

# Minutes of the seminar on " Human Development and Sustainability of Energy Systems"

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ADEME, 27 rue Louis Vicat, Paris 15

## List of participants

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### c) Other invited experts

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## Welcome address by Jean-Marie Bouchereau, Ademe

### Introduction by Bertrand Château (See the powerpoint presentation “Bertrand Chateau introduction” attached)

The aim of the seminar is to respond to several questions:

Sustainability of energy systems and policy decisions in energy RTD

- How to make sustainability criteria accepted by policy makers?
- How to make the results of the very long term studies be endorsed by them and turn into decisions in the next future?

Social viability and sustainability of energy systems

- How to characterise social viability on the very long term so as to build relevant sustainable futures of the energy systems ?
- What quantitative assumptions on demography, life styles, economic development etc... are acceptable and not acceptable in the very long term

Sustainability of energy systems: which criteria?

- How to express limits on greenhouse gases emissions, nuclear operation and wastes, land-use and other environmental impacts of energy related activities?
- How to express inter-generational equity as regards fossil fuels depletion? The role of renewables.

## Political and methodological issues related to sustainability

### - Sustainability concept in government policy

**Presentation by Richard Baron : “Sustainable development beyond the “nice and easy”** (See the powerpoint presentation “Richard Baron” attached)

The main conclusion of the presentation are:

- ➔ Sustainable development: Intra-generational equity matters too
- ➔ Business-as-usual scenarios are always more attractive for decision makers
- ➔ Projections should reveal effects of today’s decisions (irreversibility)
- ➔ Policy making towards SD may require handling major distribution issues

### - Sustainability and backcasting: lessons from EST

**Presentation by Peter Wiederkehr** (See the powerpoint presentation “Peter Wiederkehr” attached)

Presentation based on the approach and principal results of the OECD-EST (Environmentally Sustainable Transport) study.

Sustainability decision criteria according to OECD:

- Regeneration
- Substitutability
- Assimilation
- Avoiding reversibility

Recommendations for guidelines for sustainability studies

1. ?
2. Show where things get better, and where things get worse
3. Define health and environmental quality objective (emission limits, health effect limits, limits on the effects on the environment (e.g. temperature increase) – criteria locally, nationally and globally
4. Set targets (noise, air quality, ..)
5. Identify strategies to achieve goals (demand management (downsizing of car, transport avoidance (26 %), mode shifts (e.g. from car to ship), load factor) 59 %, technology 41 % share of efficiency gain for person transport))

6. Assess the social and economic implications of the visions (including external costs)
7. ?
8. Develop an implementation plan (phasing of measures)
9. Set provisions for monitoring, implementation and public reporting (people want to have problems sold)
10. Build broad support and co-operation for implementation (Disseminate **images** of the future and the proposed measures/solutions with which the individual people can identify, pilot projects)

## Discussion

### **Laura Cozzi:**

Backcasting is crucial, but it means to have a target. How to make the politicians agree on a target by 2030 or more? To make backcasting it is necessary to agree on a common vision among actors, from which the targets should be derived.

Is the public opinion and the industry really willing to do something with respect to climate change? There is an understanding in at least part of industry that sustainability might also be a business.

There is a perceptions that “the others” would not support sustainability. It is difficult for politicians to go too far ahead of public opinion. However, the public opinion might be further ahead than politicians expect.

In principle people like problems to be solved. They however need a clear vision, to accept the necessity of them taking action.

### **Maria R Viridis:**

She refers to the IEA study up to 2050, which is normative and based on 3 criteria:

- Environment sustainability
- Security of supply
- Access to energy

She underlined the difficulties to define criteria. There is not one unique criteria for each objectif, it is necessary to define several criteria by objectif.

### **Bert de Vries:**

Targets always result from a negociation among stakeholders. They can only be set from today's point of view. They might be redefined in the near future.

### **Tomas Hamacher:**

Responsability of politicians' scepticism towards sustainability: Cassandra's have always existed, but at the end technology could fix it. Why things would change in the future?

