



ENERGY ISSUES IN THE 2010S THE TOLD AND THE UNTOLD

**J.P. Contzen
16th SAC Seminar
Almaty, October 22 and 23, 2013**

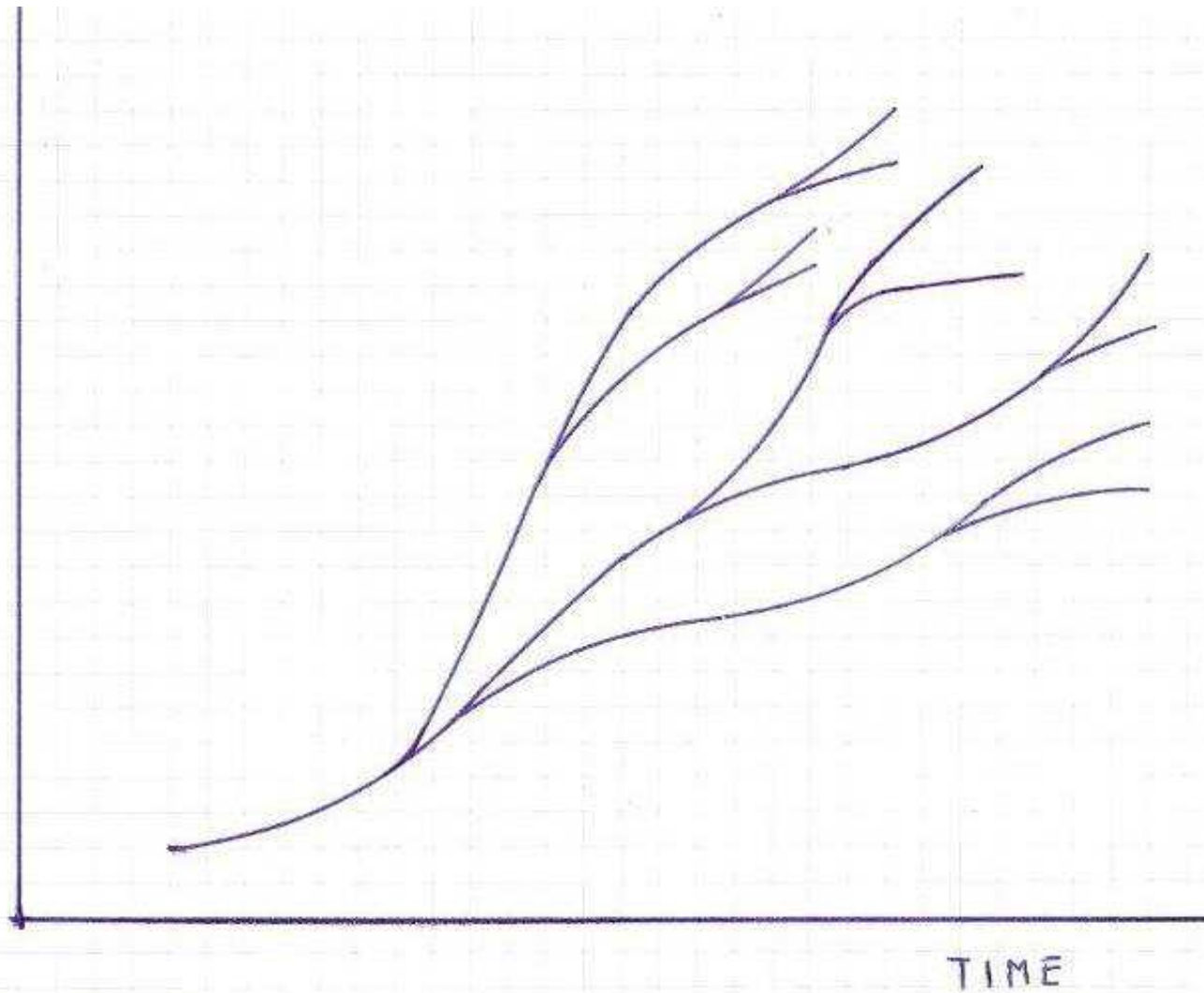
THE SEMINAR

- Interesting scientific meeting, papers of substance prompting reflection
- Not a large gathering but highly interactive
- Improvement over previous ISTC/SAC meetings in age and gender spectrum
- Discussions revealing dissenting views
- Excellent organization: most sincere thanks to ISTC staff
- Very good translation: congratulations to the interpreters

