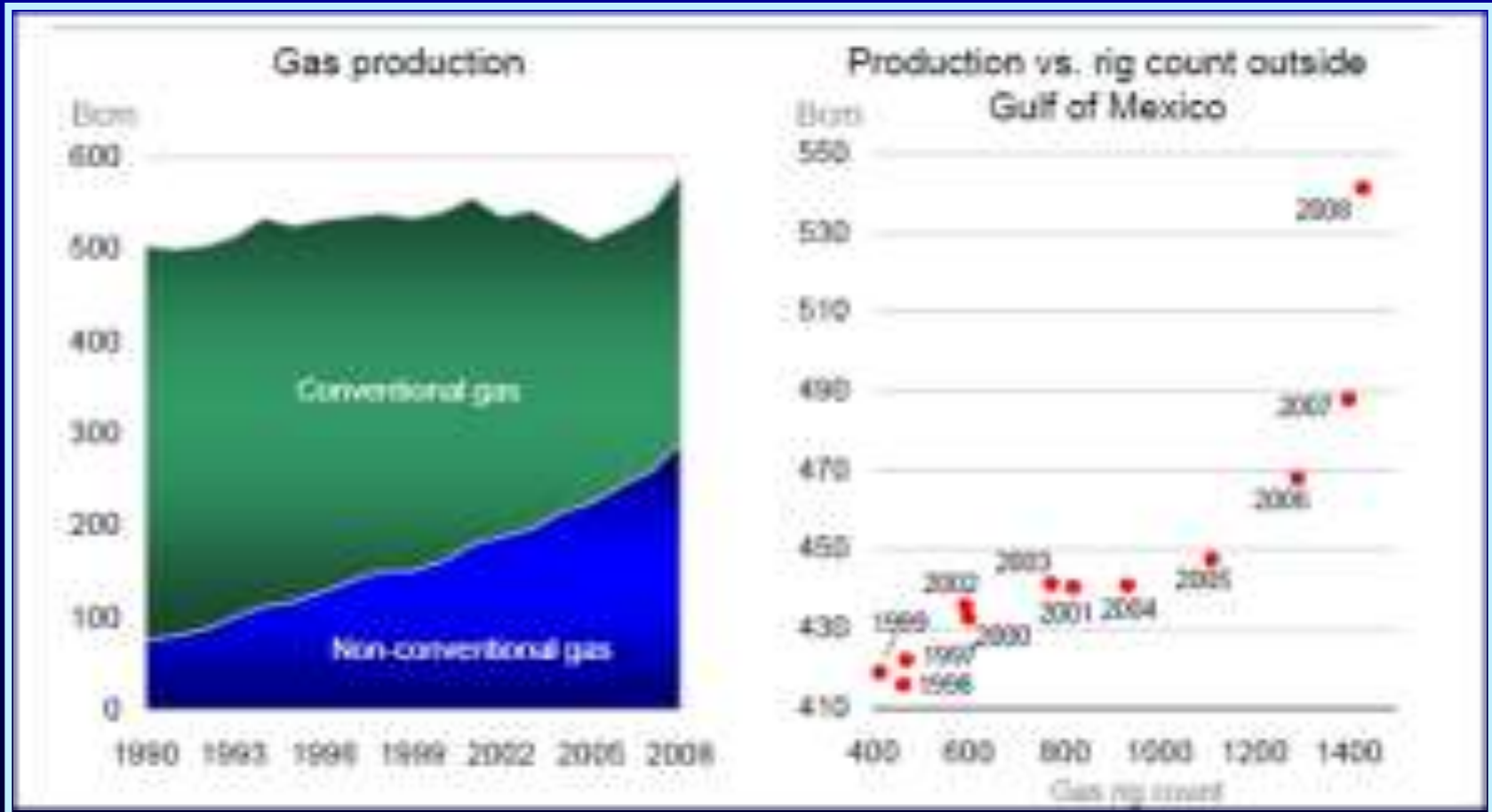
31 Janeiro 2013

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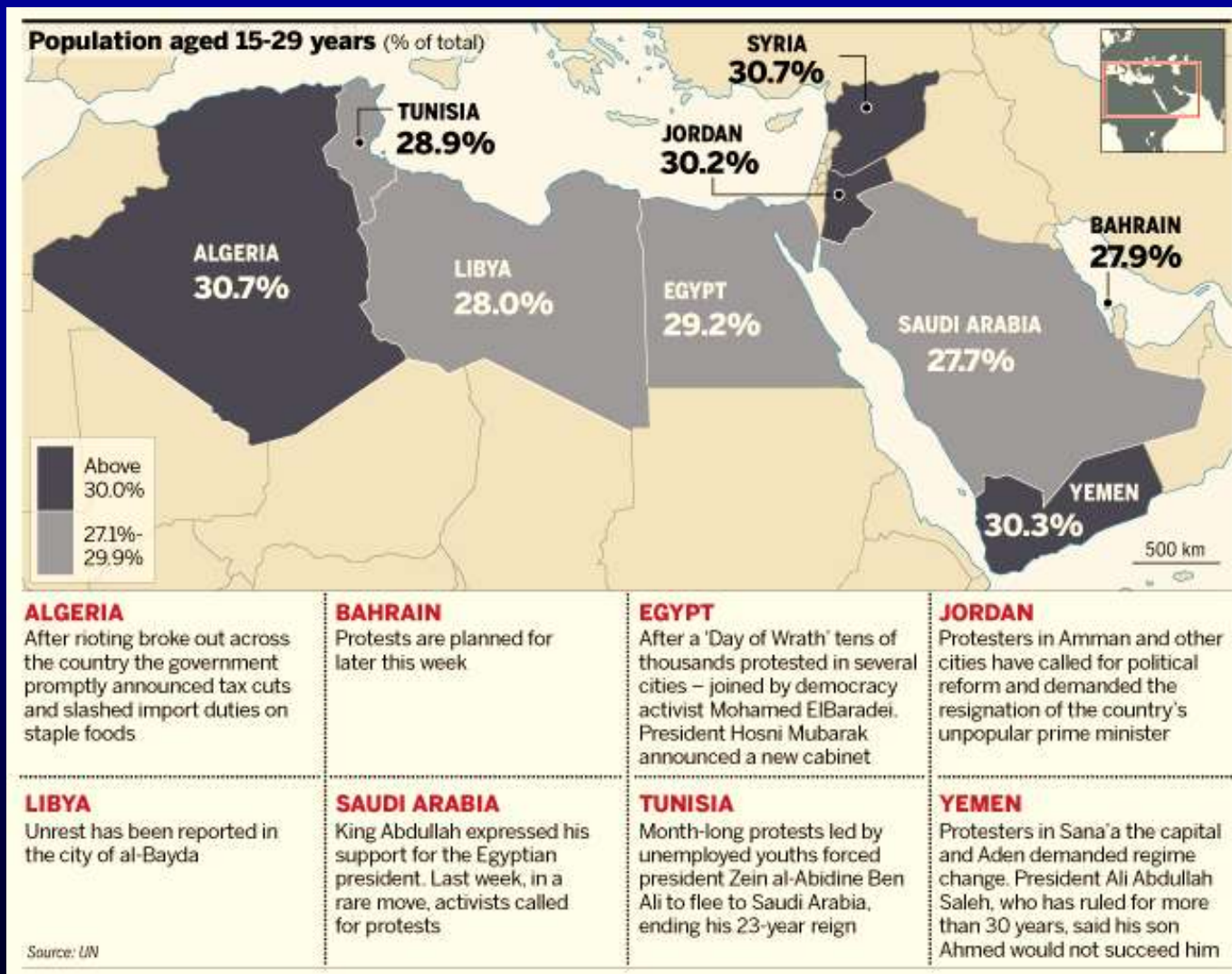
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OIL AND GAS

US Gas Production Changes



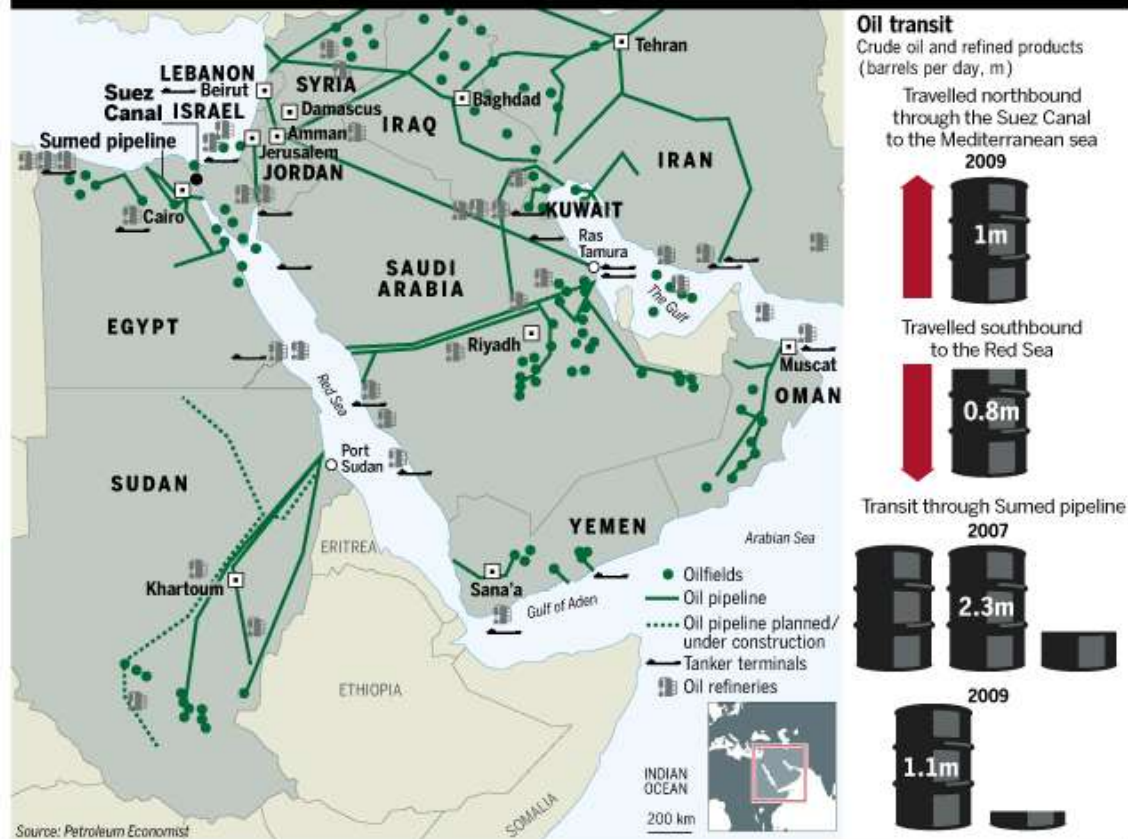
Source: BP Statistical Review of World Energy June 2009

NORTH AFRICA and MIDDLE EAST CRISIS



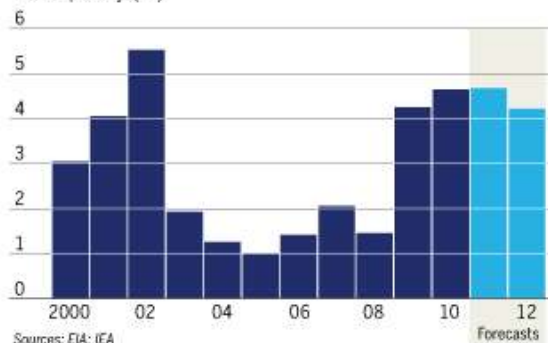
Source: FT , 1 February 2011

Closure of the Suez Canal would divert Middle East oil



Opec surplus crude oil production capacity

Barrels per day (m)



OECD total oil stock cover

Days of forward demand



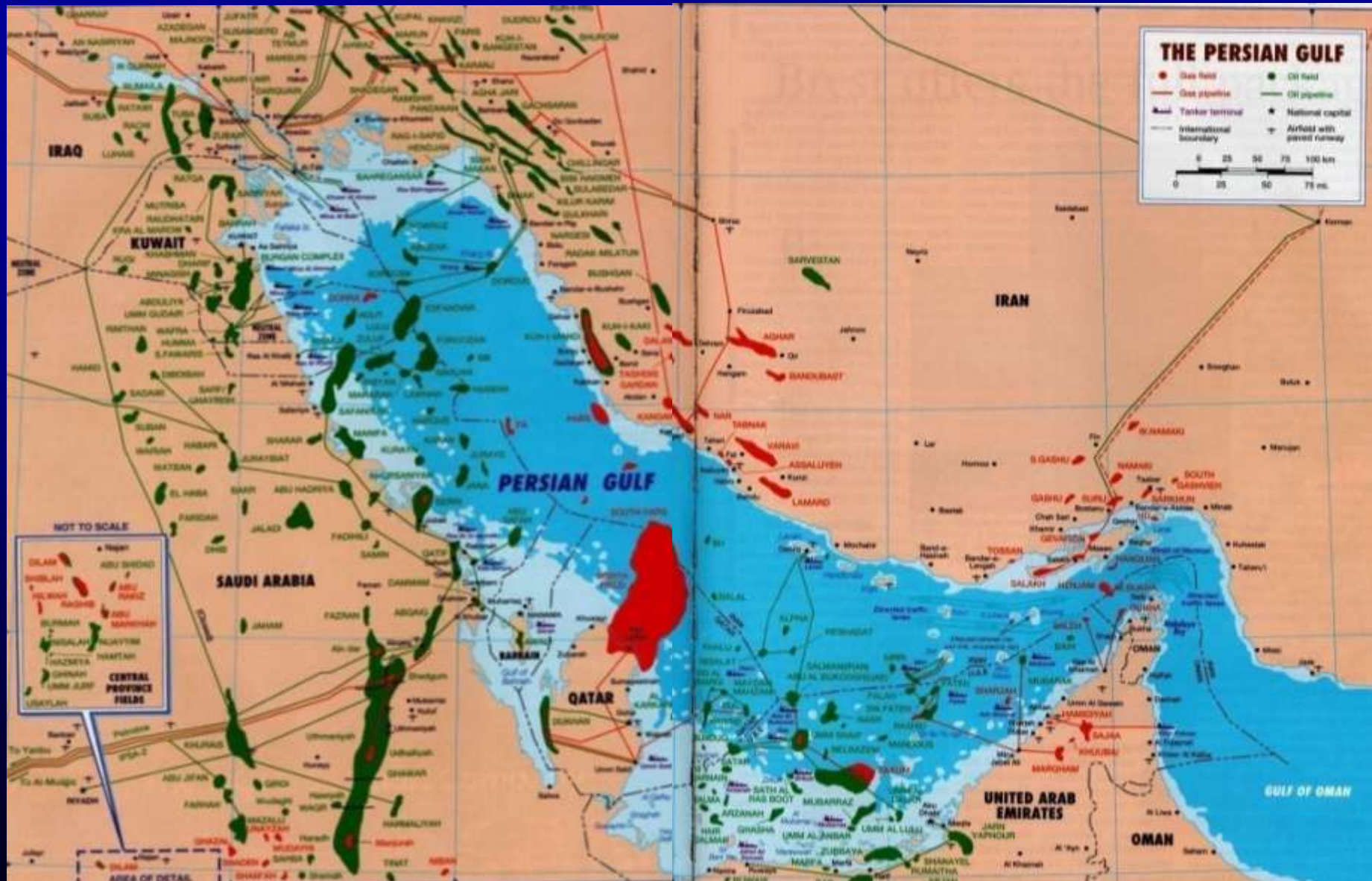
Effect on oil prices and Gulf economies



- Three competing effects
 - Damage, disruption and insecurity
 - High oil prices
 - Increased social spending and budgetary requirements

Source: 21st World Upstream Conference Global Pacific & Partners

CONSTRAINTS ON OIL AND GAS FLOW FROM MIDDLE EAST



Pirate Attack Saudi Super-Tank seized off Kenian Cost on 16th November 2008



Source: Reuters, November 2008

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OIL AND GAS

RE-EMERGENCE of ATLANTIC BASIN as MAJOR OIL and GAS PROVINCE

- US reliance on foreign imports has fallen to the lowest level in 25 years
- Brazil Pre-Salt discoveries
- Impact on West Africa from Nigeria, Gana to Angola
- Gulf of Mexico and Guyanas developments

MIDDLE EAST ROLE in a TECHNOLOGICAL REVOLUTION

- Increase of RF
- Reinforcement of ME role as a key producing region for conventional oil
- Tight Oil/Shale Oil potential
- Tight Gas/Oil/Shale Gas potential

TECHNOLOGICAL SHALE GAS REVOLUTION

- Combination of Horizontal Drilling and Hydraulic Fracturing
- Impact of Tight Oil/Shale Oil production
- Huge potential for expansion
- Effect of prices, technologies and political decisions

KEY IMPLICATIONS for OIL and GAS MARKETS

NEW REFINING PATTERN: ASIA/PACIFIC EMERGENCE

- Asia/Pacific home to 1/3 of world refining capacity
- Past 10 years every year construction of 3 large refineries
- World capacity in excess of demand
- Refining profitability is linked to utilization rates (Europe below 80%)

REVOLUTION in ENVIRONMENTAL and EMISSIONS CUTTING TECHNOLOGIES

- Need to improve CO₂ cutting technologies to sustain unconventional oil production
- Reinforcement of oil and gas domination not possible without solving environmental problems
- Clash between industry and environmental actors can be better managed and avoided

GEOPOLITICAL CONSEQUENCES

- Emergence of Asia as top consumer
- China becoming world economy engine
- A new center of gravity for trade, finance and investment
- CNOOC "think global, act locally" (Nexen/North Sea acquisition gives China a new role as benchmark producer and hedge against volatility)
- Canada to boost exports to China

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

GROWTH and SUSTAINABILITY

LOW CARBON SOLUTIONS

- Buildings
- Electric/Thermal Generation
- Transportation systems

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

ENERGY and WATER MANAGEMENT

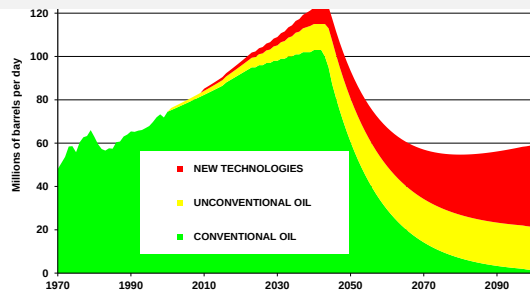
- Optimal use of local resources
- Optimization of energy used in oil/gas operations
- Efficiency and minimization of environmental impact
- Solution of increased volumes of water
- Bacterial Treatment
- Re-utilization of water