### **Richard Baron:**

Raises the question of the bifurcations. General problem of the implication of the scientists in the sustainability debate, and the role of the public opinion.

### **Peter Wiedecker:**

He underlines that he never said that select criteria is easy. The essential is to get our objectives clear. They spent about a year to fix the criteria in EST.

### **Vincent Bagard:**

Stresses the fact that, up till now, technology improvements have not been used for improving sustainability (at least in the transport area) but rather to increase the security, comfort, self esteem, fun

### **Manfred Heindler:**

Problem of the legitimacy of the policy action towards sustainability: for example, in Austria 100% were favourable to catalytic exhaust pipes, but almost nobody purchased equipped cars before it became mandatory. People are not willing to give up comfort, as long as the neighbour also did not do (was not forced to do).

Important: people need to have the perception that all people are hurt to the same extent.

### **Bertand Château:**

- Of course to speak about sustainability for 2100 has not the same impact that for 2030, but it is important for R&D
- The type of message that will come out from VLEEM has to take this time dimension into account.

**Peter Wiedecker:**

Proposition for 2 scenarios

- every thing has to be done by technology
- all is done by the demand side.

## **Towards a socially viable world :Thematic discussions**

**- Demography- Peoples' migration** (See the ppt presentation "B Chateau J Perez towards a socially viable world" attached)

Bertrand Chateau reminded briefly how demography and migration impact energy systems in VLEEM and asked the principal questions related to demography and peoples' migration:

1. Does the continuation of the population growth jeopardize the social viability in the very long term? Worldwide or regionally, or both? Is the malthusian UN assumption of stabilisation worldwide by 2050 necessary?
2. At which speed, and down to which point, a country's population can decrease without breaking socio-economic equilibria?
3. To which extent population migrations among world regions can contribute to regional socio-economic equilibria or destroy them?

### **Discussion**

**Richard Baron:**

To illustrate the impact of population decrease: 17,000 villages are now left unpopulated in Russia, although these villages have complete infrastructures for water, electricity and roads.

**Maria R Vidris & Laura Cozzi:**

The most recent population estimates from the UN have as a result that the population could stabilise at 8.6 or 8.7 billion people around 2050. They certainly revised mortality and fertility rate to obtain this stabilization: Fertility rate would stabilise at 2.1 around 2050, which is earlier than they thought before.

**Thomas Hamacher**

Fertility rate in UN study is an assumption, not a result. This raises the question of the utilisation of this assumption in prospective studies. The question of the determinants of the fertility (and their relation to sustainability) remains open.

**Bert de Vries:**

Indeed, the UN assumes that there is a convergence towards a fertility rate of 2.1 in 2050 around the world.

The IPCC did not cover migration in the long term. Migration of people to Europe could be realistic, unless Europe would decide in favour of 'Fortress Europe'.

**Peter Wiederkehr:**

An increasing proportion of the world population will live in urban areas. The needs of people in urban areas are different from the needs of people in the countryside. The consequences will be probably more important than that of migrations.

How to maintain infrastructures when population decreases?

**Maria Virdis and Laura Cozzi:**

Large-scale migration of people from developing countries to OECD countries is unavoidable because the gradient in income across the world will not disappear. This does not involve large infrastructure problems, since the infrastructure is already in place. The real problems are of cultural and religious nature. The people who tend to migrate are the brightest, so they is a loss for their original countries.

However, these countries also tend to earn money from their migrants, which therefore reduce the negative consequences of the migration.

**Richard Baron:**

Because of the very high energy consumption per inhabitant in the US, the size of the future immigration of people to the US will have a tremendous influence on the world energy demand.

**Paul Lako:**

The current administration in the US is in favour of immigration and is not in favour of the Kyoto Protocol. If Western Europe would choose the same type of immigration and at the same time stick to the Kyoto Protocol targets and even more stringent targets in the decades beyond 2010, a conflict could develop in the future.

**Laura Cozzi:**

The IEA uses the UN population estimate. They consider it as exogenous to their studies.

