

***A global legal framework
to meet the Climate Change Challenges***

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As a foreword

- ▶ **We cannot afford to focus on a limited subset of initiatives as safeguards.**
- ▶ **We need to be inductive and provide a framework within which all processes can operate and complement each other.**
- ▶ **There be a method by which the necessary synergies will naturally develop. Nothing else can deliver such a gain.**

The basics of our proposal (1/4)

Our solution is both technical and economical; it involves the introduction of a legal and administrative framework that is compatible with market economy and which truly provides hope of stabilizing CO₂ emissions by 2030 and halving them by 2050. It aims at truly innovative governance, taking what we have learned from the past into account.

This solution provides an original way of involving the general public and companies in all major countries, making it much more than a government initiative. It moves away from conventional negotiations between governments and beyond cap and trade. It will lead to a right to interfere in how countries are managed.

The framework includes four types of measures. All of this combined makes up a *world climate pact* :

- 1 The introduction of a common environmental law for the biggest countries in the world (*) which would be enshrined into their constitutions. These countries would be obliged to adhere at the risk of being excluded from the WTO. Under its constitution each major country has to include the notion of failure to assist an endangered mankind, which will increase awareness across the planet.**

Other countries would have the choice of adhering or not, depending on their own good judgment.

- (*) *For the purposes of our presentation we will refer to these core countries as the G20+. The 18 biggest countries alone account for over 70% of emissions.***

The basics of our proposal (2/4)

- 2. Conventional regulations provide a framework for market economics through long-term provisions that enable industrial companies to adjust their strategies and industrial offerings. This is a long-term vision but a conventional one with specific impacts on base-load electricity, road transport and energy for buildings and housing.**
- 3. Listed stock companies in these core countries (G20+) could freely adhere to this world climate pact. Ensuing rights would be valid for a period of seven years and could be renewed, if the companies so wish.**

The corresponding mechanism would be put in place within a few years to allow companies the time to fully work their decisions through with regard to introducing a flexible system of solidarity between developed and emerging countries.

- 4. Very simple mechanisms for stimulating public opinion and higher education to create the kind of effective mobilization that is essential to the overall success of this fight against climate change.**

Why a legal framework? (3/4)

- Economic activity can be managed either by financial incentives or by laws. We need to combine them and not to oppose them.**
- Negotiations between countries have not made much headway so far and by nature can only lead to a consensus imposed by the weakest countries and as always dictated by their prospects for the next five to seven years.**
- On average it takes more than twenty years to get new production, transport or construction projects off the ground. This is why we need to draw up the legal frameworks now for the new direction we want to take in several decades' time.**
- If it can benefit from indications on what to expect in 10-15 years, the economy can pace its R&D without dwelling too much on return on investment.**
- If we are objectively failing to assist human beings in danger, it is a legal matter. Montesquieu and Locke would have agreed in their time.**
- Building awareness and a sense of responsibility can progress at several levels as part of a whole. We will illustrate this throughout our presentation.**

An innovative proposal for structuring politics, the economy, regulation techniques and mobilizing people (4/4)

For a long time now, we have tried to reduce the topic to two issues:

- ◆ **Choosing the best way of giving a value to carbon,**
- ◆ **Getting governments to negotiate, and especially the major world governments.**

We believe that the topic should be extended to include:

- ◆ **Bringing public opinion on board, beginning with OECD members. Otherwise we will not successfully rise to the challenge.**
- ◆ **Obliging various key countries, outside of their political specifics, to integrate their commitment into their constitutions.**
- ◆ **Getting economic and financial circles in all sectors involved if they wish to do it.**
- ◆ **Admitting that emissions permits and carbon taxing are only part of what is required.**

The proposed solution is based on the following observation (1/3)

- ▶ **As the last ten years have shown, we will not find a planet-wide energy mix that is universal and can be decided upon and determined once and for all; no matter how hard we try, experience has shown that countries' differing situations, national sovereignty and the difficult nature of the topic itself mean that the quest for the Grail is never-ending. This is all the more true when we consider the date most often mentioned - 2050 - which is indeed far off.**
- ▶ **New production and transport projects will take a good twenty years to get up and running, yet we know that we have to stabilize CO₂ emissions before 2030. Time is running out and we won't get anywhere if we don't put a combination of strong incentives and drastic regulations in place. Only the invention of a means of mass electricity storage could improve this analysis.**
- ▶ **Most countries are struggling to keep up with technological progress.**
- ▶ **There are ways to find regulations that meet this objective and at the same time are compatible with medium- to long-term market economics; all we need is determination and a little imagination.**

The proposed solution is based on the following observation (2/3)

- ▶ **Emissions permits have advanced awareness of the climate issue in economic circles; there is interest in developed economies but three crippling failings exist at planetary level:**
 - ◆ **It does not allow for the future of cars or the large-scale agro-reforestation which is required. This alone accounts for 35% of the problems that must be dealt with by 2040-2050 (see the Stern Review). It is hard to think how a global regulation tool could ignore 35% of the topic.**
 - ◆ **It has practically no chance of being accepted by India and then Russia, if not China. China defined principles in the recent weeks that would be really discrepant with them !**
 - ◆ **We would not be able to mobilize populations and the main stakeholders on the fight against climate change using such a tool. Governments alone will not be enough to rise to the challenge, if the people feel that this is beyond them and will be dealt with using technical tools which do not call upon their involvement; a modern governance is required.**

These discussions do not prevent cap and trade systems from playing a major role in the regulations to be determined, in the leading developed countries at the least.

Several carbon values (3/3)

As we will later examine in a detailed way, there are several carbon values. Here are the conclusions of work carried out by the International Energy Agency:

- ◆ The lowest value, for energy savings in construction and agroforestry (less than 20 €/T CO₂) which has little effect on the decisions made by economic players. Nonetheless this accounts for 25% of the issue.
- ◆ The highest value (in excess of 150€ / TCO₂), which holds for automobiles and for which we cannot simply content ourselves with observing the growing number of cars in the world. This accounts for 25% of the issue by 2040.
- ◆ Between the two are intermediary values (40-100€/TCO₂), for industry and collective transport, more uncertain for carbon capture and sequestration (we will only have figures between 2015 and 2020, if pilot programs enable this).

Given that it takes up to twenty years to make changes, we must look for regulations (governance) that are not limited to looking for a uniform carbon value.

So what?

- ▶ Obviously if readers and the panel do not share the aforementioned observations, our proposal would lose much of its relevance.
- ▶ All of the proposed measures appear compatible and consistent with what we know about the current or foreseeable potential of technologies. Our overall proposals avoid setting a too rigid framework which could later curb unanticipated development of technologies.
- ▶ A large section of our proposal is based on the idea that it would be impossible to effectively deal with the issue if baseload electricity, transportation and reforestation accompanied by true agro-reforestation policies are not dealt with in detail.

The proposed system (1/16)

Our initiative boils down to a clear set of governmental measures and a global constitution which complements and binds them. The main measures we have suggested and which structure our proposal relate to the following:

- **A common environment law proposed within the G20+ and which forms a constitutional element shared by major countries.**
- **A potential link between all these measures and WTO regulations.**
- ◆ **Or in more concrete terms:**
 - **Incentives for energy savings in buildings, with a view to reducing global demand by 10%.**
 - **Regulating baseload electricity within the G20+ not by an energy mix but through emission objectives in grams of CO₂/KWh with a view to reducing emissions by 2025 and further reducing them between 2030 and 2040.**
 - **A clear and strong statement on the role of renewables at least for semi-baseload and peak electricity (at least half of these two forms of electricity by 2025 or even 2020).**

The proposed system (2/16)

- ◆ **Eliminating the sterile opposition between renewables and nuclear, so that civil nuclear can be developed safely.**
- ◆ **Technological progress objectives in particular for road travel (otherwise this topic alone would derail the others), with a view to compensating as of 2020 growth in the automobile fleet by technical progress.**
- ◆ **Capture and sequestration/transformation of CO₂, combined with a move towards electricity in road transportation (hybrid rechargeable cars, electrical cars) could help to dedramatize the issue of the Middle East.**
- ◆ **Inviting private corporations to voluntarily adhere to the fight against climate change with the possibility of allocating up to 0.5% of their added value (tax free). This is essential in forging solidarity between old industrialized nations and new upcoming powers, in particular India and China.**
- ◆ **A double initiative for reforestation (support for ambitious plan, possible sanctions for any deviations in the form of international loans).**

When reading these proposals any observer should bear in mind the scale of the stakes involved.

The proposed system (3/16)

- ▶ **On first reading our proposals, the reader may see what makes them different:**
 - ◆ **An institutional pact engraved in the constitutions of the key countries across the world, key point explained in more detail later.**
 - ◆ **Objectives to gradually reduce automobile emissions per kilometer traveled, and scrap old vehicles emitting more than 110g CO₂/km by 2025.**
 - ◆ **Interest-free loans within developed countries for projects that halve housing emissions.**

The proposed system(4/16)

- ◆ **Private companies in G20+ countries will be able to adhere to the world climate pact and deduct 0.5% of their added value from taxable profits to fund the fight against climate change and in particular CCS in the major developing countries and national reforestation programs. The economy will thus be associated with the world climate pact in order to mark a possible commitment alongside governments.**
- ◆ **Higher education establishments awarding doctorates and masters' degrees will be obliged to dedicate at least 1% of their teaching to topics directly related to these issues.**
- ◆ **A distinction between baseload power (which is available 24 hours a day) on the one hand and peak or semi-baseload on the other hand, to put together sustainable electricity development policies in the major countries.**
- ◆ **A consistent set of actions for governments and companies regarding their responsibilities and the penalties they may face should they fail to meet their obligations.**
- ◆ **The assessment of public opinions within the G20+.**
- ◆ **The creation of a right to intervene in how countries are managed.**

An institutional pact enshrined in the constitutions of the G20+ (5/16)

This pact provides for three types of measure:

- 1. Each person, company and institution has the duty to include climate concerns into policies.**
- 2. To ensure no action is so great that it delays global greenhouse gas stabilization to after 2030, public authorities shall adopt proportionate measures in order to hold back the damage. The notion of failure to help an endangered mankind is also introduced.**
- 3. In line with its political system, each country can adapt its organization by taking the following guideline into account:**

An institutional pact enshrined in the constitutions of the G20+ (6/16)

Laws can be referred to a sustainable development board before promulgation, either by the executive power or by at least 20% of parliament members.

Provisions contrary to the interest of future generations cannot be promulgated or put into application.

The sustainable development board can be petitioned within the scope of a dispute calling into question the application of the sustainable development charter. This petition must include at least 500 000 signatures and/or 1% of the population from within the country.

Any country's sustainable development board sums up the legal decisions taken within a G20+ country and communicates the most important of these to sustainable development boards in other G20+ countries.

The G20+ and the WTO (7/16)

The leading twenty countries in the world are responsible for over 70% of current emissions and over 70% of the world economy.

The question is whether to focus on the G20 countries which met to discuss the global financial crisis, or whether we should also include countries that are already members of the OECD but which did not attend the G20 meeting? In our opinion the choice is more political than technical.

Any country which refuses to assume its responsibilities should be excluded from the WTO.

If naturally the existing framework would allow to define a similar ambition by 2012, the link with WTO would be totally unnecessary. That is more a matter for diplomats than for the panel.

But it is an important one : the existing framework can be a very good one if the States use it in a efficient way, that means not for delaying the right negotiations.

A duality outside of the G20+ (8/16)

- ▶ **The proposed mechanism leaves countries that are not part of the G20+ free to adhere to the pact if they so wish.**
- ▶ **Should they not adhere to the pact, industrial companies in these countries will pay a minimum tax on the carbon value of their exports to G20+ countries as of 2020.**
- ▶ **With this system of taxes in G20+ countries, half will benefit countries in which exports will be penalized (half of the money) and half the countries that opted to adhere to the world climate pact.**
- ▶ **By adhering, countries could :**
 - **Either commit to stabilizing their carbon emissions by 2025 and beyond to 30% above their 2000 levels at the most,**
 - **Or commit to generating at least 35% of their energy without emitting CO₂ by 2030.**

Involving companies through an original mechanism (9/16)

The extent of the challenge and the issues related to solidarity between nations call for a unique form of proactive involvement from businesses. The following innovation should therefore be implemented :

- ▶ **Private companies in the G20+ would be invited to adhere to the climate change pact by 2012. Those who do shall commit 0.5% of their added value as of 2014, to one of the following:**
 - ◆ **Financing R&D**
 - ◆ **The funds dedicated to modernizing homes**
 - ◆ **Half of CCS costs**
 - ◆ **The reforestation plans.**

At least half of their expenses should be outside the OECD.

- ▶ **Companies' commitment to the climate change pact should take the form of seven-year renewable periods.**

This argument is also required so that populations do not consider that the economy has unburdened itself of likely challenges to be overcome.

The public opinions stimulation (10/16)

It is impossible to succeed without mobilizing public opinion. There is no denying that governments will only be credible if the public opinion, in developed countries at least, is seen to be mobilized in a comparable manner.

Beyond the notion of failure to assist an endangered mankind, the spirit of our proposal lies mainly in the following measures:

- ◆ **Interest-free loans for housing projects that halve CO₂ emissions (something we all understand).**
- ◆ **Cars scrapped after 2025 if they emit more than 110g of CO₂/km.**
- ◆ **Companies involved in the global climate pact (it's not only individuals that will have to pay).**
- ◆ **Right to refer to the sustainable development boards of the G20+ (a type of parliamentary office) if a petition has 500,000 signatures and 1% of the population from within a particular country (offices can refuse to investigate); regular televised progress report every five years in G20+ countries broadcast in all other countries.**
- ◆ **Regular surveys of public opinion.**
- ◆ **NGO-type measures of solidarity for companies penalized in the G20+.**

Introducing a mechanism to interfere (11/16)

By:

- ▶ **Creating parliamentary offices to assess scientific and technical choices in all G20+ countries, these offices will have to communicate results across the world every three years.**
- ▶ **Imposing at least three worldwide university assessments at a high level, following a call for bids and made every three years.**
- ▶ **Inciting companies, who wish to do so, to get involved, leading them to join forces later to make their suggestions.**
- ▶ **Creating dedicated television channels, via a call for bids.**
- ▶ **Obliging universities and business schools that offer masters and PhD courses to dedicate at least 1% of their classes to "meeting the challenge facing our planet."**
- ▶ **Continuously gauging public opinion, in particular in OECD countries.**

Introducing a mechanism to interfere (12/16)

The suggested structure introduces a mechanism to interfere in how countries are managed.

The WTO would head the system and could create an adapted legal system, similar to what was put in place for the international court of The Hague or even to take proceedings against heads of government who knowingly took action that went against world interests.

The suggested structure in its objectivity would thus introduce in a number of ways a true right to interfere using numerous components.

A context to be designed (13/16)

Would this proposal be very well known, the countries would be prompted to look at it very seriously. Because improved at least one solution is feasible. Would it be hidden governments and industrial companies could be the subject of large-scale court cases, charged with failing to assist humanity in danger and face potential fines in the form of percentages of revenues for many long years to come.

Threatened islands or even coastal areas would be especially justified in launching such procedures along with compensation requests in line with their current GDP.

This would be the most striking aspect of a mechanism to interfere.

Naturally the key question for the panel would be to consider or not that an award given to our proposal would force the key countries to act as well as to speak.

The originality of the solution (14/16)

The originality of our solution stems from:

- ▶ **The governments of developed countries alone will not be enough to determine the action required for true stabilization by 2030. Companies and the general public must be brought on board.**
- ▶ **This is essential if we want to get away from inter-country power struggles and get China and India involved.**
- ▶ **With a date twenty years in the future, we need a mix of constitutional and administrative measures.**
- ▶ **Even if technologies will be able to stabilize CO₂ emissions by 2030, it appears paradoxical not to put in place a system which will facilitate the operation of such technologies.**
- ▶ **We have to introduce a mechanism to interfere in how public affairs are managed, and to do so in a sufficiently diverse fashion to ensure that it is done in an objective manner.**
- ▶ **Should we win the prize, governments will be obliged to move forward together or explain why they will not. The prize will thus have an additional incentive effect.**

A response to a geopolitical and moral issue(15/16)

The proposal has two sides, geopolitical and moral:

From a geopolitical point of view:

- ▶ **Each powerful or leading state in globalization wants to continue to grow and not be held back by new constraints.**
- ▶ **In India and China, energy is the only thing curbing growth and everyone is dreaming of having a car and electricity like those in the developed world; television has played its part.**
- ▶ **Governments are judged on criteria that are so complex that it is difficult for them to look 20-25 years into the future.**
- ▶ **For the past twenty years and in spite of many efforts, developed societies have not been successful for positioning international negotiations....., they are not in a position to suddenly do what it takes to put the topic on the top of their agenda.**
- ▶ **The whole oil issue and all that goes along with it (Islam, the West and terrorism) has taken too much of a toll over the past ten years for us not to learn some lessons: we will gradually have to relax the climate energy/climate issue if we want more peace in the world.**

A response to a geopolitical and moral issue ***(16/16)***

From a moral point of view:

- ▶ **The disappearance of the world as an unlimited source of marvel would threaten the well-being of mankind and all that their arts, sciences and cultures have taught him.**
- ▶ **Through its flexibility, the proposed system avoids the pitfalls of negotiations with 200 countries; it addresses an issue much more difficult than free world trade which, in a time of general growth, took over twenty years to be put in place.**
- ▶ **Just in case, some governments would refrain from thinking about it, countries which are trying to delay world negotiations would sense the warning.**

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***The most striking features of our
proposal***

The need for stabilization by 2025 or 2030 at the latest

- ▶ **Once in the atmosphere, a CO₂ molecule cannot be destroyed by light; it can disappear in the upper layer of the oceans by transformation into carbonate or by photosynthesis.**

The average lifetime of CO₂ in the atmosphere exceeds one century.

- ▶ **Even after the peak of emissions and as long as they have not decreased below 3 GtC/year, the amount that oceans and biosphere are able to absorb, CO₂ concentration will continue to grow.**
- ▶ **This phenomenon could even become irreversible (on a human scale) if the absorption capacity of oceans and lands were to decrease.**
- ▶ **It is therefore paramount to start decreasing the emissions as soon as possible.**

Governments, the financial community and public opinion must convince themselves that this can be done as early as 2025, or 2030 at the latest. this worldwide objective has unfortunately only partly emerged from the Copenhagen convention.

Technologies exist to meet this challenge (1/6)

Technologies to rise to these challenges already exist or are highly likely to exist by 2015; the proposed climate pact offers the possibility of implementing them:

- ▶ **Technologies for coal-fired plants which reduce emissions by one third exist already but no-one is forced to implement them. Even before 2015 it is possible to have coal-fired plants which emit 600 g CO₂/KWh as opposed to 1000 for plants sold since 2000.**
- ▶ **The average car emissions vary from area to area from 160g CO₂/km to 280 g CO₂/km, yet we already know how to manufacture five-seaters which generate less than 110 g CO₂/km.**
- ▶ **All the necessary technologies (roofing, insulation, glazing) to reduce the demand for heating and cooling by at least 35% in old housing.**

We know how to cut lighting consumption tenfold without losing more than 3% in brightness.

Technologies exist to meet this challenge(2/6)

Heat pump/solar water heating are used by two thirds of the planet to provide up to 50% of heating requirements from solar power and earth heat. Wood heating and/or electric heating could improve this figure even more.

- ▶ **Hydro-electric power is only used to 30% of its potential and where there is wind onshore wind turbines are of a major interest for the coming years. Geothermal power has also been used very little up until now.**
- ▶ **Experimental technologies to capture/sequester CO2 will exist by 2020; regulatory constraints are what is delaying the financing of any large scale operations. On the other hand, geology alone is preventing CO2 capture and sequestration in at least half of Asia.**
- ▶ **Technologies to produce synthetic fuels at less than 150\$/barrel exist but with a 5% interest rate on investments, which nobody is discussing.**
- ▶ **Long-distance electricity transportation technologies (HVDC and AC) will exist by 2010.**

Technologies exist to meet this challenge(3/6)

- ▶ **If we would recycle nuclear used fuels on a large scale, we would easily counter the limited availability of uranium ore to develop reactors which have proven themselves in terms of safety to meet an increasing demand for nuclear energy. Fast breeders are another likely technology.**
- ▶ **Concentrating solar thermal power costs less than 150, possibly 120€/MWh in areas that receive a lot of sunlight.**
- ▶ **Electric trains could be developed extensively.**

Technologies exist to meet this challenge(4/6)

- ▶ **The technology already exists to manufacture cars (high performance thermal engines for light vehicles and more especially rechargeable hybrids) which can travel at the same speeds and give off at least three times less pollution than current cars which account for 15% of the world problem.**
- ▶ **If 30% of the world's baseload electricity is provided by coal-fired plants with the best available technologies (600 g CO₂/KWh), 30% by nuclear, 30% by coal-fired plants with CCS, and 10% from hydroelectricity and renewable energies, and if semi-baseload and peak electricity which makes up 40% of total electricity is increased to 50% by renewables, CO₂ emissions due to electricity would be divided by four per kWh produced, compared to now. And this accounts for 40% of the world problem.**

Technologies exist to meet this challenge (5/6)

- ▶ **Agroforestry which represents at least 15% of the issue in the longterm is a matter of organization and not technology.**
- ▶ **We can assume that we can manufacture natural gas and synthetic oil by recycling carbon materials. Finetuning such technology is not a major problem.**
- ▶ **In so-called polluting industries which use a lot of heat, electricity could technically replace fossil fuels. This is a matter of relative cost.**
- ▶ **On the other hand 15% of the topics are dependent on national situations and public willingness to rise to the challenge, in particular to make energy savings in old buildings and to develop collective transport.**

Leading the average citizen to believe that the development of long-term technology is the indispensable but uncertain condition for meeting these challenges amounts to deceit.

False ideas regarding technology (6/6)

Some believe that technology, by its very nature, will progress in leaps and bounds and save the day. Unfortunately this is wrong or wishful thinking :

- ◆ **Technical progress will likely help solar power to progress but it won't make the sun shine at night!**
- ◆ **We may be able to travel 200 km in electric cars by 2015, but we have no scientific knowledge which allows us to hope to mass store enough electricity to cover the needs of several days of consumption in a country.**

Other key topics have been identified in the technological roadmaps of the major countries but success depends more on how quickly things are put in place on an industrial level than on new breakthroughs in fundamental research.

Pretending or presuming that the opposite is true amounts to weakness or carelessness.

Determined modernization of old housing (1/2)

- ▶ **After 2015, in all OECD countries where private property is recognized, it could be envisaged that no housing shall be sold without the following:**
 - ◆ **An environmental audit carried out by the authorities or companies approved by delegation**
 - ◆ **Monitoring of an interest-free loan to carry out improvement work to the value of €25 000 or even €30 000 per owner.**
- ▶ **Starting immediately, similar incentive measures (interest-free loans) should be put in place at least in OECD countries once individuals commit to modernization projects to halve CO₂ emissions.**

Determined modernization of old housing (2/2)

As we will see later, 80% of electricity can be produced without CO₂ so there is no reason why the following:

- ◆ **Wood heating**
- ◆ **Solar water heating + heat pump**
- ◆ **Electric heating (naturally CO₂ free electricity)**
- ◆ **Geothermal heating**

could not cover 80% of heating requirements by 2020 in all G8 countries and 50% in the seven most populated countries.

From 2020, anybody using fossil fuels for private heating should pay a tax of at least 50€/T CO₂ in OECD countries and at least 30 €/T CO₂ in the other G20+ countries.

Major proposals relating to baseload electricity

With the challenge of combating climate change in mind, G20+ countries should, as of 2015, no longer roll out coal-fired power plants that emit more than the best technologies already available i.e. 600g of CO₂ per Kwh.