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

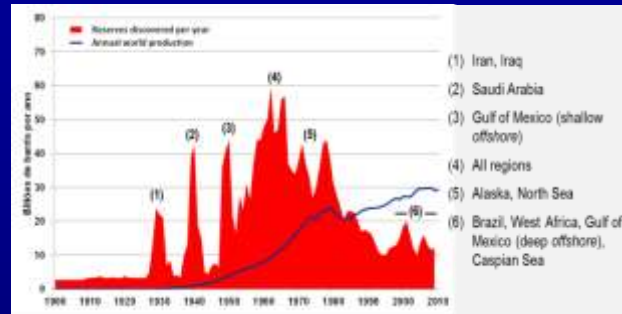
KEY CHANGES UNDER DEVELOPMENT

From CONVENTIONAL
to UNCONVENTIONAL



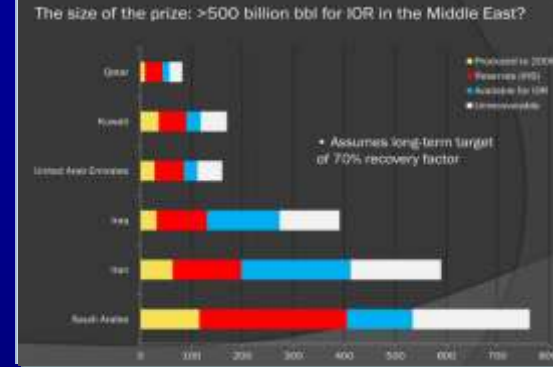
Source: "Universe of Oil and Gas Industry"

RATIO PRODUCTION / NEW RESERVES
- THE DECLINE for CONVENTIONAL -



Source: IEA/"Universe of Oil and Gas Industry"

IOR / EOR POTENTIAL



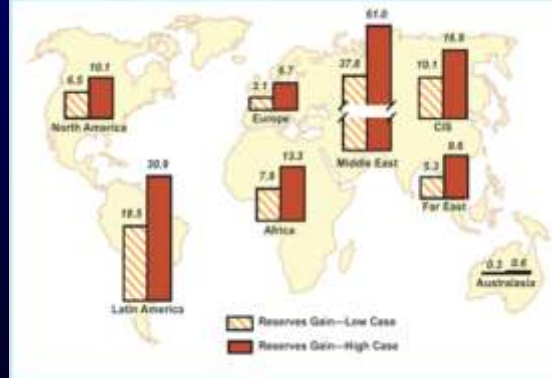
Source: 21st World Upstream Conference

GROWING DOMINANCE of
UNCONVENTIONAL RESERVES

	World Reserves (TCF)
Coal bed methane	3,200
Shale gas	6,400
Tight gas	3,900
TOTAL	13,500

Source: IEA

MAXIMIZATION of RECOVERY FACTORS



Source: IHS CERA

GROWING NEED OF MINING the OCEANS



Source: IEA

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DELIVERING ENERGY to SUSTAIN ECONOMIC DEVELOPMENT

- Maximization of RF
- New wave of EOR technologies
- Better knowledge of reservoirs

DIGITAL OIL FIELDS

- Conversion of information into knowledge
- Huge contribute to optimization RF

MAJOR ENGAGEMENT of INDUSTRY in TRANSPORTATION SOLUTIONS

- Role of oil continue to dominate for decades
- Major improvements on Internal Combustion Engine
- Emergence of alternatives (Electric/Hybrids/Gas/Fuel Cells/ /Chemical/Aerospacial propulsion)

MAJOR EXPLORATION BREAKTHROUGHS

- Remote Onshore areas
- Huge Offshore focus
- Considerable gains from Sea Bed Logging
- Impact on Onshore

OIL and GAS INDUSTRY: A VISION of the FUTURE

MULTI-ENERGY

- Portfolio to include different segments of energy chain
- Oil and gas assets combined with renewables, biomass, GTL, etc.
- Energy efficiency
- Energy management

ROLE of UNCONVENTIONAL GAS

- Energy mix changes
- Golden Age of Gas
- World Energy Matrix under transformation
- Hydrates of Methane
- Coal Bed Methane

BETTER ENVIRONMENTAL and EMISSIONS CUTTING TECHNOLOGIES and SOCIAL RESPONSIBILITY

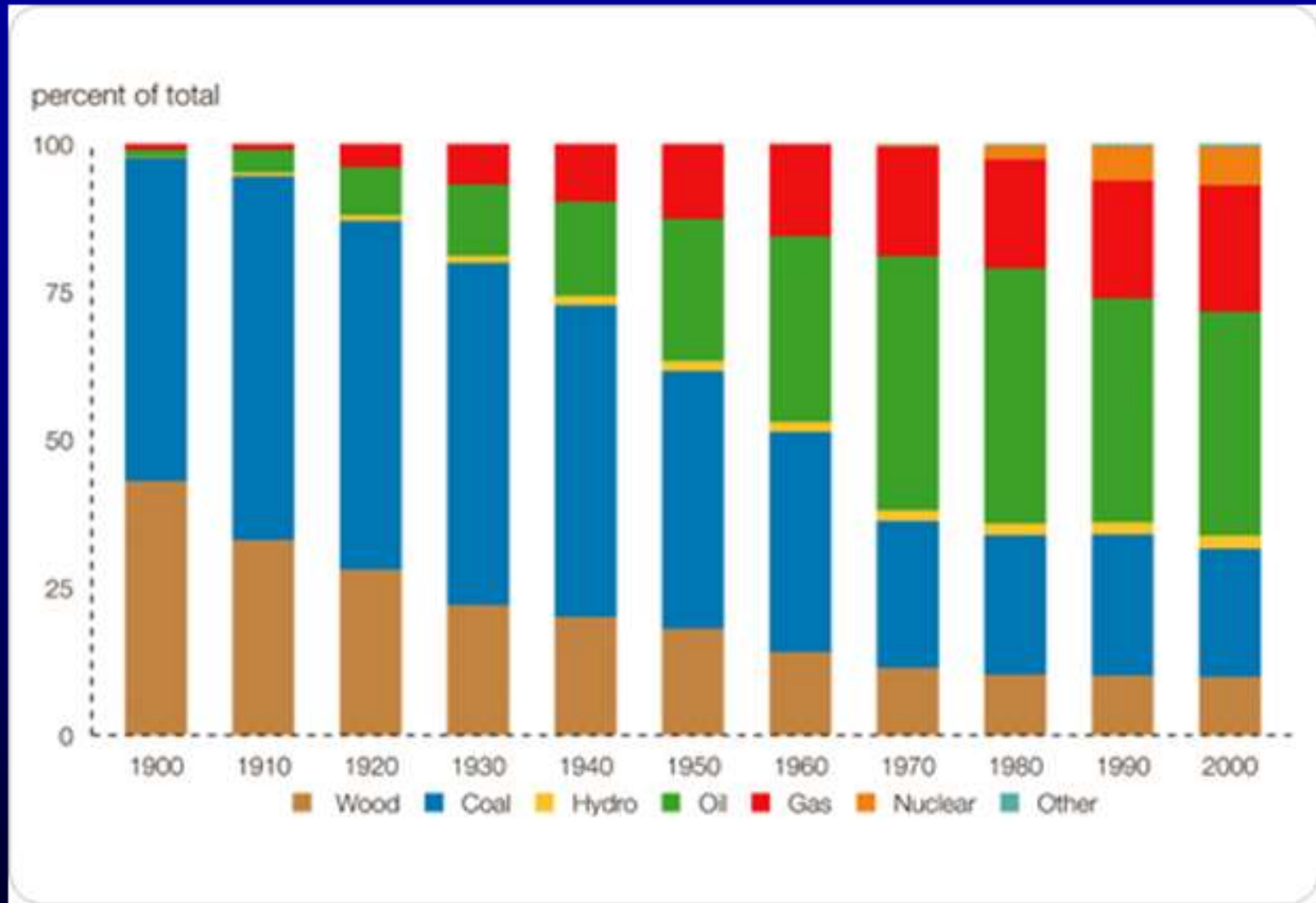
- Clean technologies
- CO₂ sequestration to extend hydrocarbons life
- In-country value
- Local content
- Social responsibility projects

BETTER SECURITY SYSTEMS

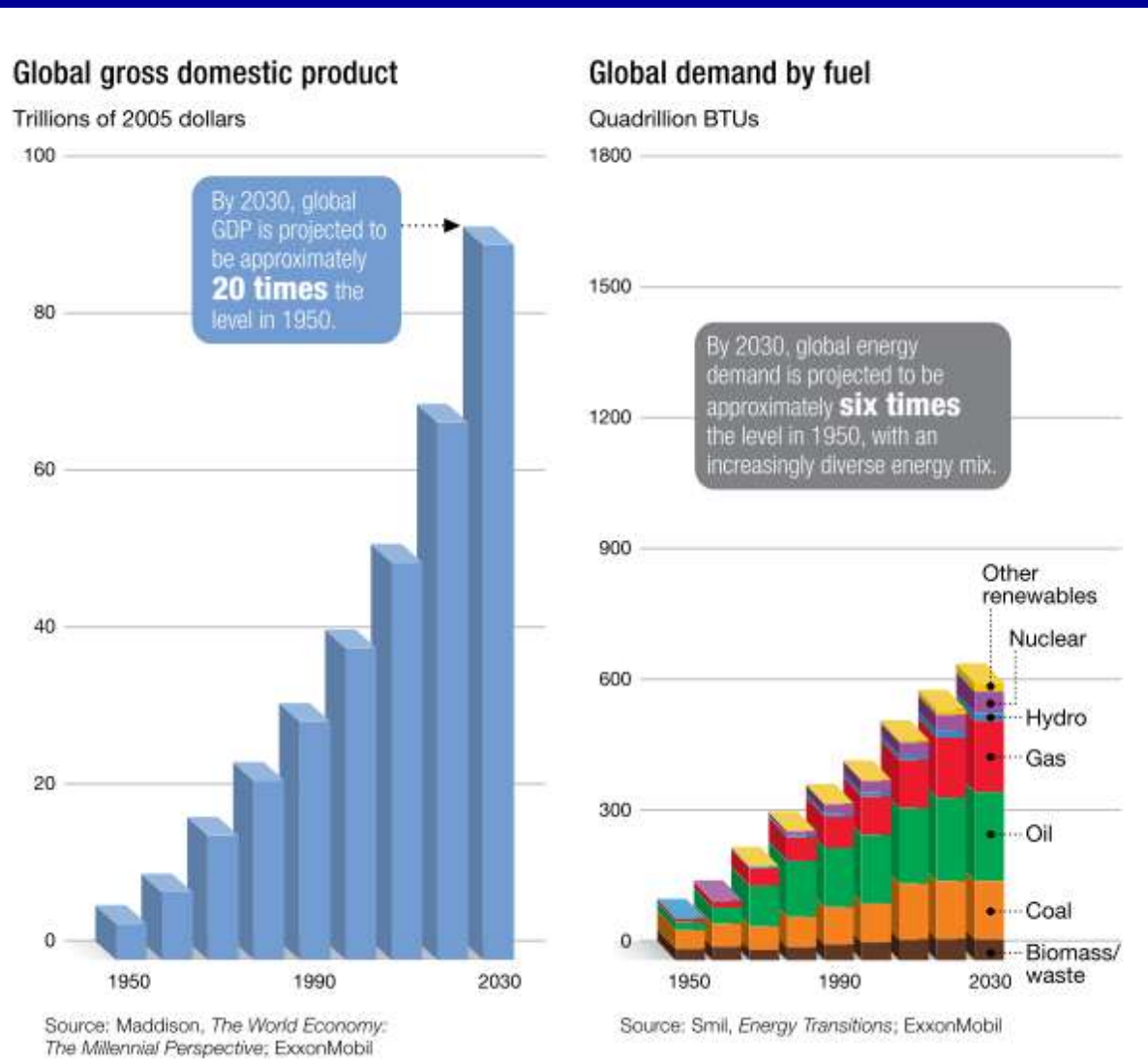
- Cyber attacks more often
- Recent cyber attacks on Saudi Aramco, Qatar RasGas, etc.
- Threats to trade flows in congested areas
- Piracy on sealanes

3. *A BUSCA de SOLUÇÕES CAPAZES de RESPONDER à ECONOMIA, DEMOGRAFIA, e ALTERAÇÕES CLIMÁTICAS*

Evolving Energy Sources



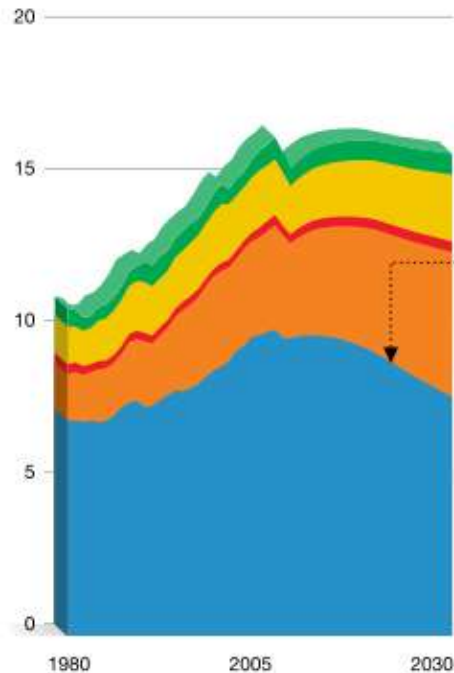
ECONOMIC GROWTH AND FUEL DEMAND



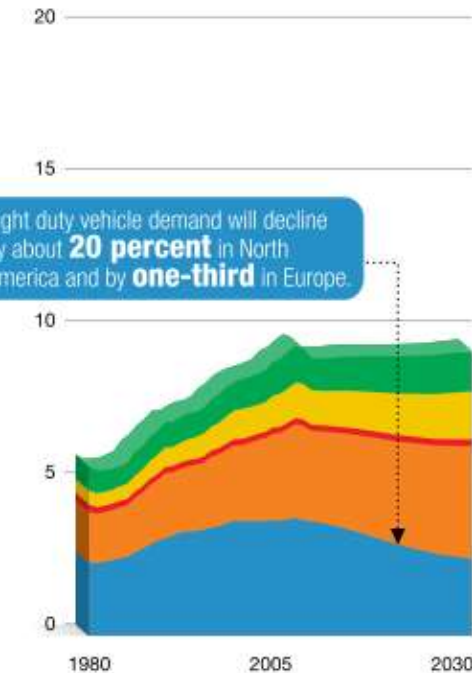
TRANSPORTATION FUELS TO SEE RISING DEMAND

Transportation demand by region

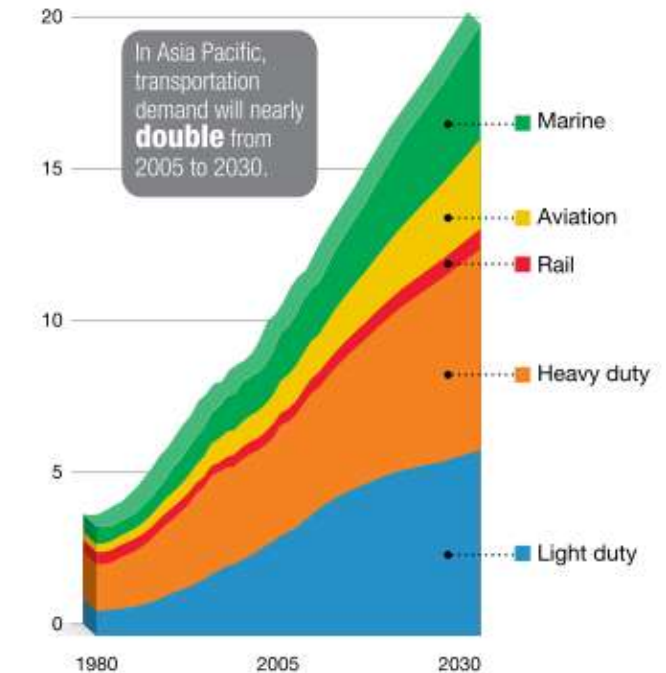
Millions of oil-equivalent barrels per day
North America