EVOLUTION OF ENERGY SCENARIOS (1)

- We should be aware of the fallacy of homogenous statistics, of the mirage of arithmetical averages. There is no global scenario but a series of local, regional cases
- The evolution of energy scenarios follows the pattern of chaotic systems described by Ilya Prigogine, i.e. segments of deterministic progression (dictated by technological advancement, industrial and regulatory time lags, availability of financial resources, etc.) punctuated by points of bifurcation

ENERGY
DIVERSIFICATION



EVOLUTION OF ENERGY SCENARIOS

(2)

En ces points {de bifurcation}, le comportement du système devient instable et peut évoluer vers plusieurs régimes de fonctionnement stables. En de tels points, une “meilleure connaissance” ne nous permettrait pas de déduire ce qui arrivera, de substituer la certitude aux probabilités

Ilya Prigogine et Isabelle Stengers
Entre le Temps et l'Eternité

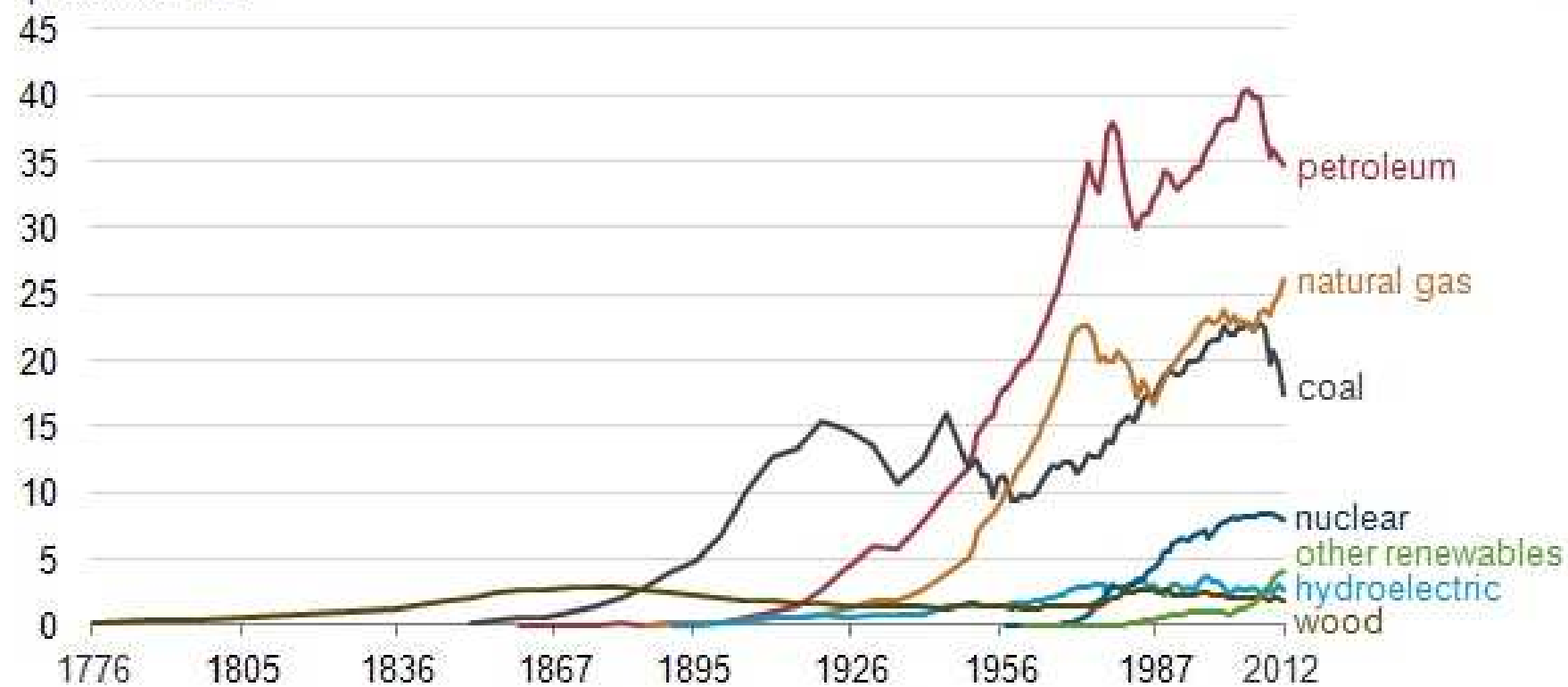
EVOLUTION OF ENERGY SCENARIOS

(3)