The two main objectives for the G20+ could therefore be:

- ◆ **2022-2025: a new fleet of power plants built to supply base-load electricity comprising plants emitting less than 250g of CO₂ per KWh, compared to an average of 600g/CO₂/KWh today.**
- ◆ **By 2035: this objective could be made even stricter by applying a limit of 250g of CO₂ per KWh, or even applying this limit to the entire installed fleet. If CCS has proven itself by 2020, this objective could be made stricter still and brought to 200 or even 150 g CO₂ /Kwh.**

Major European utilities should specify an objective for 2050 (100 g CO₂ /Kwh).

And other forms of electricity

Renewables could generate at least 15%, or even 25%, of the world's electricity, i.e. over 50% of the total semi-base load and peak load electricity. Depending on the country, the principal renewables could be wind power, biomass or solar power.

The contribution of renewables could even be more in the long term.

If CCS is technically possible and if nuclear can be developed in countries that have the capacity, the electricity generated in the G20+ countries today from fossil resources, with no CCS, could be reduced from 75% to less than 25% in 25 to 30 years' time; this represents an improvement factor of at least three.

CCS and CO₂ potential use

Even if technical uncertainties persist and if the cost is not yet really known, it is essential that CCS be industrially feasible by 2015 at the latest.

Numerous underground storage possibilities exist in the US and Western Europe; we should be careful not to presume that the same holds true for China, India and Japan as this is likely not the case.

We also need to take into account that when CO₂ is recycled with H₂ and electricity, it can be turned into oil.

The challenge of transport (1/3)

The transport challenge facing us is three-fold:

- ◆ **Personal road transport will in all likelihood increase as the population grows and people in countries such as China, India and elsewhere, aspire to own a car. TV images have shown us the American dream, and we would be naive to underestimate future growth.**
- ◆ **Goods transportation is also growing with economic globalization. As we benefit today from its low cost, there is nothing holding back its growth.**
- ◆ **Finally, when all's said and done about geopolitical risks, it is clear that if the entire economy depends more and more on access to Middle-Eastern oil and gas resources in order to operate, and if this part of the world remains plagued by violent tensions and the obsession with oil and gas income, then political instability may continue and even intensify to the point where climate change is always pushed back as a lesser priority.**

Two-phase transformation of road transport (2/3)

Car manufacturers, in particular in Europe and Japan, have shown that it is possible to produce cars that emit 90g CO₂/km, so there is no excuse for having cars on the market post-2015 that emit more than 160 g CO₂/km.

This objective has been set for the EU and should be extended to the G20+ by 2016.

Beyond 2016, within the G20+ the maximum authorized CO₂ emission level for each new car sold should be reduced each year.

A strong message to the general public (3/3)

Driving lessons should start to include a section on minimizing energy consumption when traveling from A to B (eco-friendly motoring training).

An extremely strong message could be that after 2030 all vehicles that emit more than 110g CO₂/km will be taken off the road.

The switch to electricity and converting carbon materials into synthetic oils

Road transport should start moving towards electricity; it is essential that transport be converted to completely electric or rechargeable hybrid. This will not happen on a large scale immediately.

The transition of energy systems may well be aided by the technical possibility of recycling the various carbon materials into synthetic oils (coal, biomass, organic waste, etc.).

Peak oil would therefore be less worrying than it is claimed; our ability to overcome this geopolitical constraint should be appealing.

It could be also very important for airplanes and shipping of goods.

Promoting agricultural and forestry activities that are more in keeping with climate objectives

As we already know and as noted a long time ago by the National Academy of Science in the US (1991):

« We must provide firm political support and large-scale financial support to long-term forest conservation operations, to provide the necessary training for managers and employees and to set up organizations dedicated to the conservation and management of genetic forestry resources...This cannot fall upon just some nations. We will only succeed if the whole planet works together. »

Any international loan of more than \$50 million should be the subject of an impact study on the effects of the planned location on climate deregulation. If this study were to yield negative results, a counter-study could be requested by the party petitioning. If this second study should also turn out to be negative, the loan should be suspended. Of course, international bodies which adhere to this objective must make such a commitment public.

Promoting true reforestation

Today, countries that want to put a stop to deforestation and commit to reforestation have no incentive to do so.

Any country which wishes to put in place a reforestation plan representing at least 5 million metric tons of CO₂ over the next ten years should be helped out, in particular by the private sector, under conditions to be determined later.

To make such plans even more attractive, we could even consider that a reforestation plan – in addition to reforestation expenses - could be supported by up to one third of its value in irrigation or agro-forestry expenses essential for agricultural development.

Get the public on board (1/2)

We will not successfully change energy systems if opinion leaders are not involved in this change. This is why our proposals favor three types of measure:

- 1. An annual assessment in all G20+ countries of the status of public opinion.**
- 2. Business measures which can be easily communicated on a world scale such as:**
 - ▶ Interest-free loans at least to housing projects in OECD countries that aim to halve CO₂ emissions.**
 - ▶ Ban on cars emitting more than 110g CO₂/km after 2025.**
 - ▶ Systematic taxing of fossil fuel powered heating after 2020.**
- 3. We know that the danger of taking the planet into a dead-end was due to a lack of education and training, in particular of our elite class.**

Get the public on board (2/2)

To combat this risk, we suggest:

- ◆ Any university or management school offering a masters' degree or doctorate program and with more than 30% of its students who go on to work in market economics should be able to justify dedicating at least 1% of its classes to global sustainable development. This objective should be included in the international assessments in force.
- 4.** Global news channels to inform world citizens of the issues linked to the fight against climate change should be launched by a call for bids within the next five years.
- 5.** In all G20+ countries the top one thousand most original initiatives should be rewarded collectively (every three years) and their knowledge disseminated.

Towards a new equilibrium in incentives and constraints (1/6)

Emission permits (companies sell or buy rights to emit CO₂ under medium-term global objectives set by governments) do not appear to be a suitable regulatory tool on a worldwide level:

- **Such a tool presumes that, every five to seven years, governments will be capable of imposing upon themselves shared emission reduction objectives. The recent past leads us to doubt in this capacity.**
- **Emission permits don't fall within the political choices that countries such as India, China or even Russia would be willing to implement; they would demand solidarity from other countries as the problem was created well before their economies took off.**
- **If half of the problems to be dealt with can be at a cost of 50€/T CO₂, work carried out by the IEA shows that the remaining half should cost between 80 and 150 €/T CO₂. The first of these figures would not be enough to deal with the issue while the second would curb any revival in economic growth.**
- **Such technocratic tools do nothing to mobilize the general public.**

If we apply this to the consumption of petrol alone, this figure of 50€/T CO₂ in 2020* would correspond to an increase in the cost of liquid fuel of 10 c€/l. Such an increase, especially if made over several years, is not a tragedy and can be explained across the board.

Taking into account inflation between now and then this figure is probably comparable with 30-35€ today (2009), or 50\$.

Towards a new equilibrium in incentives and constraints(2/6)

We can only hope to tighten the noose by using a combination of incentive and regulatory tools.

Incentive: To stimulate the economy, ensure that the number of cars grows in relation to demographics, promote energy savings and recourse to heat in housing in developed countries to a maximum, incite companies to break from their current R&D priorities (less than 3% of the world R&D budget is currently devoted to climate change!), get utilities and their shareholders on board to plan their investments in line with global objective of stabilization by 2030, give countries outside of the G20+ the option of adhering to the global climate pact.

Regulatory: Because public finances will not be enough to trigger a true change in energy choice, because time is running out – global inertia last a minimum of thirty years – and because developments that are continuous and progressive can only be designed in the medium term.

Towards a new equilibrium in incentives and constraints(3/6)

The proposed system of governance makes provision for a means of a constitutional call to order because the planet is in danger, obliging the various governments to mutually communicate on their choices.

If the problem is a planet-wide one and is recognized as such, governments should at least recognize it to be so on a political level.

Let's not forget that morals and the economy can join forces.

What is involved here is the fact that by doing something to save the climate and the planet, the economy will also survive. Because the issues involved are starting to merge. Our economy is joining our survival.

Tax, incite or regulate? (4/6)

If carbon value is not the best tool on a worldwide scale for energy savings in the home and agro-forestry, regulations and incentives could be used for the home and international loans for agro-forestry.

Similarly, as regards cars, regulations are the way to go.

This holds for 40% of the issue to be dealt with by 2050.

With regard to electricity, industry and public transport we have the choice between:

- a) wanting to displace taxation to give a value to carbon.
- b) regulating baseload (emissions in g CO₂/Kwh), semi-baseload and peak electricity (promoting renewable energies).
- c) basing the policy on an emissions permit as much as possible.

If we think that we have succeeded in showing that combining solutions (a) and (b) is the safest route to take, we could also claim that in extremely industrialized countries solution (c) is extremely well adapted and easily defended.

Fines under the proposed system (5/6)

It is based on three main ideas:

- ▶ Countries which do not adhere to the global climate pact will be subject to a tax of 50€/TCO₂ on their exports to the G20+.**
- ▶ Sectors outside of housing, energy, transport, agro-forestry (20-25% of the problem) must, by 2015, submit plans to stabilize their emissions by 2025, under the control of the IEA.**
- ▶ Regardless of where they are situated, companies which export more than 50 M€ to a G20+ country may have to simply pay fines of up to 50€/TCO₂ emitted, in proportion with revenues generated, if their policy is deemed contrary to parliamentary decisions taken in application of the constitution (like traffic fines when you pass through a stoplight).**

Fines... (6/6)

Our proposals are based upon a maximal recourse to regulations as much as possible to avoid all the pitfalls of a general carbon tax... and penalties that can amount to 50€/TCO₂ .

The main mechanism is the following : any company - regardless of where the head office is situated – which generates more than 50 M€ in revenues in any G20+ country and whose product policies obviously go against the objectives of the climate change pact should be prosecuted in G20+ countries and be made pay fines of up to 50€/T CO₂ as of 2020.

The funds collected in this manner could be used:

- ♦ **Half for developing public transport in the country of the sanctioning court or to the fund which facilitates modernization plans for private housing**
- ♦ **Half toward aid actions for development, education and health in countries outside of the G20+ which have signed the climate change pact.**

There would be a certain recognition of virtue for all those countries that freely adhered to the world climate pact.

If we have to do better than stabilizing CO2 emissions by 2030 and halving them by 2050 (1/2)

Some people believe that the climate challenge is even tougher than the IPCC forecasts and that the curve representing the increase in ocean temperatures is already on red alert. If this is the case, we believe that the following action should be taken:

- ◆ **Take a tougher stance on obliging individuals to use non fossile heat as much as possible in first world countries (solar water heating, heat pump, etc.), give a five-year deadline for insulating all housing used more than three months per year, give the public authorities the possibility of using satellite-borne photographs to alert those who consume the most, etc.**
- ◆ **Oblige all those in the G20+ countries to scrap cars which give off more than 100 g of CO₂/km by 2020 and not 2025. Now that would result in general outcry!**

If we have to do better than stabilizing CO₂ emissions by 2030 and halving them by 2050(2/2)

- ◆ **Force the industrial sectors which are responsible (for their type of activity) for more than 1% of world CO₂ emissions to submit their sector plans by 2012 and not 2015.**
- ◆ **Impose by 2015 international comparison of all means of capturing CO₂(direct transformation of vegetation into charcoal + hydrocarbons, direct transformation of CO₂ into synthetic oil, co-electrolysis of CO₂ and water) and any resulting norms with regard to the percentages of oil to be produced using these technologies.**

These limited measures will not change the logic of what has been designed; they could toughen the application if we really want to reach the maximum of what is theoretically possible within a shorter time.

There are three possible scenarios (1/2)

Following our work on the topic, we see three possible scenarios for the planet:

- ◆ **The first is the conventional power struggle between nations – the economic and financial crisis will prompt them to delay any serious negotiations until world economic growth picks up again. In the meantime, new CO₂ emissions may well stabilize but the store of CO₂ molecules in the atmosphere will continue to grow. As government leaders are mainly judged on the confidence they inspire for the short to medium-term, there is not doubt that such a scenario offers many advantages.**
- ◆ **The second scenario is the one we have attempted to define – an international law which is sufficiently attractive but constrictive enough to force us to gradually change current trends.**

There are three possible scenarios(2/2)

- ◆ **The third scenario would see the general public and especially the younger generation develop awareness, and governments and the economy become powerless in the light of the challenge. The temptation would be to say that all key technologies should become the shared property of mankind. Which basically means that for around 30% of the market GDP (transport, housing and energy in particular) technologies become public and worldwide.**

If India and China were to show an interest in such a scenario, developed countries would complain at seeing all their competitive advantages disappear for 30% of the market GDP.

Middle East, oil, cars and the climate (1/3)

- ▶ **The West has long suffered from the link between its supply of oil – needed for its economy to function – and geo-political and religious troubles in the Middle East.**
- ▶ **Many countries in the regions and pressure groups and interest groups with close connections to terrorism think that we are much more dependent on oil than we really are. Oil – and natural gas – are as much geopolitical in nature as economic.**
- ▶ **Awareness of the climate issue has grown gradually over the past ten years through the scientific work that has been carried out and the already obvious instability of our climate as observed in our daily lives.**

At the same time, it has become clear that, especially in the US, no-one hopes to be able to impose a democratic transition on Islam or ensure the free circulation of goods before tackling the climate issue.

Thus the situation prevailed where it didn't take much to reassure ourselves that there was good reason to deal with security of supply in first world countries before really knuckling down to the climate issue.

Middle East, oil, cars and the climate (2/3)

The dual analysis of energy and the climate which is put forward in our proposal leads us to take a new look at difficult issues. It therefore has a political scope that technical and economical considerations should not skirt around or hide.

- ▶ **Rechargeable hybrids from Toyota and electric vehicles with an autonomy of 180 km will be launched by 2011/2012. They could lead to a 70% decrease in emissions due to cars if the electricity itself is generated without producing CO₂.**
- ▶ **Technologies exist which can at least double the quantity of nuclear electricity per available kilo of uranium (100% MOX PWR, recycling of used fuel since the start of the nuclear era, actions on cuts at all stages of the cycle, Pu-Thorium based reactors). Regardless of whatever happens with fast breeder reactors, nothing prevents us from having 2,000 reactors as opposed to the 450 that exist today.**

Middle East, oil, cars and the climate (3/3)

- ▶ **We could easily make CO₂ free synthetic oil from coal, biomass or organic waste at a cost of around 150€/barrel, with a 5% interest rate, if we wanted to ease the issue of oil prices between 2015 and 2030.**
 - ◆ **Gradually but resolutely move toward electricity in the automobile industry.**
 - ◆ **Know how to do so using nuclear – but not exclusively nuclear.**
 - ◆ **Having the back-up of synthetic oils should make the issue of energy/climate an economic and moral one, neither of which it is today.**

If first world countries are pragmatic, they could just help solve the issue of the Middle East in twenty years or so.

To conclude (1/2)

There is every reason to believe that our series of eighty proposals:

- ◆ **Would help meet the 3 GtC emissions target by 2050 without decreasing global economic growth to a value of less than 12 months of profit over the next 60-70 years**
- ◆ **Would constitute the safest and least costly way of doing so**
- ◆ **Take into account the most likely technical progress to come, without depriving us of the benefits to be expected from the market economy**
- ◆ **Would be easy to communicate to economic and financial circles, as well as to intellectuals and the general public, which would unavoidably influence the states**
- ◆ **Would force private companies within the G20+ to show unambiguously whether or not they intend to partake in the necessary efforts. Without the active participation of the economy, it will be extremely difficult to forge solidarity between well developed countries and developing countries.**
- ◆ **Would combine the series of measures proposed and the need to pursue sustained economic growth to the benefit of underprivileged countries.**

To conclude (2/2)

- ◆ **Would create a true right to interfere in how countries are managed.**
- ◆ **Will oblige listed companies within the G20+ to state whether or not they intend to get involved. If the economy is not on board, it will be very difficult to forge solidarity between former developed countries and developing countries.**
- ◆ **Would radically change the level of planetary consciousness and thus the taking of responsibilities. The innovation we suggest would even drive this acceleration.**
- ◆ **Would truly reconcile the measures suggested and the need to continue with sustained economic growth to the benefit of underprivileged countries in particular. Till now ability to destroy ourselves has by far exceeded our ability to govern ourselves.**

Back matters to the file

***A global legal framework
to meet the Climate Change Challenges***

Alain Buaille

The context (1/2)

- 1. Climate change raises more and more concern worldwide. Some countries are starting to react and mobilize.**

The 2007 Nobel Peace Prize received by Al Gore and the IPCC epitomizes the awakening of a degree of consciousness but this consciousness is still far from being embodied into a global action plan measuring up to the challenge.

- 2. Even though the long-term target (3 GtC released in 2050) was endorsed by the 2007 and 2008 G8 summits, the road to implementation is still very long.**

In spite of the Copenhagen conference, or in relation with the difficulty of this topic, there is a high risk that the major countries of the world are still having difficulty converging their time schedules and criteria to come to joint decisions.

Only half-hearted efforts would lead to dramatic consequences.

The context (2/2)

- 3. As it is difficult for *any* State to rise above national interests and selfishness, we should explore the possibility of **inventing a legal framework for their consideration.****

The issue is less difficult than many people think :

Can there be an evolution in the realm of International Law able to stimulate technological breakthroughs? An evolution forceful enough to really trigger a mutation but without impairing current market mechanisms?

Our basic ideas (1/5)

There is every reason to believe that our series of **eighty proposals**:

- ◆ Would help meet the 3 GtC emissions target by 2050 without decreasing global economic growth to a value of less than 12 months of profit over the next 60-70 years
- ◆ **Would constitute the safest and least costly way of doing so**
- ◆ Takes into account the most likely technical progress to come, without depriving us of the benefits to be expected from the market economy
- ◆ **Would be easy to communicate to economic and financial circles, as well as to intellectuals and public opinion, which would unavoidably influence the states**

Our basic ideas (2/5)

- ◆ **Would force public limited companies within the G20+ to show unambiguously whether or not they intend to share the necessary efforts. Without the active participation of the economy, States will be powerless.**

As we will show later, our proposals are based on fair knowledge of the economic and technical data pertaining to the different energy chains.

We do not attempt to forecast, suggest or define any given global energy mix, we do not believe it can be done with any degree of certainty, but we propose a legal framework compatible with what we know today.

We shall progressively introduce, throughout this paper, the proposal which could constitute this framework.

Our basic ideas (3/5)

We underline :

- ▶ **The necessity that a few key countries (around 20-25 which we call G20+) become party to an international agreement: any such country refusing to participate would be excluded from WTO (cf. page 212).**
- ▶ **The importance (at least in the G20+ countries) of amending the Universal Declaration of Human Rights by adding the right to a preserved environment, of the same universal value (cf. pages 194 – 205).**
- ▶ **The possibility open to the other countries to participate in this global climate pact, with counterparts granted to the voluntary parties (cf. page 212, 213, 220).**
- ▶ **The opportunity given to the public limited companies in the G20+ to adhere to the global climate pact, thus creating the conditions for a true solidarity between the emerging economies and the old economic powers (cf. page 181).**
- ▶ **A coherent set of judicial actions against possible failure by states or companies to fulfill their obligations.**

Our basic ideas (4/5)

From a more technical point of view, most of our proposals are mere common sense, but some are more innovative, such as:

- ▶ The need for a common emissions stabilization target as early as 2025 (cf. page 33).**
- ▶ The setting up, common to all developed countries, of specific conditions to the sale and acquisition of real estate from 2015; attribution of bonuses to individual endeavors to halve CO₂ emissions (cf. pages 60, 77).**
- ▶ The two-step mutation of the automobile fleet to achieve 90 then 65g CO₂/km, leading to the phase-out by 2030 of vehicles emitting more than 110g CO₂/km (cf. page 127) and implementation of training programs for eco-driving (cf. page 126).**
- ▶ Division by a least a factor three of CO₂ emissions per kWh by 2030 and division by 5 by 2050, making a distinction between baseload power on the one hand and peak or semi-baseload on the other hand, in order to force the development of every needed energy source (cf. pages 111-114).**

Our basic ideas (5/5)

- ▶ **Provisions to induce planetary reforestation (cf. pages 134-138).**
- ▶ **In addition to CO₂ capture and underground storage (CCS), development of the direct transformation of CO₂ into synthetic fuel, which can be achieved with electric power and hydrogen as by-products through water electrolysis (cf. pages 101-110).**
- ▶ **Mandatory inclusion of specific courses within the cursus of the main MS, MBA and PHD (cf. page 221).**

A – General Energy Overview

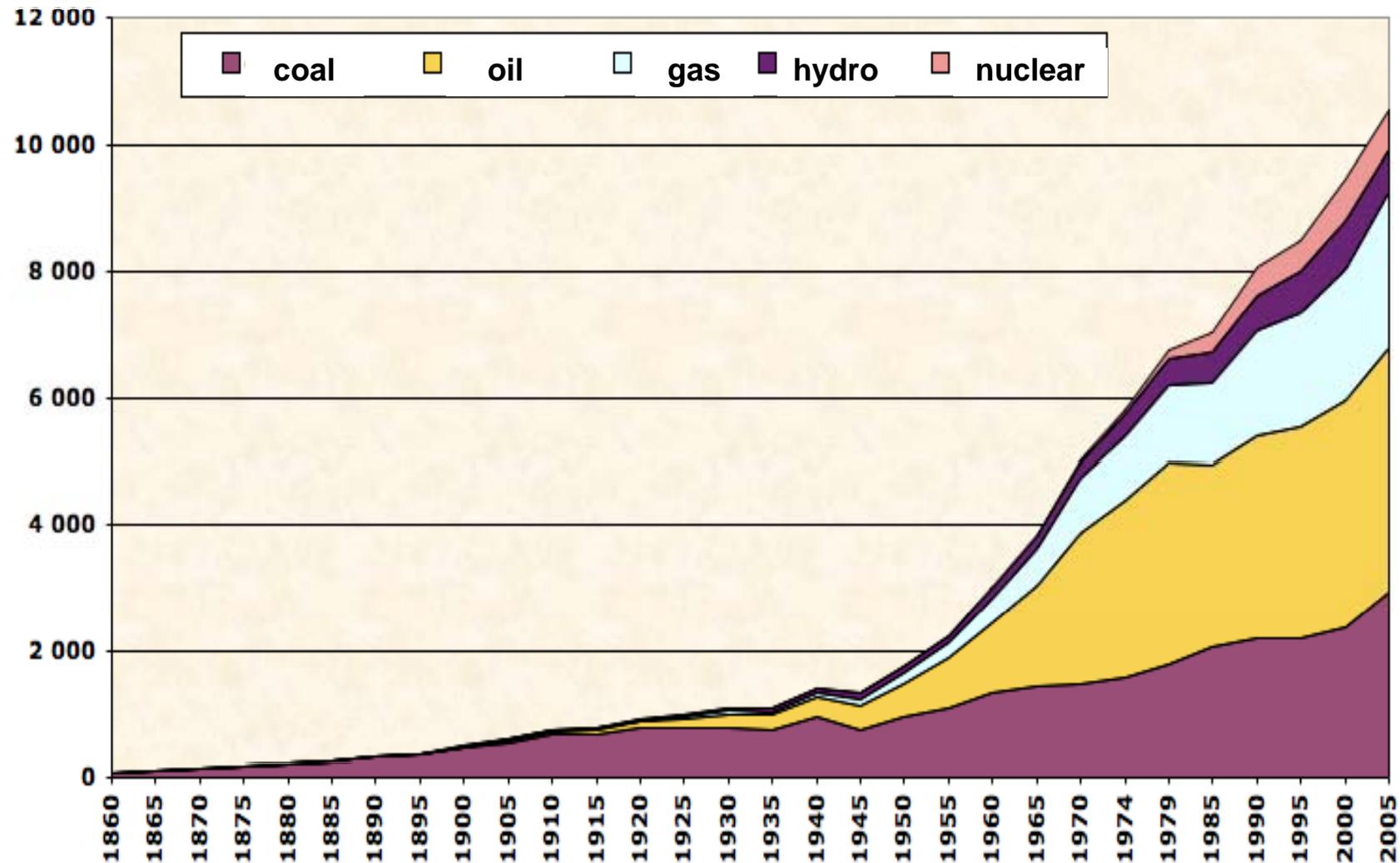
Preamble

In this first part, we have seen fit to recall and summarize data to provide a general overview of the global energy situation.