Europe

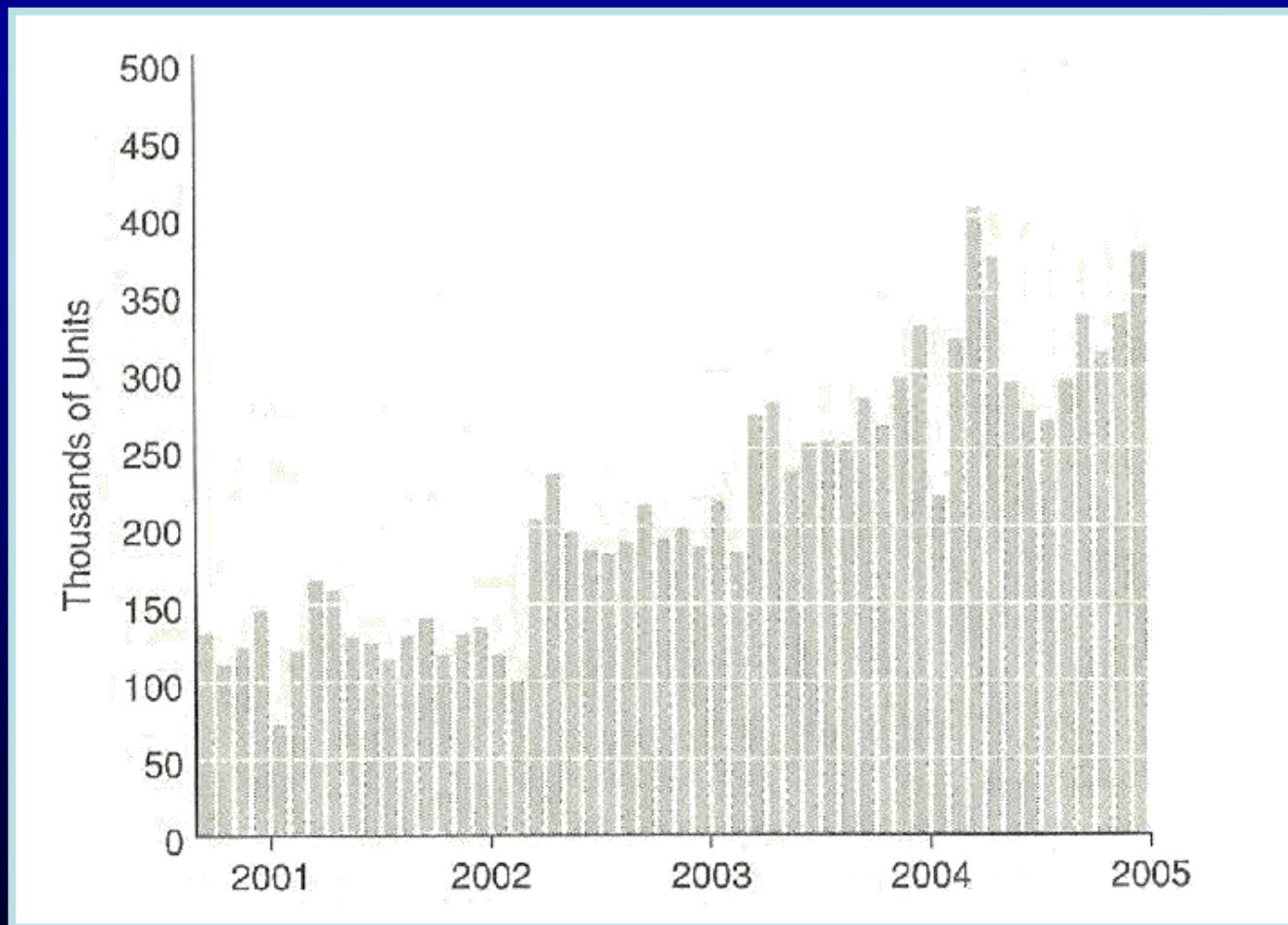


Asia Pacific

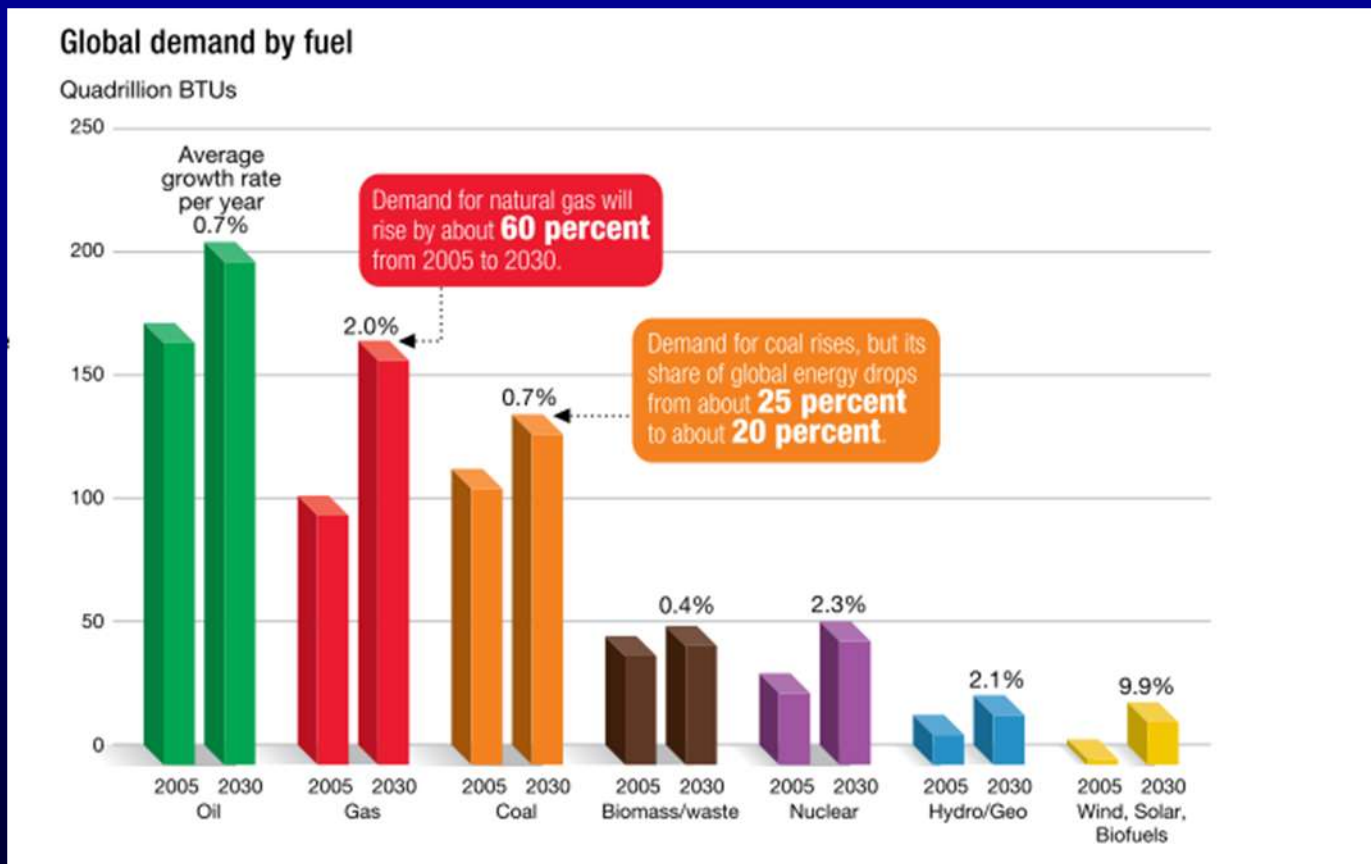


Source: Exxon Mobil, the 2010 Outlook for Energy: A view to 2030

Monthly Vehicles Sales in China: All Cars and Light Trucks



DEMAND FOR ALL FUELS TO RISE THROUGH 2030



Source: Exxon Mobil, the 2010 Outlook for Energy: A view to 2030

WHAT ALTERNATIVES? FOCUS ON TRANSPORTATION

- Batteries and plug-in cars
- Electric vehicles
- Advanced biofuels
- Natural gas vehicles
- Evolving smart-grids integrating plug-ins
- Greener electricity generation
- Advances in the internal combustion engines
- Increasing fuel efficiency
- Advanced diesels
- New lighter materials

EXPANSION OF GAS UTILIZATION

- Substitution for power generators
- Use in transportation
- Gas to liquids (GTL) technology improvements
- Environmental pressures

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 pollutant of fossil fuels
- . May play key role in transition of energy paradigm

GAS DRIVERS

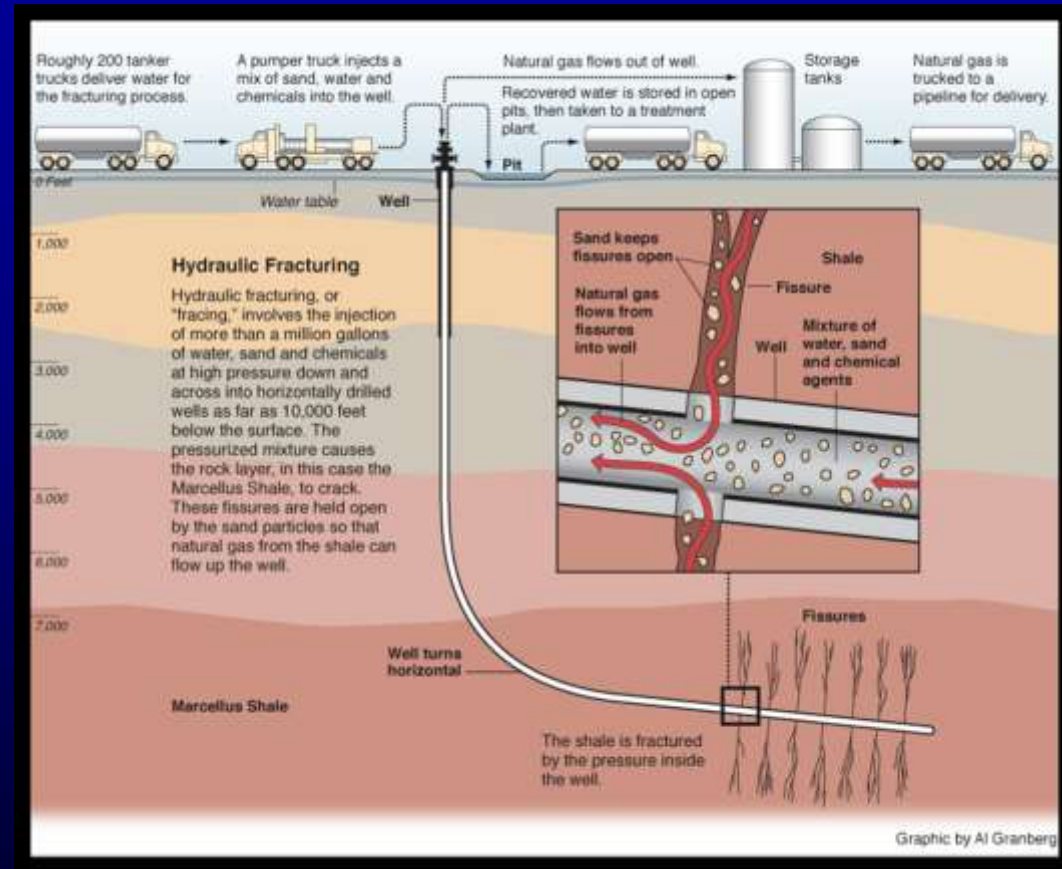
EFFECTS OF JAPAN NUCLEAR CRISIS

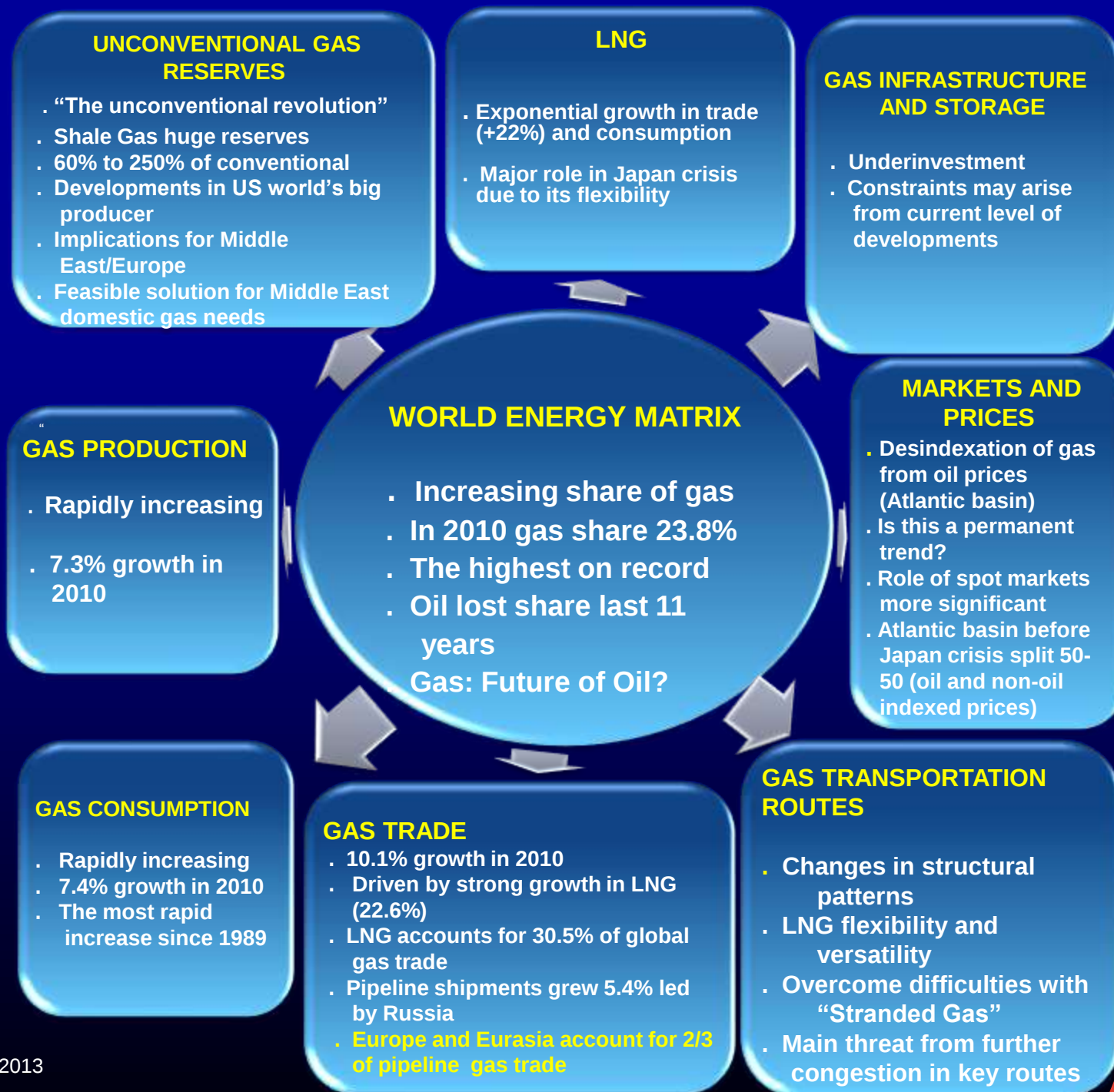
- . Decision of some countries to slowdown nuclear power (Germany, Italy, Japan)
- . Opens a more decisive role for Gas

PRODUCTION SOLUTION: HYDRAULIC FRACTURING

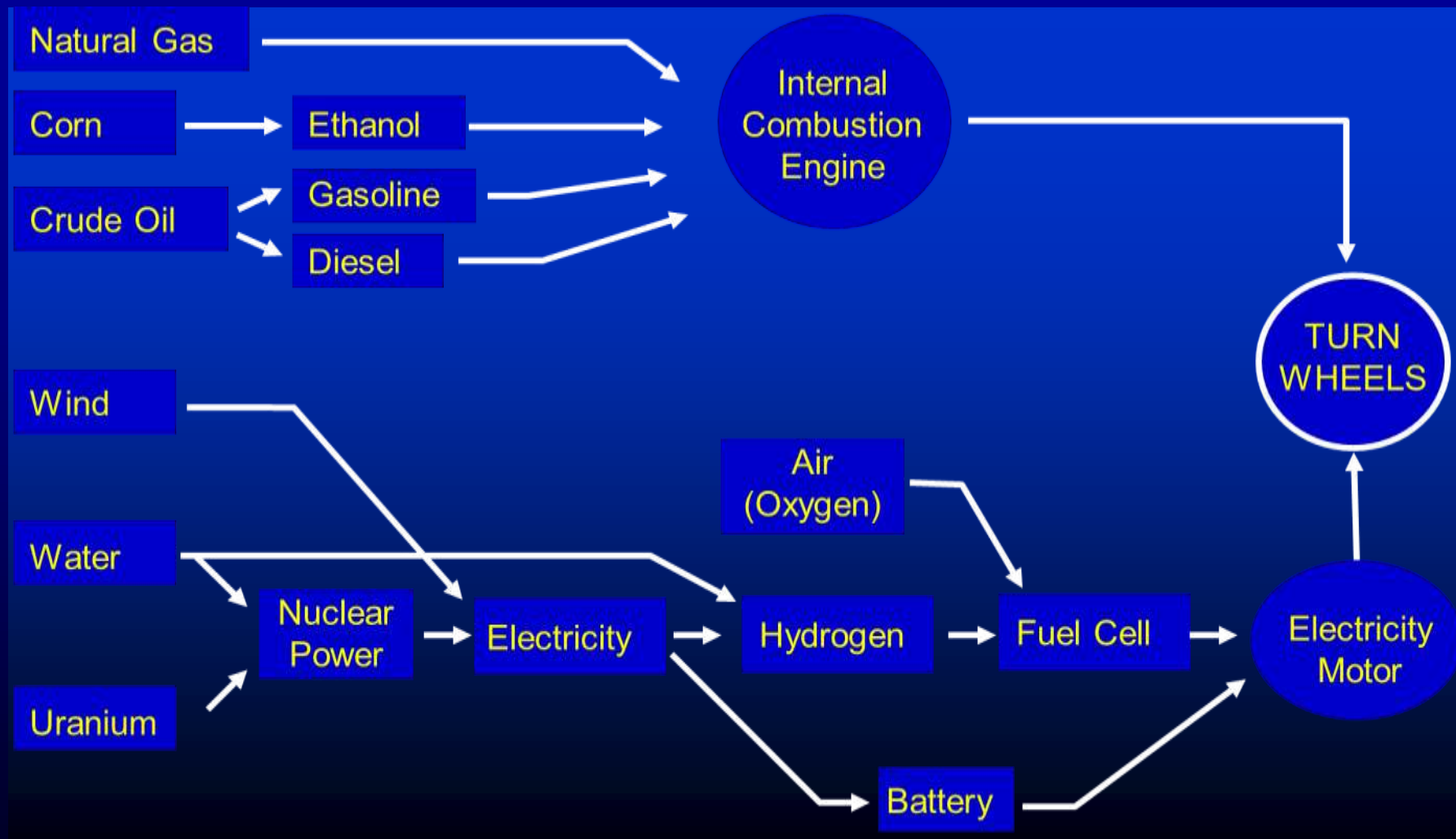
- Fracture Technology is responsible for USA success in gas shales

- Use large amount of water in a short period of time to develop a gas well
- Addition of sand or other material (proppants) to the fluid to keep induced fractures open
- Most wells are horizontal with one or more horizontal legs extending to the target sections
- The legs may extend more than 2 Km from the surface location of the well

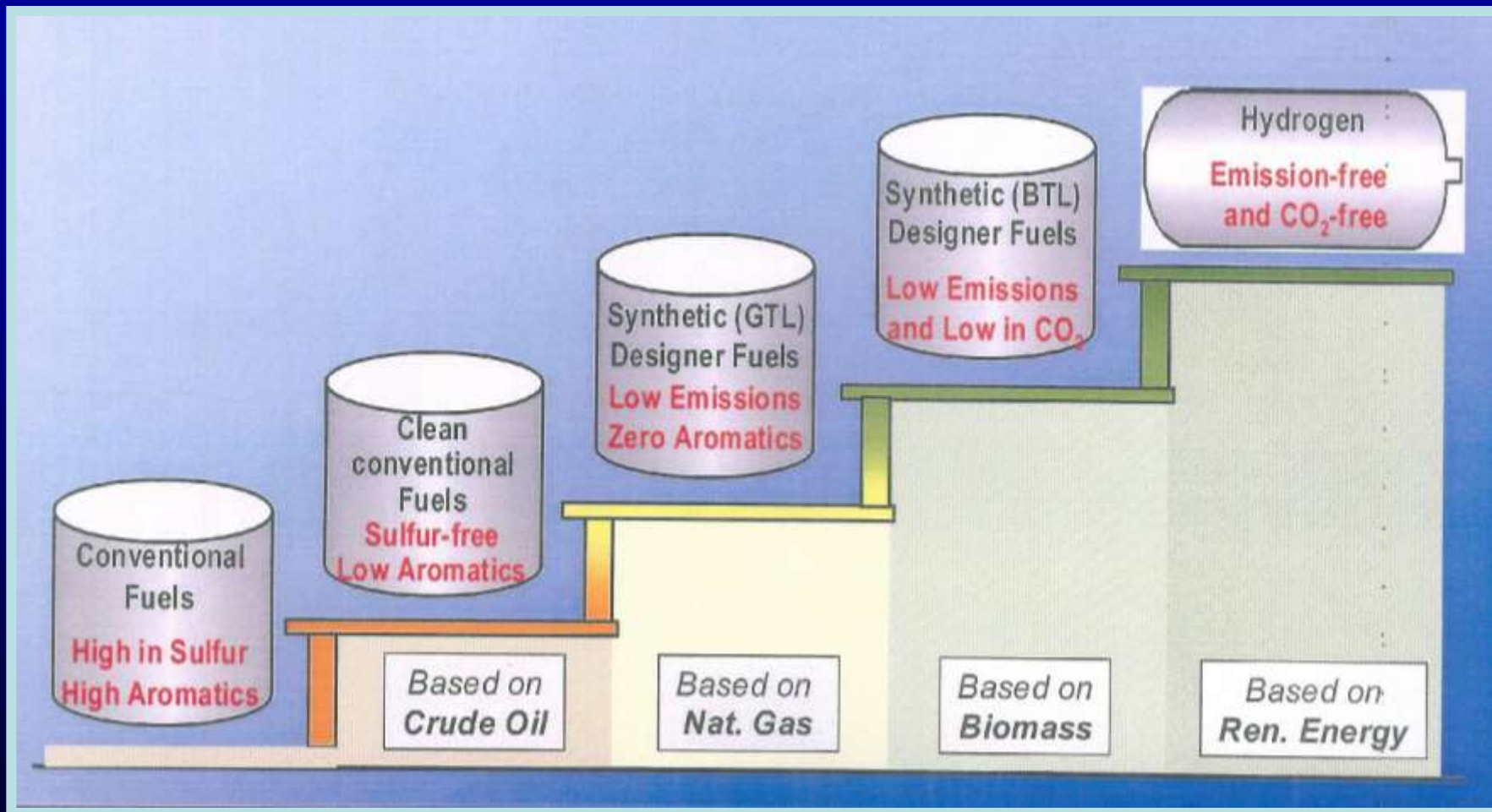




Energy Road Map and Solutions: Many Possible Paths Leading to Same “Destination””



STRATEGIC DEVELOPMENT STEPS OF FUEL



Source: Daimler Chrysler/Research Technology 2003

HOW IT WILL CHANGE?