- When bifurcations occur, governments and civil society in different countries react in different ways, this leads to increasingly fragmented systems and further chaos rather than to a stabilized new system. The real challenge is coping with such a situation in a world prone to energy exchanges, hence a pronounced trend towards energy security and a different organization of energy fluxes

History of energy consumption in the United States (1776-2012)

quadrillion Btu

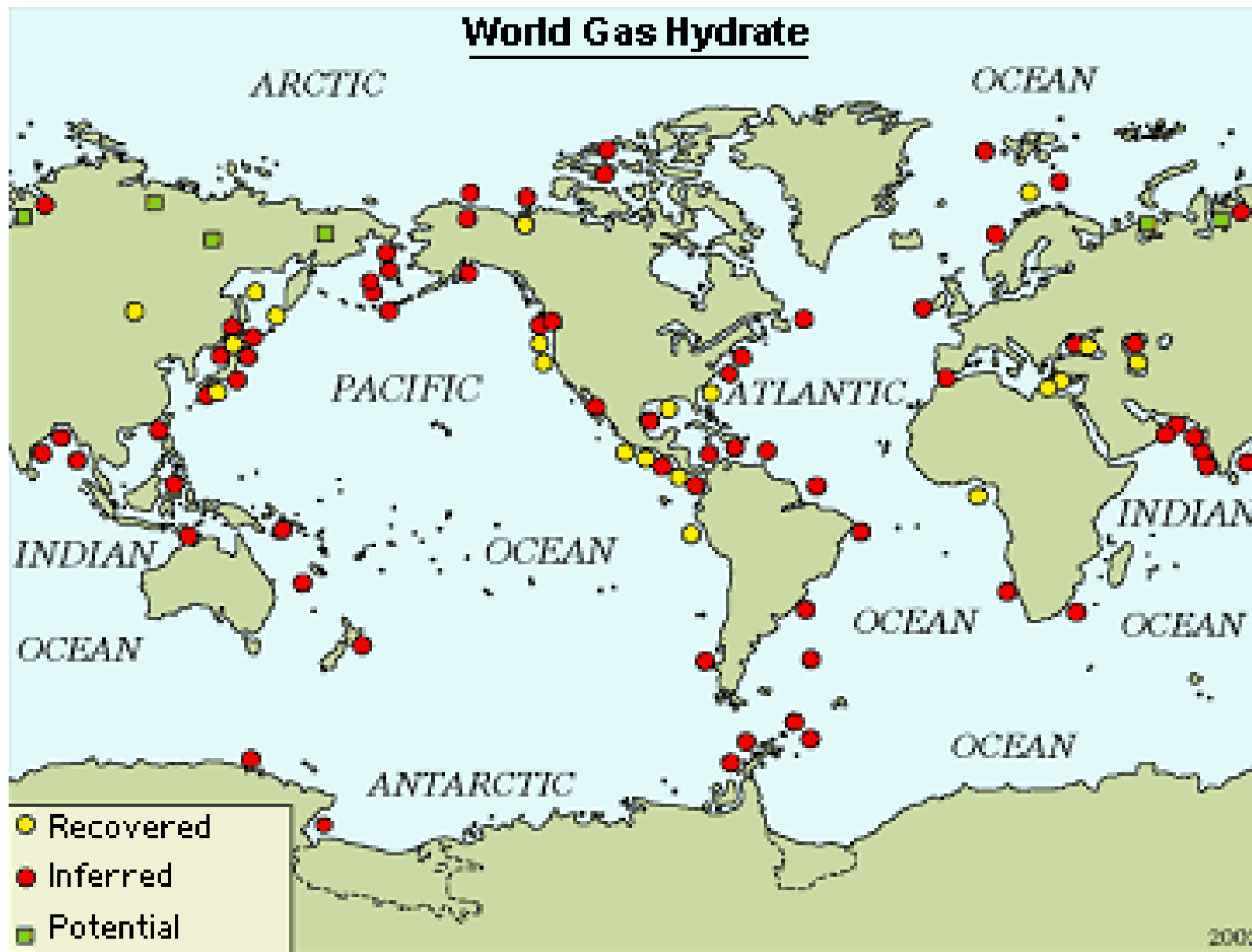


EVOLUTION OF ENERGY SCENARIOS

(4)

- Significant points of bifurcation have been:
 - The exploitation of oil (1863)
 - The peaceful use of nuclear energy (1950)
 - The use of natural gas for energy purposes (1960)
 - The oil crisis (1973)
 - The large scale use of renewables and of cogeneration (1990s)
 - Chernobyl (1983) and Fukushima (2011)
 - The reduction of subsidies to renewables following the financial crisis (2009)
 - The exploitation of tight and shale gas (2010)
 - The exploitation of clathrates (2012) (?)