We realize that our readers are well enough informed not to need this global presentation.

However, as its reading will take less than 20 minutes, we decided not to skip it: if only one or two slides were to interest a reader, this part would be well worth it.

Global primary energy consumption since 1860 (excluding conventional biomass) (1/2)



Source Schilling & al + Observatoire énergie

Global primary energy consumption since 1860 (excluding conventional biomass) (2/2)

- ▶ **Since Man discovered how to use fossil fuels, mankind's energy consumption has consistently increased. We consumed five times as much energy in 2000 as in 1950.**
- ▶ **Thinking that this acceleration will immediately or spontaneously decrease would not be realistic.**
- ▶ **Demographic growth is a large part of the problem.**
- ▶ **For the last century and a half, no energy form has ever decreased. There are always good reasons to hope for the continuation of past trends.**



▶ **World population is growing as never before:**

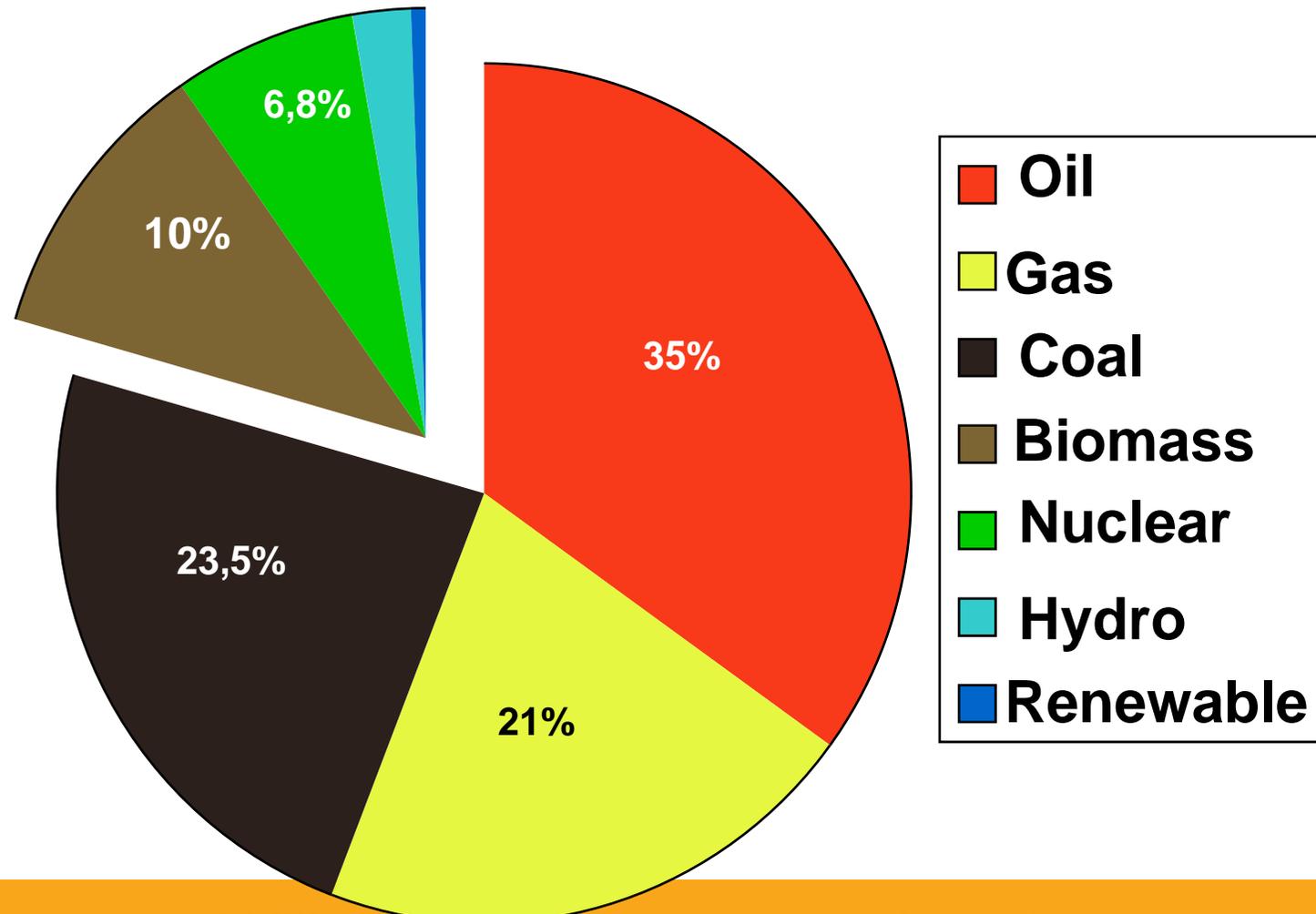
- ◆ **3 Billion in 1960**
- ◆ **6.5 Billion today**
- ◆ **9 Billion probably by 2050**

Even though it is possible that we reach stabilization, or even decrease, later on

- ▶ **..... And already today 1.5 billion people have no access to electricity.**



2000: 6 billion human beings consumed 10 Gtoe



2006: 6.5 billion human beings consumed 11.7 Gtoe

Even modest, global energy growth is unavoidable

▶ **China and India :**

If *only* 500 million people in each of these countries had a car (of current model) by 2030, that would add 3 Gtoe to the global demand i.e. 25% of the total present energy consumption!

(In this figure, half comes from transportation and half in other related developments, because no inhabitant of a mildly developed country would spend more than 50% of his energy for transportation alone.)

And there may be even more cars

▶ **All over the world, television advertises the American way of life,** a mixture of comfort and material wealth, and this echo reaches today close to 4 billion people (4 times the population of the rich countries!)



Even slowed down by ambitious energy conservation programs, consumption will go on increasing... if we still want continued economic growth and a minimum development in the Third World.

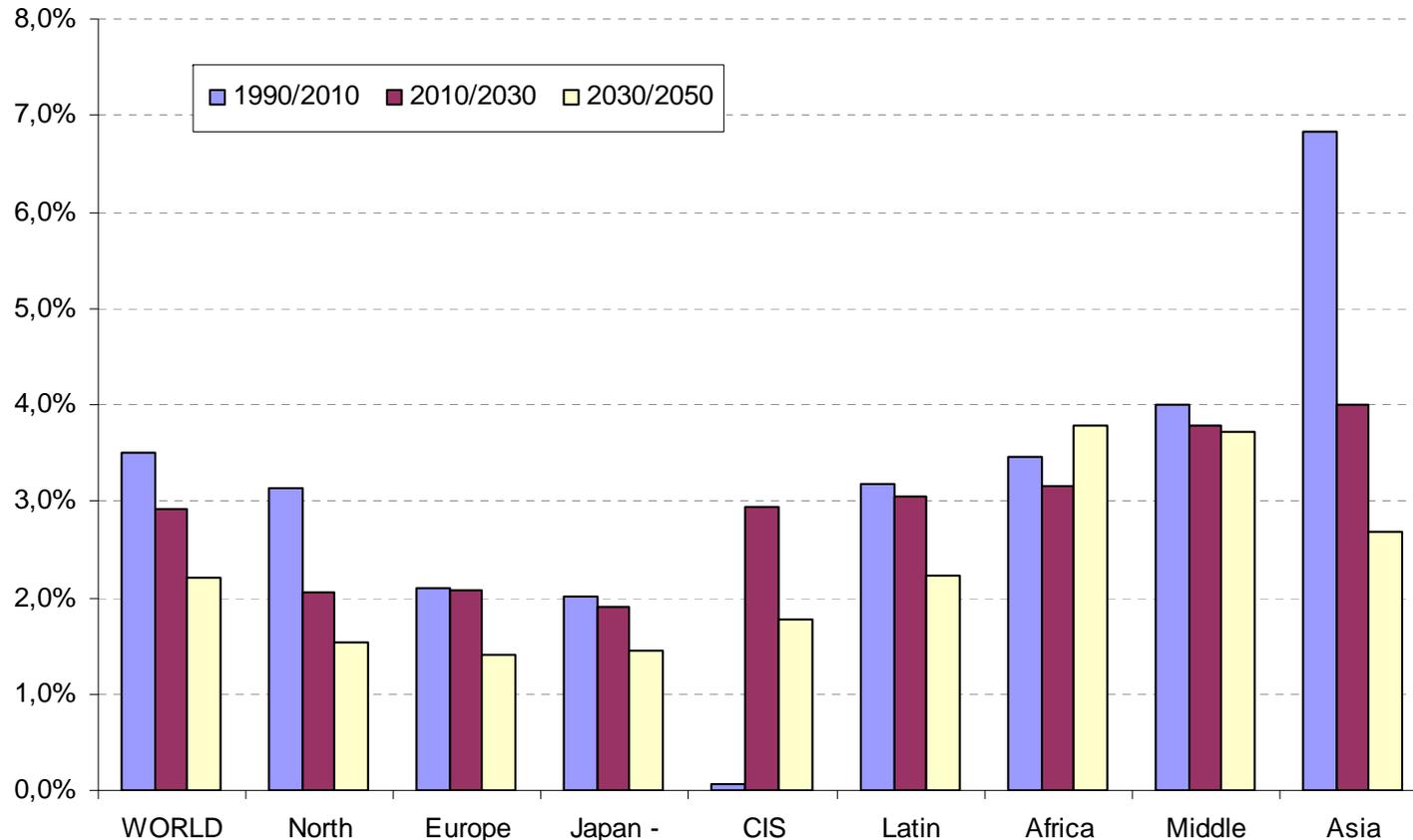
All energy sources have specific strengths ...

- **Coal is plentiful and well distributed across the globe, enough for centuries.**
- **Oil is easy to ship and store: it is the ideal transportation fuel. It is also a precious chemical feedstock.**
- **Gas can often substitute for oil in energy uses. It is cleaner but less easy to ship and store.**
- **Hydropower is renewable. In favorable sites, it can be very inexpensive.**
- **Uranium is well distributed. Nuclear power is very concentrated, and the price of uranium constitutes a small fraction of the nuclear kWh cost.**
- **Solar and wind power are renewable.**

... and specific weaknesses !

- **Coal:** Pollution, accidents in mines, Greenhouse effect.
- **Oil:** Not very plentiful and extremely heterogeneously distributed, spillages and Greenhouse effect.
- **Gas:** Heterogeneously distributed, can explode, Greenhouse effect (including methane leakages).
- **Hydropower:** Good sites often remote, flooding of fertile areas, dam breaks.
- **Uranium:** Radioactive waste, complex technology, risk of severe accident, proliferation (?)
- **Solar & Wind power:** Intermittent, cost. Wind is fickle and the sun does not shine at night.

Nobody wants economic growth to slow down



- ▶ **Despite a deceleration of the population growth, global GNP is expected to be multiplied by 3 or 4 by 2050.**
- ▶ **Energy availability is the limiting growth factor in India and China**
- ▶ **Economic crisis has cast some doubts ... but everyone hopes growth to be back.**

Source AIE, 2006

Legitimate convictions.....

- ▶ **Coal will continue to play an important role in energy supply, because its reserves are larger than oil and gas together, and because several key players (USA, Russia, China, India) have plenty of it.**
- ▶ **Replacing oil products for transportation will take a long time, because you cannot change overnight the fleet of cars and trucks and because oil products are easy to store, ship and distribute.**
- ▶ **As long as we do not know how to store electricity on a grand scale, intermittent renewable energy sources (sun, wind) can only remain complementary electricity sources.**

Today, they cannot be a suitable global answer to the baseload electricity supply (the power which is needed all year long 24 hours a day)... with the exception of a few countries where sun is plentiful and suitable areas are huge and cheap, like in deserts.

..... which may lead to impotence (1/2)

- ▶ **IF you explain that, as long as vehicles have not mutated, the demand for oil products cannot be limited – they are too vital for our economy**
- ▶ **IF you explain furthermore that coal is essential for future power production, with or without carbon sequestration (CCS) ...**
- ▶ **IF you add that, since people are still reluctant to broadly develop nuclear power, one is forced to rely on natural gas ...**
- ▶ **IF you complete the picture with the statement that renewables cannot overnight supply more than 20% of the global energy demand...**

... which may lead to impotence (2/2)

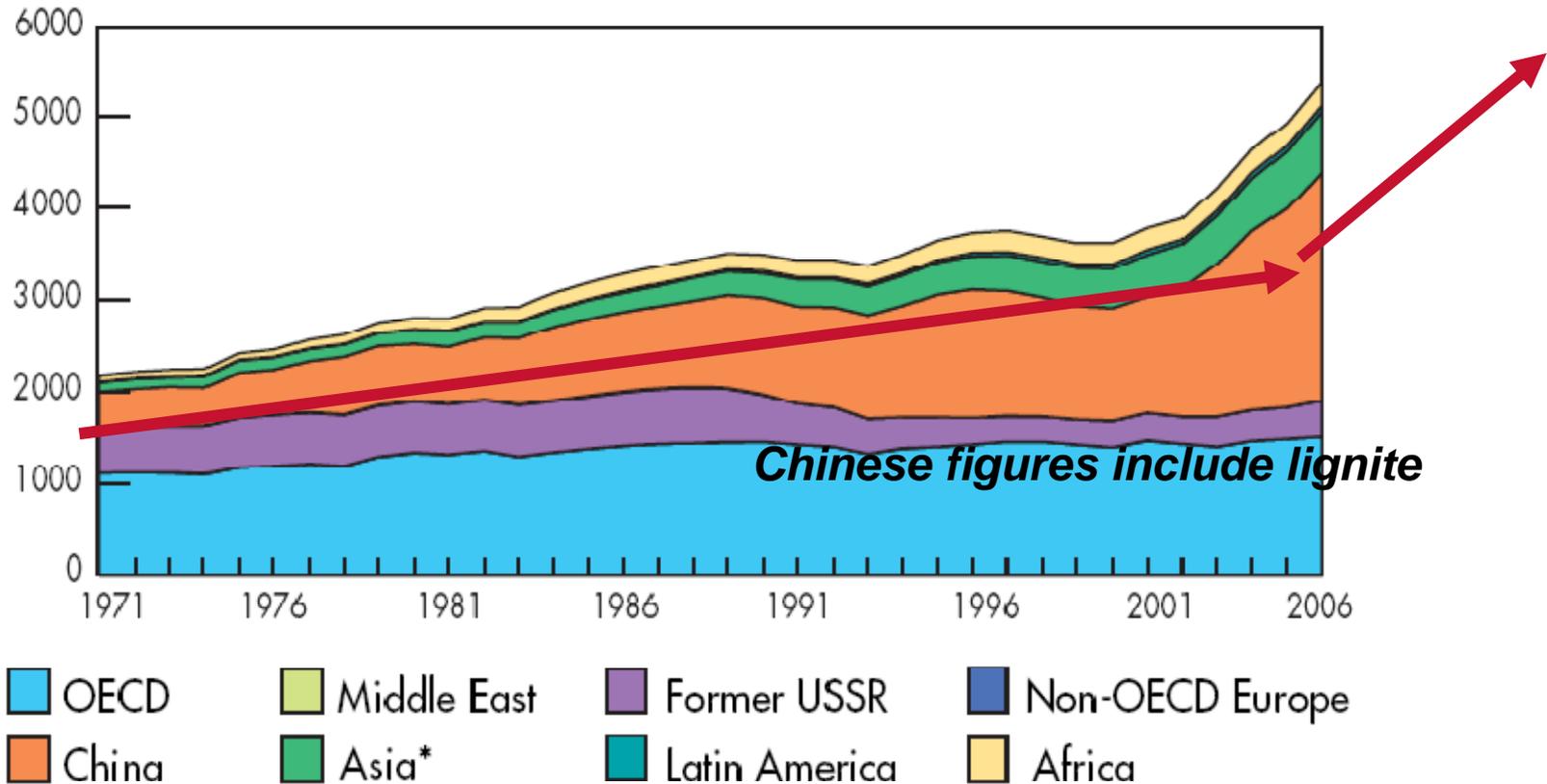
.... THEN you will explain that :

- ◆ Continued economic growth is impossible without at least 75% of your energy mix supplied by fossil fuels,**
- ◆ Renewables are fine, but they should be deployed much more aggressively;**
- ◆ Nuclear power is controversial so that its development should remain optional;**
- ◆ AND you shall conclude that, without a miracle in CCS R&D, (a feasibility largely demonstrated by 2015 which seems impossible) there is simply no acceptable answer to the climate challenge.**

The aim of our proposal is to find the loopholes in this reasoning and to offer positive answers.

Hard Coal Production

For the time being, electricity growth remain based on coal... while oil and gas supply most of the other needs



Intuition from simple arithmetic's

JM Jancovici expresses the global total CO₂ emission as the product of 4 factors :

$$t \text{ CO}_2 = (t \text{ CO}_2 / \text{Gtoe}) \times (\text{Gtoe} / \text{GNP}) \times (\text{GNP} / \text{pop}) \times \text{pop}$$

Which reads : Mass of CO₂/year = (CO₂/consumed energy) x (consumed energy/buying power) x (per capita buying power) x (world population)

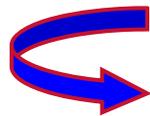
Given that

1. World population will grow by ~ 50 % in the next 30-40 years.
2. Economic growth must go on if we hope to improve the life of the poorest.
3. The amount of energy input to produce goods and services should decrease owing to technological progress, but we cannot expect more than a 30 % decrease over the period of time under consideration.

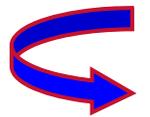
As a result the bulk of the necessary reduction in the greenhouse gas emissions must rely on the first factor, namely the amount of CO₂ emitted by unit of consumed energy: that is where we must act !

The fight against Climate Change: A Problem previously unknown, on 3 accounts

- 1. Our economic universe is made of uncertainties and successive adjustments of the economic actors' strategies, which constitutes the very essence of the market economy.**



We can therefore state in good faith that the future cannot be predicted and that we should refrain from attempting such prediction.



But we must not stop at that statement. That would be like saying : things are too complex, let's pretend they don't exist.

The fight against Climate Change: A Problem previously unknown, on 3 accounts

- 2. Any regulation aimed at fighting climate change would deeply affect at least 25% of the merchant GNP in OECD countries and the giant emerging countries : attempting to act without an overall vision would be mere delusion.**

Such regulation will be at least as, *if not more*, difficult to promote than the GATT negotiation.

But this negotiation will occur under a state of emergency.... or, as was the case during the last two decades, will drag along despite the growing dangers.

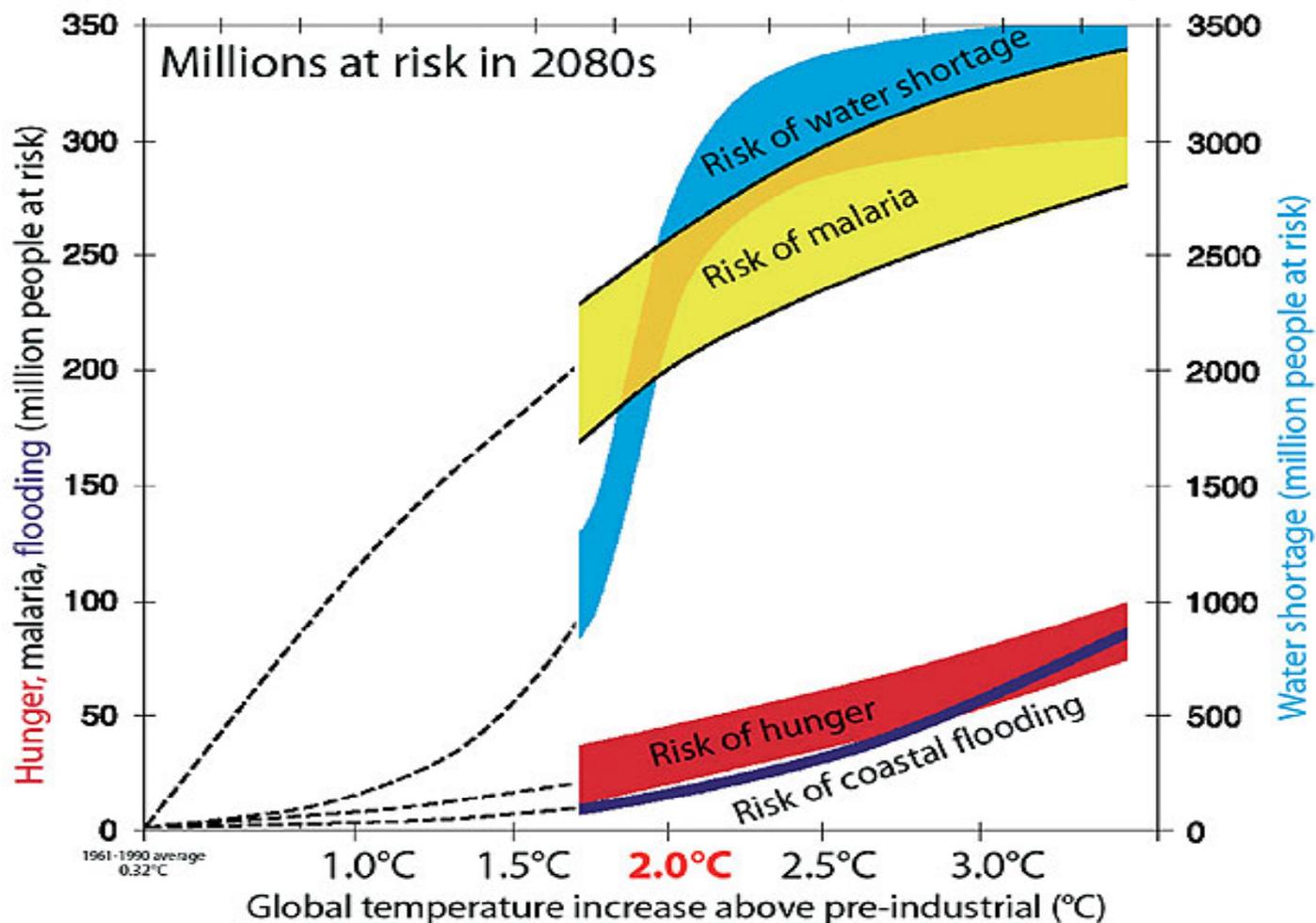
- 3. The challenge will be impossible to meet without the participation of China and India. As at least 35% of the additional emissions will come from those two countries, any regulation not implying them would be wishful thinking.**

The fight against Climate Change: A Problem previously unknown, on 3 accounts

This entails 3 consequences seldom acknowledged :

- ◆ **China and India will demand, as a condition to their participation, that part of their efforts be shared by developed countries;**
- ◆ **Leadership will no longer be limited to the usual game between USA and Europe;**
- ◆ **Russia, the strategy of which is based on energy, shall be reluctant to question it, all the more so if China and India drag their feet.**

**Some thresholds not to be crossed:
Millions of people at risk
due to a global temperature increase above pre-industrial levels
(source Parry et al., 2001).**



Source: Parry et al. (2001) "Millions at Risk" *Geo. Env. Change*. Graph adapted by M. Meinshausen, Nov. 2004.
 Note: The original graph presented relative to pre-industrial levels above 1961-1990 average (see Hulme, Mitchell et al. 1998), not above pre-industrial. The 1961-1990 average is 0.32°C above pre-industrial levels (1861-1890). Thus, a 0.32°C temperature difference has been added to the original scale. Furthermore, the original graph presented temperature levels in 2100 for different CO2 equivalent concentration scenarios. For a climate sensitivity of 2.5°C (as identifying the work of Parry et al.), the 2000 temperature level for the 5550 CO2eq emission path has been about 1.4°C above 1961 (0°C above pre-industrial).