**- Time budget and life style change-Equal sex to instruction and labour- Geopolitical regional and interregional universal cultural acceptability** (See the ppt presentation "B Chateau J Perez towards a socially viable world" attached)

Bertrand Château reminded quickly how time-budgets, gender inequality and cultural diversity impact energy systems in the VLT, in VLEEM and Jaime A. Perez presented the principal question related to this subject:

1. « Papy cohorts » pensions: how long shifting time from paid work to leisure (aspiration of working social cohorts in post-industrial countries) can continue when the population is decreasing and aging?
2. Equal gender access to instruction and labour : is the dilemma « maternity or social participation » an issue as regard very long term socio-economic viability?
3. Cultural ethnocentric unipolar world or diverse multi-modern societies? Any chance that the « american way of life » could be a sustainable world standard?

**Discussion**

**Bert De Vries**

It is very difficult to make relation between the energy consumption and aspiration for self accomplishment. We do not know how people change their demand pattern when they get more wealthy. Unclear in what they really invest for additional self-accomplishment. Models used today by economists are much biased by the US reference.

**Jaime A Perez**

Carefull with ethnocentric views. Self accomplishment does not necessarily mean consumption in all countries.

**Vincent Bagard**

In western societies, material and energy is wasted in favour of saving time. In Southern countries it is the other way round (their time is "cheap").

Inverse correlation of income and number of children.

**Laura Cozzi**

We are too much focused on our own culture and wealth level. In China the number of children is not chosen by parents. In Islamic cultures women have different options to chose upon than in the west.

**Jaime A Perez**

In moment of crisis only imagination is more important than knowledge. It is difficult to extract our own prejudices from our scientific work.

**Bertrand Chateau**

Key problem: we do not know what people will do with their wealth in hundred years. But we should say something and explore all limits which cannot be surpassed (e.g. the time limits). Important to develop consistent assumptions.

There is a possible conflict in the long-lasting substitution of leisure time for work time. Another possible conflict between the increasing value of time and that of goods and services. These discussions aren't so much touch in long term studies, although they are very important for the very long term. We have to use as much as we can existing knowledge to say something. Is our current development model sustainable?: Or should we reconsider the substitution of leisure time for work time in countries with population decreasing and aging?

**Bert de Vries & Vincent Bagard**

Indeed, the time for work could re-increase because of lack of social security cover and retirement.

**- The discussion about welfare, poverty and social link was deleted because of a lack of time.**

## **Building up an environmentally sustainable energy world, keeping resources for future generations and preventing geopolitical ruptures**

**- CO2 emissions**

**Presentation by Bert de Vries: "An environmentally sustainable energy future: simulations with the TIMER/IMAGE model"** (See the ppt presentation "Bert de Vries" attached)

Bert de Vries gives an overview of the SRES study done with the model IMAGE2.2 for the IPCC.

Two discriminating factors for designing the scenarios: globalisation versus regionalisation, priority for material wealth versus priority for sustainability and equity.

A fundamental problem: how to settle criteria for concentration level for greenhouse gases, or for emissions? There is no absolute answer (from the decision viewpoint), but a result of a negotiation process between the cost of abatement and the perception of the risk related to the climate change. Not clear yet. Are stabilized concentrations necessary? Which level in the range 450-650 ppm? EU has adopted targets in terms of maximum 2° increase in temperature.

Book: B. de Vries, J. Goudsblom (eds.); *Mappae Mundi; Humans and their Habitats in a Long-Term Socio-Ecological Perspective – Myths, Maps and Models*; Amsterdam University Press, Amsterdam 2002; ISBN 90 5356 535 3

### **Discussion**

**Manfred Heindler**

Is there some unexpected effect of learning?

**Bert de Vries**

The development in case of nuclear power has been unexpected. The accident at Chernobyl has not been expected. The next one has been wind power. The costs of wind have come down, but the social acceptance has been lower than expected.

**Jaime A Perez**

Do you connect the model with the HDI (Human Development Indicator)?

**Bert de Vries**

Yes we do.