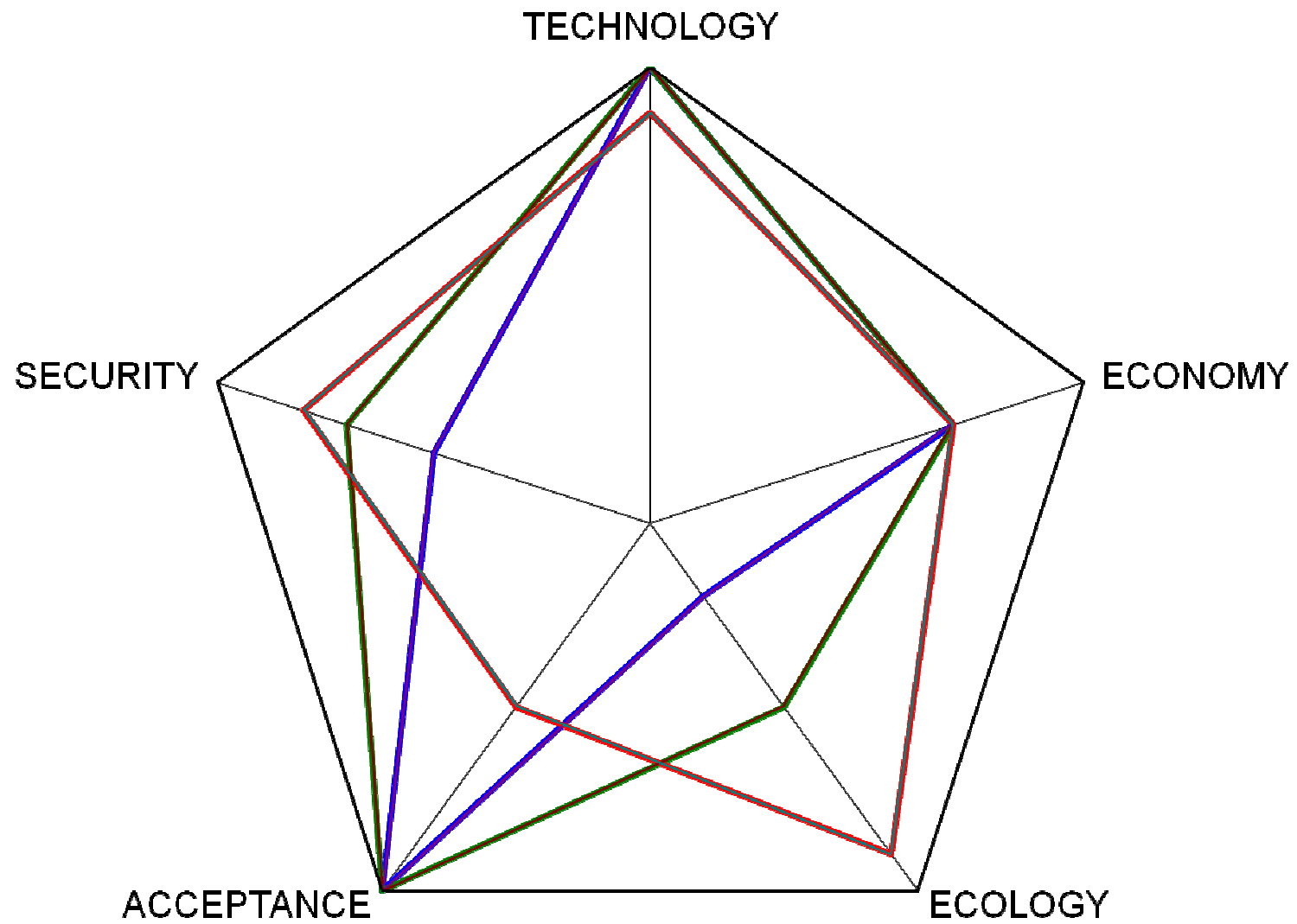
World Gas Hydrate



EVOLUTION OF ENERGY SCENARIOS

(5)