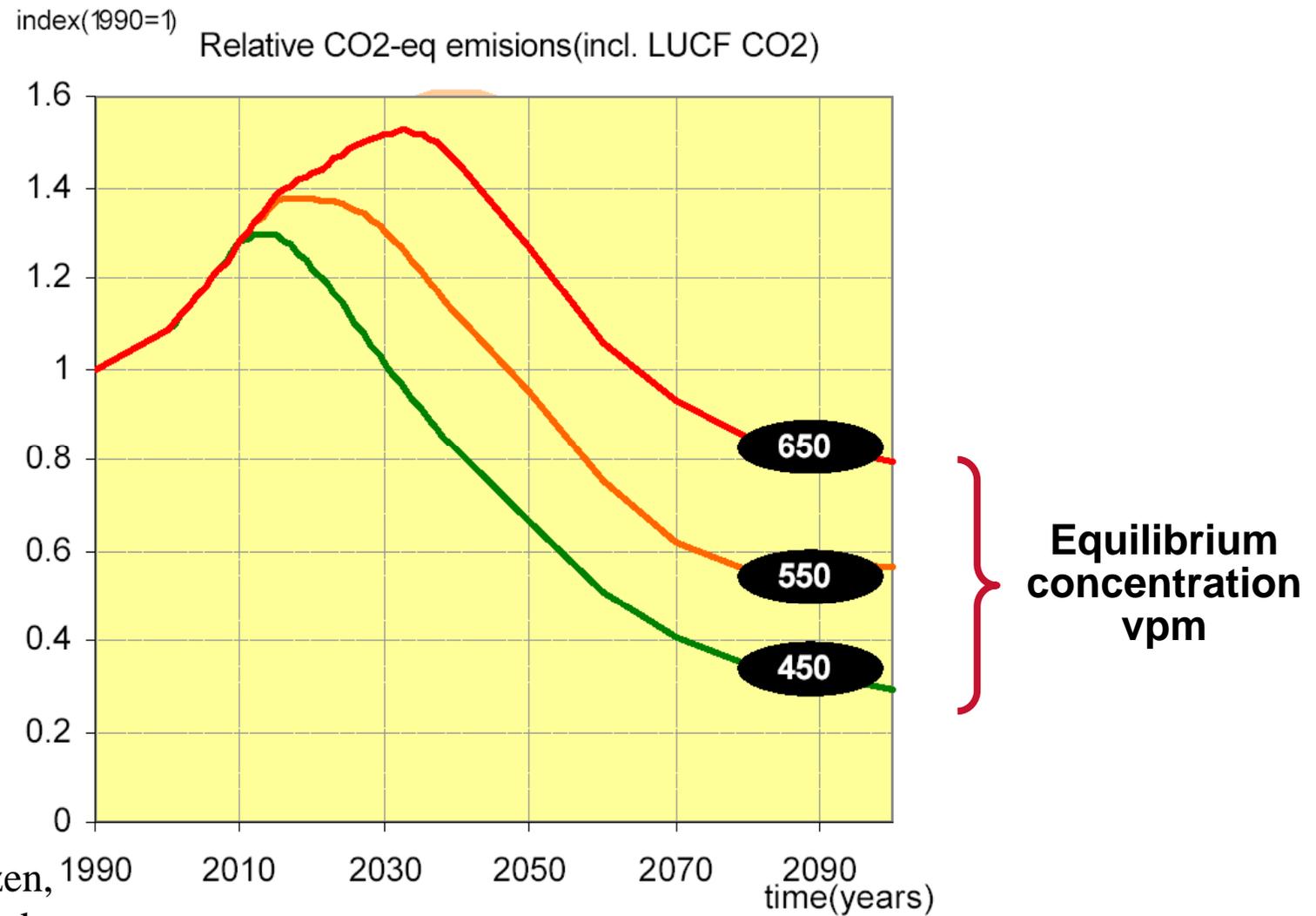
CO₂ targets to be defined

We can keep arguing whether the present trends will lead to a doubling in carbon emissions in the next 40, 50 or 60 years, whether we take a growth rate of 1.2% /y, 1.5%/y, or 2%/y, but let's not forget that:

$(1.015)^{40} = 1.81$	$(1.015)^{50} = \mathbf{2.10}$	$(1.015)^{60} = 2.44$
$(1.012)^{40} = 1.61$	$(1.012)^{50} = 1.82$	$(1.012)^{60} = \mathbf{2.08}$
$(1.020)^{40} = \mathbf{2.21}$	$(1.020)^{50} = 2.69$	$(1.020)^{60} = 3.28$

Give or take a dozen years, this table shows that the current trends, all things kept equal, would lead to a **doubling of our carbon emissions by 2050**when we should divide them by a factor 2 !

CO₂ and scenarios



Source: den Elzen, 1990
Meinshausen and van
Vuuren, 2006

Imperial College
London

The frightful inertia of phenomena

- ◆ **Once in the atmosphere, a CO₂ molecule will not be destroyed by light: it will only disappear in the upper layer of the oceans by transformation into carbonate.**

This mechanism is very slow. The average lifetime of CO₂ in the atmosphere exceeds one century.

- ◆ **Even after the peak of *emissions* and as long as they have not decreased below 3 GtC/year, the amount that oceans and biosphere are able to absorb, CO₂ concentration will continue to grow.**
- ◆ **This phenomenon could even become irreversible (at a human scale) if the absorption capacity of oceans and lands were to decrease.**
- ◆ **It is therefore paramount to start decreasing the emissions as soon as possible.**

The states, the financial community and public opinion must convince themselves that this can be done as early as 2025.

A global regulation should primarily concern the largest countries

The poorest countries cannot, obviously, be asked to amend a situation for which they carry no responsibility.

The costs of the energy transition must be borne essentially by the largest countries, which must assume their share of the burden.

Country	Population million	GDP billion US\$	CO₂ Emission million t/year	kg CO₂/\$	t CO₂ /capita
USA	297	10 996	5 817	0,53	19.6
EU 27	492	11 607	3 976	0,34	8.1
China	1 305	7 842	5 060	0,65	3.9
India	1 095	3 362	1 147	0,34	1.1

A planned decrease, not merely the end of growth

Many citizens do not realize today that **we must as soon as possible decrease the emissions and not merely stop their growth.**

This will be all the more difficult that it takes :

- ◆ 20 years to renew a fleet of cars, 30 to 40 years to renew a fleet of power plants,
- ◆ 30 to 40 years to modernize the heavy industrial machinery needed to manufacture intermediate goods.
- ◆ 50 years and more to re-design urban landscapes.

Any public policy, be it on a global scale, cannot be decided against public opinion or without public awareness of the situation. This awareness is growing, indeed, in the developed countries, but what about elsewhere... ? Do people realize the extent of inertia? Do mitigating measures appear inaccessible?

G20+ populations should be polled over a score of questions to get an idea of how the man in the street currently pictures the topic. This poll should be regularly updated (twice a year?) to allow the citizens of the large countries to evaluate their own degree of mobilization (Proposal 1)

CO₂ Targets to be defined and refined

As IPCC experts recommend to go down back to 3 GtC/year by 2050 to save our climate,

We shall set this target for 2050, with an intermediate milestone stop the growth of the global emissions by 2025 if possible (proposal 2).

Without such a midway milestone, public opinion, governments and financial circles would be permanently tempted, till 2020, to delay decisions and let future generations assume the mutations.

The worst case would be an opposition between low growth rich countries with GHG reduction targets and high growth emerging economies where energy scarcity would be the main impediment to growth.

The debate which never was: possible CO₂ regulations

Despite a recent willingness expressed in 2006, notably through the British proposals during the Gleneagles Summit, Heads of State have long avoided addressing five essential issues:

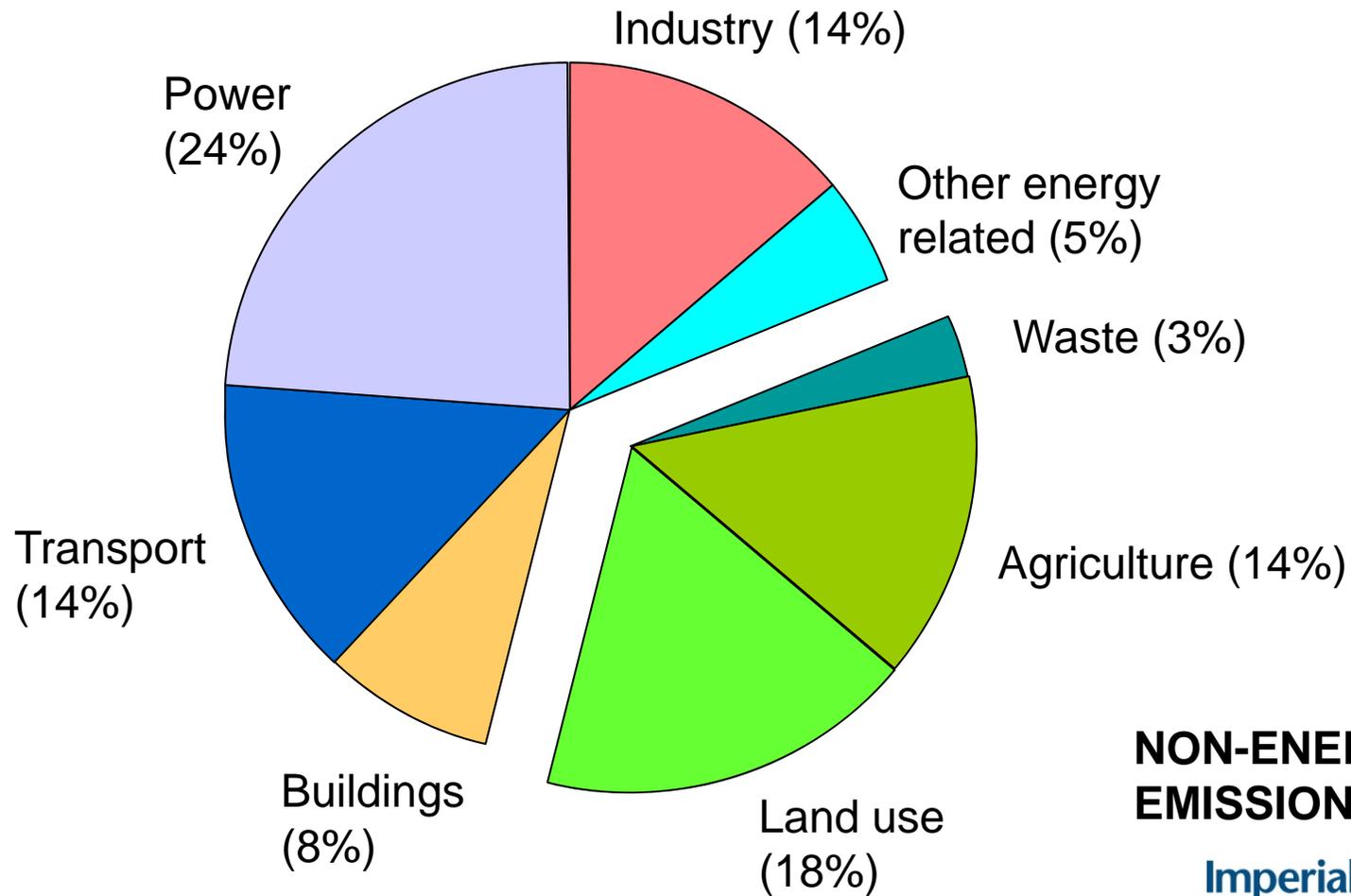
- ◆ **Do we really want to stabilize emissions, and starting when?**
- ◆ **Are governments willing and able to impose regulations. If such is the case, how can we balance regulations and taxes?**
- ◆ **Which signals are sent to motivate industry to boost R&D efforts by 2017-2018 ?**
- ◆ **Are we ready to tax imports from countries or industries not willing to abide by the rules?**
- ◆ **Are the messages sent to the financial circles saying that we can win or that the battle is already lost?**

The target agreed upon during the last G8 is, however, to go back to 3 GtC by 2050.

Greenhouse-gas emissions in 2000, by source

ENERGY EMISSIONS

Source : Rapport Stern (2006)

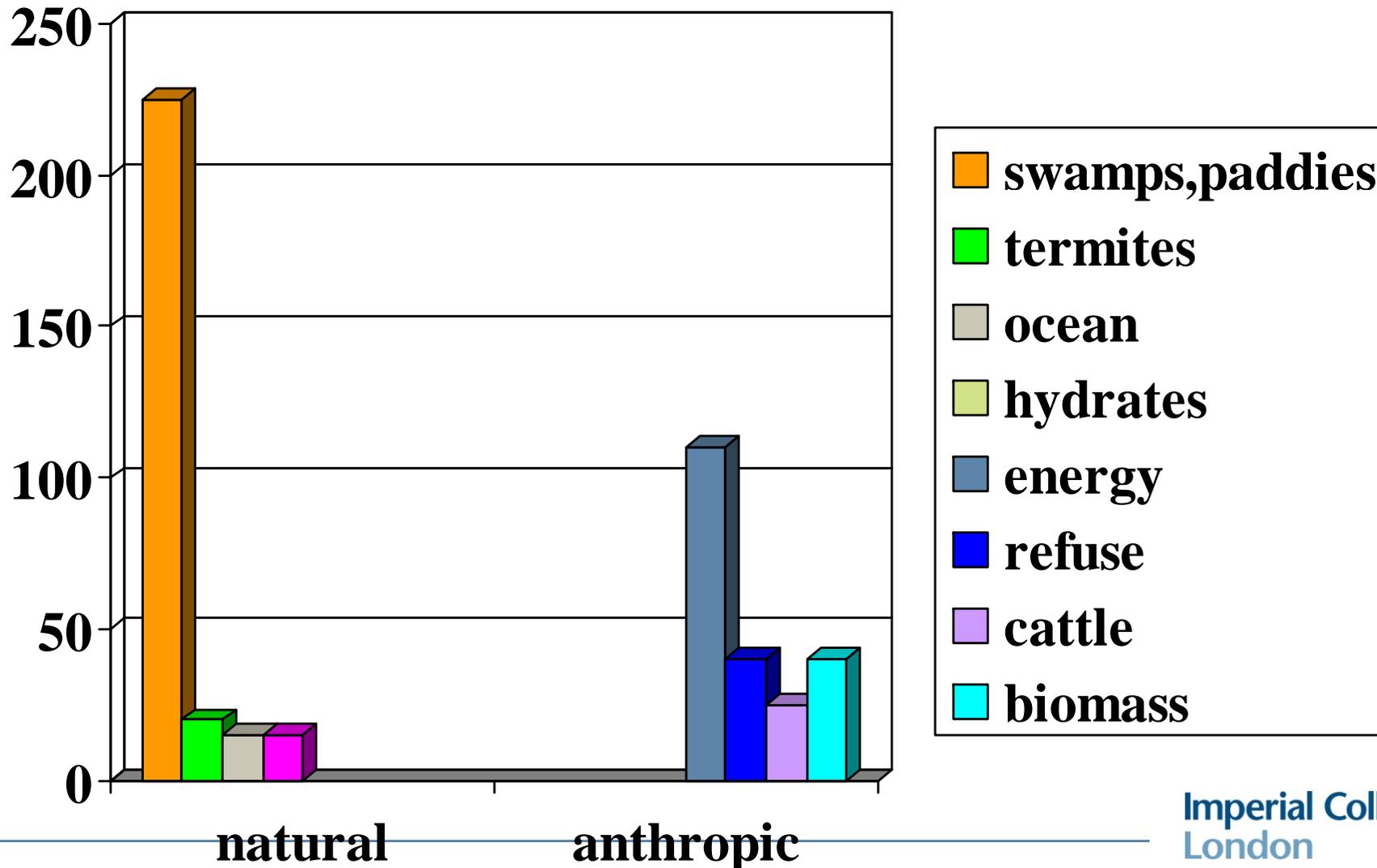


NON-ENERGY EMISSIONS

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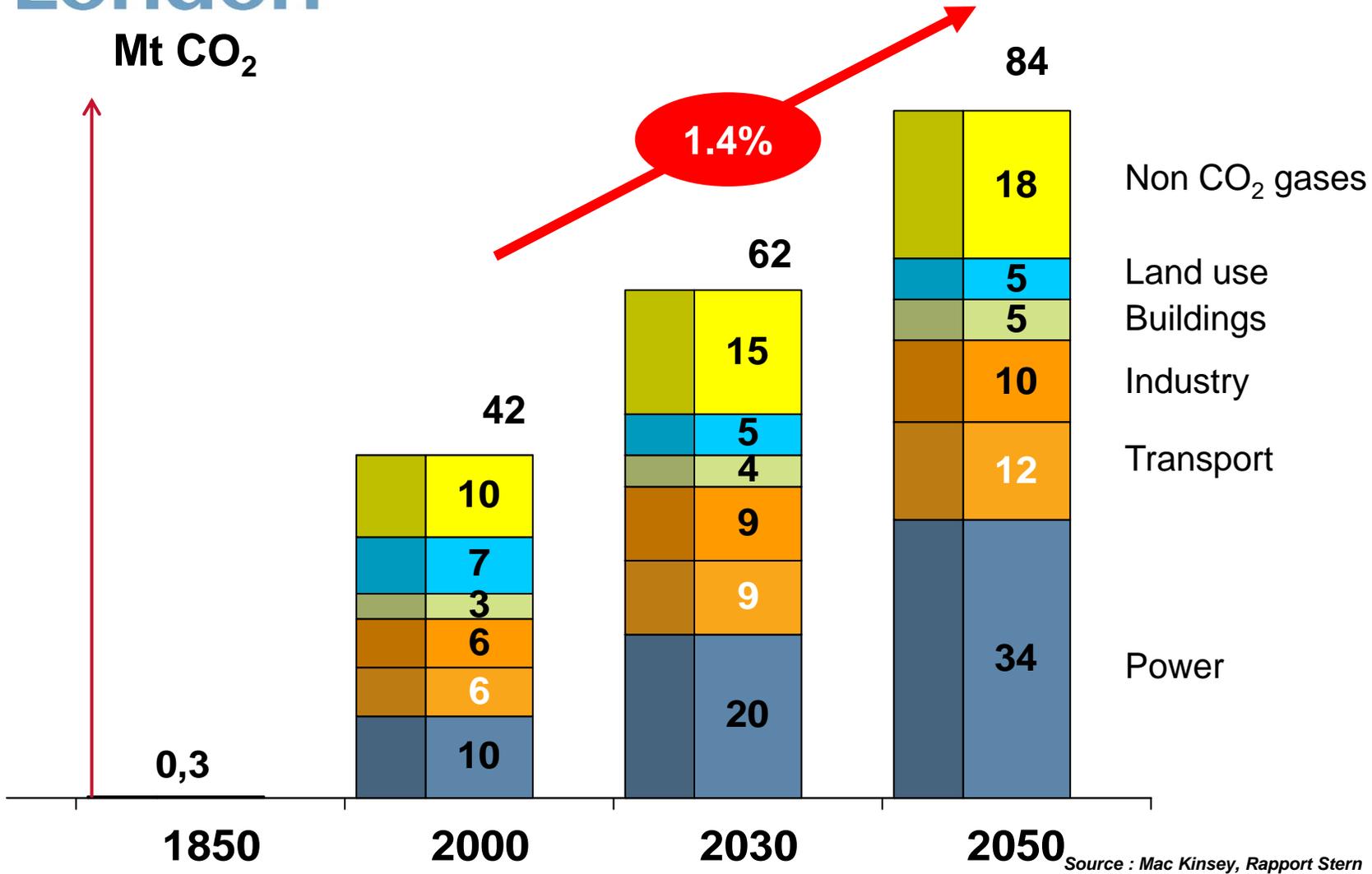
Methane Sources, million metric tons per year

CO₂ is not the only Greenhouse Gas



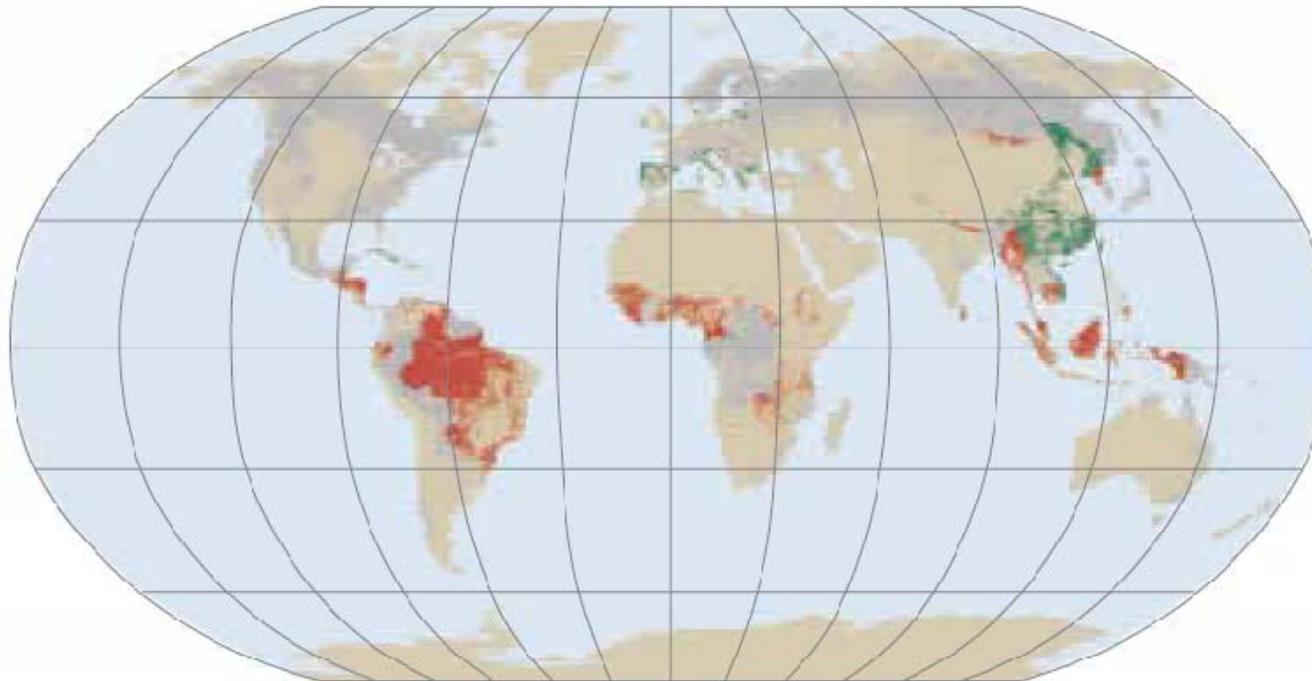
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*Many areas are concerned:
Emission growth forecasts, per sector*

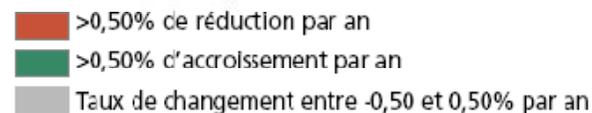


Forests vs. Agriculture

The more population grows, the more forests disappear to provide for new agricultural areas (even though Europe and, more recently China are reforesting)...