Next 20 years impact will be incremental

It takes time to get large scale projects and MASS PRODUCTION

CERA projections: by 2030 plug-in and electric cars could be 25% of new CAR SALES

Slow turnover of car fleet may limit initial reduction on fuels consumption

Impact will grow after this period

Greater efficiency in internal combustion engines, advanced diesels and regular hybrids will play major impact on near future

THE FUTURE of WORLD ENERGY MATRIX

IEA : Global Energy use will increase 50% (2006-2030)

By 2030 oil still provides 30% of world's energy

To smooth the DEMAND growth it is not possible to roll back economic growth

WHAT IS THE SOLUTION?

Find new technologies

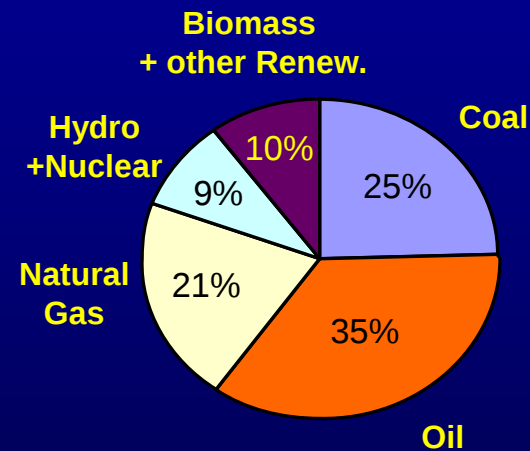
Find alternatives to oil that can be:

- Economically competitive
- Convenient
- Reliable

4. O PAPEL das TECNOLOGIAS e a EVOLUÇÃO em CURSO

THE DOMINANT OIL MODEL

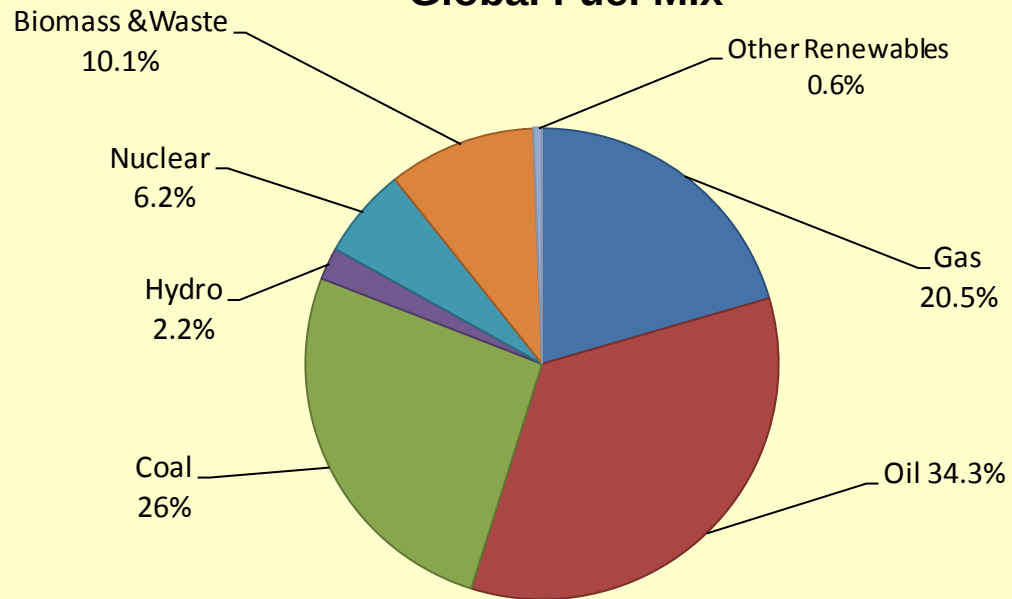
- Centered in oil and fossil fuels -



- KEY FEATURES**
- Centered - oil model
 - No diversity
 - Flow in one direction
 - No good energy mix
 - Heavy and costly
 - No flexibility

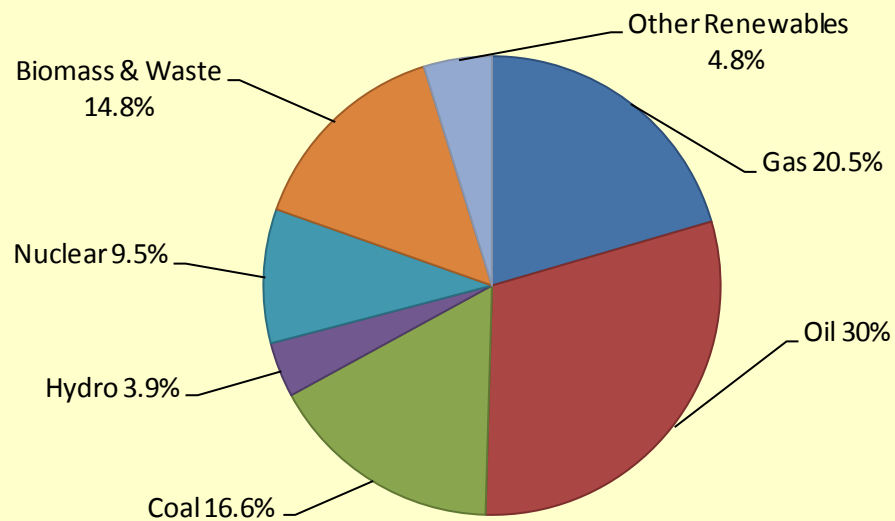
Global Fuel Mix 2006

Global Fuel Mix



Source: IEA World Energy Outlook 2008

Global Fuel Mix 2030 - 450 Policy Scenario



Source: IEA World Energy Outlook 2008

EDIFÍCIOS

- . Revolução na Iluminação:
20% electricidade mundial
- . LED/SSL
- . Construção: o ambiente envolvente
- . O Desempenho Energético
- . “Zero-Energy Homes”
 - A Microgeração

Tecnologias Emergentes: Descarbonizar a Economia

- . Eficiência Energética
- . Competitividade Económica
- . Segurança
- . Sustentabilidade Ambiental

TRANSPORTES

- . Carros Eléctricos
- . Fuel cells/Hidrogénio
- . Biocombustíveis de 2ª GERAÇÃO
- . GTL
- . CTL
- . BTL
- . Propulsão Química:
 - Indústria Espacial;
compostos
de hidrogénio
- . Motores a PLASMA
(Vasimir/NASA)
- . A Revolução dos hidrinos:
 - propulsão a baixa pressão e
plasmas mistos de hidrogénio
(solução Blacklight Power)

NANOTECNOLOGIAS

- . Produção/Armazenamento de Energia
- . Eficiência Energética
- . Novas técnicas de processamento de hidrocarbonetos

GERAÇÃO ELÉCTRICA E TÉRMICA

- . Sequestro e armazenamento do Carbono:
 - Pós-Combustão
 - Pré-Combustão
 - Oxy-Fuel
- . Electricidade 30% mais cara
- . “CLEAN COAL”: FUTUREGEN (EUA): 1ª Central integrada
 - PRODUÇÃO Electricidade + Hidrogénio com sequestração de CO₂
- . Gaseificação do Carvão: conversão em gás (H+OC)
- . Produção Hidrogénio
- . Energias Renováveis:
 - Eólica/Solar/Ondas/Geotérmica/Biomassa
- . Energia Nuclear: 3ª e 4ª Geração

“SMART GRIDS”

- . Produtor / Consumidor
- . Redes distribuídas e descentralizadas

HOW TO MINIMIZE CO₂ EMISSIONS?

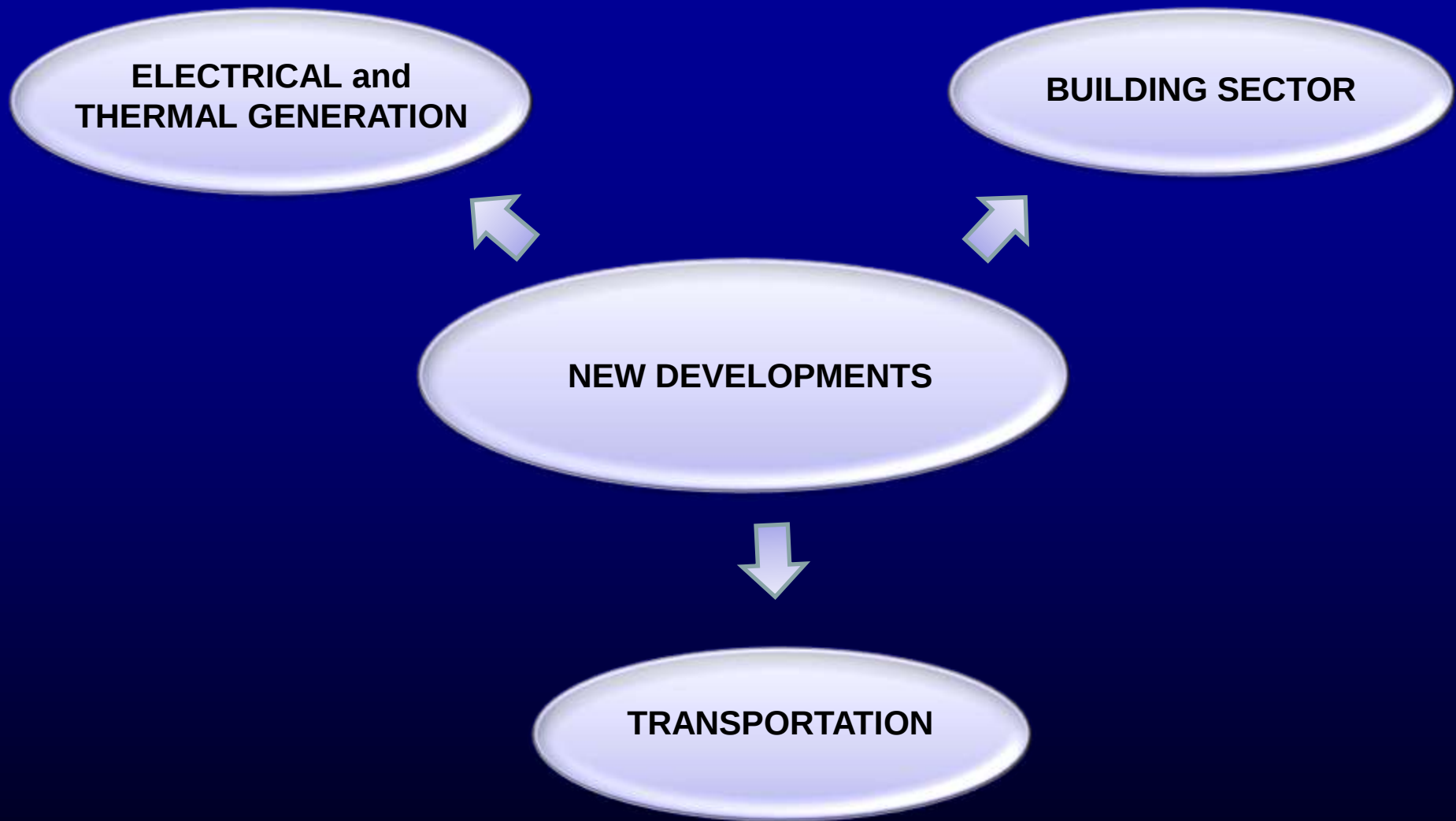
POWER- GENERATION

- ▶ CO₂ SEQUESTRATION
- ▶ UNDERGROUND STORAGE
- ▶ CLEAN-COAL TECHNOLOGY

TRANSPORTS SYSTEM

- ▶ HYBRID CARS (Combustiv + Electric Motors) - Minim. CO₂ Emissions
- ▶ FLEXI-FUEL (Biofuels + Conventional) - Low CO₂ Emissions
- ▶ GTL (With Diesel) - Low CO₂ Emissions
- ▶ HYDROGEN (Fuel-Cells) - No CO₂ Emissions

ENERGY EMERGING TECHNOLOGIES



ENERGY EMERGING TECHNOLOGIES

BUILDING SECTOR

TECHNOLOGIES	STATUS and EFFECTS
• SOLID-STATE lighting (SSL) ▪ Semi-conductor diode ▪ Organic-light diode	• Commercially Available • Lighting accounts for 15-20% of energy consumption in buildings
• ZERO-ENERGY HOMES ▪ Solar water heating ▪ PV technologies ▪ Micro-Generation	• Reduce significantly annual net consumption of primary energy • Explore full potential of renewable resources

ENERGY EMERGING TECHNOLOGIES

ELECTRICAL and THERMAL GENERATION SECTOR

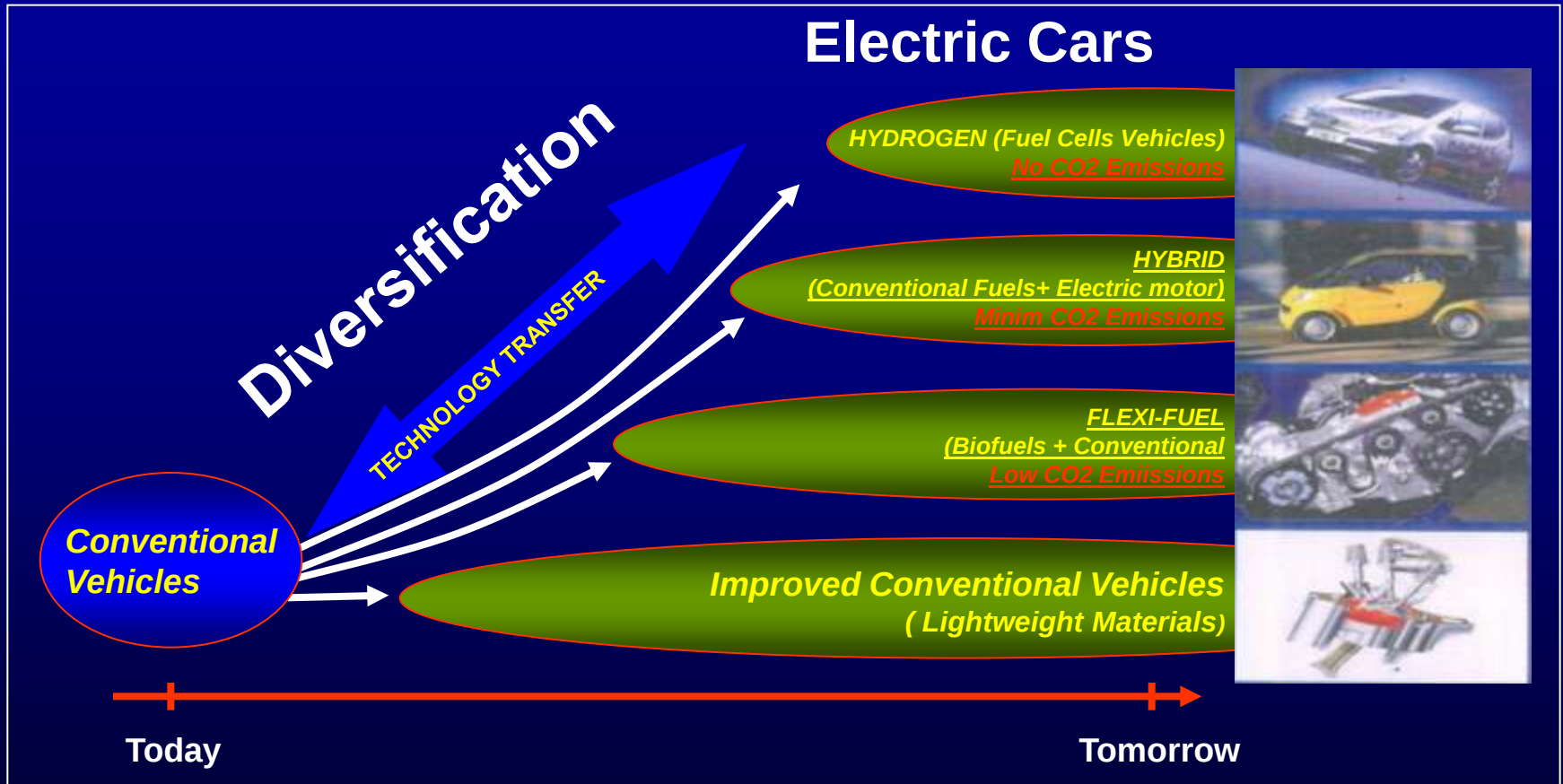
TECHNOLOGIES	STATUS and EFFECTS
● CARBON CAPTURE SEQUESTRATION ▪ Use of amine scrubbers (amines react with CO₂) ● CARBON STORAGE (Depleted oil/gas fields; Coalbeds; Saline Formations; Ocean)	▪ Allow continued use of fossil fuels minimizing CO₂ emissions ▪ Currently too costly ▪ Not yet commercial available: Pilot Projects ▪ Conoco/Shell/Scottish/Southern Energy Project ▪ UE Elstam project in Denmark
● ADVANCED FUEL CELLS ▪ Different materials; operate at different temperatures ▪ STATIONARY POWER Fuel Cells (can be connected to the electricity grid) ▪ PHOSPHORIC ACID Fuel Cells (operate at low temperature ; efficiency rates of 37 to 42%) ▪ MOLTEN CARBONATE Fuel Cells (use nickel; can achieve 50% efficiency)	▪ Operate similar to batteries but do not lose their charge ▪ Rely on a supply of hydrogen ▪ Costs have been reduced but still high ▪ Some like MOLTON cells are operated experimentally as power plants ▪ Two obstacles: costs / hydrogen supply