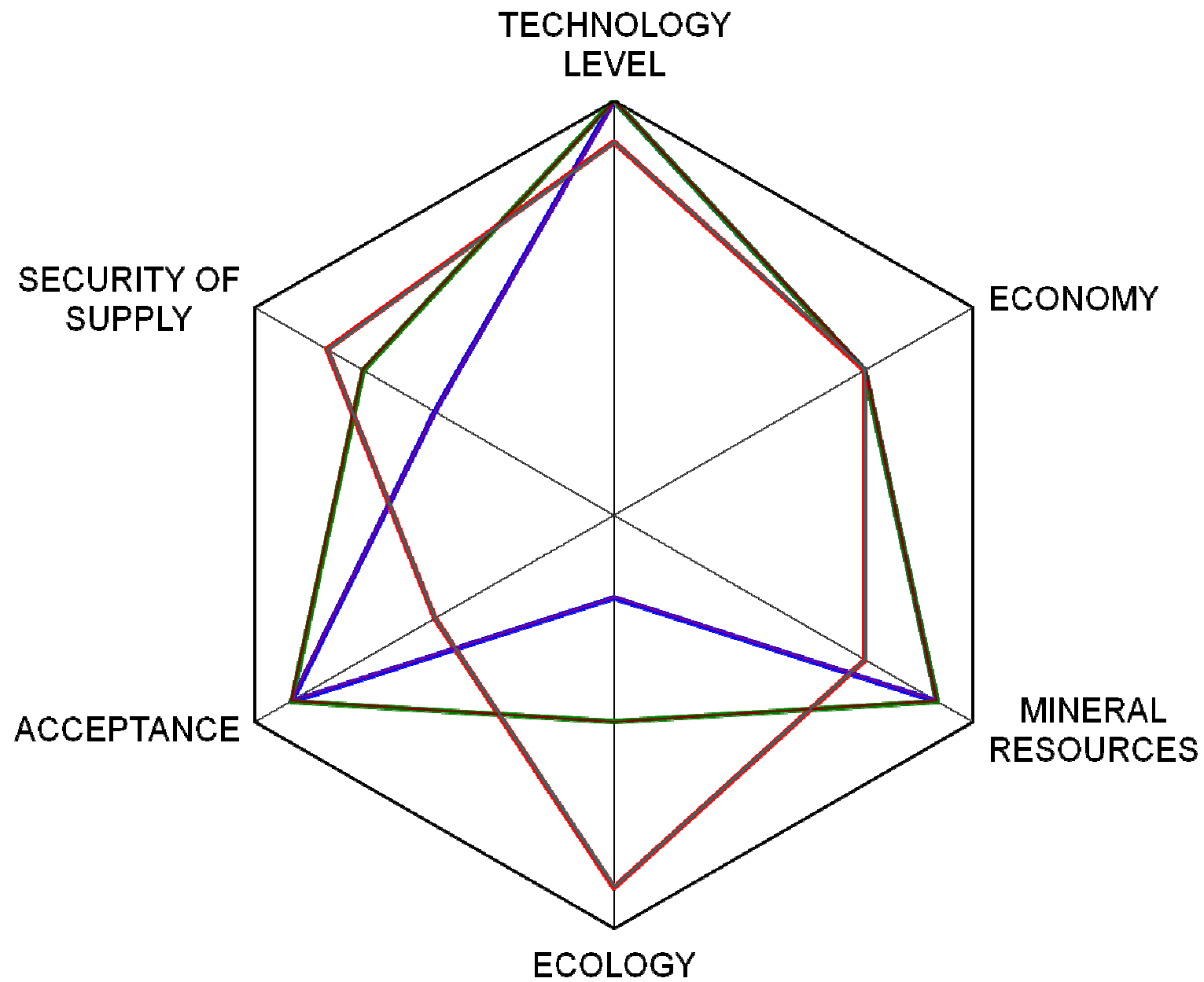
- Countries have reacted so far not only to the challenge of energy security but also to four other factors, hence the pentagon of:
 - *Security*
 - *Technology*
 - *Economy*
 - *Ecology*
 - *Acceptance*, safety determined by experts being overtaken by its perception by Society



EVOLUTION OF ENERGY SCENARIOS

(6)

- In the future, there will be the need to add a new additional factor i.e. mineral resources. The pentagon becomes a hexagon. Managing adequate mineral resources becomes a new technological challenge for energy production. Secondary (recycled) rather than primary materials should be the choice for the future but it might take another 20 to 30 years to exploit the right technologies



THE ROLE OF MINERAL RESOURCES (1)

- Study by B. Goffé (U. Aix-Marseille) and O. Vidal (U. Joseph Fourier Grenoble) of the limitations for renewable energies development through availability of earth mineral resources (Pour la Science, n°431, Sept. 2013)
- Last generation wind generators consume per kWe produced, 20 to 40 times more steel and 6 to 15 times more concrete than a nuclear reactor of the EPR type.