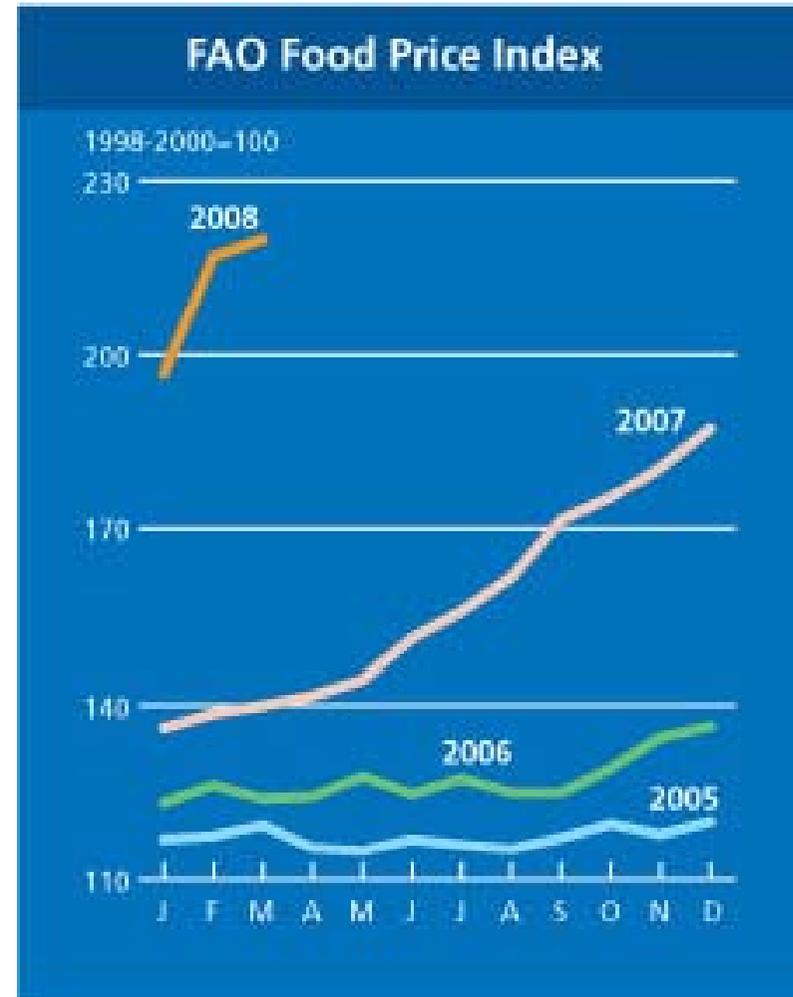
Changes in forested areas 2000-2005



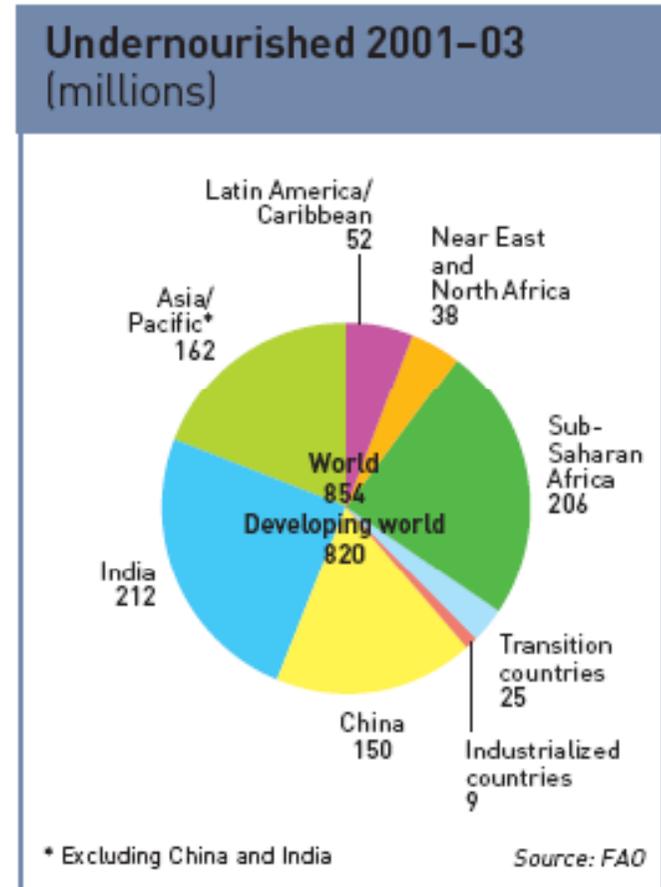
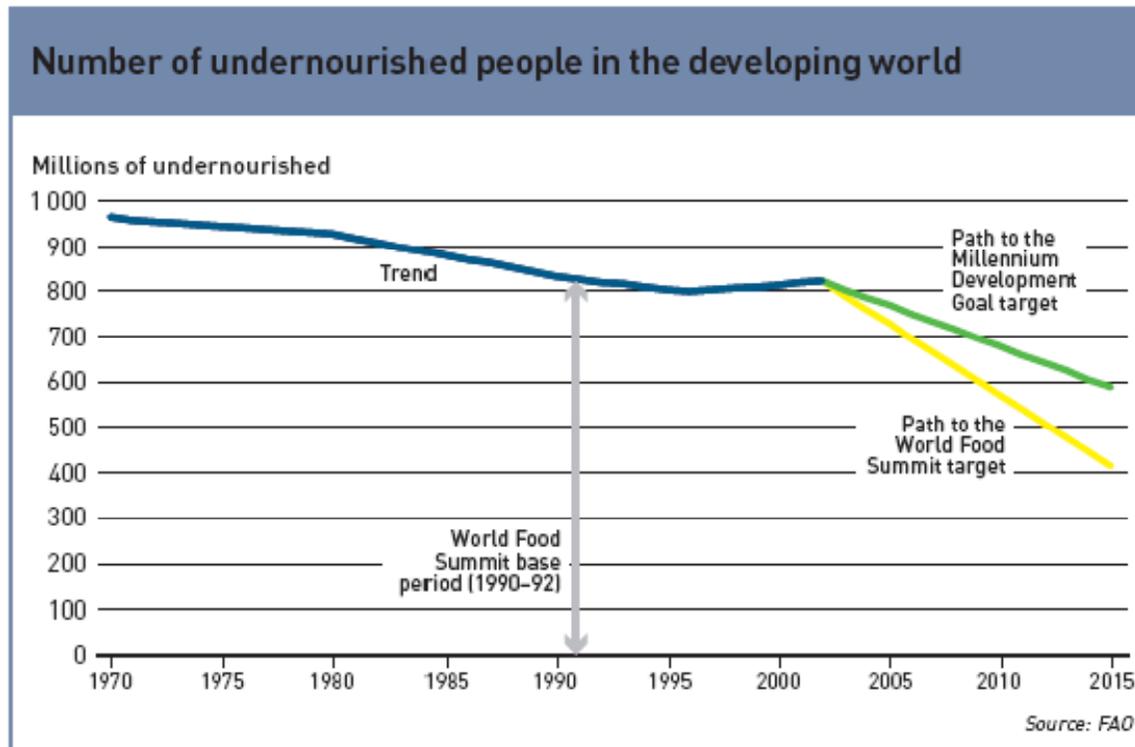
Changements de superficies forestières 2000-2005 *Source* FAO *Global Forest Resources Assessment 2005*

Tensions on Food Supply

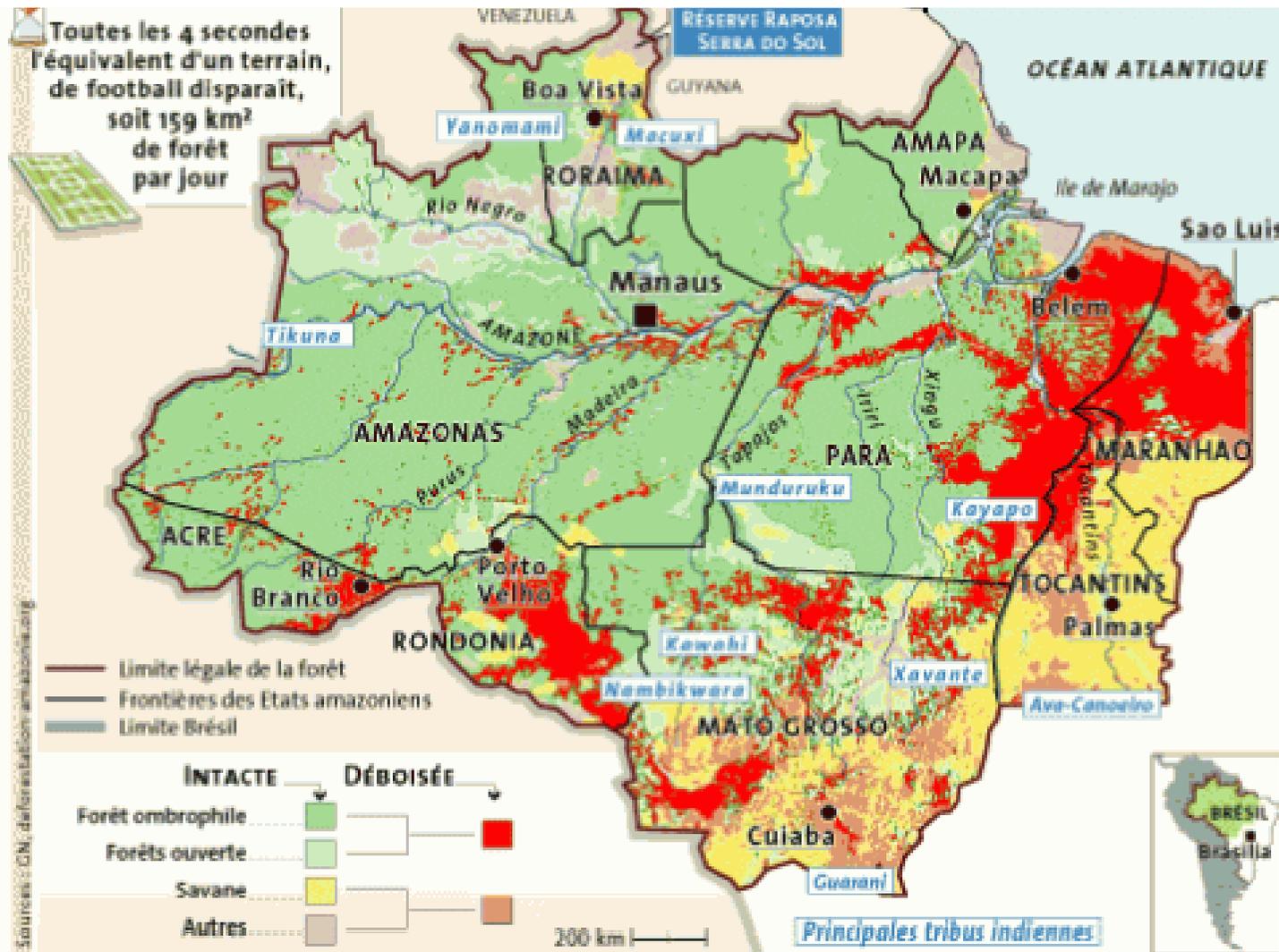
- ▶ Biofuels tend to divert productive resources (land, manpower, capital) from food productions. Biofuels can reduce human food availability, because the demand for cereals, sugar or oleaginous and other staple food by the biofuel industry can compete with the demand for food. This new demand drives the prices up. (FAO, 2007)



Undernourishment: no progress



The deforestation of the Amazons goes on but at a lower speed



There are however hints of progress: IEA technology scenarios 2008

Measuring progressively the extent of the climate-energy challenge, the IEA has finally decided to speak out.

In the 2006 World Energy Outlook, IEA ventured for the first time for an alternative scenario leading to a CO₂ emission decrease by 16 % between 2006 and 2050. This scenario was meant to take into account technological progress as expected today.

In its 2008 Energy Technology Perspectives 2050 report, IEA presents both ACT and BLUE scenarios. The former targets 2050 emissions back to the current level and the latter, a GHG concentration stabilized at 450 ppm.

A Change of Paradigm: IEA 2008 analyses – what they tell us

Over the last years CO₂ emissions and the oil consumption have kept increasing: the reference scenario has worsened, but:

- ▶ By implementing technology already available or under advanced development, it is possible to bring 2050 emissions back to their 2005 level (ACT scenario)**
- ▶ To bring 2050 emissions back to half their 2005 level, we need a drastic change of trend implying the implementation of technologies still in their infancy, with no guarantee of success (Blue scenario)**

A few figures...

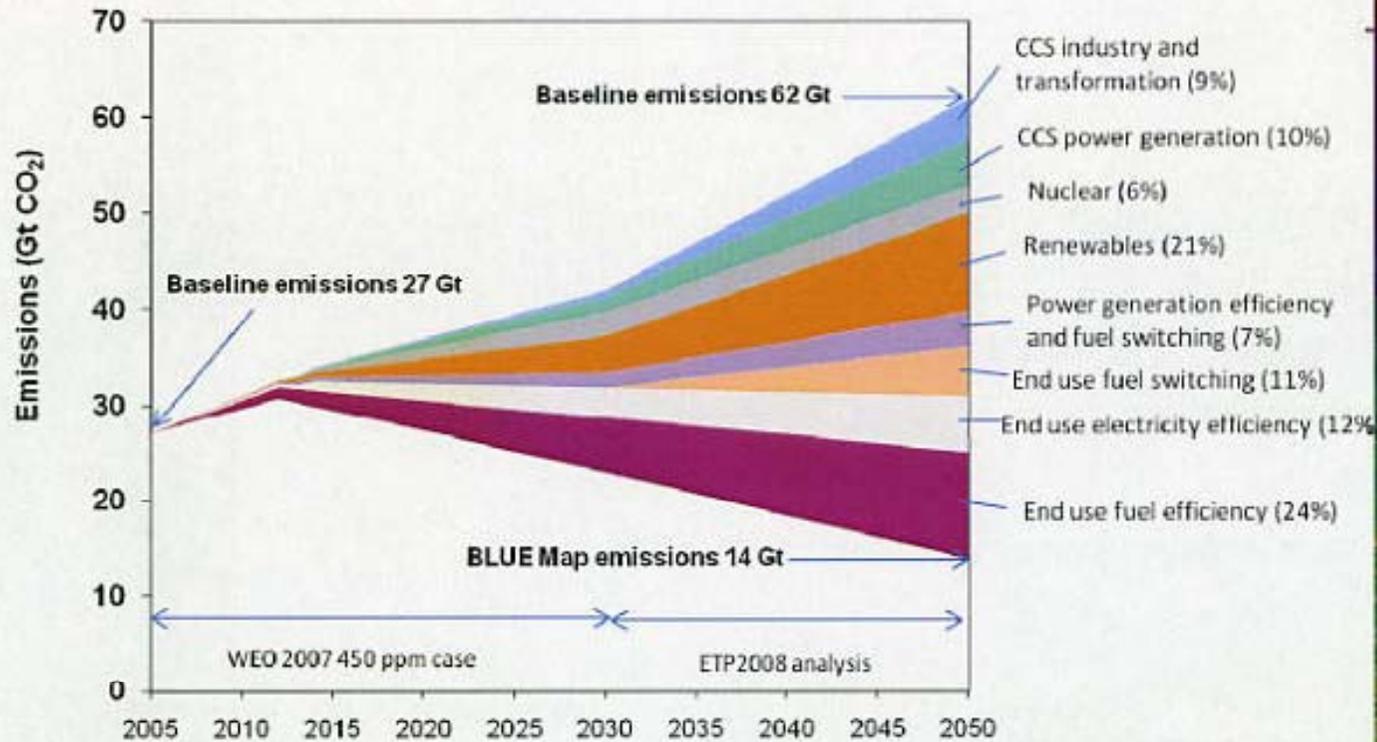
	2005	2050	
		Baseline	Blue
Global primary energy consumption (Gtoe)	11.4	23.3	15.7
Energy based emissions GtCO₂	28	62	14

- ▶ **Industrial Implementation of all CO₂ reducing technologies up to 50€ per avoided metric ton.**
- ▶ **Additional investment: 17 trillion \$, i.e. 400 G\$/year (0.4% GDP).**
- ▶ **Power Sector: CCS implementation and massive shift toward renewables + nuclear power renaissance.**
- ▶ **Transport: improvement of current vehicles (smaller) and market penetration of hybrids. Some amount of biofuels.**

- ▶ **Implementation of all CO₂ reducing technologies, up to an industrial cost of \$200 per avoided metric ton – perhaps up to \$500 if some developments are not successful (medium 40-120).**
- ▶ **Additional investment: \$ 45 trillion, i.e. \$ 1100 billion/year (1.1% GDP).**
- ▶ **Power sector: renewable supply 46% of the mix. Acceleration of nuclear power (32 GWe per year) to supply 24% of the mix by 2050.**
- ▶ **Transports: Biofuels (trucks and planes), plug-in hybrids, electrical vehicles, fuel cells (H₂)**

A New Energy Revolution....

Cutting Energy Related CO₂ emissions



Improved efficiency and decarbonising the power sector could bring emissions back to current levels by 2050. To achieve a 50% cut we would also have to revolutionise the transport sector.

In support of the G8 Plan of Action

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ENERGY
TECHNOLOGY
PERSPECTIVES
2008

Scenarios &
Strategies
to 2050

INTERNATIONAL

ENERGY 
AGENCY 

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Conclusions drawn from IEA scenarios

- ▶ **ACT scenario** does not assume that feasibility and competitiveness of large scale CCS is demonstrated.

It requires the systematic implementation of every technology already available or forecasted with 99% confidence.

It would be compatible with a carbon value below \$ 50/ton CO₂, which happens to be the precautionary value recommended throughout our present report.

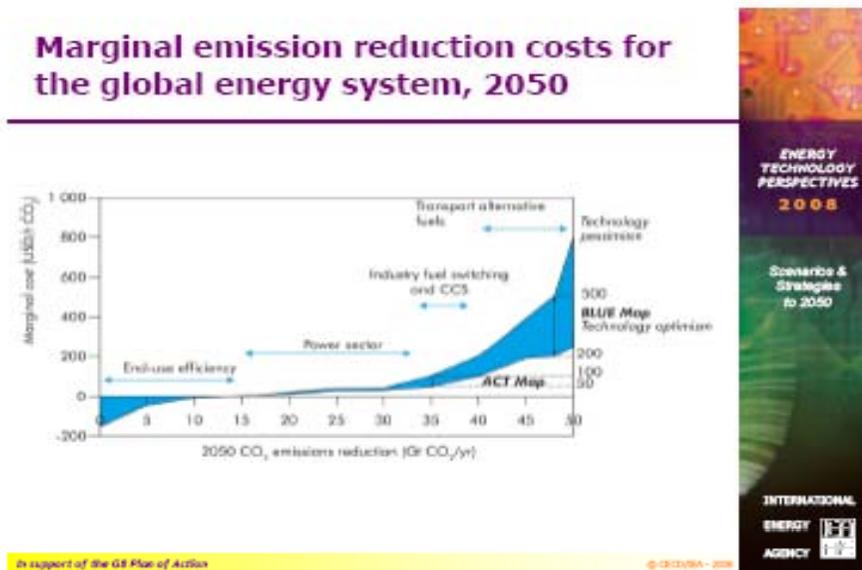
- ▶ **BLUE scenario** shows that a much higher carbon value must be set to generalize CCS and force the most emitting industries to modify themselves. Even higher carbon values would be needed to affect the transports.

Moreover, IEA implicitly underlines the high degree of uncertainty affecting the CO₂ value to be forecasted or recommended, concerning at least one third of the mutations necessary to preserve our planetary ecosystem.

Combining this certainty with that uncertainty shall be one of the key point of our thesis.

A single carbon tax would prove inefficient

The IEA work shows clearly that the needed parallel mutations would require very different carbon values.



It would therefore be a delusion to hope that a single carbon tax would suffice to trigger the revolution. If the whole world had a comparable economic development and if every actor could act rapidly, this measure might be efficient. But obviously both hypotheses are unrealistic.

Some ratios which should be meaningful for the financial circles

Under the IAE BLUE scenario, the cumulated additional investment until 2050 (compared with the reference scenario without special concern about the climate) would amount to 1.1% of the global GDP.

Even if IEA were wrong by a factor 2, such additional investment would not amount to one full year of the global economic growth.

The conclusion is clear: meeting the climate challenge will not impose an unbearable burden on the global growth.

It is far from certain, furthermore, that these additional investments result in a lower growth. It is quite possible that a more sustainable growth cause a quest for competitiveness, itself a source of growth.

It is time now to draw some conclusions from this overview:

- ◆ Even with strong conservation efforts, the demand for energy will double if we want to generalize access to energy and improve the standard of living of the poorest (otherwise, 1.5 billion people or more will continue not to have access to electricity).
- ◆ We have to anticipate a situation in 2050 with a lot more than 2 billion cars, perhaps 3 billion.
- ◆ Electricity should represent an increasing share of energy, especially in view of the trend to urbanization in the emergent countries.
- ◆ Technical progress may be quicker than anticipated, as experienced many times in the past but the inertia of fleets and infrastructures is incredibly high (more than 15, may be 20 years).

So what (2/3)

- ◆ Technologies already available or very likely to reach maturity show that we have the ability to meet the challenge: the IEA scenarios have the merit to prove it. As technologies are very likely to keep progressing, **we should overcome the combined defeatism of the economic and political circles, relayed by the media, pretending that our problems cannot be solved.**

By themselves, the issues of road transportation and deforestation demonstrate the need for a global management: without it, 40% of the emissions growth would stay out of control, with no hope of emissions peak by 2030.

- ◆ We used to trust governments to invent the proper world policy. However, this trust in states seems to ignore three critical facts :

So what (3/3)

- Common sense tells us that regulation must, above all, have a legal basis.

Regulation must have a legal aspect. If we are objectively in a situation of non-assistance to endangered Mankind, it is a legal matter (proposal 3). Montesquieu as well as Locke would have agreed in their time.

- Economy is so concerned that it must be a partner. Our proposal will be an original voluntary partnership, starting from the following observation :

No company can pretend to engage in sustainable development and not propose anything worthy while being a party to a global climate pact. We shall come back to such a proposal to the major G20+ companies (cf. proposals 49-51).

- Last but not least, public opinion unaware or feeling powerless cannot be mobilized unless made actors of the necessary changes. Otherwise, climate change risks to remain for a long time a crucial theme combining only writing by the media and impotence.

B – An initial analytical approach

We are now going to look at what we can hope to achieve in the world's twenty or thirty biggest countries as regards:

- ◆ **Energy savings in civil engineering with a true break from using fossil fuels**
- ◆ **More systematic use of heat as a substitute for electricity**
- ◆ **Reducing CO₂ emissions due to energy generation by a factor of a least three compared to today**
- ◆ **More energy-saving road travel with a gradual move towards electricity and a stabilization in emissions by 2020**
- ◆ **Agriculture and forestry more respectful of climate objectives: a pro-active support approach to reforestation**
- ◆ **Pivotal role of nuclear energy**
- ◆ **Large recourse to renewable energies, especially solar power**
- ◆ **Getting companies involved: an incentive for public limited companies.**

We will illustrate that by matching technical and industrial realities and through good management it is possible to stabilize our emissions by 2030, and we can reduce them in the meantime even with economic growth.

These analytical initiatives will lead us to propose around 45 measures to make this become an economic reality.

Most of the measures relate to regulations: they can be put in place within 5-7 years to facilitate developments in behavior and strategy.

Now is the time to put them in place if we want to avoid falling victim to the inertia of the installed fleets.