ENERGY EMERGING TECHNOLOGIES

ELECTRICAL and THERMAL GENERATION SECTOR

<i>TECHNOLOGIES</i>	<i>STATUS and EFFECTS</i>
• NANOTECHNOLOGIES • Thin Solar Silicon Panels • Light Materials	▪ FOCUS on NANOMETER SCALE ▪ Potential Larger IMPACT in BUILDING PHILOSOPHY

TRANSPORTS: NEW PARADYGM



ENERGY EMERGING TECHNOLOGIES

TRANSPORTATION SECTOR

<i>TECHNOLOGIES</i>	<i>STATUS and EFFECTS</i>
• NEW LIGHT-DUTY VEHICLES ▪ ENGINE (variable valve timing and lift; camless valve actuation; friction reduction) ▪ TRANSMISSION (variable transmissions; six-speed; electronic controls to improve efficiency) ▪ ADVANCED LIGHT-WEIGHT MATERIALS (high strength alloy steels; aluminium castings; improved aerodynamics) ▪ IMPROVED PUMPS (electronically driven devices)	▪ Improve performance and fuel use ▪ Improve safety and efficiency ▪ In 2004 engines with 4 valves per cylinder installed in 74% of New Cars ▪ Fuel economy may improve 15 to 25% ▪ Synergetic effects by combined efficiency of different technologies ▪ Reduction in costs may result in increased market penetration

ENERGY EMERGING TECHNOLOGIES

TRANSPORTATION SECTOR

TECHNOLOGIES	STATUS and EFFECTS
• SYNTHETIC FUELS ▪ GAS –TO-LIQUIDS (GTL) (Distillate is primary product; 50-70% of total yield; can use natural gas with high CO2 content; need to improve the thermal efficiency of GTL process; suite of integrated GTL technologies not been used on a commercial scale)	▪ Chemical conversion of natural gas into petroleum fuels ▪ Reaction with air (or oxygen) to produce syngas which is fed into a Fischer-Tropsch reactor ▪ Significant costs of GTL plants ▪ GTL is profitable when oil prices exceed 25 US\$/BBL ▪ Economics of GTL are extremely sensitive to cost of GAS
• COAL-TO-LIQUIDS (CTL) ▪ Indirect coal liquefaction ▪ Direct coal liquefaction	▪ Transforms coal into liquid fuels ▪ CTL is competitive at oil price 30 US\$/BBL ▪ Require economies of scale ▪ Direct conversion shows greater efficiency

ENERGY EMERGING TECHNOLOGIES

TRANSPORTATION SECTOR (Cont.)

TECHNOLOGIES	STATUS and EFFECTS
• BIOMASS TO LIQUIDS (BTL) ▪ Gaseification technology based on CTL process; BTL reaction is exothermic and requires a catalyst; there are 13 known processes; BTL technology at pilot-plant stage development	▪ Production of fuels from waste wood and other non-food plant sources ▪ Does not conflict with increasing food demands ▪ 5 tons of Biomass yields 1 ton of BTL ▪ 1 hectare of land generates 4 tons of BTL ▪ BTL fuels more expensive than gasoline or diesel ▪ Competitive with oil at 80 US\$/BBL

ENERGY EMERGING TECHNOLOGIES

TRANSPORTATION SECTOR (Cont.)

TECHNOLOGIES

- **RENEWABLE FUELS OR BIOFUELS**

- **ETHANOL PRODUCTION** (Technology mature for corn-based and sugar-based ethanol; is the most widely used biofuel; produced by fermenting sugars with yeast enzymes that convert glucose to ethanol;

BASICALLY there are two Ethanol Production Technologies

- Sugar fermentation
- Cellulose conversion

Variety of feedstocks like forest waste, grasses, municipal waste)

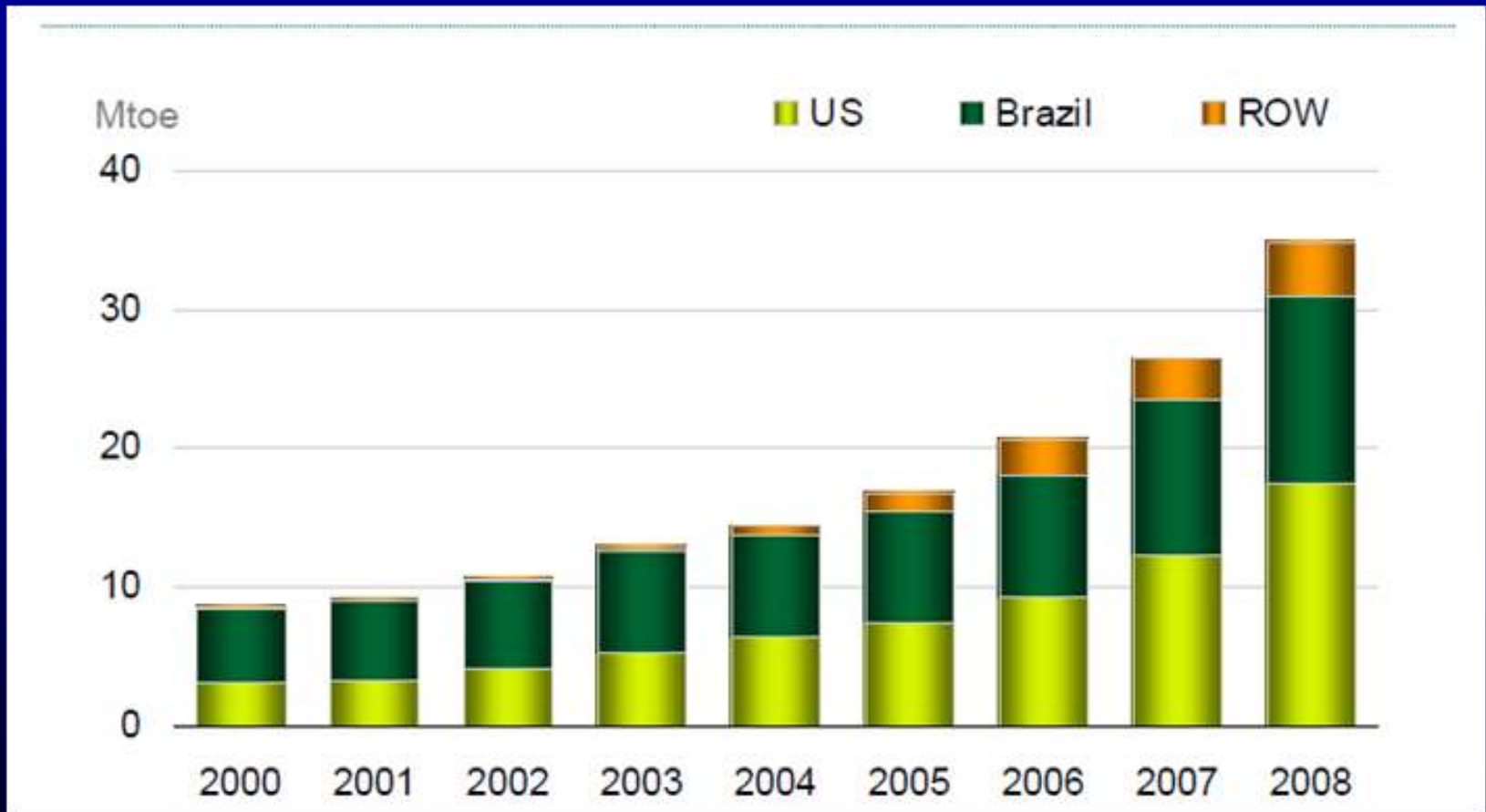
- Can be blended with conventional fuels (diesel/gasoline)
- Production costs are 2 or 3 times more expensive than conventional fuels
- Costs reduction through production scale
- Challenge is to secure sufficient raw material feedstock
- Production Biofuels requires significant land use
- Capital costs for a corn-based ethanol range from 21000 to 33000 USD/Barrel of capacity
- Risk: drought which can limit the feedstocks
- Competition with food supply is an issue
- In the US ethanol production is limited to 12 billion gallons to avoid to disrupt food markets

ENERGY EMERGING TECHNOLOGIES

TRANSPORTATION SECTOR (Cont.)

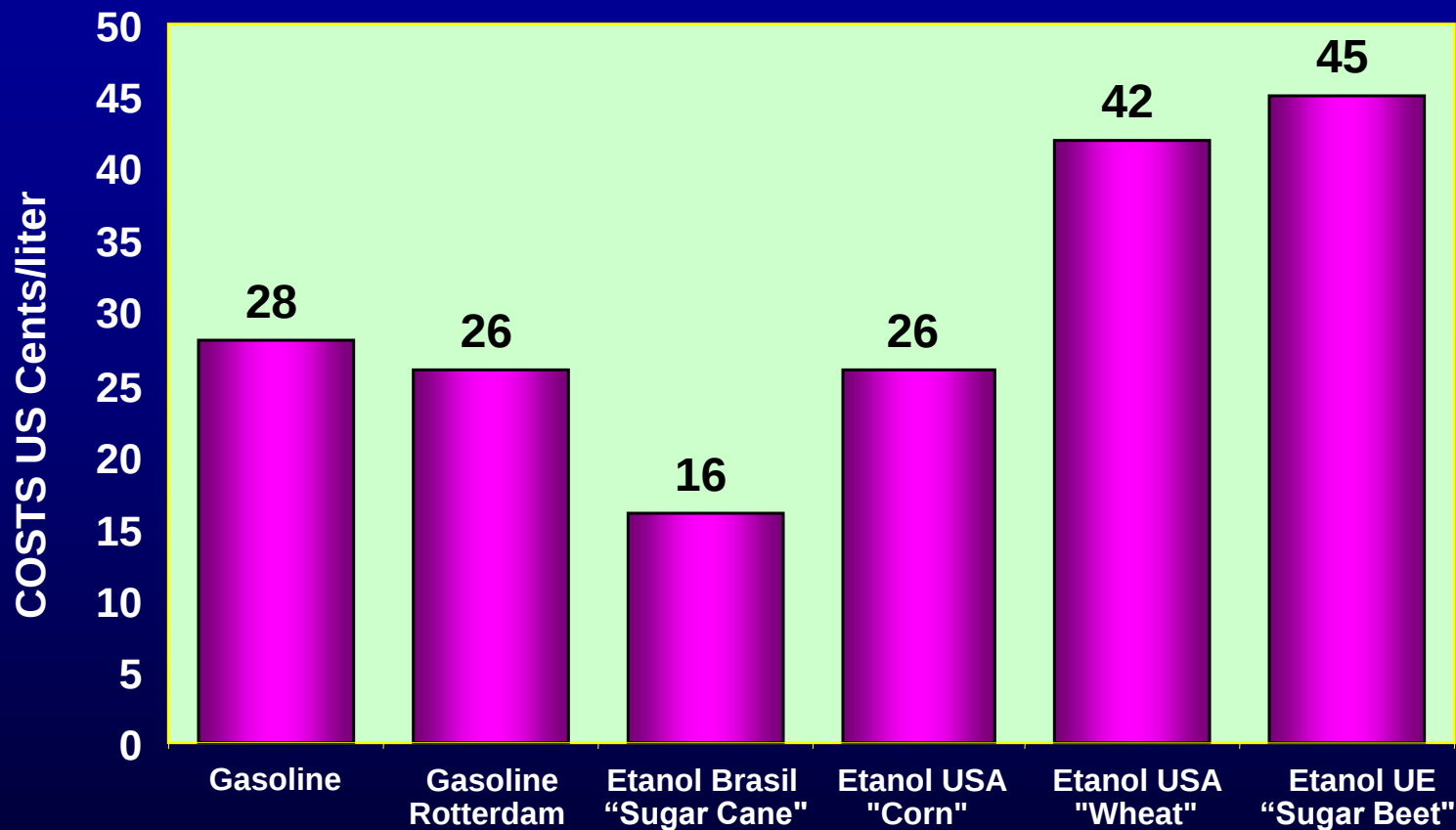
▪ BIODIESEL PRODUCTION (Technology is mature and proven; feedstock undergoes an esterification process which removes glycerin and allows the oil to perform like traditional diesel; used mainly as additive to conventional diesel)	▪ Can be produced from Soybean oil, palmoil, rapeseed oil, sunflower oil ▪ Risk of blend instability and tendency to form an insoluble matter ▪ Capital costs similar to ethanol ranging from 9800 to 29000 UD\$/barrel of capacity ▪ Can be used in stationary applications (heat and power generation)
● NANOTECHNOLOGY ▪ Very strong, very light materials that can revolutionise the transport system	▪ Applications in the industrial sector could yield into a new revolution ▪ Reduce per capita energy consumption ▪ Potential impacts on human health to be addressed ▪ Applications on energy still at speculative stage

Global Ethanol Production



Source: BP Statistical Review of World Energy June 2009

ETHANOL VS. GASOLINE PRODUCTION COSTS



Source: F. O. Light's, 2005

BALANÇO ENERGÉTICO NA PRODUÇÃO DE ETANOL

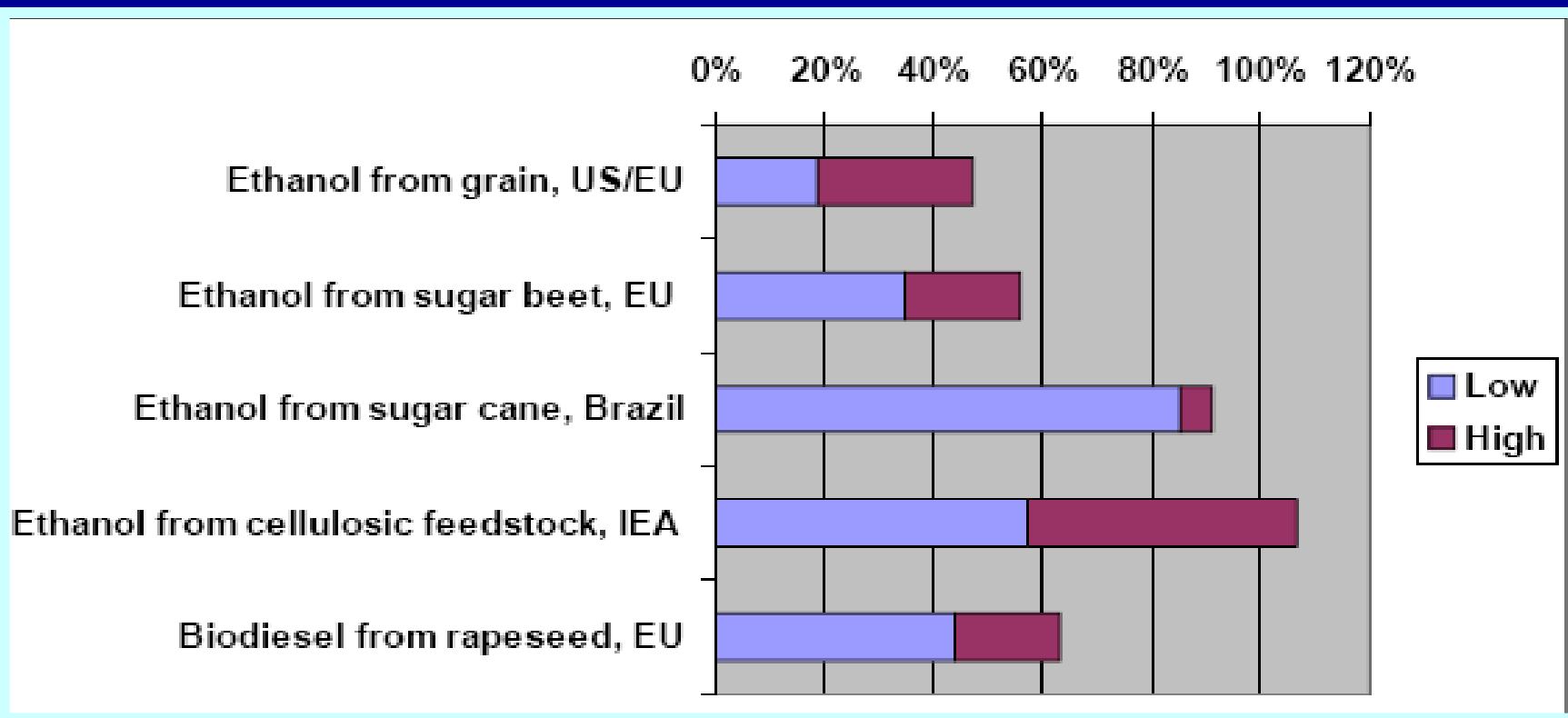
MATERIAL UTILIZADO	OUTPUT/INPUT DE ENERGIA
MILHO	1.3 – 1.8
TRIGO	1.2
CANA-DE-AÇUCAR	8.3

Fontes: F. Licht e Macedo (2004)

BIODIESEL BENEFITS

- **Help mitigate CO₂ Emissions**
- **US DOE and DOA 1998 Study: Biodiesel reduces net CO₂ emissions by 78% compared to Petroleum Diesel.**
- **Help ensure National Energy Security through replacing imported Petroleum Products with domestic alternative fuels.**
- **Biodiesel closed carbon cycle: CO₂ released into atmosphere when BioDiesel is burned is recycled by growing plants.**
- **Biodiesel can be operated at any diesel engine with little or no modification.**

COMPARISON OF CO₂ REDUCTIONS FROM BIOFUELS (Ethanol and Biodiesel) COMPARED RESPECTIVELY WITH GASOLINE AND DIESEL



Source: IEA

OS PRINCIPAIS POLUIDORES E O PROTOCOLO DE QUIOTO

- . EUA não ratificaram
- . China e Índia?
- . Distribuição assimétrica de emissões
- . Até 2025 as emissões na China vão subir 118%
- . O efeito de Kuznetz

TRANSPORTES

- . 95% da Frota Mundial depende do petróleo
- . 1985-2005: 950 mt para 2500 mt

EQUAÇÃO ENERGÉTICA

- . Como responder ao desenvolvimento económico e ao crescimento demográfico?
- . Economias emergentes consomem 50% da energia e são responsáveis por 80% do aumento do consumo nos últimos 5 anos
- . Parque Automóvel: até 2030 cresce 4 vezes
- . Urbanização/Industrialização/Motorização
- . Planeta consumiu 11.400 Mtep e emitiu 27.000 Mt CO₂ (2007)
- . 2000-2030: consumo de energia vai crescer 60% (17.700 Metp) e emissões CO₂ precisam descer 15% (23.000 Mt)

UM MUNDO SEM CO₂?