**- Nuclear issues**

**Presentation by Benjamin Dessus and Yves Marignac: "Nuclear Energy and Sustainable Development : *criteria and indicators*"** (See the ppt presentation "Benjamin Dessus" attached)

The main provisional conclusions and question asked by the presentation are :

The final goal and criteria should include :

- 1 - No major accident "physical possibility"
- 2 - No proliferation "physical possibility"
- 3 - A zero long-lived high level waste inventory
- 4 - A real contribution to development

They differ from the present strategies which deal mainly with the reduction of the consequences of the drawbacks induced by non fulfilling these criteria (for example the non proliferation treaty, the waste burying, the confinement walls etc.)

These global criteria are much more difficult to fulfil :

So it would be useful to discuss indicators which would give a dynamic information on the progress towards SD , not only on individual technologies , but at the same time on the whole world situation (taking into account the consequences of the stock of past and present technologies to the balance sheet).

The nature and the number of these indicators is a first question to discuss and propose to the democratic debate.

If adopted , the quantitative evolution of these indicators could be discussed at different levels, from nations to UN organisations, in a process similar to the climate or biodiversity negotiations, to fix the steps and the commitments necessary

## **Discussion**

### ***Laura Cozzi***

Who decides which developing countries can have a nuclear plant?

### ***Benjamin Dessus***

We can't say "no nuclear for such or such developing country" and pretend to achieve sustainability. We can't say to Nigeria or Senegal you can't have a nuclear power plant.

### ***Rosella Viridis***

IEA has to make projections on nuclear power in developing countries. Some countries, like Iran, seem to pose a problem with regard to proliferation.

### ***Benjamin Dessus***

It is impossible to say to Iran, Senegal or Algeria that they are not allowed to build nuclear power stations. If you want to have compatibility between nuclear and sustainability, it must be available for all countries.

If you think of nuclear power as a means of reducing CO2 emissions, you will need e.g. 4,000 nuclear reactors instead of the current approximately 400 nuclear reactors.

### ***Gerhard Kolb***

Smaller nuclear reactors than the current class of 1,000 to 1,500 MW reactors are considered. There are also technologies in the early stage of research which could be used to destroy plutonium, ADS systems and fast reactors. The most serious problem would be proliferation. Those reactors could be operationally safe. The small reactors could support development in developing countries. Proliferation could be made more difficult from a technical point of view.

If you would like to introduce transmutation, you will need partitioning technology. In the short and medium term you will have to accept the risk of proliferation, because there are large amounts of plutonium stored at reprocessing plants and elsewhere.

If you want to tackle the problem of HLW, you could introduce technologies like ADS and fast reactors. However, that would increase the risk of proliferation. Furthermore, the stock of plutonium will increase during say 50 years and will decrease gradually afterwards. After 150 years the amount of plutonium could be the same as today. That is a difficult message for policy makers.

Some of these technologies will have to be developed.

### ***Benjamin Dessus***

You will have to accept that you have some nuclear waste and risk of proliferation in the decades to come.

### ***Thomas Hamacher***

The proliferation issue is important. Some areas in the world have come to some stage of development of nuclear weapons, e.g. India and Pakistan. But this has not so much to do with the development of civil nuclear energy.

The possible negative consequences of plutonium and HLW are not of the same nature as those of greenhouse gas emissions.

**- The discussion about Land use, noise and other industrial risks was deleted because of a lack of time and because of the person which would done the presentation can't come.**

## **- Resources**

**Presentation by Mark Whiteley : Ressources** (See the ppt presentation "Mark Whiteley" attached)

The main conclusion of the presentation are:

Resource options for 2100 point at:

- Coal, *renewables*, nuclear energy, hydrogen, or a mix
- Must look at the whole fuel cycle

Each option has its advantages and disadvantages!