At the end of this second section, we will show that a realistic global energy mix could lead to 3 GtC emissions by around 2050/2060.

B1 –
Win the first battle by making energy
savings

The major issue of energy savings in the construction industry

The following facts are not new!

- ◆ **1°C less when heating means 7% less on your heating bill and we are not any less well off if we keep our homes heated to 20°C in winter!**
- ◆ **If we all used today's most high performance “white” or “brown” materials, we could reduce the consumption of these materials by 30%.**
- ◆ **By using high performance glass, as used in new buildings, we could reduce the average cost of heating by 15%. But who knows that? Who makes such information known? A well insulated roof leads to savings of 20%.**
- ◆ **The total current average consumption of buildings is 400 kWh/m² in primary energy, 2/3 of which is for heating. Today proper renovation can bring this figure down to 200 kWh/m² or less; this represents **progress of a factor 2.****
- ◆ **We know how to build buildings that consume 50 kWh/m² (heating and hot water).**

Possible savings using the best available technologies

France	Toe/cap average 1995	Toe/cap best available technology	Comments
Domestic	845	360	-
Heating/air-conditioning	740	300	Bringing the fleet to current norms
Household appliances	35	25	Best appliances 1995
TV, computers	70	35	Sleeping mode optimization
Tertiary	505	250	-
Heating/air-conditioning	415	200	As for domestic
Specific uses	90	50	Sleeping mode optimization
Food	360	250	50% savings in refrigeration and cooking
Industry	775	580	-
Intermediate production	625	450	Eco-processes and recycle
Including equipment and consumption goods	150	130	-
Transports	805	450	-
People	490	250	Cars 4 l/100 km & 13.000 km/year
Goods	315	200	
TOTAL	3290	1890	-

Saving 30% of our energy consumption without impairing our quality of life is possible.

Modernizing old buildings and houses

Today, every G8 country uses more than 30% of its energy for heating (private heating, hot water). Sometimes it can even be 40%. What an opportunity if we can do better !

Experts estimate that we could make energy savings of at least 30% in housing by using house equipment technologies (insulation, energy-saving appliances) and all without affecting our standard of living.

In all OECD countries where private property is recognized, the following could be applied after 2015: no housing shall be sold without the following:

- ◆ An audit carried out by the authorities or companies approved by delegation***
- ◆ Monitoring of a 0% loan to carry out improvement work to the value of €25,000 or \$40,000 per owner (proposal 4).***

Modernizing old buildings and houses

If countries were to opt for a regulatory or tax tool to meet a similar objective they would obviously be quite free to do so.

Less than four years is needed for ROI for most of these investments so they could be considered economical and not “costly”.

Their activation won't be so easy, as individuals are far from having enough cashflow, or would seem affected by this kind of investment.

Limit as much as possible the use of fossil fuels in private homes

There is absolutely no reason today to favor gas as a means of heating. *As we will see later, 80% of electricity can be produced without CO₂ so there is not reason why the following:*

- ◆ ***Wood firing***
- ◆ ***Solar water heating + heat pump***
- ◆ ***Electric heating***
- ◆ ***Geothermal heating***

by 2020, could not cover 80% of heating requirements in all G8 countries and 50% in the seven most populated countries (proposal 5).

From 2020, anybody using fossil fuels for private heating should pay a tax of at least 50€/t CO₂ in OECD countries and at least 30€/t CO₂ in the other G20+ countries (proposal 6).

Common sense measures

Nobody would consider selling a car that is unsafe and does not comply with regulations in force.

The same should apply for housing that consumes too much energy.

This is all the more pressing as without *ad hoc* mobilization with regard to housing, people will not be truly involved in the other difficult challenge facing us –transportation.

States should look at the positive effects the actions would have on economic growth (proposal 7), as they are likely to be as much a source of growth as an economic cost.

Effective communication of energy-efficient buildings

This is obviously of interest for new housing and in new towns. A vivid example:

HOUSES WITH NO HEATING IN SWEDEN!

When a house loses less than 15-20 kWh/m² per year (after retrieving heat from the extracted air) this can be compensated by direct solar gains, the occupants themselves and lost heat from lamps and household appliances. As this passive house no longer needs heating, the extra costs of insulation are counterbalanced.

For twenty houses with no heating systems in Gothenberg (Sweden) the extra costs and savings per apartment were quantified as follows:

- ◆ Reinforced insulation: + 1650 to + 2200 €
- ◆ Air/air exchanger: +1100 to + 2200 €
- ◆ Triple glazing: +1650 to + 2200 €
- ◆ Total additional costs linked to thermal energy: + 4400 to + 6600 €
- ◆ Savings from lack of heating system: - 4400 to -5500 €
- ◆ Extremely high performance electrical appliances: + 1100 €
- ◆ Solar water heating: + 2200 €

Each of the countries in the G20+ should determine the best communications plan to make these facts known. Calls for bids should be launched in the various countries and an annual review of global communications on the issues carried out under the IEA and communicated to governments (proposal 8).

***To anyone who would call
such measures extravagant***

It would be useful to compare the cost of such measures with the value of existing constructions in the developed country members of the OECD.

We would doubtless discover that the cost of this measure is less than 1% of the value of existing construction and that it offers ROI in less than five years.

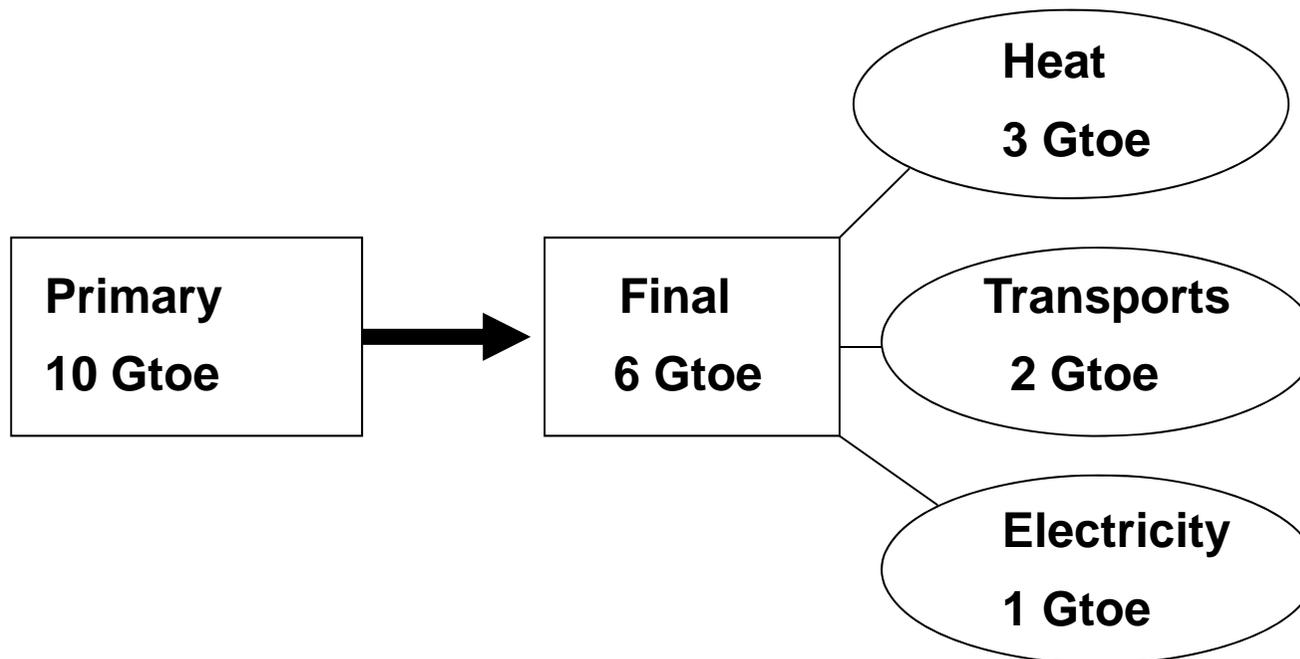
If the public funding could not cover the so-called “exorbitant” cost of this measure, it would not be impossible to finance it by changing property transfer taxes (proposal 9).

B-2
More systematic use of heat

Why focus on heat?

Heat is not specifically accounted for in international statistics.

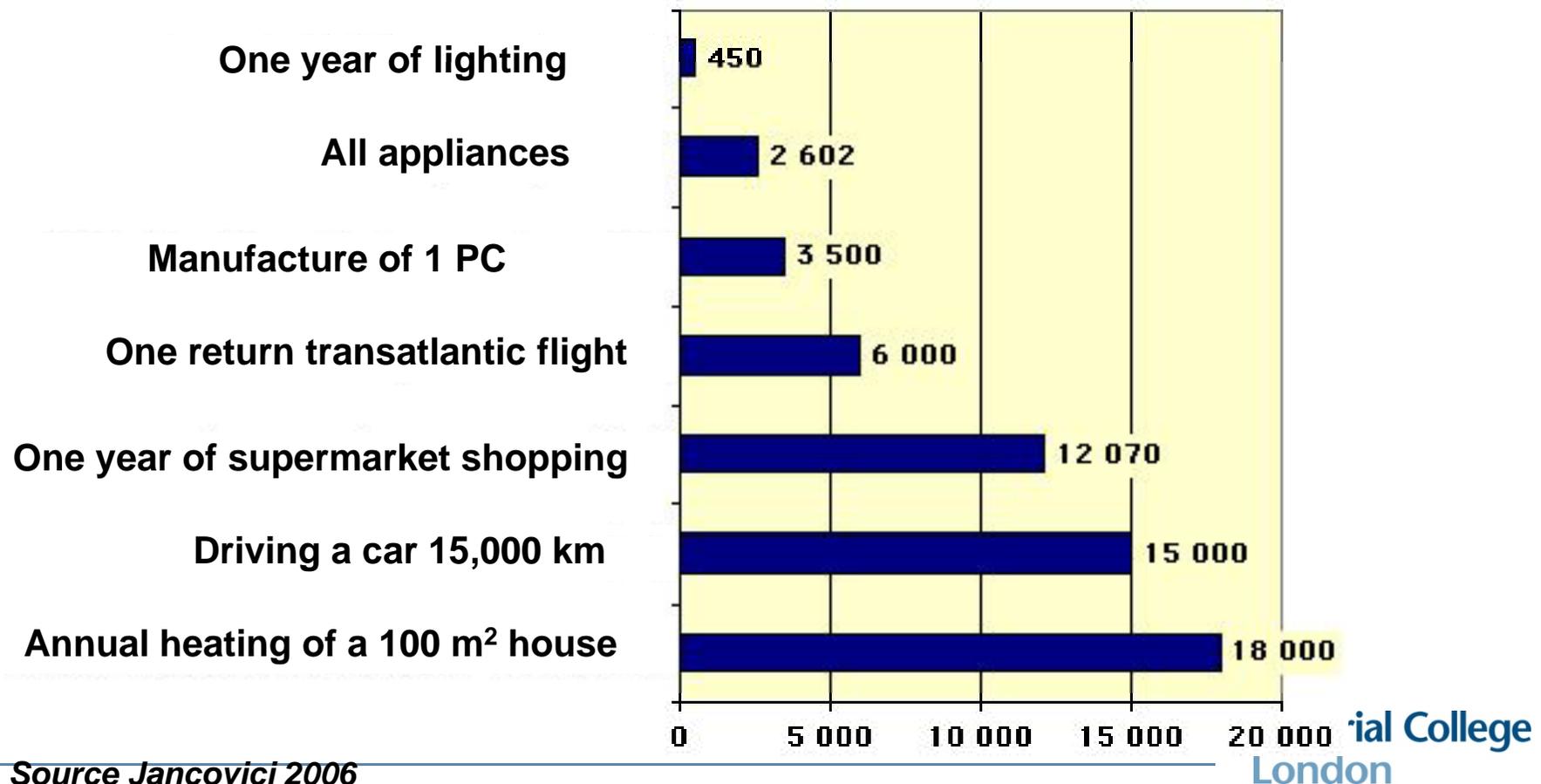
But, among the final uses of energy, heat is paramount.



Heat in Housing

In developed countries located in the temperate areas of the globe, heating accounts for a major share of energy consumption.

In France, for instance, 45% of final energy is mainly used for heating buildings.



Source Jancovici 2006

- January 2010 - Alain Bucaille – Proposal drawn up with the participation of B.Barré and MN.Hamel

Underrated technical progress

Political decision-makers, the general public and economic and financial circles are not aware of acquired technical progress and highly likely progress by 2015:

- ◆ **Solar water heaters**
- ◆ **Wood firing**
- ◆ **Heat pumps**

Electricity growth higher than average energy demand

	Primary energy Gtep	Electricity TWh
1974	6	6,000
2000	10	15,000

The trend in final worldwide energy consumption towards replacing solid fuel by liquid fuel or even more so by vectors distributed on a grid (gas and electricity), as they are much more convenient and flexible to use.

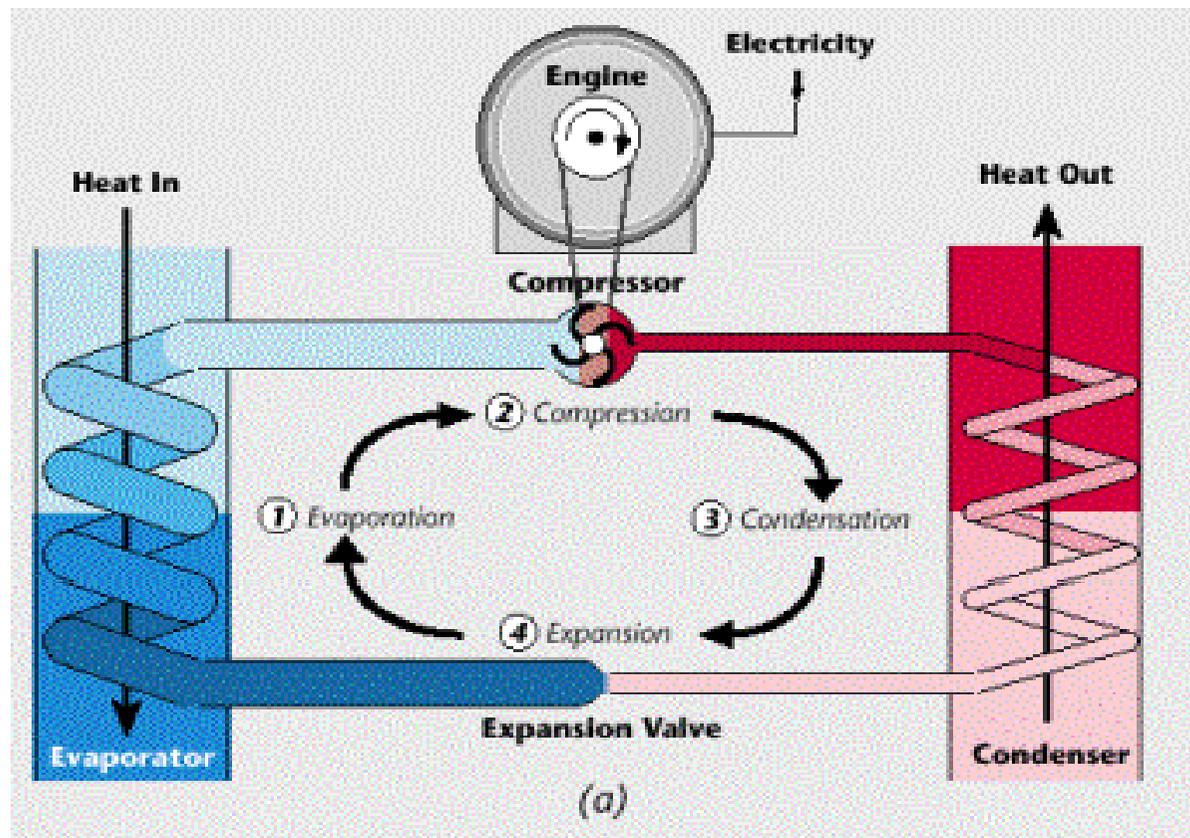
Loss of yield from thermal-based electricity generation is more than made up for by the electricity yield at the final use stage (engines, heating, information, communications, etc.)

Technical progress not fully valued A mature CO₂ saving technology: the heat pump

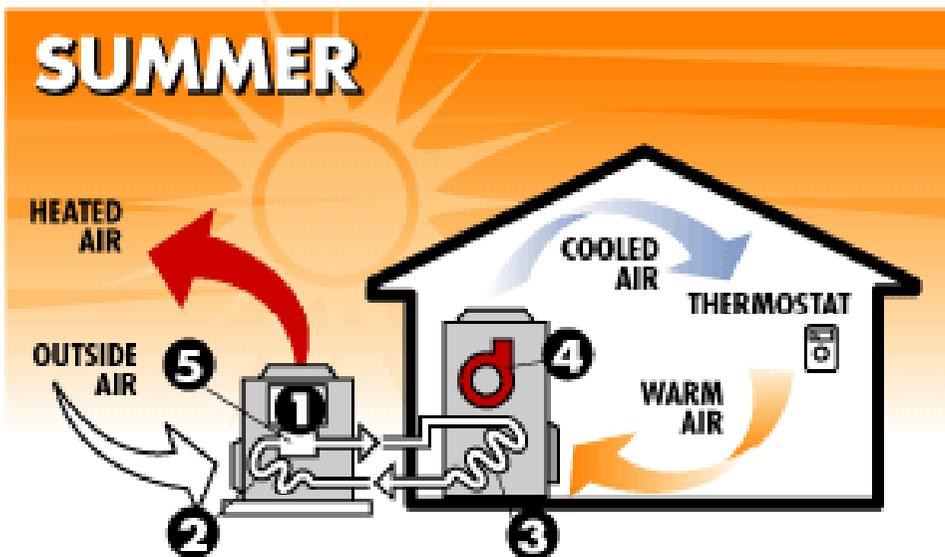
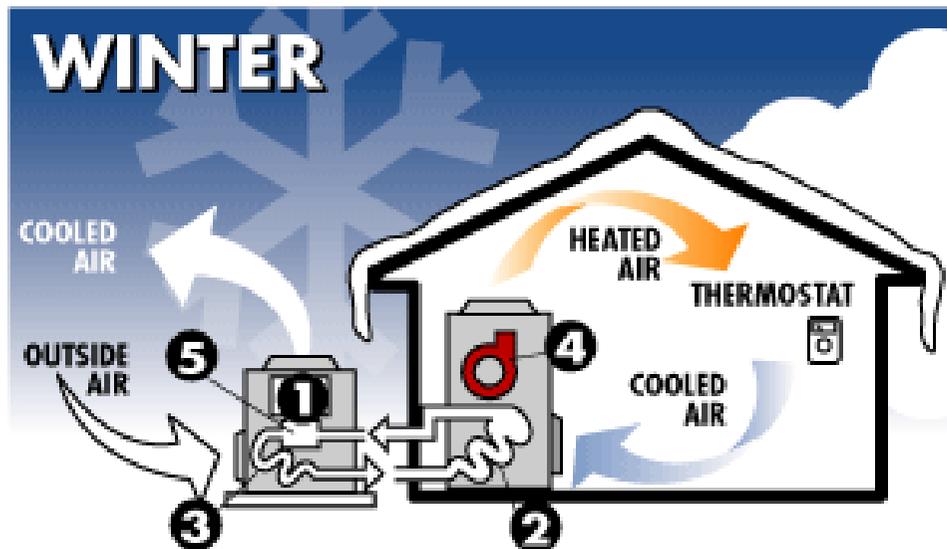
- ▶ **A *fully mature* technology which has the potential to decrease the amount of primary energy required by a factor 2 to 6 already exists for the heating and air-conditioning of buildings: the heat pump. Heat pumps use electricity to “move” heat from the outside to the inside (or vice-versa), instead of simply producing it**
- ▶ **This gain in energy efficiency directly reduces CO₂ emissions even if the electricity is generated from fossil fuels**
- ▶ **If the electricity mix is mostly CO₂-free, with a high share from nuclear power and renewables, emission reductions are even greater**
- ▶ **Due to the costly initial investment heat pumps did not really take off worldwide in the past as fuel oil and gas were cheap and CO₂ emissions not a concern**
- ▶ **Japan and Sweden extensively use this technology, and recent progresses in efficiency make it even more attractive.**

How does a heat pump work (1/2)?

- ▶ The heat pump is based on the second principle of thermodynamics, formulated by Sadi Carnot in the 19th century, the same principle on which thermal motors and refrigerators are based.



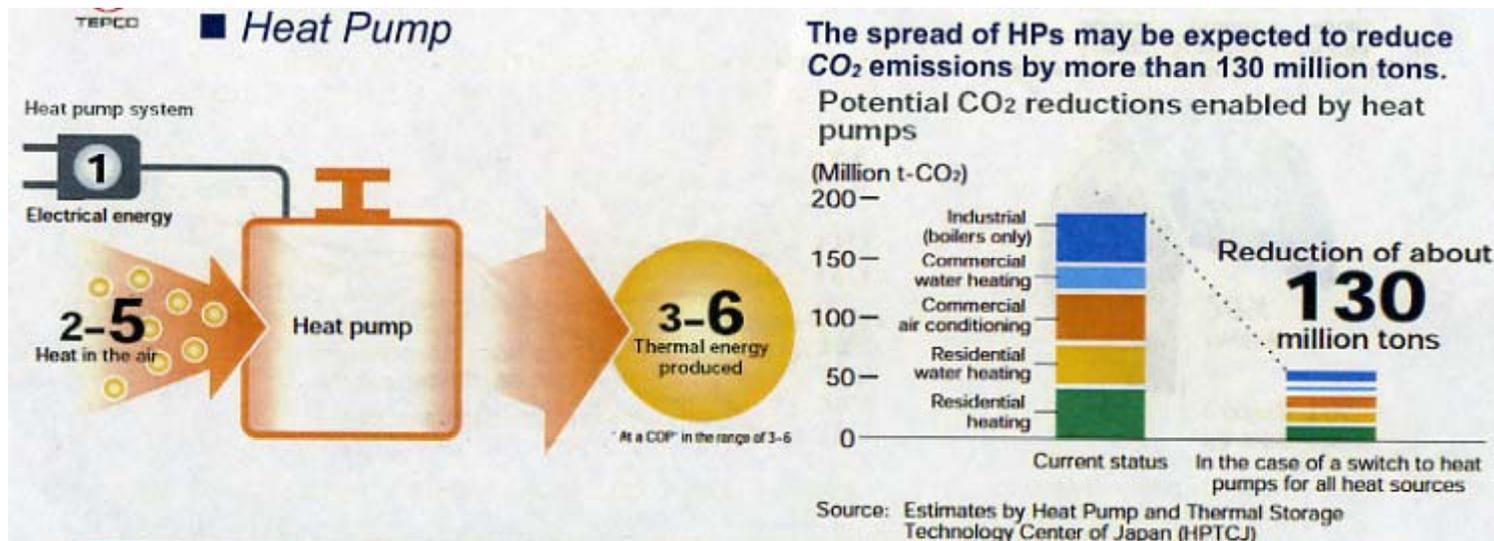
How does a Heat Pump work (2/2)?



1. **Compressor:** this increases the pressure of the coolant so that it will accept the maximum amount of heat from the air.
2. **Condenser:** coils that move heat to or from the outside air.
3. **Evaporator:** coils that move heat to or from the air inside the home.
4. **Air handler:** fan that blows the air into the ducts of the home. Components 1, 2, 3 and 4 are found in all standard air conditioners.
5. **Reversing valve:** changes the heat pump from air conditioning to heating, and vice versa.

Potential CO₂ savings from heat pump technology

- ▶ According to the Japanese HPTST Center, extending the use of heat pumps to heat and cool buildings and to heat water in all economic sectors (domestic, business and industry) could reduce the total CO₂ emissions in Japan by **as much as 10%**!