THE ROLE OF MINERAL RESOURCES

(2)

- The production of renewable energy systems require notably Fe, Cu, Al, concrete (cement, sand), glass (sand plus various minerals, with high purity for guaranteeing transparency), chemicals derived from hydrocarbons (resins, plastics), In (for PV panels), Nd and Dy for wind energy electric generators
- Ores are getting lower in useful concentration due to exhaustion and they require increasing quantities of energy for extraction and processing: in 2010, they represented 22% of the energy consumption of the world industry (US DoE)

THE ROLE OF MINERAL RESOURCES

(3)

- Lower concentrations will lead to higher energy consumption: for Au, concentrations divided by 5 mean 10 times more energy for processing and 10s to 100s times more water
- Mines are generally far from energy production sites inducing losses in energy transport. Some optimization should be performed

EVOLUTION OF ENERGY SCENARIOS

(7)

- In some European countries, employment created by the extension of the recourse to renewables is considered as an additional factor. In Belgium, if the transition to an energy system based at 100% on renewables in 2050 would be implemented, the job creation would be between 21000 and 65000 full time equivalents before 2030 (unemployed in 2012: 368000). Even taking account technological progress, the cost of such a system would be nevertheless 20% higher than a system still using fossil fuels

EVOLUTION OF ENERGY SCENARIOS

(8)

- Advantages lie, beyond job creation, in reduction of GHGs emission and in the limitation of energy imports (greater security and smaller energy bill)
- Will in the future the hexagon become a heptagon?

WHAT HAS BEEN HIGHLIGHTED?

(1)

- Energy security: a preoccupation for all nations in a unstable, diversified world; differences in the definition of what it means
- The controversy on nuclear energy: accept the diversity of positions
- The continuous role of oil: not dead yet, still leading in world energy consumption

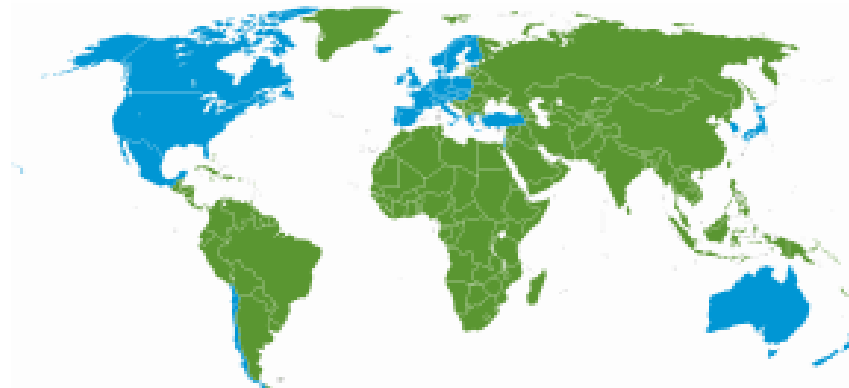
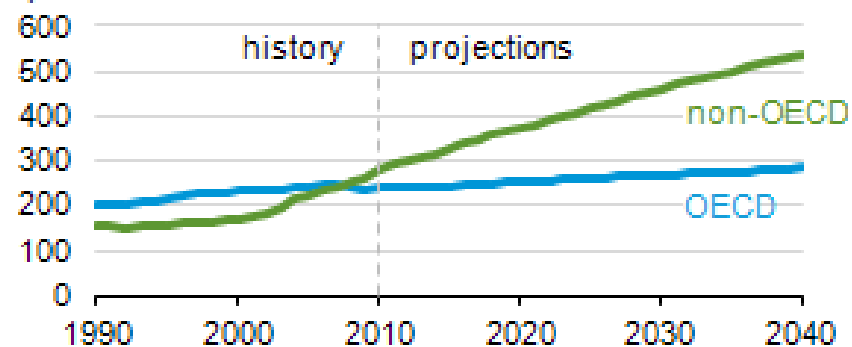
WHAT HAS BEEN HIGHLIGHTED?