DESENVOLVIMENTO ECONÓMICO DOS PAÍSES EMERGENTES E ENERGIA

- . Carvão: 70% da matriz energética da China
- . China: em cada 5 dias há uma nova central a carvão
- . EUA/CHINA/ÍNDIA: a relação com o carvão
- . Consumo do carvão é o que mais cresce: 5% ao ano
- . A ineficiência energética: China consome 7 vezes mais recursos que Japão/Unidade PIB

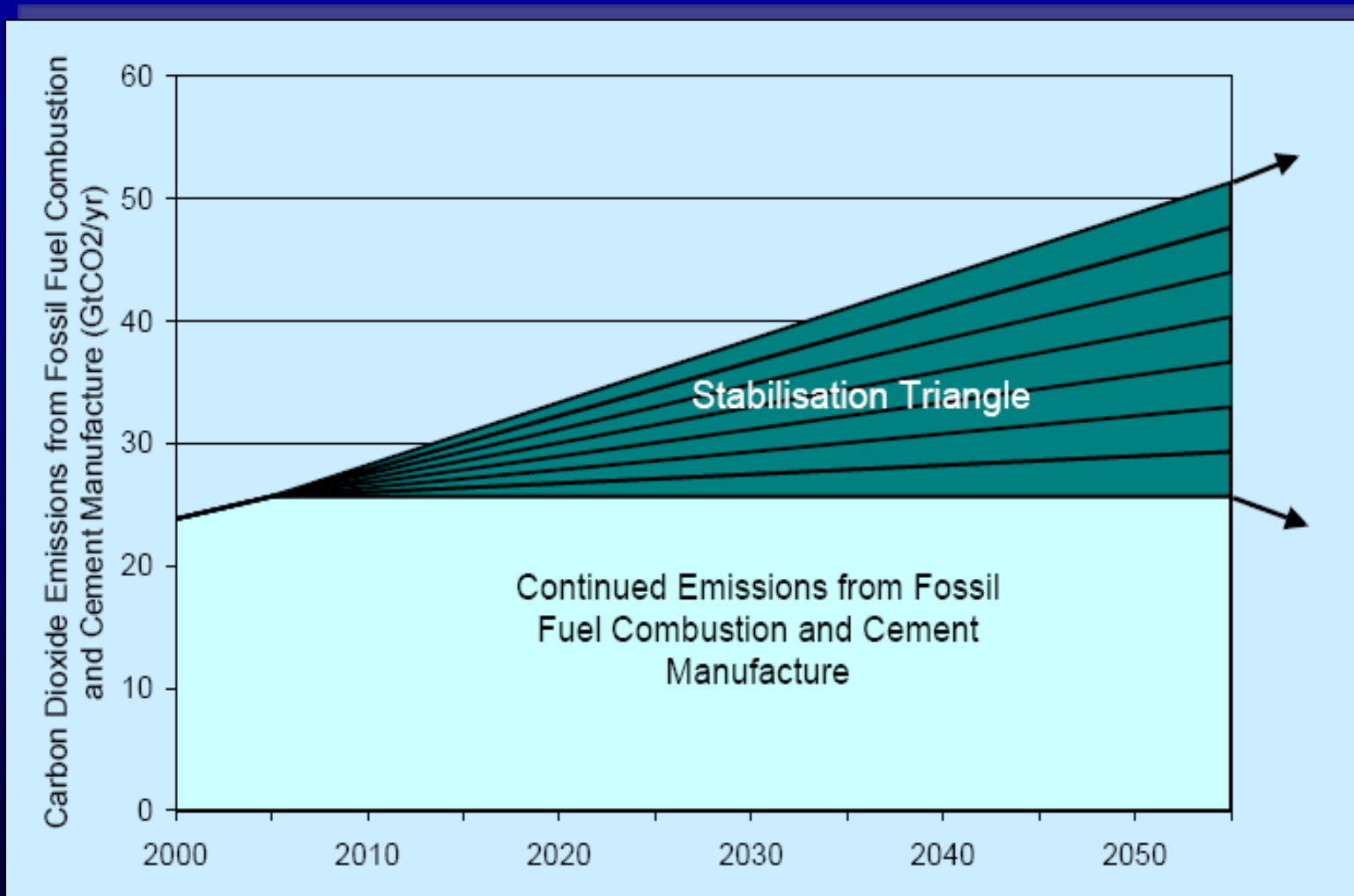
“DESIGN MECHANISM” para a Redução das Emissões de CO₂

- . “Cap-and-trade” não é o ideal
- . Papel entidades financeiras que dominam o mercado e aprisionam os ganhos
- . Os recursos financeiros NÃO financiam as inovações Tecnológicas que reduzem as emissões
- . 1990-2005: Emissões CO₂ aumentaram 35% no mundo

“GAS FLARING”

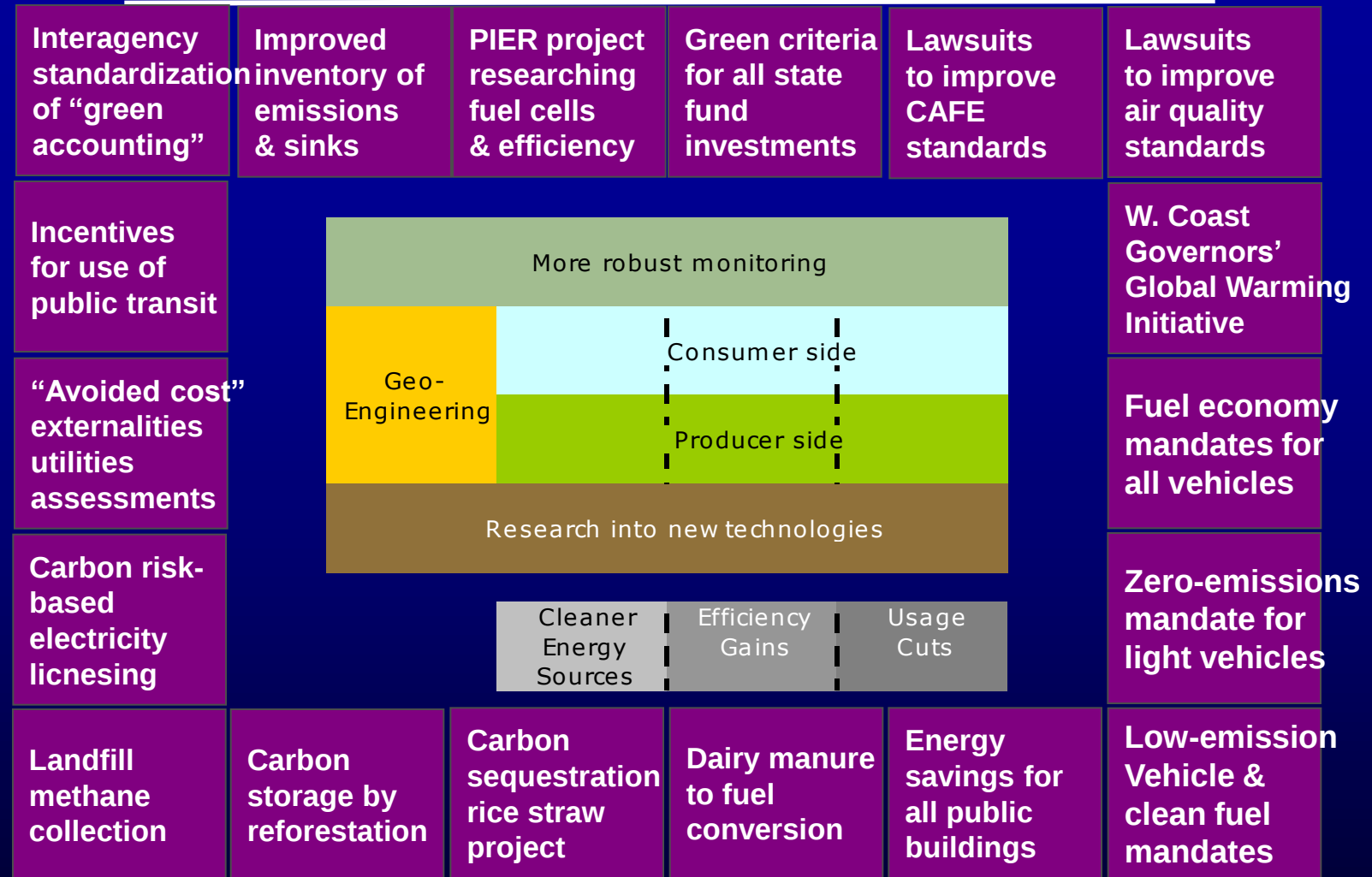
- . Planeta queima 150 mil milhões m³ gás/ano.
- . Consumo da América Latina e Central mais 15%
- . Emissão de 400 milhões ton CO₂/ano
- . Eliminação é equivalente a 3.000 projectos do “CLEAN DEVELOPMENT MECHANISM”

Socolow and Pacala's "wedges"



Source: Pacala and Socolow (2004)

GHG Mitigation Policies: The California Experiment



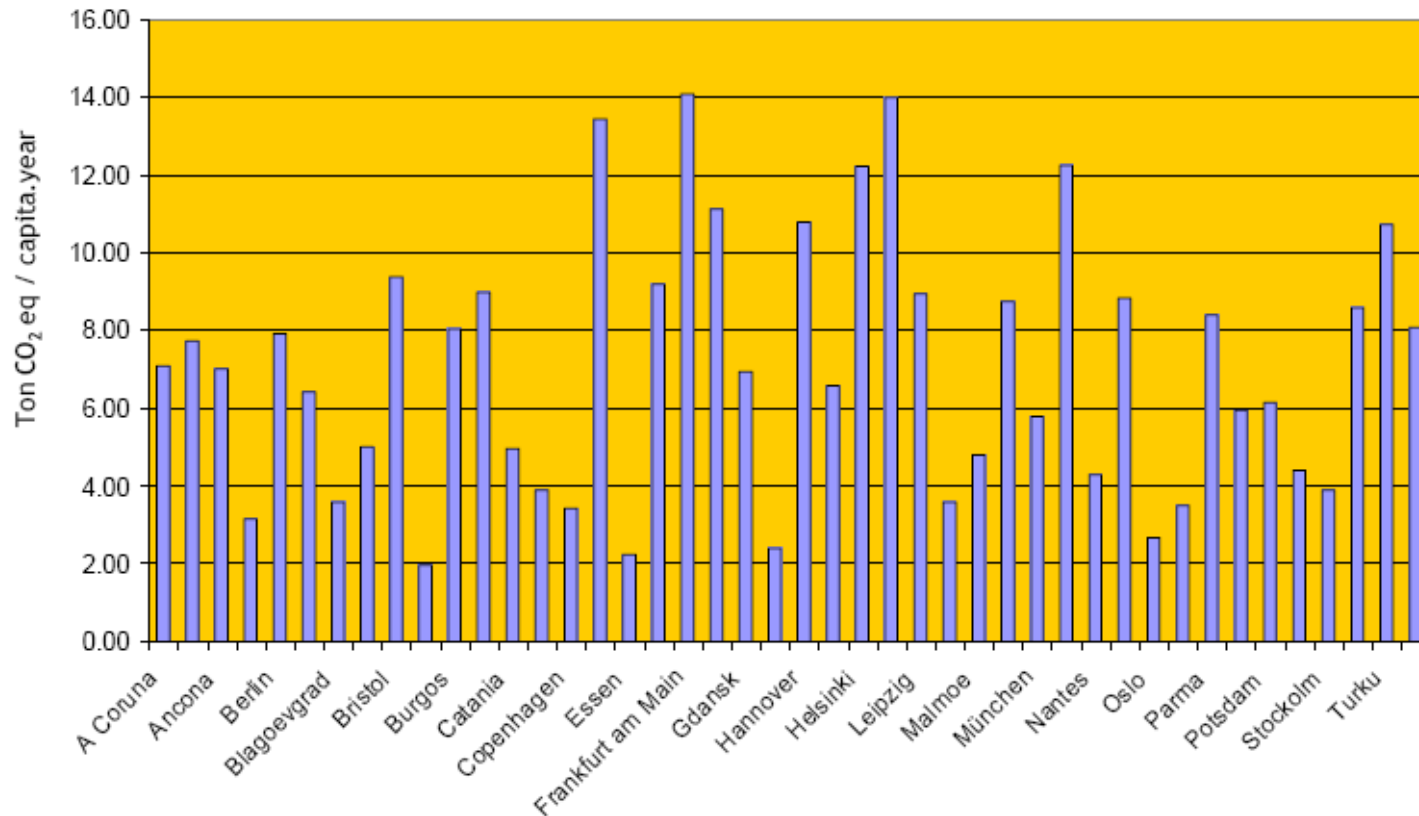
Both an attempt to identify policies that work and a recognition that many different approaches will be required.

Source:



Key Components for CO₂ Reductions: CITIES

Cities Benchmarking (CO₂)

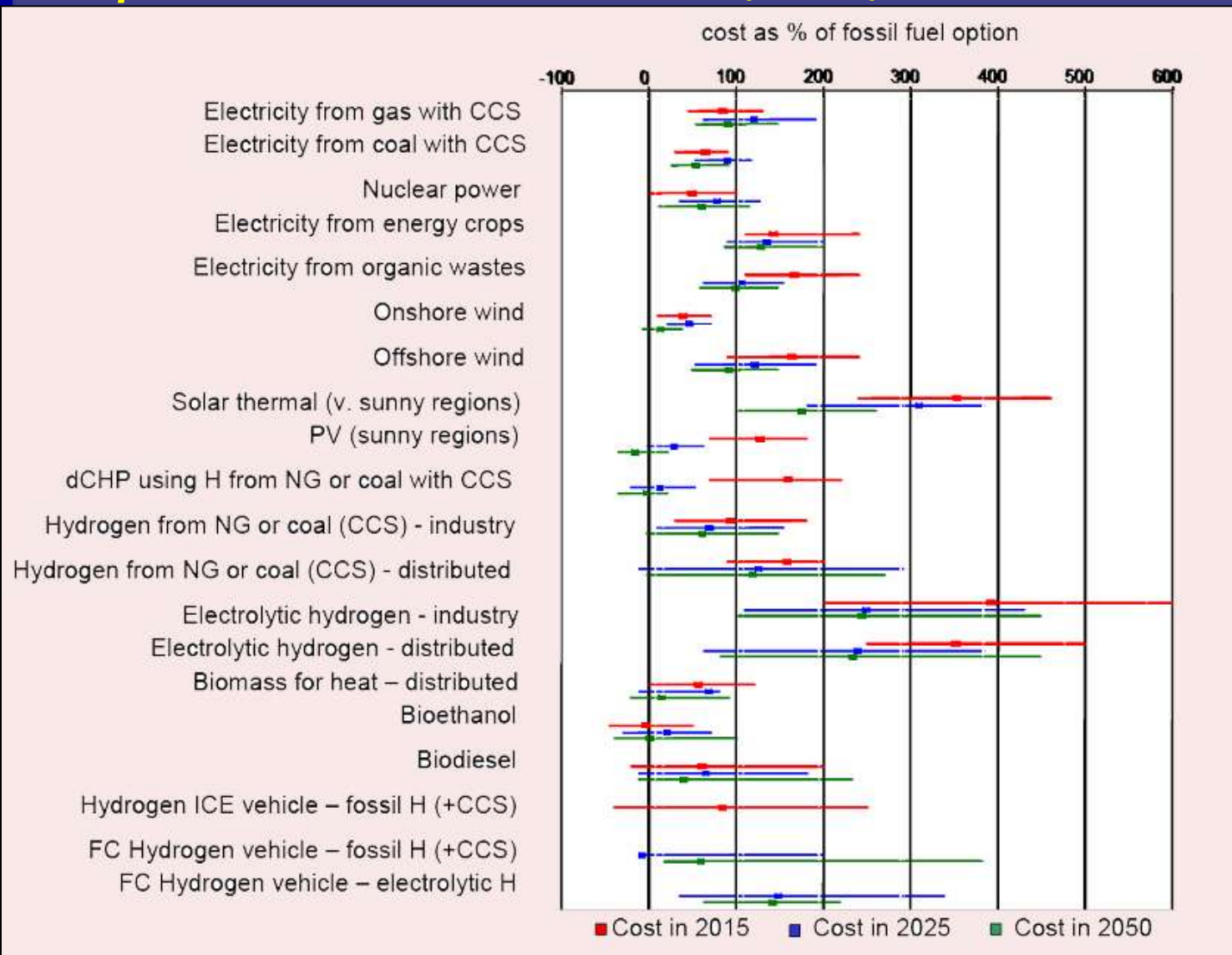


Potentials of Future Fuels and Powertrains



Source: Daimler Chrysler -2003

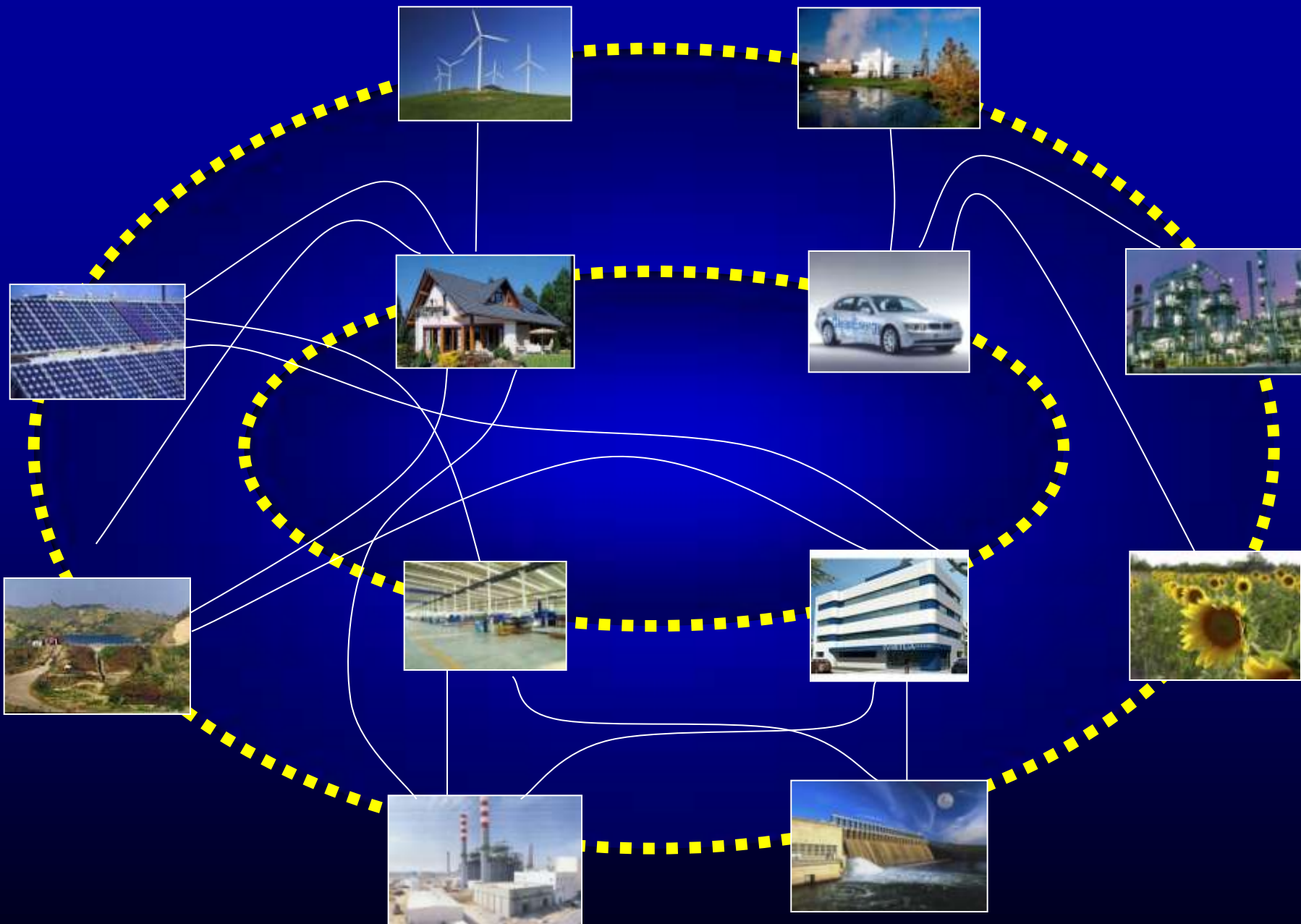
Unit Costs of Energy Technologies: Proposal of fossil-fuel alternative, 2015, 2025 and 2050