- ▶ Extrapolation to a penetration of 30% by heat pumps in the whole world for the same purposes could, according to the IEA HP working group, reduce global emissions by 6%. All this without the technical uncertainties which are part and package of less mature technologies (CCS for instance).

Potential CO₂ savings from heat pump technology

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- ▶ Extrapolation to a penetration of 30% by heat pumps in the whole world for these uses could, according to the IEA HP working group, reduce the global emissions by 6%. All this without the technical uncertainties which are part and package of less mature technologies (CCS for instance).
- ▶ Heat pumps are almost essential to take full advantage of the “warm” geothermal sources.

Underrated technical progress

Combining solar and wood heating and heat pumps we could reduce private energy consumption by at least 35%. If we combine these different types of heating with CO₂—free electric heating, we could easily meet 50% of private heating requirements with no CO₂ emissions.

There is no reason not to help G20+ inhabitants achieve this if they agree to make major energy savings and adopt clean energy projects which could halve their CO₂ emissions.

G20+ inhabitants who commit to modernization initiatives in their homes leading to a halving of their CO₂ emissions, should be supported from now with interest-free loans, the cost of interest should be borne by the State or by private funds from companies who have signed up to the global climate change pact (proposal 10).

Geothermal should not be neglected (1/2)

- ▶ **High temperature geothermal is also a major source of electricity in a number of places where magma rises to the surface of the Earth (Iceland, California, Italy, Guadeloupe).**
- ▶ **Most countries have aquifers which can be used to provide tepid water for direct heating or combined with a heat pump. The water must be re-injected into the hot water table, far enough for it not to cool down (around 1 km). The Dogger aquifer in the Paris basin is between 800 and 1500 m underground and provides water at 80°C.**

Geothermal should not be neglected

The greater Paris region has 10 million inhabitants and:

- 34 geothermal installations connected to the Dogger in operation**
- 80,000 Toe saved each year (two thirds of the French geothermal production)**
- 150,000 equivalent homes heated and supplied with hot water through geothermal energy**
- 10% of energy distributed by heat networks in the greater Paris region (50% in the Val de Marne *département*)**
- Co-generation facilities associated with geothermal production on around 55% of sites**
- 250,000 metric tons of CO₂ emissions avoided**

If 100 large cities did so to the same extent 25 million metric tons of CO₂ emissions would be avoided.

7.5% of electricity to be replaced by heat in G8 countries?

Nothing would seem to stand in the way of such an objective (proposal 11) or its evaluation by the IEA based on OECD-specific methods (examination by an international team based on national contributions and resulting in public reports).

Subject to verification, any substitution should be encouraged, taking carbon at less than 50€/t CO₂ (proposal 12).

States would be quite free to decide how to get involved (regulations, tax, subventions). We should keep in mind proposal 10 and which would specifically apply to those who commit to halving the emissions in their homes.

**B 3 – Reduce CO₂ emissions from
electricity generation by at least a factor
of three**

Electricity demand outgrowing average energy demand

Satellite pictures showing growth from the early 1970s



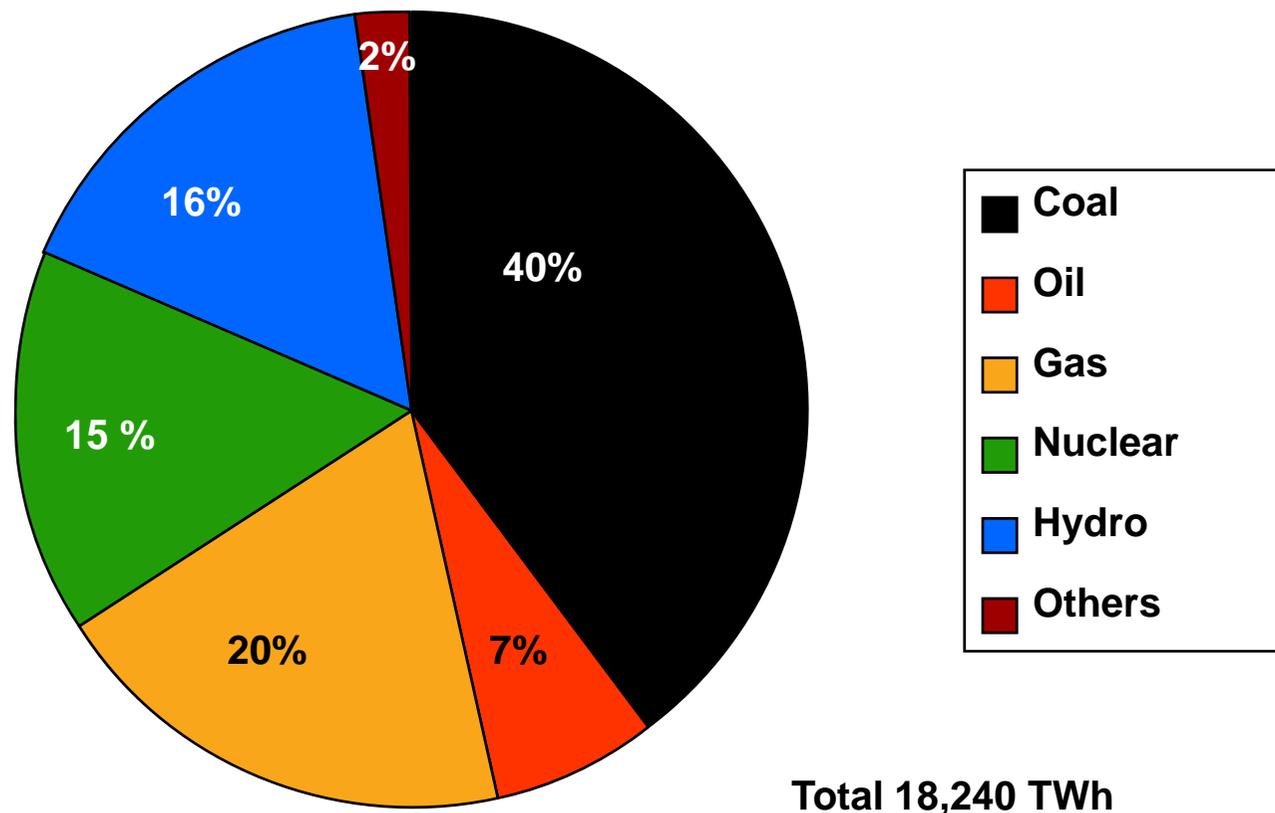
In 2005: population + 30%, energy consumption + 111%, power generation + 136%



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on

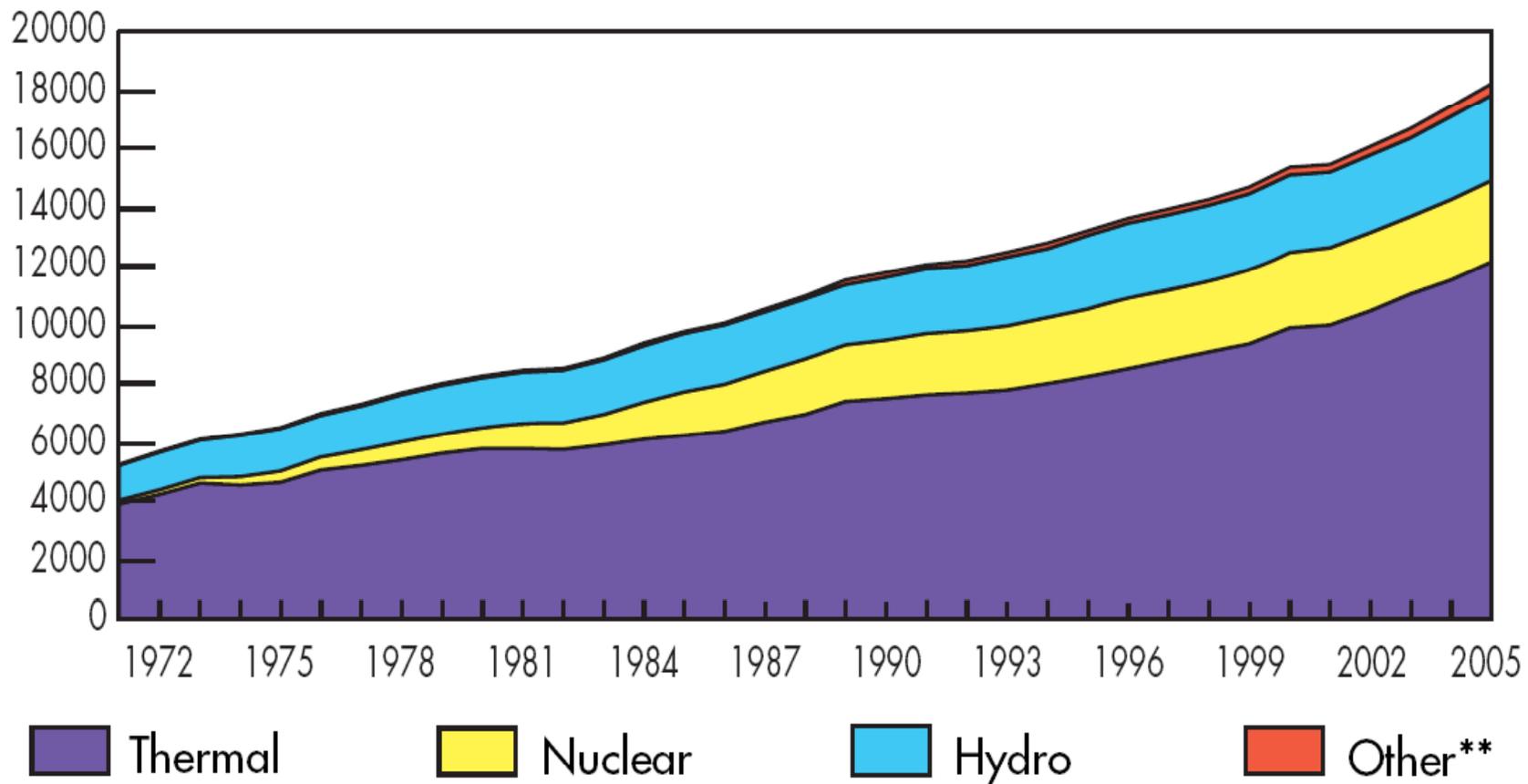
Global electricity generation by source

Power production, the source of almost 50% of global CO₂ emissions, is still largely based on fossil fuels



***Despite all the talk about climate change,
most of our power is still generated by fossil fuels***

Evolution from 1971 to 2005 of World Electricity Generation*
by Fuel (TWh)



■ Thermal ■ Nuclear ■ Hydro ■ Other**

Electricity generation by source (1/2)

- ▶ **Our needs for electricity generation resources vary according to their annual period of use, how long they can be used for over a year, their ability to follow demand, and how quickly they can be brought online.**
- ▶ **For “base-load” (i.e. year-long) electricity, “constant stream” hydro-electric plants and nuclear plants are currently the best solution.**
- ▶ **For “peak” electricity, hydro-electric is virtually irreplaceable.**

Electricity generation by source (2/2)

- ▶ **Clean coal and gas both have a place in a diversified energy mix.**
- ▶ **Wind power is good when there is wind but the wind doesn't blow on request. Furthermore, there is not enough wind and it is fairly irregular on 25% of potential zones; substitution sources are required. It appears (see Denmark) that wind power cannot exceed 15% of total electricity generation.**
- ▶ **A well connected network is required which must be capable of constantly regulating power intensity, voltage and frequency.**

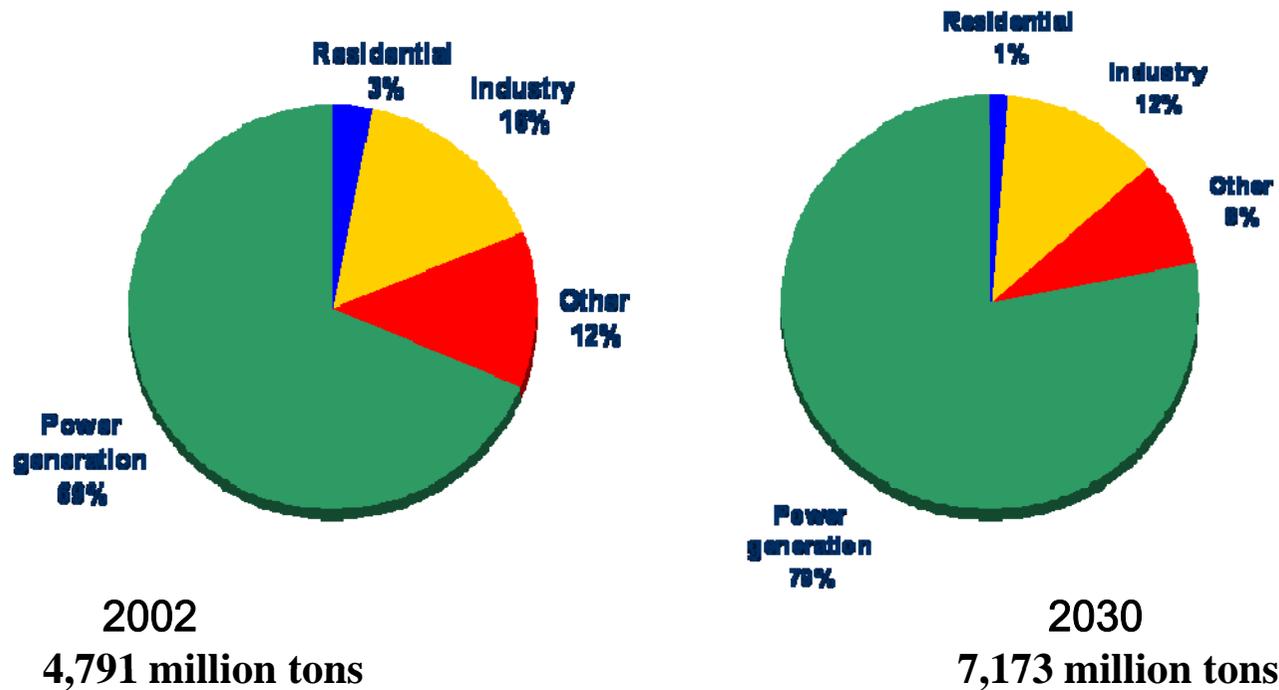
Investment – a major factor

Given the scale of the investments to be made (22 trillion \$₂₀₀₆ by 2030, according to the IEA) and that these will mostly be in facilities with very long service lives (more than 40-50 years), it is obviously essential to establish the clearest, most explicit regulatory framework possible.

It would be paradoxical for developed countries to constantly alternate between:

- ◆ **a desire to liberalize markets, and**
- ◆ **the setting of general political objectives of varying stringency, leading to trends that have no bearing on electricity prices, depending on whether or not countries wish to take up the challenge of combating climate change.**

The possible accelerated growth of Coal



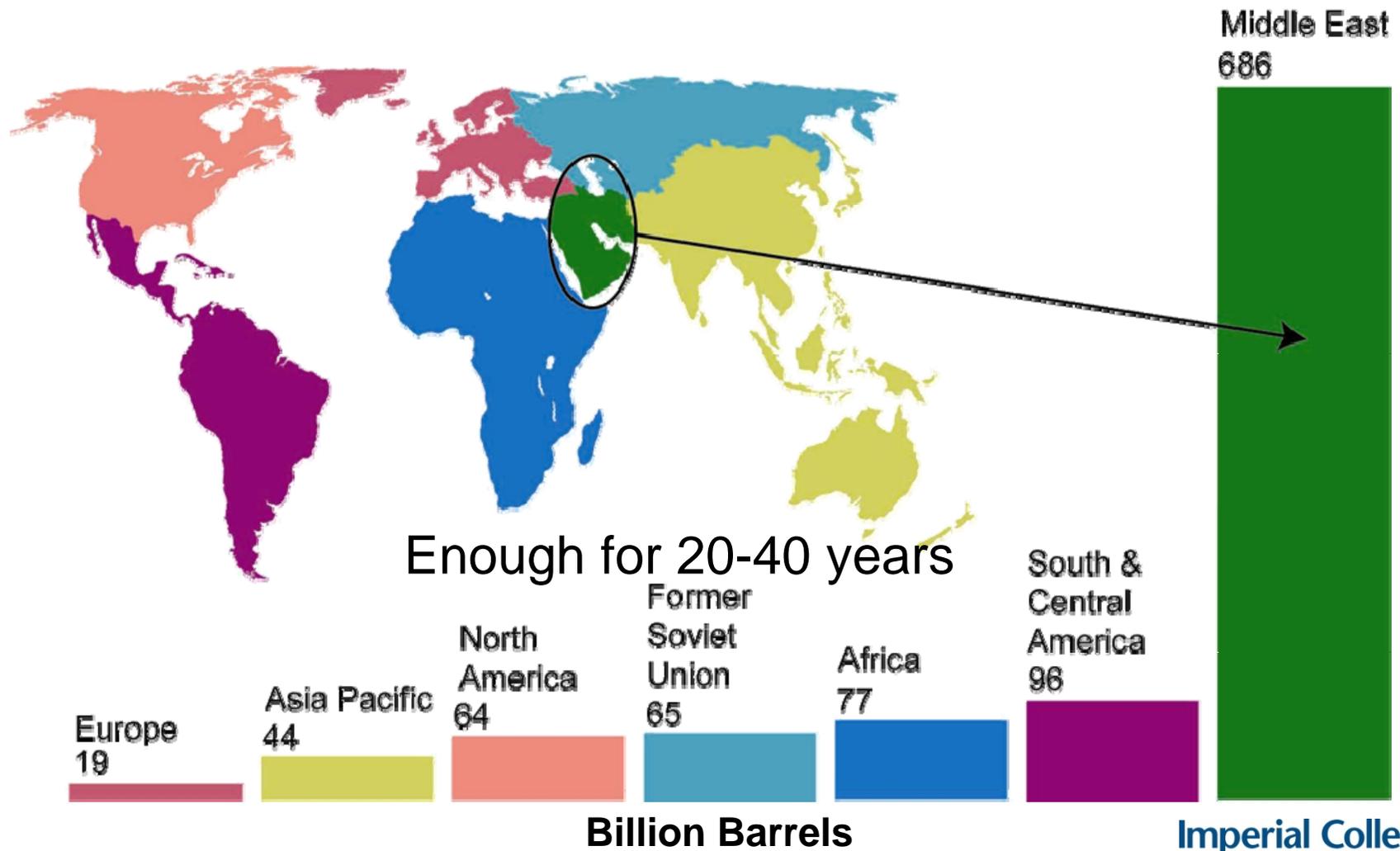
The question is whether this growth (currently in excess of an additional 1000 MW per week in China) will be achieved with or without CO₂ emissions; today, unfortunately, it is with CO₂ emissions.

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Source: IEA, 2004, 2007

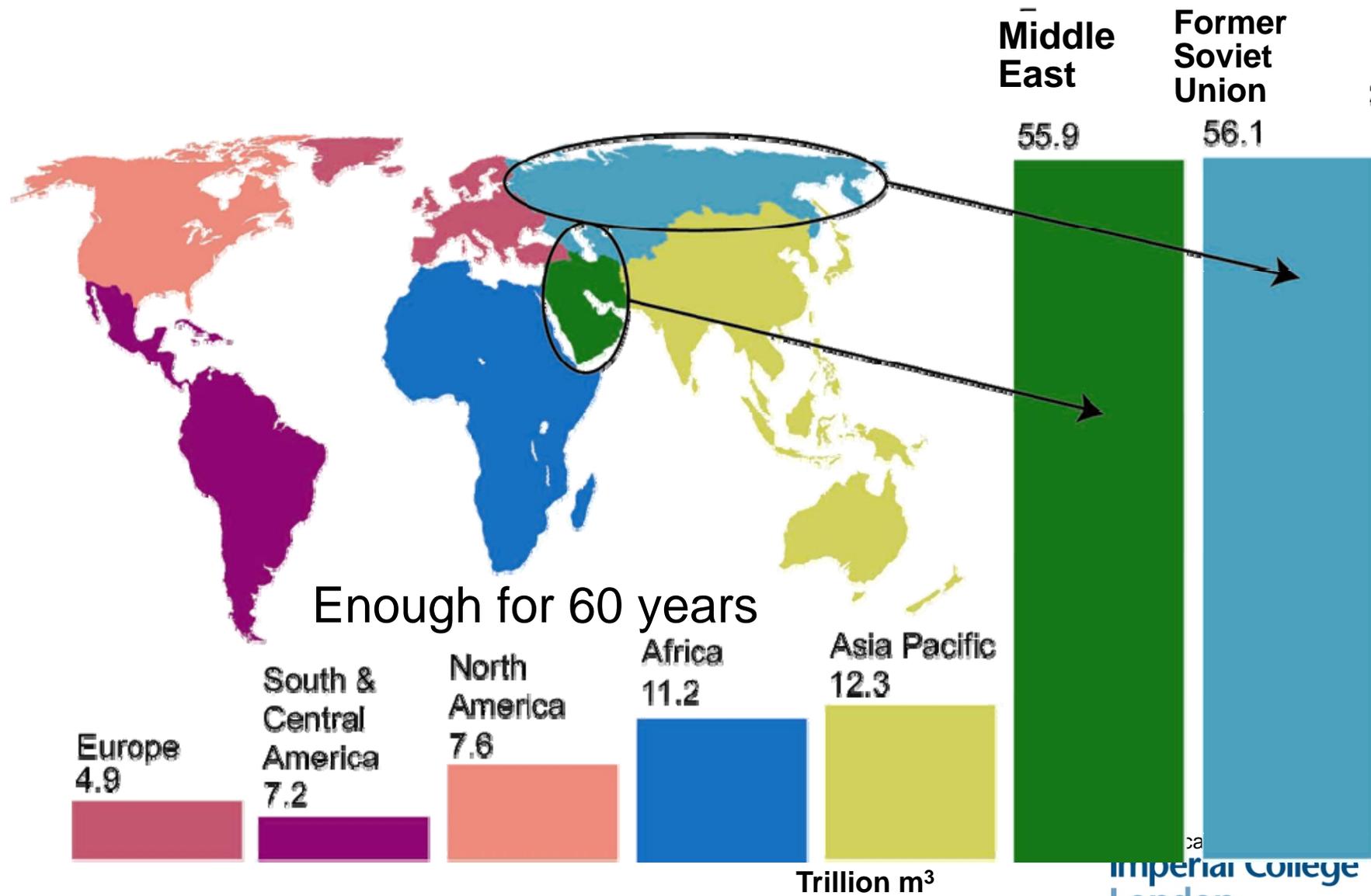
If we look at things from the point of view of reserves, only coal and nuclear have sufficient reserves for the very long term.

Where is there Oil?



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Where is there Natural Gas?