(2)

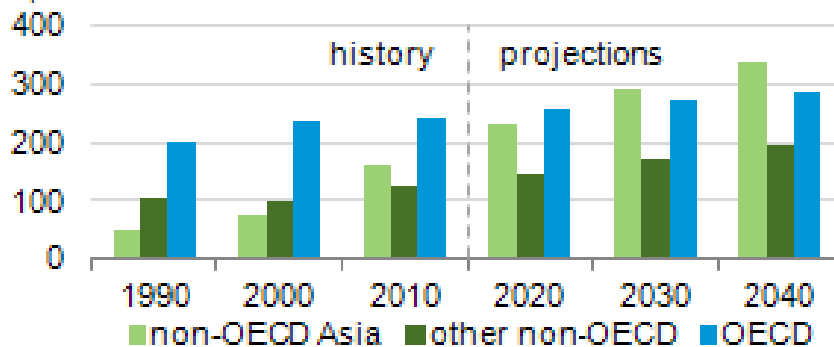
- The persistence of the importance of coal: it will rejoin oil as top energy in 2030. Use of coal has skyrocketed in emerging economies in the past 50 years: Brazil 699%, Turkey 784%, Taiwan 1295%, Mexico 1338%, S. Korea 1503%, China & HKG 1543%, Indonesia 33982%

THE U.S. ENERGY INFORMATION AGENCY PROJECTS THAT WORLD ENERGY CONSUMPTION WILL INCREASE 56% BY 2040

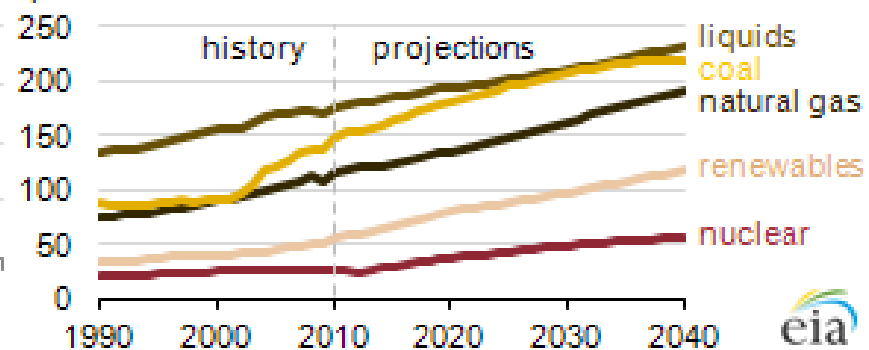
World energy consumption
quadrillion Btu



World energy consumption
quadrillion Btu



World energy consumption by fuel
quadrillion Btu



WHAT HAS BEEN HIGHLIGHTED?

(3)

- The ramping up of renewables as a local resource, linked to local geographical and social conditions (Role of weather forecasting in improving their utilization not mentioned)
- The extension of the range of hydropower to local, low level production
- The role of geothermal energy for electricity production but also for domestic heating (Add biofuel production)

WHAT HAS BEEN HIGHLIGHTED?

(4)

- The future of hydrogen as energy storage: boosted by development of renewables e.g. hydropower, solar PV, wind, also by actual implementation of applications, both stationary and mobile, driving technological improvements
- The hesitation about wave energy utilization: an issue of cost? Problem of collecting the produced energy?

WHAT HAS BEEN HIGHLIGHTED?

(5)

- The impact of energy choices on electricity generation and distribution: smart grids, decentralization of networks up to the level of groups of buildings, driving forces for moving in this direction are technological and economical considerations as well as risk management

WHAT HAS NOT BEEN DISCUSSED? (1)