Fonte: Nicholas Stern / Denis Anderson published on the Stern Review web site

The FUTURE WORLD ENERGY MARKET

SCENARIOS	FEATURES
MODEL I ▶ “GREENER FOSSIL FUELS” MODEL – Existing Model But “Renewed” and “Corrected”	▪ “Clean-coal” technology proves commercial ▪ CO2 Sequestration technology become commercial and competitive ▪ CO2 storage solved without posing environmental concerns ▪ Continued use of fossil fuels with minimum CO2 emissions ▪ Hybrid and flexi-fuel cars prove competitive ▪ BIOFUELS (EthanolBiodiesel) applied to the transport system ▪ GTL/CTL/BTL proved commercially attractive
MODEL II ▶ The “RENEWABLES MODEL”	▪ Micro-generation massive projects in houses, buildings domestic and industrial facilities ▪ Advanced fuel cells provide the bulk of electricity generation capacity ▪ Biofuels become core in transport system ▪ Combination of Hybrid / Flexi-fuel / GTL cars
MODEL III ▶ The “HYDROGEN MODEL” - Most DISRUPTIVE CASE	▪ Nuclear (not fission as it exists but 4th Generation HTG Reactors + feasibility of Nuclear fusion) provide the bulk for electricity generation ▪ Cheap production of HYDROGEN (as a residual of Nuclear power generation) used as source for the Transport system ▪ Advanced fuel cells using cheap hydrogen and powering the whole transport system



ADFERSIT

Antônio Costa Silva – Presidente da Comissão Executiva

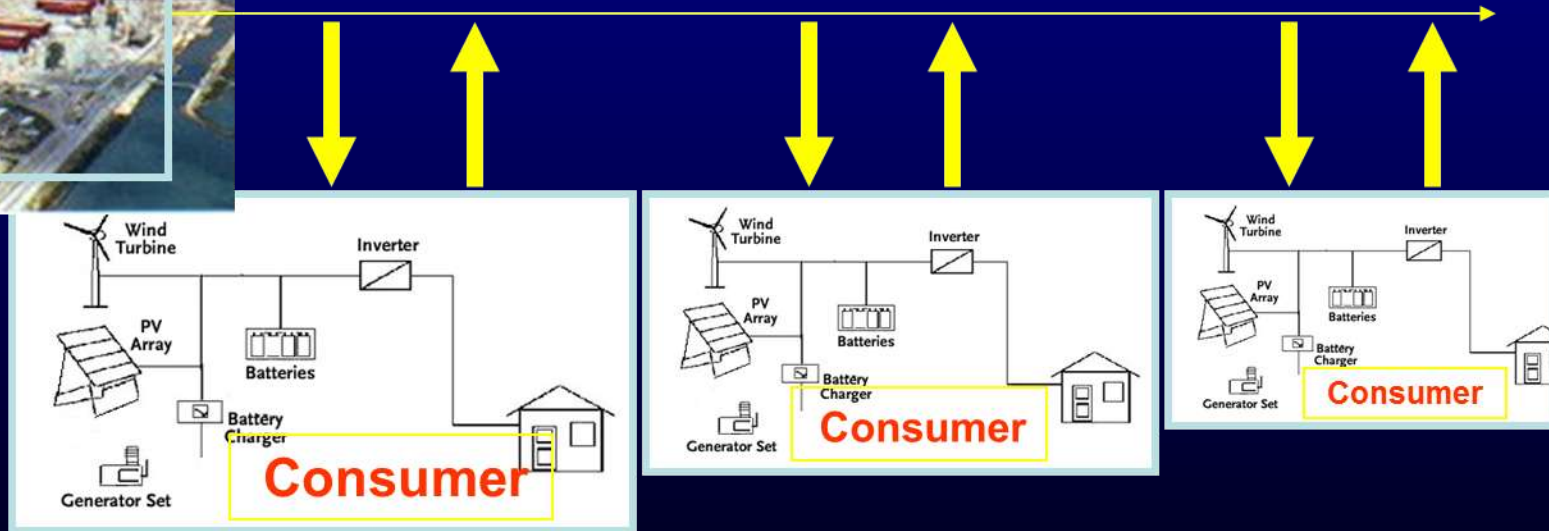
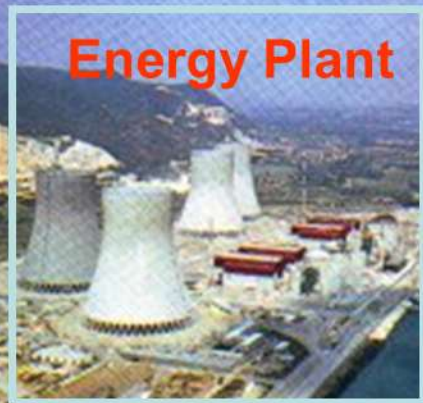
31 Janeiro 2013

75

PARTEX
OIL AND GAS

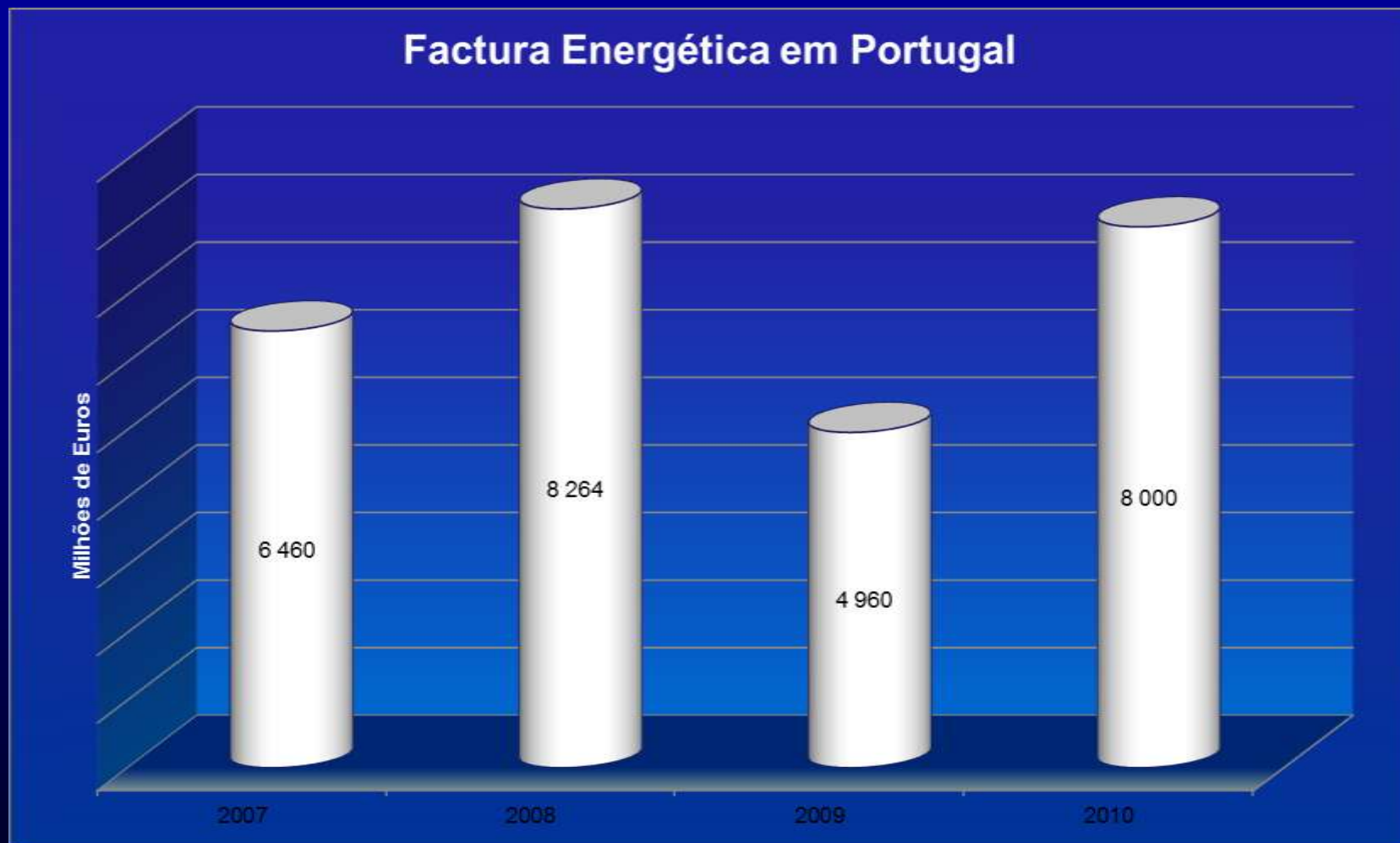
New Concept:

- The consumer is simultaneously producer of Energy
- Flux in both directions
- Focus on interdependent and flexible networks
- The system has not one centre; is multi-centered



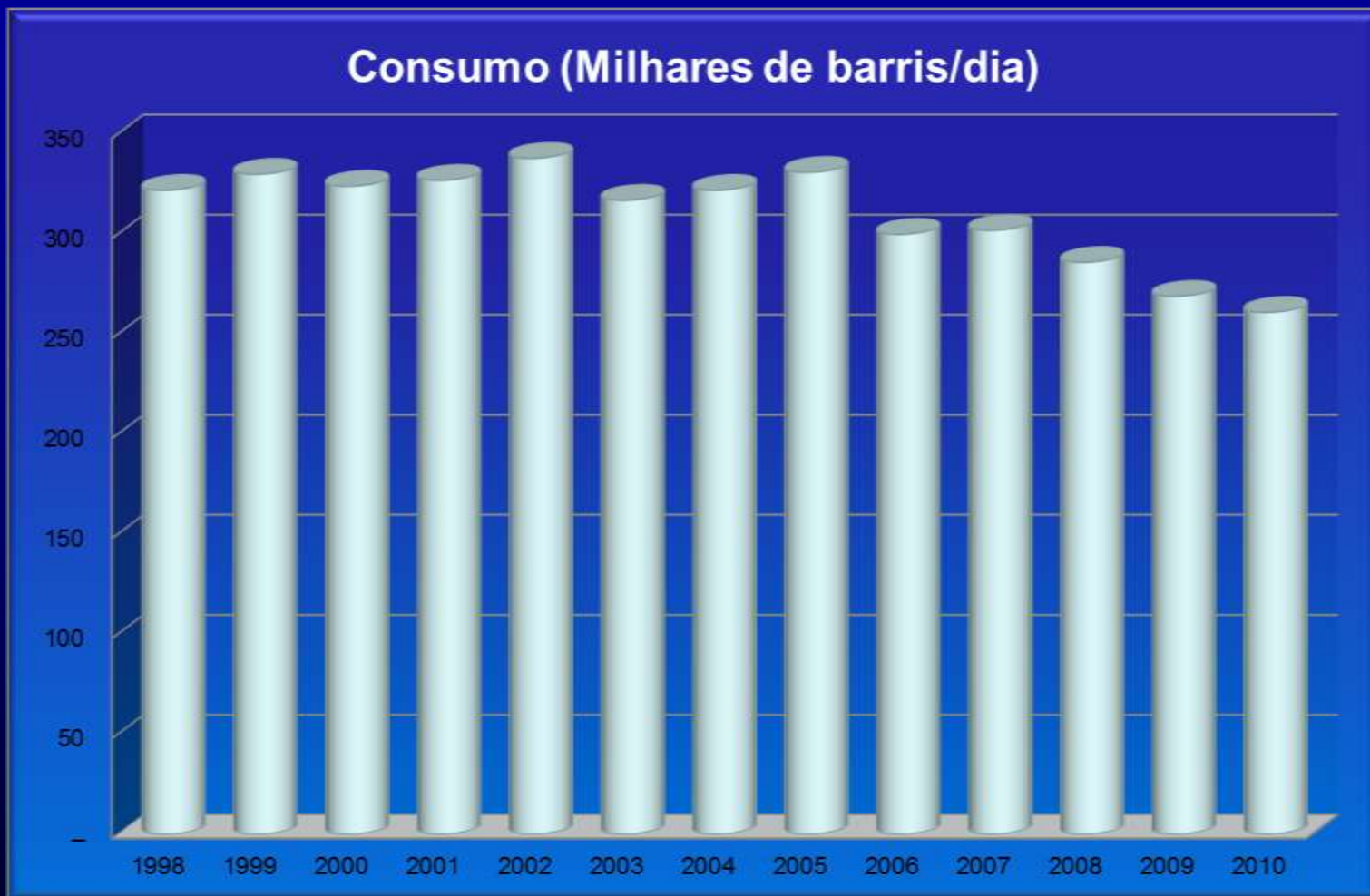
5. O CASO de *PORTUGAL* e o *QUE FAZER?*