- Equality
- Networks & infrastructure
- Meeting all types of demand
- Safety

Ultimate drivers for new energy networks likely to be non-resource issues

Revolution & cultural shift - political confidence/arrogance

## **- Geopolitics**

**Presentation by Laura Cozzi : Long term view on geopolitical issue** (See the ppt presentation "Laura Cozzi" attached)

Her presentation showed that:

- Gas grows fastest in absolute terms & non-hydro renewables fastest in % terms, but oil remains the dominant fuel in 2030
- 62% of the increase in world demand between 2000 and 2030 comes from developing countries, especially in Developing Asia
- Energy trade between regions more than doubles between now and 2030, most of it in the form of oil
- Almost all the increase in production occurs outside the OECD, up from 60% in 1971-2000
- OPEC Share in world oil production will reach 54% in 2030 from 38% today
- Asia sees the biggest jump in import dependence, while OECD imports also continue to rise, especially in Europe
- Net oil imports surge from 1.7mb/d in 2001 to 9.8mb/d in 2030
- World emissions increase by 1.8 % per year to 38 billion tonnes in 2030 – 70% above 2000 levels
- About energy security:
  - IEA countries recognise the significance of increasing *global interdependence* in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants.
  - *Diversity, efficiency and flexibility* within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as

*diverse as practicable*. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

- Energy systems should have the ability to respond promptly and flexibly to energy emergencies....

- The environmentally sustainable provision and use of energy is central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should where practicable have regard to the Polluter Pays Principle.

- *More environmentally acceptable energy sources need to be encouraged and developed*. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority

**Presentation by Maria R Virdis : “Energy and environment issues for the 21<sup>st</sup> century”** (See the ppt presentation “Maria R Virdis” attached)

The main conclusion of the presentation are:

- Anything we do in the direction of abandoning fossil fuels in favour of some form of reproducible energy vector or fuel will automatically ease the resource scarcity problem.

- In this respect environmental sustainability, sustainable resource use and long term supply security may well have the same solution.

## Discussion

**T. Hamacher** points out that, concerning renewable energies, harvesting the energy is decentralised because the resources are diffuse, but the utilisation may well be centralised: it is a matter of infrastructures and costs. Therefore the argument of the low density of the renewable energy sources is not relevant as regard the potential of these energies to fulfil the demand in the distant future.

**B. Chateau** raises the question of the depletion rate of the fossil fuels resources, in the spirit of sustainability (availabilities for future generation). **M. Virdis** expresses scepticism as regard Bruntland statement on sustainability applied to fossil fuels resources; markets and prices will take care of the problem well before the peak in production will be reached. But this is a matter of time schedule in the development of R&D, so that alternatives are ready and cost effective at the appropriate time.

## - Conclusions

**Bertrand Chateau** thanks everybody for their presentation and comments. He said that a synthesis report on how to account for sustainability in very long term energy studies will be written, and will be sent to all the participants for comments before released in VLEEM project documentation.

## Bibliography:

B. de Vries, J. Goudsblom (eds.); *Mappae Mundi; Humans and their Habitats in a Long-Term Socio-Ecological Perspective – Myths, Maps and Models*; Amsterdam University Press, Amsterdam 2002; ISBN 90 5356 535 3 (Book on historic development of human population as reaction on environmental conditions)

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# ANNEX 1

## Agenda

- 9:30 a.m. Welcome addresses: Ademe, EC-DG-RTD  
Introduction ; B. Château**
- 10:00 a.m. Political and methodological issues related to sustainability**  
- Sustainability concept in government policy ; [M. Colombier](#) (20')  
- Sustainability and back-casting : lessons from EST ; [P. Wiederkehr](#) (20')  
- Discussion (20')
- 11:00 a.m. Coffee break**
- 11:15 a.m. Towards a socially viable world :Thematic discussions**  
- Demography – Peoples' migration  
    o [Introduction (5') , [B Château](#) + Discussion (30')]  
- Time budget and life style change - Equal sex access to instruction and labour - Geopolitical regional and interregional universal cultural acceptability  
    o [Introduction (5') , [J.A. Perez](#) + Discussion (30')]  
- Welfare, poverty and social link – Economics  
    o [Introduction (5') , [J.A. Perez](#) + Discussion (30')]
- 1:00 p.m. Lunch**
- 2:15 p.m. Building up an environmentally sustainable energy world, keeping resources for future generations and preventing geopolitical ruptures**  
  