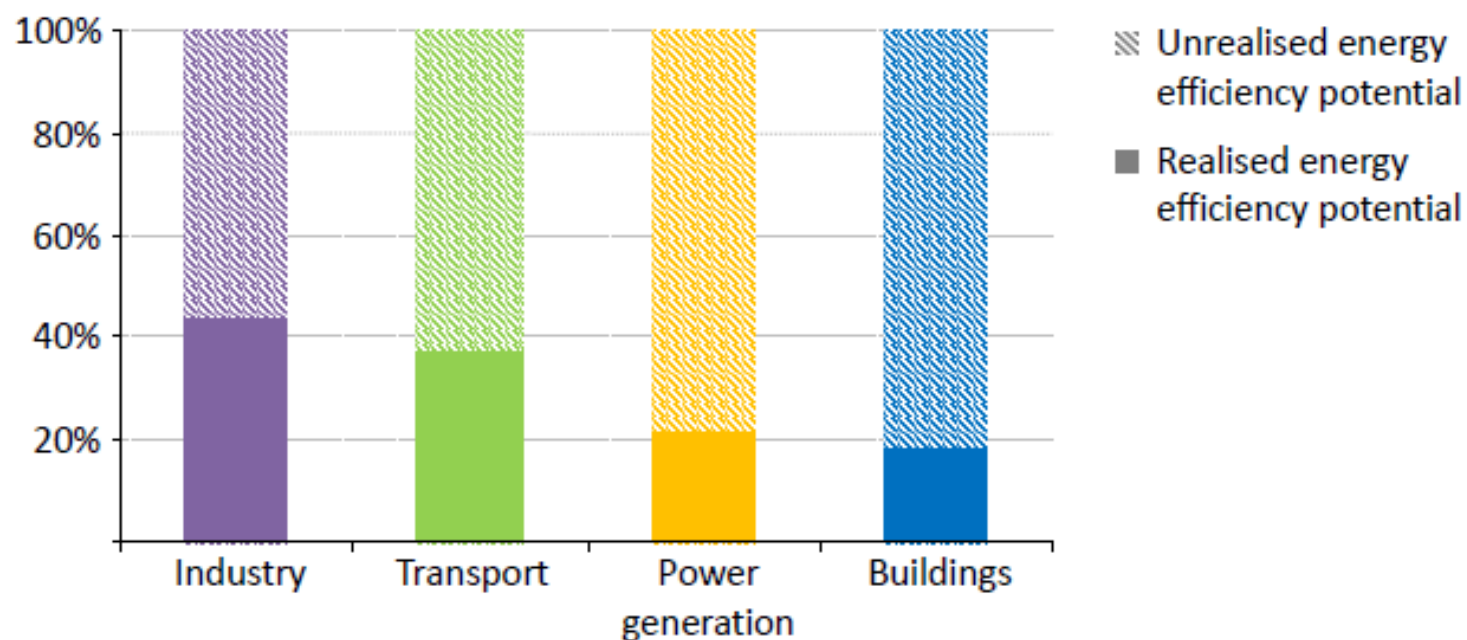
- Some themes which correspond to scientific and technological capabilities of the countries of Central Asia and the Caucasus and could be relevant to their needs have not been discussed in depth:
 - The importance of energy storage, small and large scale: a comeback of compressed or liquefied air?
 - The potential of non-food biofuels: a hot subject

WHAT HAS NOT BEEN DISCUSSED? (2)

- The possible interest of fuel cells for stationary applications
- The importance of weather forecasting in renewable energies' planning
- The implementation of energy efficiency measures: a way for improving energy security, reducing the energy bill and giving the possibility for growth in energy consumption in developing countries

ENERGY SAVINGS IN THE EU

Energy efficiency potential used by sector in the New Policies Scenario



Two-thirds of the economic potential to improve energy efficiency remains untapped in the period to 2035

WHAT HAS NOT BEEN DISCUSSED? (3)

- The potential of carbon capture and storage, its development requires good knowledge in chemistry and in geology
- Beyond direct utilization and physical storage of CO², chemical transformation and bio-transformation can be considered (algae)

THE INTEREST OF OIL COMPANIES FOR CARBON CAPTURE AND STORAGE

- Dirk Smit, a VP at Royal Dutch Shell, emphasized on October 9, 2013 the expertise of oil companies in geophysics which could be key to developing CCS. For pumping CO₂ underground, no one has a better head start on knowing how to do it than oil companies. One unresolved issue relates to how long the CO₂ can be stored. The experience of oil companies in characterizing reservoirs could help answer the question
- Earlier in October 2013, Shell's CEO Peter Voser mentioned that CCS, along with biofuels and natural gas for transportation "could be the bedrock of our future competitiveness"

IN CONCLUSION (1)

- The energy scene is an increasingly complex one with a growing number of criteria being use for selecting the best mix of energy sources. Nations react differently according to their geographical and political situations, hence a great diversity of energy systems in spite of the general trend towards globalization

IN CONCLUSION (2)

- A lot of opportunities is still unfolding for new energy technologies. Let us hope that this seminar will act as a stimulant for their development and contribute to their implementation

***спасибо за ваше
внимание!***

***Thank you for your
attention!***