Impacto Económico da Dependência Excessiva de Combustíveis Fósseis



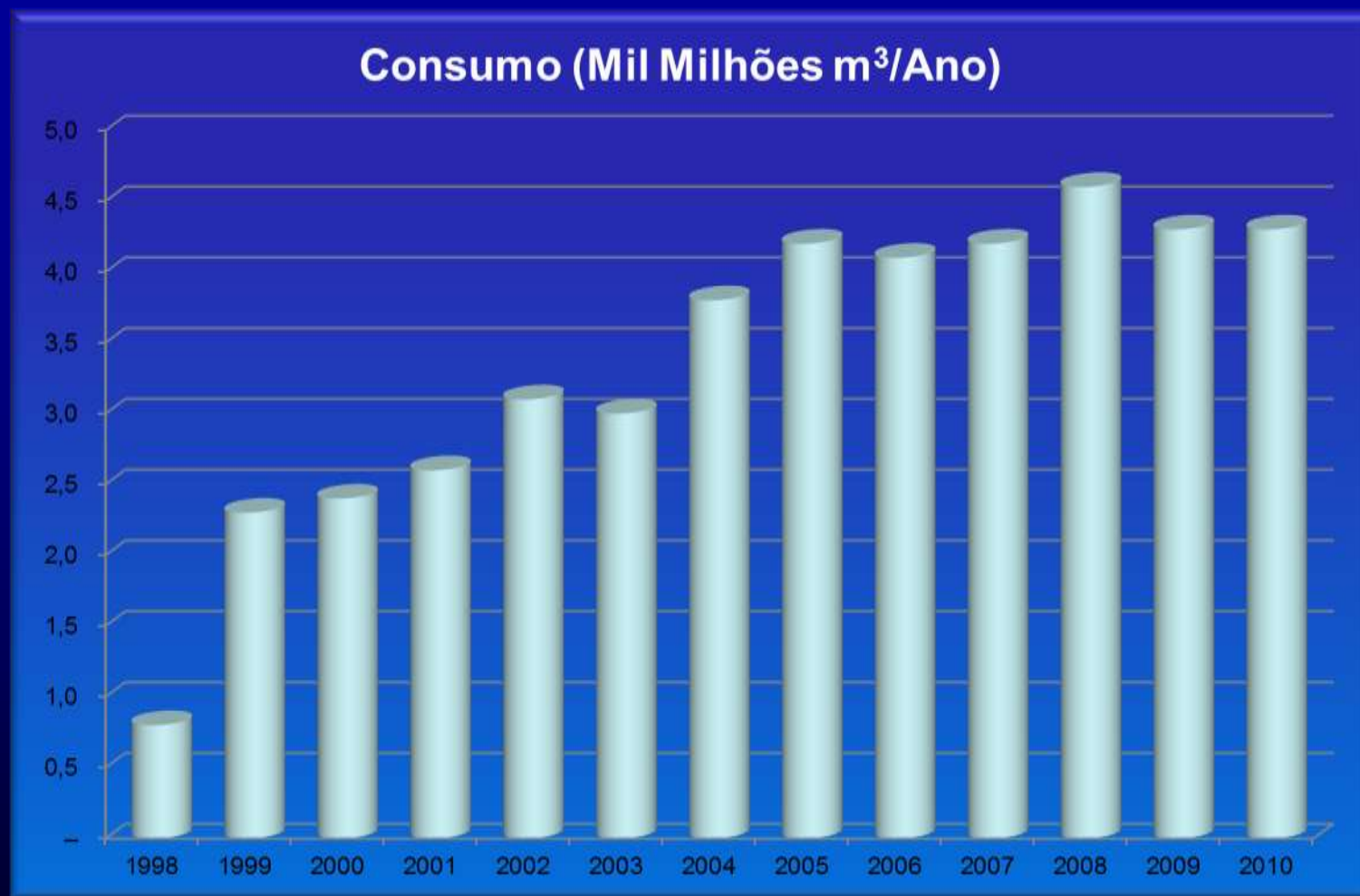
Fonte: DGEG

Evolução do Consumo de Petróleo em Portugal



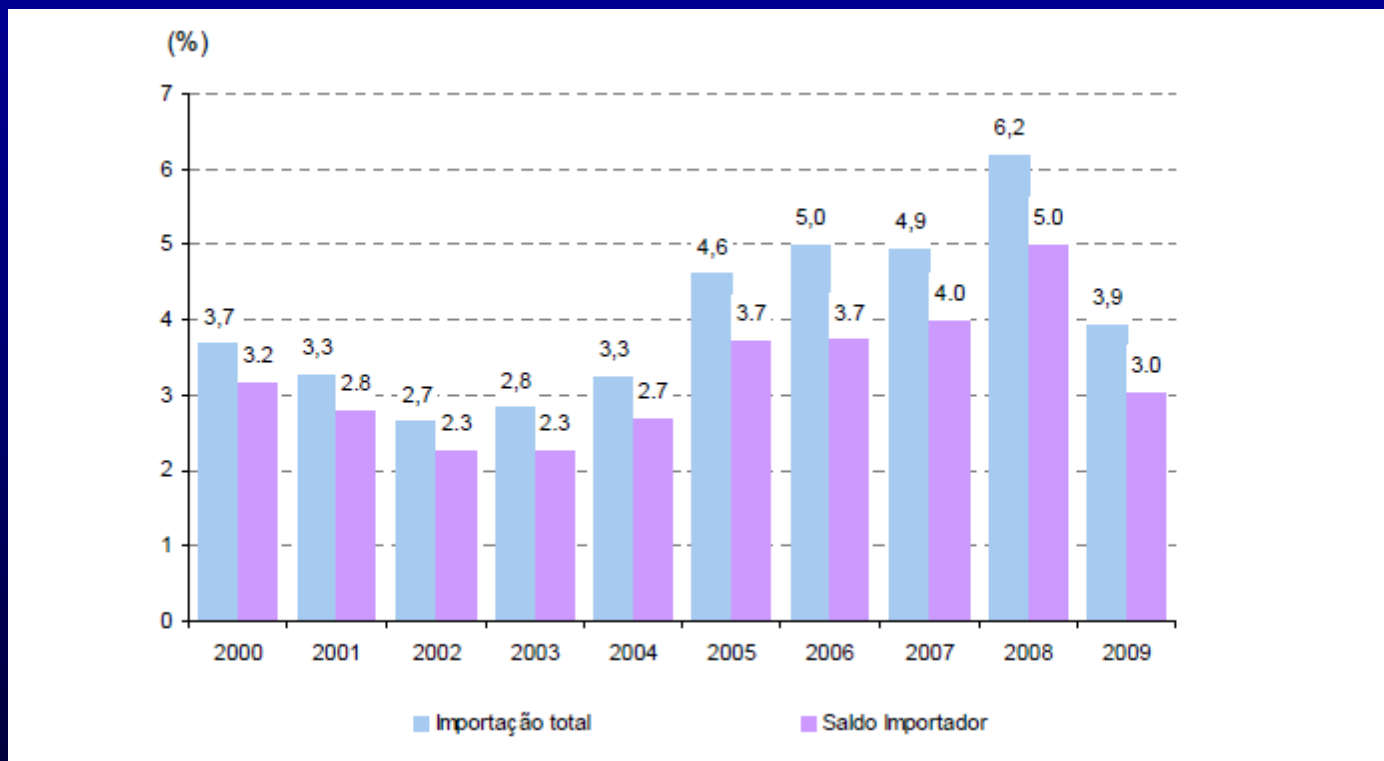
Fonte: BP Statistical Review of World Energy – Junho 2011

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 (€)

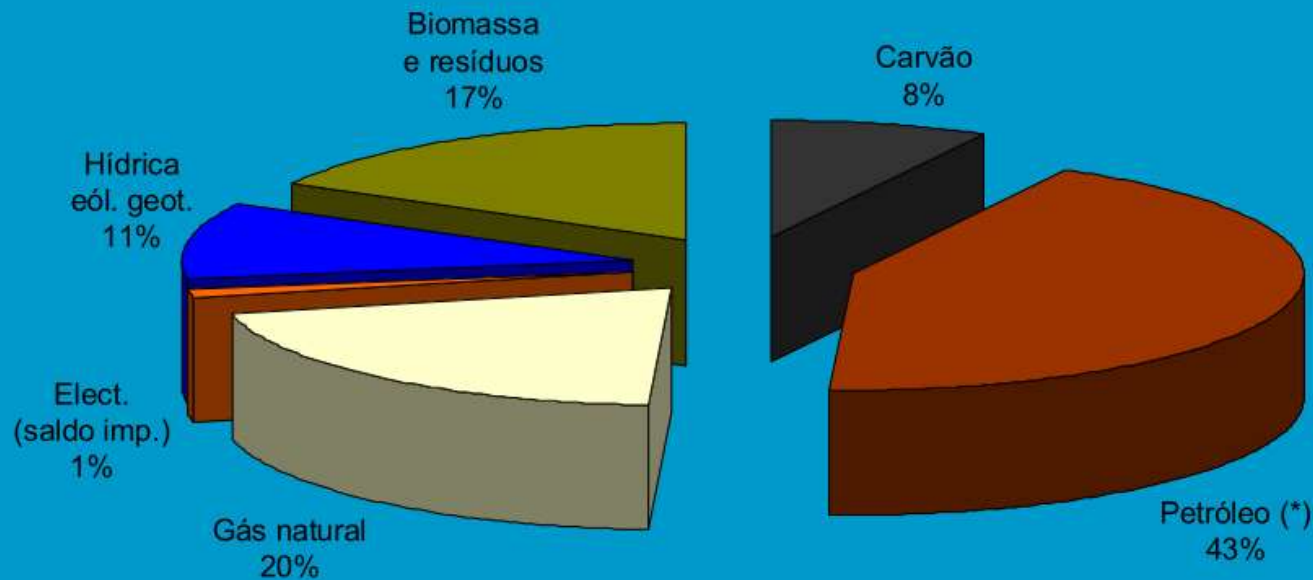


Fonte: DGEG

Fontes de Energia Primária Portugal, 2010

Renováveis: 28%

2010



(*) Excluindo utilizações não energéticas

Fonte: Prof. José Sucena Paiva

O que fazer em Portugal

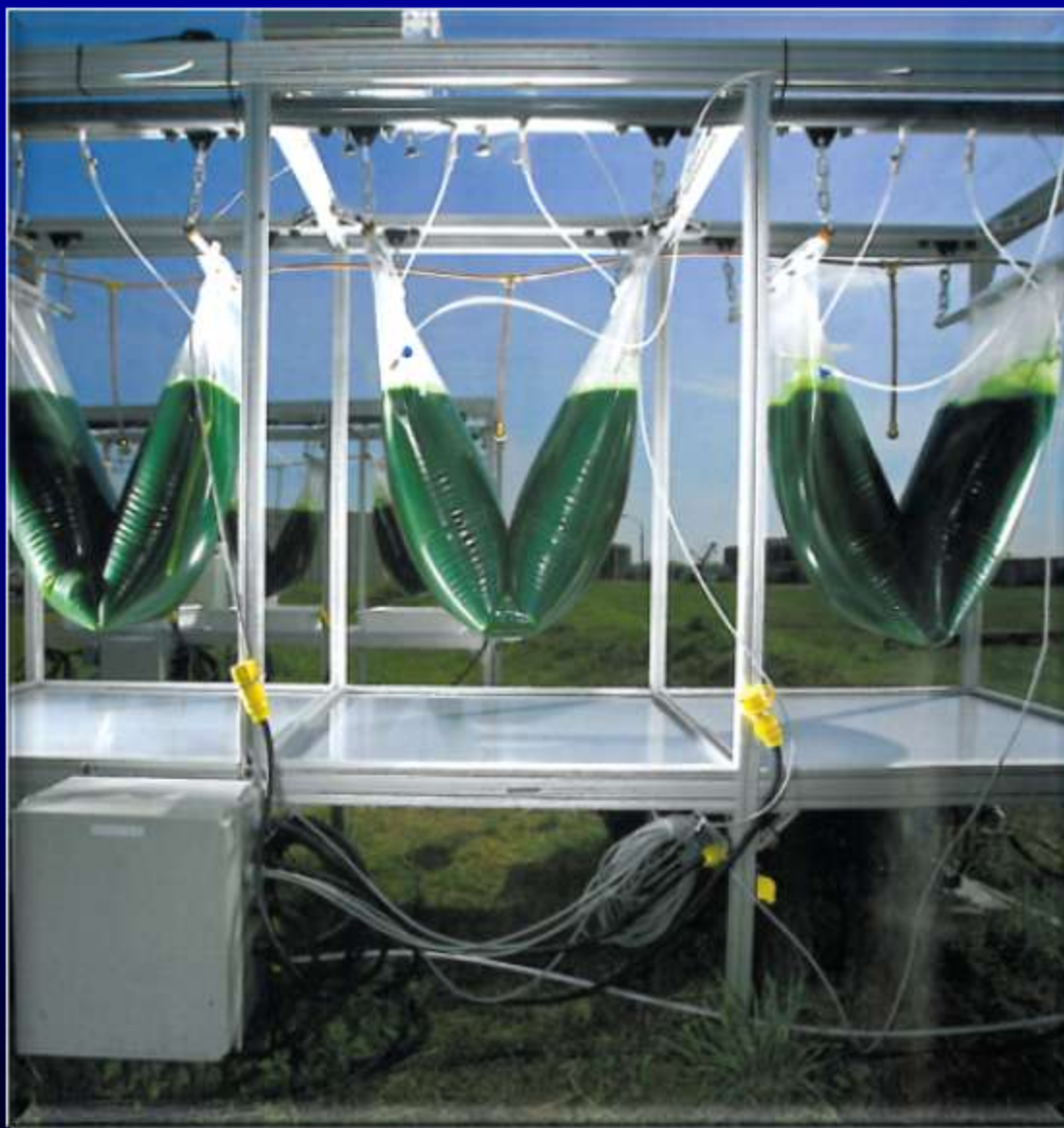


MATRIZ ENERGÉTICA: PORTUGAL e MUNDO

ENERGIAS	SITUAÇÃO ACTUAL	VANTAGENS	DESVANTAGENS	FUTURO
PETRÓLEO	• 43% do consumo de energia primária do país • Dominante no sistema de transportes	• Competitivo mas preços a subirem • Versatilidade	• Poluente • Preço a subir • Dependência de países instáveis	• Declínio da sua dominação • 11 anos seguidos a perder "Share"
GÁS NATURAL	• 20% do consumo de energia primária do país • Importante para a geração eléctrica e térmica	• Procura estável ou em ascensão • Reservas abundantes • Preço competitivo • 30% mais eficiente que o carvão	• Menos poluente dos combustíveis fósseis	• Idade dourada do gás • Combustível de transição e destino
CARVÃO	• 8% do consumo de energia primária do país • Importante para a geração eléctrica e térmica	• Reservas grandes nos EUA, China, etc. • Competitivo	• Muito poluente	• Em declínio
NUCLEAR	• Não existe em Portugal • Arrefecimento na sua utilização depois do desastre de Fukushima • Há 440 centrais nucleares no mundo; França 75% da electricidade	• Energia limpa, sem emissões de CO₂ • Competitividade do ponto de vista económico	• Gestão dos resíduos radioactivos • Preocupação com a segurança • Integração na rede eléctrica nacional	• Reactores de 4ª Geração mais seguros mas ainda não comerciais • ITER/Fusão Nuclear (2050)

ENERGIAS	SITUAÇÃO ACTUAL	VANTAGENS	DESVANTAGENS	FUTURO
ENERGIAS RENOVÁVEIS	A produção doméstica renovável representa 28% do consumo da energia primária	- Recursos endógenos - Diversificação da matriz energética - Menor dependência do exterior	- Preocupação com a competitividade económica de algumas energias renováveis - Intermitência	- Maior papel das energias renováveis - Uso das redes inteligentes para lidar com a intermitência
EÓLICA	4081 MW de potência instalada em Portugal - Contribuição importante para a geração eléctrica	- Recursos endógenos - Energia limpa - Redução dos custos de produção - Já é competitiva com gás natural e carvão	- Intermitência - Necessidade de back-up das centrais convencionais	- O seu papel está em ascensão - Preço do petróleo mais elevado viabiliza a sua utilização
HÍDRICA (incluindo a PRE)	5390 MW de potência instalada (Mini-hídrica 410 MW)	- Competitividade do ponto de vista económico - Energia limpa		Apenas 50% da capacidade hídrica nacional é utilizada
SOLAR TÉRMICA	- Pouca penetração no país 250 000 m² de painéis solares	- Potencial do país elevado (3 000 horas de exposição solar) - Redução custos de produção nos últimos anos	- Competitividade económica - Intermitência	Em ascensão
FOTOVOLTAICA	- Progresso lento e hesitante - Opção grandes centrais de Moura e Serpa não é correcta - Objectivo do PNAEE de 164 MW até 2015	Opção só é aceitável no âmbito da produção descentralizada de energia em regime de micro-produção	- Produção fotovoltaica centralizada não melhora eficiência do sistema electro- produtor - Desperdício no transporte e distribuição de energia	- Em ascensão - Mais I & D

ENERGIAS	SITUAÇÃO ACTUAL	VANTAGENS	DESVANTAGENS	FUTURO
BIOMASSA	- Necessidade ampliar a sua utilização - País coberto 35% por floresta - Produção 7 Mt resíduos por ano - Potência instalada insuficiente	- Recurso endógeno - Aproveitamento biomassa fixa populações no interior e cria emprego - Permite tratar a floresta e prevenir incêndios	- Falta de quantificação da biomassa florestal - Competitividade económica	Em ascensão
BIOCOMBUSTÍVEIS	- Necessidade ampliar a sua utilização - País tem terrenos em pousio subsidiados que podem ser aproveitados - Atenção que o país é fortemente deficitário em cereais	- Recurso endógeno - Oferta de mais uma solução para o problema dos transportes - Diminuir a necessidade de importação de petróleo - Baixa emissões de CO₂	- A selecção das culturas é crítica - Evitar competição com culturas alimentares	- INETI tem experiência de 25 anos no aproveitamento de micro-algas para fabrico de biodiesel - Mais I & D
ENERGIA das ONDAS	- 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	- Portugal tem das melhores zonas costeiras para o aproveitamento deste recurso - Energia limpa	- As tecnologias conhecidas estão ainda a nível experimental - Competitividade económica	Mais I & D



ALGAS DE RÁPIDO CRESCIMENTO

**Central eléctrica Phoenix
(Arizona)**

Absorvem CO₂

**Produzem 45 000 litros
Biodiesel/Hectare/Ano**

ENERGIAS	SITUAÇÃO ACTUAL	VANTAGENS	DESVANTAGENS	FUTURO
HIDROGÉNIO e PILHAS de COMBUSTÍVEL (“Fuel Cells”)	- Resultados concretos ainda escassos - Hidrogénio é a energia menos conhecida do país	- O hidrogénio é um vector energético atractivo do ponto de vista ambiental - Apenas produz água na sua combustão - Produção de hidrogénio por diferentes vias	- Competitividade económica - Autonomia das pilhas de hidrogénio	Mais I & D
COGERAÇÃO	- Produção e utilização de electricidade e calor (sob forma de vapor e água quente ou fria) - Potência instalada de 1 200 MW em Portugal	- Permite aumentar a eficiência energética de um sistema convencional em que 2/3 dos combustíveis utilizados são desperdiçados - Permite aproveitar o calor residual e recuperar mais de 70% de energia	Viabilidade económica em especial no referente à remuneração tarifária da energia gerada na cogeração e vendida à rede	Em ascensão
GEOTERMIA	- Penetração ainda exígua - Necessita de melhor aproveitamento dos recursos geotérmicos (calor terrestre)	- Recurso endógeno - Recursos nos Açores e Trás-os-Montes - Exemplo da Islândia (100% da electricidade gerada pela geotermia)		Em ascensão

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.



IMAGEM TÉRMICA do DESPERDÍCIO de ENERGIA

- ✓ Washington, 2012
- ✓ Estrada Congestionada
- ✓ Veículos em filas lentas
- ✓ Só 15% da energia fornecida pela gasolina é utilizada

TRANSPORTES: QUESTÕES

- Enorme dependência externa do petróleo e seus derivados;
- Poluição elevada e emissões de CO₂;
- Congestionamento do tráfego nas cidades, mais desperdício e baixa de produtividade;
- Volume desproporcionado do transporte individual em relação ao público;
- Portugueses não têm hábito de utilizar preferencialmente os transportes públicos;

SOLUÇÕES

- Desenvolver um novo paradigma para a mobilidade urbana baseado no transporte público;
- Criação de uma nova cultura com restrições na circulação do carro individual e dificuldades de estacionamento nos centros urbanos de alta densidade;
- Rever políticas de planeamento e ordenamento urbano;
- Apelo e educação para a utilização dos transportes públicos;
- Melhor gestão de acessibilidade às cidades e soluções de integração com a rede de transportes públicos.

WHAT ALTERNATIVES? FOCUS ON TRANSPORTATION

- Batteries and plug-in cars
- Electric vehicles
- Advanced biofuels
- Natural gas vehicles
- Evolving smart-grids integrating plug-ins
- Greener electricity generation
- Advances in the internal combustion engines
- Increasing fuel efficiency
- Advanced diesels
- New lighter materials

A SUSTENTABILIDADE

- . Como gerir os recursos?
- . O binómio Energia/Ambiente
- . A regulação das interfaces

A EFICIÊNCIA ENERGÉTICA

- . Uma nova cultura
- . A racionalização no uso da energia
- . Como lidar com os edifícios, o parque automóvel, as instalações, os equipamentos

PLANEAMENTO INTEGRADO DO TERRITÓRIO

- . As cidades
- . Um NOVO conceito de urbanismo
- . O espaço rural
- . As interfaces

AS POLÍTICAS PÚBLICAS

- . “Para que serve a política?”
- . Visão política
- . Os incentivos e o exemplo
- . A capacidade ambiental
- . Gerir para o futuro

FORMAÇÃO NO SÉCULO XXI

- . QUESTÃO ENERGÉTICA é uma QUESTÃO DE CIDADANIA
- . EDUCAR os Consumidores
- . MUDANÇA de HÁBITOS
- . LUTA CONTRA o desperdício
- . Figura do CONSUMIDOR/PRODUTOR

TRANSPORTES E MOBILIDADE

- . UM NOVO MODELO conceptual
- . As tecnologias: eléctrica, hidrogénio, química
- . A MOBILIDADE: eficiência
- . A eficiência do veículo e do combustível
- . O paradigma da MOBILIDADE como PROCURA derivada e forma de consumo
- . A acessibilidade
- . A MOBILIDADE SUSTENTÁVEL:
 - Ordenamento do território
 - Restrição do automóvel
 - Transportes Públicos
- . A indução e a evaporação do tráfego
 - + estradas + estacionamento = + tráfego
 - + transporte público + passeios = + peões

ECONOMIA

- . O papel do mercado
- . O papel da REGULAÇÃO
- . Os “Design Mechanisms”

TECNOLOGIAS

- . As Redes Inteligentes
- . As Nanotecnologias
- . As Energias Renováveis
- . A Energia Nuclear

OBRIGADO