- CO2 emissions [Introduction (15') + Discussion (35')] ; [B. de Vries](#), RIVM  
- Nuclear issues [Introduction (15') + Discussion (35')] ; [B. Dessus](#), GC  
- Land-use, noise, and other industrial risks [Discussion (35)];
- 3:45 p.m. Coffee break**
- 4:00 p.m**  
- Resources [Introduction (15') + Discussion (30')]; [M. Whiteley](#), ESD  
- Geopolitics [Introduction (15') + Discussion (30')]; [L. Cozzi](#), IEA
- 5:30 p.m. Conclusion**

## ANNEX 2

### Memorandum on sustainability issues in view of very long term energy studies

*"If skyline runs always further every time you moves on his direction, you will never reach it, so what use has-it? The use of skyline is precisely to keep you going forwards." Eduardo Galeano.*

*"Earth does not belong to us, we belong to the Earth". North Amerindian chef Seattle.*

*"People put to themselves only problems they can solve". French popular saying.*

*« There will always be on Earth enough to satisfy everybody's need, but there will never be enough to satisfy everybody's greed." Mahatma Gandhi.*

#### Introduction to the seminar.

The VLEEM project intends to build an operational tool linking human development and welfare with environment sustainability on the very long term (2100) for energy R&D decisions.

This Seminar on "Human Development & Sustainability" aims at two majors objectives.

The **first objective** is to clarify the following question: under which conditions, about overall human future context, the reflections on the very long term energy systems remain meaningful? Which key context elements would make personal and social life acceptable enough throughout the world in one century from now, from cultural, social, economical and geopolitical points of view, so that no major social, sanitary, civil and military geopolitical irreversible catastrophes occurs all along the century? Acceptability in the VLEEM context is understood in relation to four simplified socio-cultural functions : providing, in quality and in quantity, enough food, shelter, self accomplishment and paid work to human beings.

The **second objective** is to share views on practical criteria that energy systems should imperatively respect, in order to foster sustainability on environment, resources and energy related geopolitics.

For the VLEEM Consortium, the ultimate purpose of the seminar is afterwards to translate its conclusions into precise quantitative assumptions, as regard the drivers of demographic and socioeconomic evolutions in one side, and in precise quantitative criteria for environment, resources and geopolitics sustainability to be fulfilled, in the other side.

## 1- Towards a socially viable world.

Social and economical development. Economic accounting beyond the GDP. Sustainable development and economic growth. New concepts. Mr. A. SEN' welfare vision.

*Producing better instead of producing more? Stopping or reducing instead of increasing? renewing instead of dilapidating? Respecting or mutually agreeing instead of unilaterally violating? getting the necessary instead of abusing? sharing instead of cumulating?*

By developing the Human Development Indicator (HDI), the UNDP has emphasized the necessity to address human development in broader terms than just economic growth or GDP growth. Nobel Prize A. SEN concept of welfare<sup>1</sup> can be seen as referring to a quality of life resulting of improving standards of quantitative cultural and socio economic well being: in this, it also goes well beyond the usual GDP approach.

“The Human Development Indicator (HDI) measures the average level reached by a given country according to three essential criteria of human development: longevity, access to knowledge and life level. Those three aspects are respectively based on the life hope, the level of instruction (adults alphabetization ratio combined with access to primary, secondary and superior schooling ratios) and income per inhabitant, corrected and expressed in parity of purchasing power (PPP).”

*Translated from French, in Rapport Mondial sur le Développement Humain 2001 (p.14) :*

In order to clarify what a socially viable world might be, the following questions should be addressed during the seminar:

- **demography:**  
*is the United Nations prospective hypothesis of stabilization of the human population by the end of this century necessary? Which inferior and superior limits to world population evolution can be envisaged? To which extent the aging of the population may become a major threat on economy and social equilibrium?*
- **time budget and life style change:**  
*how to settle the question of trade-offs between working and leisure time? Of fertility and feminine growing participation on labor-force?*
- **welfare, poverty, and social link<sup>2</sup>:**  
*how to measure welfare in comparative terms? Does it reflect social injustice? Which link exists or may exist between globalization and poverty? what is and what will be a socially acceptable society in 2100?*

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<sup>1</sup> **Welfare** n., good fortune, happiness, health and prosperity (of person or community, etc); maintenance of person in such condition, money given for this purpose. In **The Oxford Dictionary**.

<sup>2</sup> See Amartya SEN in **Selected bibliography** (last page).

- **equal sex access to instruction and labor:**  
*beyond its close relation to above issues does the equal access of sexes to education and work constitutes a sustainability condition in it self?*
- **economics:**  
*beyond GDP which definition of economic growth? does sustainability involves a minimum economic growth? what should be captured on economic growth? how to relate it to welfare?*
- **peoples' migration:**  
*should we consider limits the allocation of population away in rural, suburban or urban living areas? Which limit for migration among world regions?*
- **geopolitical regional and inter regional universal cultural acceptability:**  
*is the "business class shell" scenario sustainable?  
Is the cultural diversity enforcing or threatening sustainability in ethnocentrically lead world? there is an alternative to language culture and religious unilateral supremacy? Which efficient counter-power regulation could guarantee welfare sustainability if one polar empire fails to do so?*

## **2- Building up an energy world environmentally sustainable, keeping resources for future generations and preventing geopolitical ruptures <sup>3</sup>.**

*Resource economy. Exploitation of finite resources and sustainability. Environment aspects. General. Climate change. radio-toxic substances and sustainability. Global political aspects. Globalization versus unilateralist "clash of civilizations".*

Sustainability concept has developed along the public awareness on health and life dangers after some anthropogenic and natural environmental great scale catastrophes which occurred in the decades.

Public consciousness is slowly growing since the apparition of Minamata's disease which stroke fishermen newborn children since 1965. It followed throughout nuclear radiation on surrounding inhabitants of Chernobyl nuclear central and chemical air pollution affecting neighboring people of Bhopal factory, oil water pollution from tankers as *Erika*, *Valdez*, *Prestige* destroying marine, island and continental littoral biological diversity and landscape.

In one hand, historical United Nations international meetings as the Earth Summit of Rio de Janeiro and Kyoto Conference about climate change related to green-house emission gazes contributed to diffuse sustainability concept and stake. In the other hand, direct personal citizens' concern through mass tourism, mass migration and mass media is constantly arising.

Which criteria should we adopt as regard future energy systems to make human development sustainable from environment, resources and geopolitics viewpoints?

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<sup>3</sup> Herman Daly five principles of sustainability (from TIPPETT p. 16) :

1. Waste emissions should not exceed the regeneration rate.
2. Human scale (throughput) should be limited to a level which is within carrying capacities.
3. Technological progress for sustainable development should be efficiency-increasing rather than throughput increasing.
4. Waste emissions should not exceed the renewable assimilative capacity of environment.
5. Non-renewable resources should be exploited but at a rate equal to the creation of renewable substitutes.

- **environment** : *how to express sustainability in regard of climatic change? to which extent long life nuclear wastes are and will be acceptable in a sustainable world? To which extent is land-use a matter of sustainability? To which extent other pollutions affecting biological diversity and landscape are and will be acceptable in a sustainable world? which culturally acceptable degree of biological diversity and which future for genetically modified organisms (GMO)? is and will be precaution principle a necessary component of sustainability ? what does it means for major industrial risks?*
- **resources**: *is comprehensive depletion of oil and gas resources an acceptable assumption? To which extent exploitation of renewable natural resources as wind, solar, hydropower is acceptable without creating social catastrophe?*
- **geopolitics**: *what means energy security in a sustainable world? what does it implies in terms of energy resources access and control? which are and which will be acceptable policies among producers' and consumers' nations?*

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