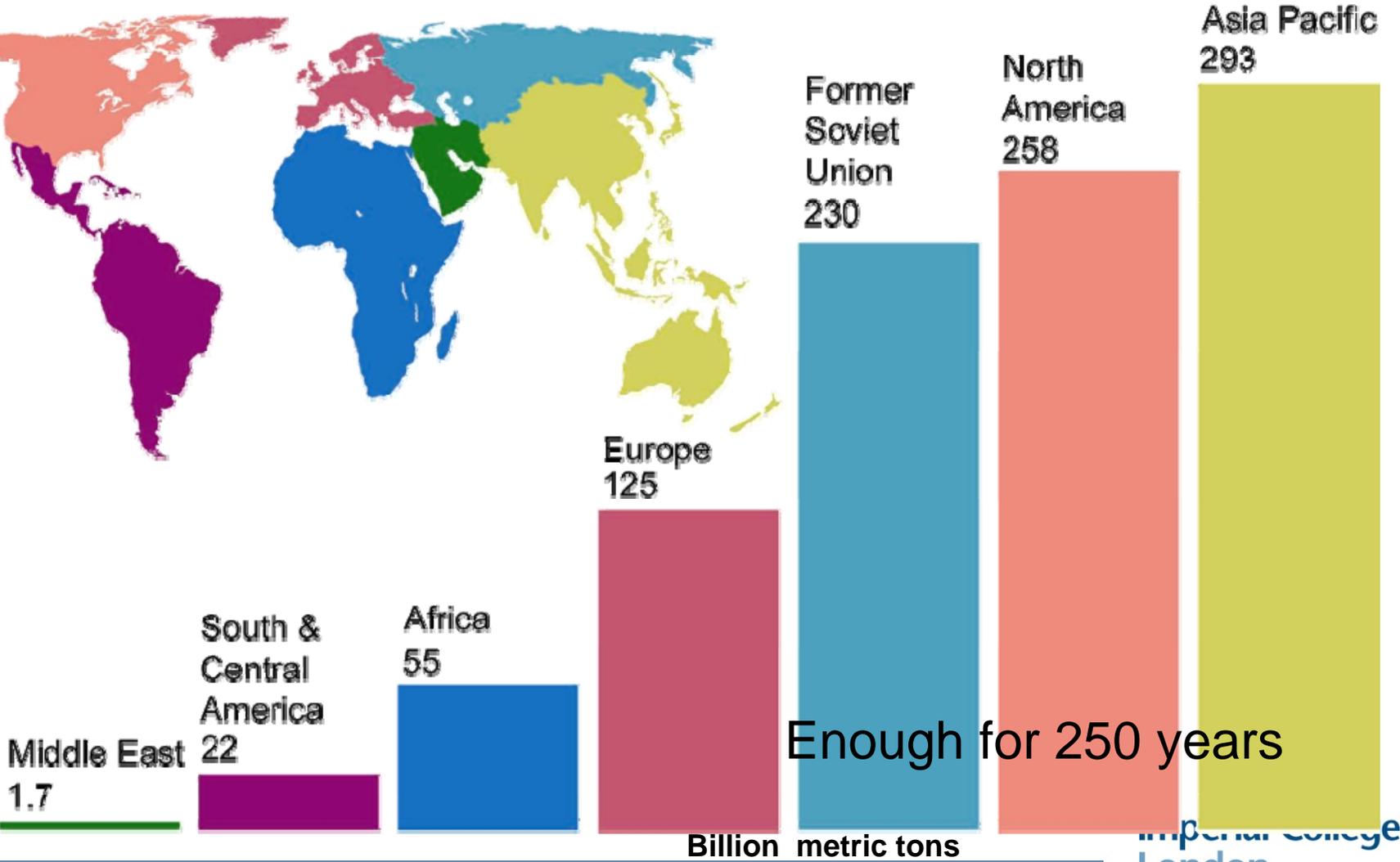
Gas in the very long term

- ▶ **Opinions differ as to when the conventional gas peak will occur: 2045, 2055 at the latest.**
- ▶ **If demand were to grow by more than 2.5% per annum, the peak would occur before 2050.... and the competition between global regions would quickly become even fiercer than it is today ... especially if Russia were to put more emphasis on prices than volume.**
- ▶ **We sometimes hear about methane resources in hydrates, but this is not much more realistic than getting uranium from seawater.**

Coal and nuclear: the two main solutions for baseload electricity

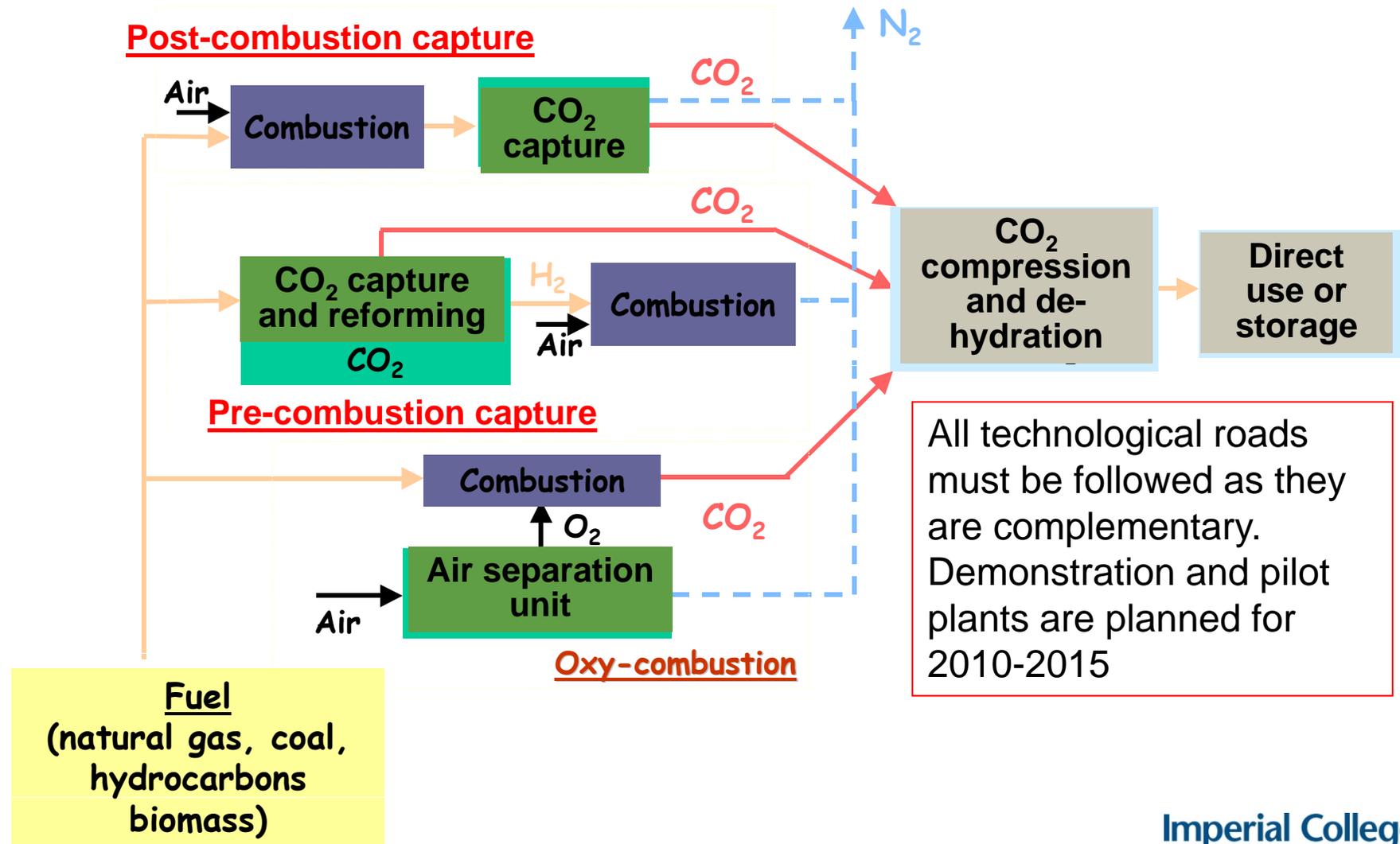
- ▶ **Base-load electricity (production twenty four hours a day) is often confused with other types of electricity. It is not possible to generate this electricity from intermittent sources (there is no sunshine at night, there is not wind every day).**
- ▶ **As far as reserves are concerned, for the top 50 or 60 economic powers in the world, the choice for base-load electricity comes down to coal or nuclear.**
- ▶ **.... And we will need all we can get.**
- ▶ **Only countries which enjoy a lot of sunshine and the available space is big will be able to avoid this dualistic choice.**

Where is there Coal?

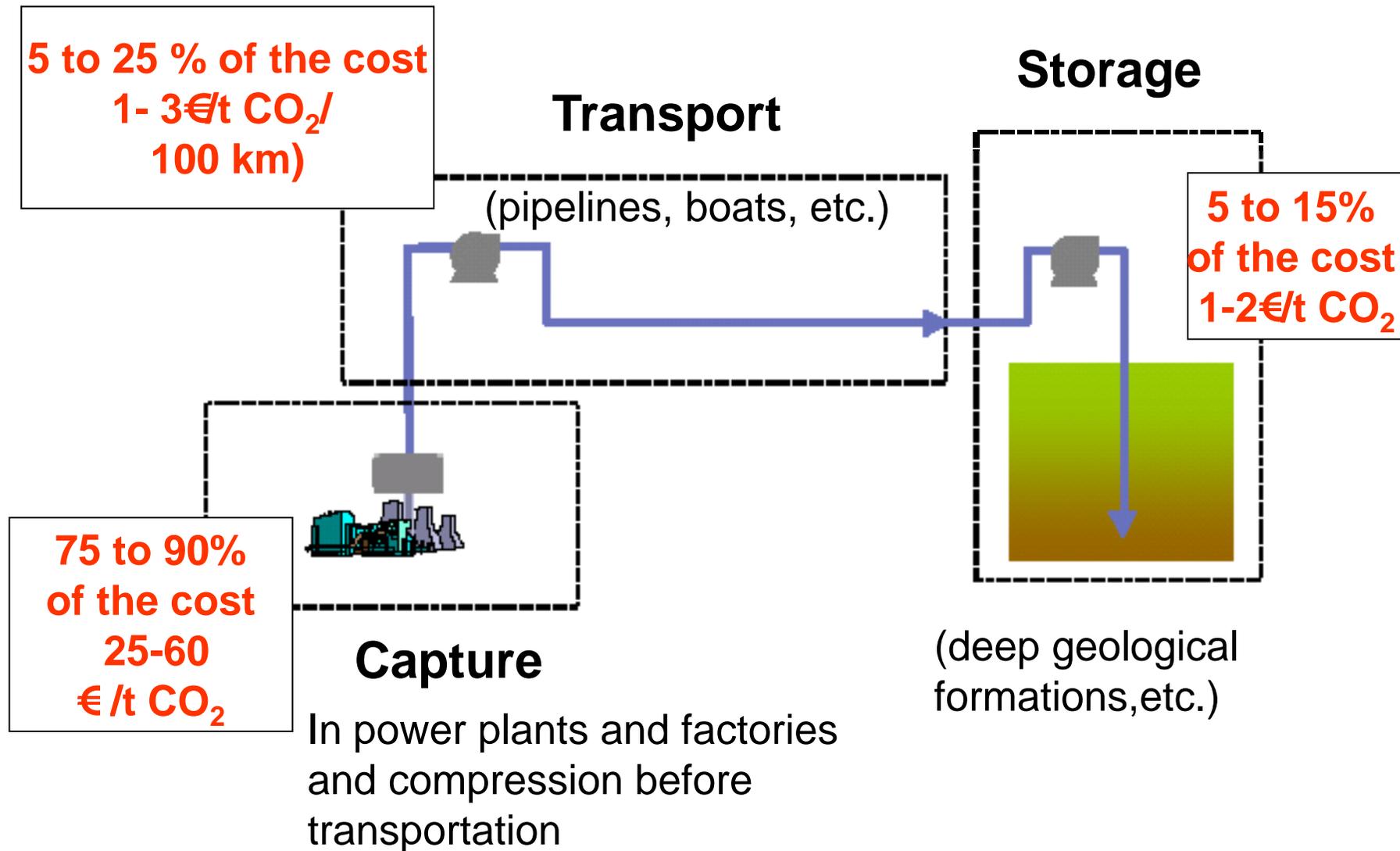


- January 2010 - Alain Bucaille – Proposal drawn up with the participation of B.Barré and MN.Hamel

CO₂ capture: different possible options



The 3 Steps and their costs



CO₂ capture and storage

- ▶ **This will cost more than 50 euros/t CO₂, a figure that will have to be applied to 6 GtC emitted, i.e. 20 Gt CO₂. Some estimates have even put the minimum realistic cost of storing pure CO₂ at €80 per metric ton/CO₂.**
- ▶ **The sustainability of pipelines and piping systems will have to be validated.**
- ▶ **Fortunately there are lots of opportunities for storage in salt aquifers, but these may or may not be located in certain countries or regions for geological reasons. This could be the case for 35% of the global economy.**
- ▶ **Capture and storage will be necessary but this is not our only option.**
- ▶ ***The IAE and other parliamentary offices mentioned on the following pages should assess the true prospects of carbon capture/storage (proposal 13).***

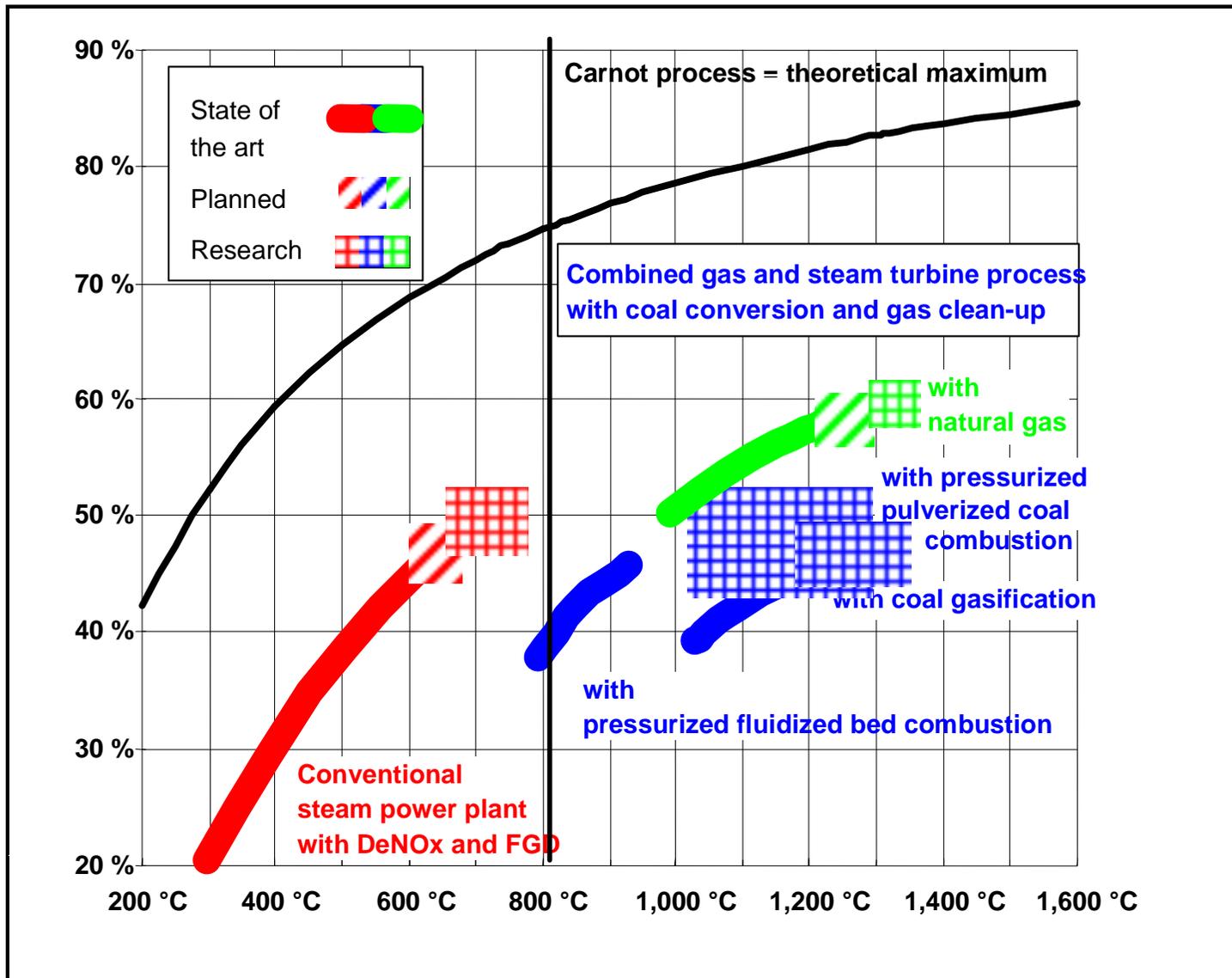
Major but less visible progress in coal

- ▶ **The current yield of the world's coal-fired plants is around 31% (i.e. 28-44%) depending on region and age.**

A 10% improvement in yield translates as a 20% reduction in CO₂ emissions. Upgrading the global fleet by 2010-2015 would probably cut emissions by 1.5-2 Gt/year, and is therefore the first immediate lever for improvement.

- ▶ **A second lever could be improving the current performance of the best plants, which are developing significantly (fluid bed plants, powdered coal plants, supercritical plants operating at 600°C and 300 bar). Yield of up to 47-48% by 2015, or even 50%, should be attainable.**

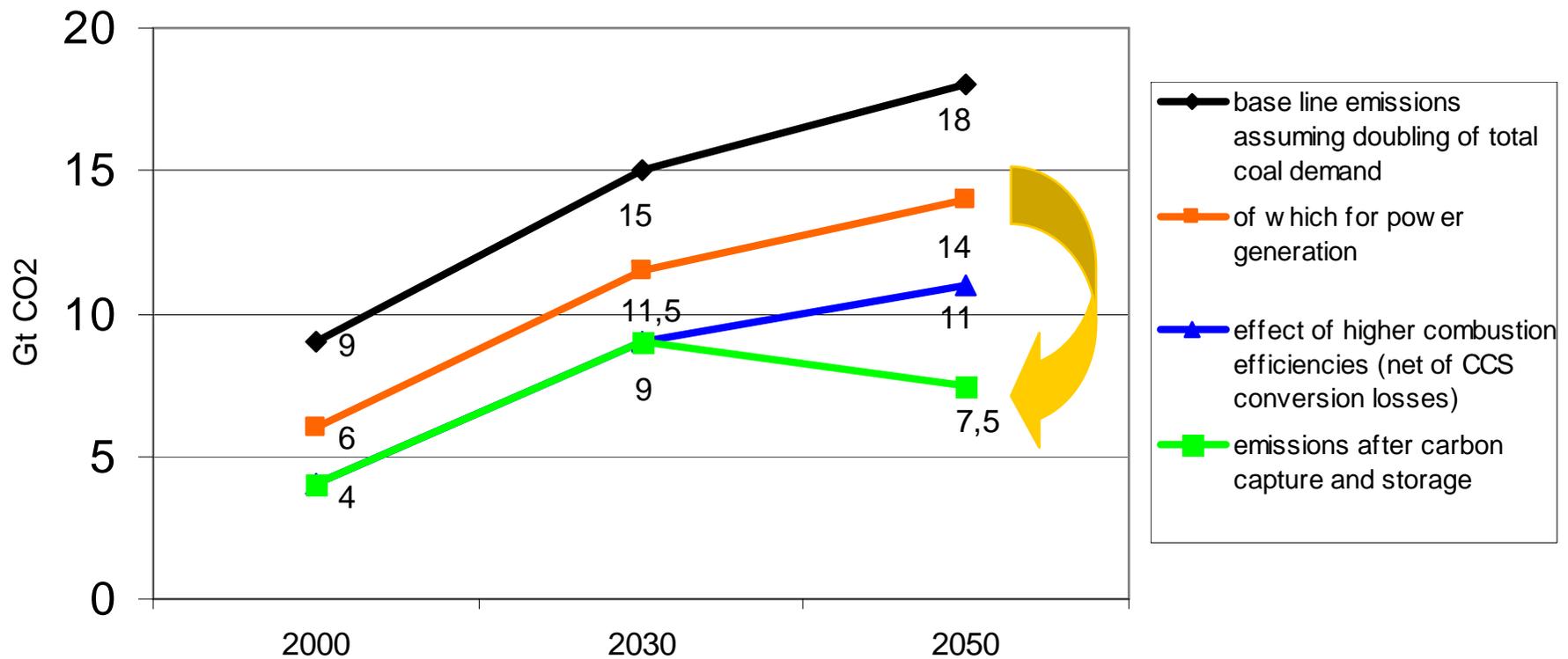
This type of technological development should be a first-line action, rather than pushing subsurface storage technology that has yet to be validated (long-term corrosion of pipes, leaktightness of saline aquifers).



There is still a lot of room for improvement in coal plant efficiency

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Global CO₂ emissions from coal-based power plants, and mitigation potential 2000-2030-2050



By combining high efficiency coal plants and CCS we could halve CO₂ emissions by 2050

An alternative that is still underestimated (1/10)

Until now, we have only considered eliminating CO₂ by capture and storage deep underground.

However, today we see the possibility of transforming it into oil using electricity, with the mass-production of hydrogen.

The critical path is as follows:



Patents are being filed for this, which leads us to believe that such a transformation could be achieved at a cost of around \$150/barrel, if it is to take place using nuclear power during off-peak times, and considering a monetary rate of less than 5%.

If the price of oil was to sustainably remain above 150\$/barrel, this option should be seriously considered (proposal 14).

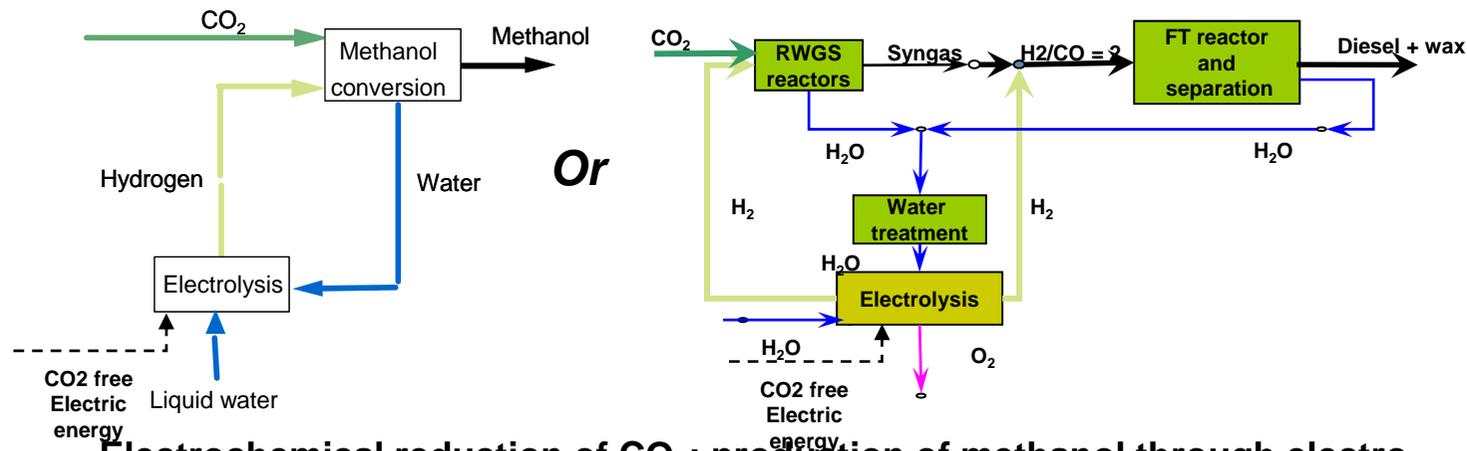
Different ways to decrease CO₂ emissions (2/10)

▶ CO₂ Capture and Storage

- ◆ CCS is technically viable
- ◆ CCS is dependant upon the availability of geological storage and industrial scale deployment is still a long way off
- ◆ No major impact is expected before 2025

▶ CO₂ Capture and Valorization can be implemented shortly

- ◆ Case 1: CO₂ recycling from unavoidable sources such as fossil fuel power generation, steel mill, cement manufacturing, etc.
 - CO₂ to Liquid: production of synfuel or chemical intermediates from CO₂



- Electrochemical reduction of CO₂: production of methanol through electro reduction of CO₂ in a steam electrolyzer

- ◆ Case 2: achieving a net CO₂ sink through biochar production

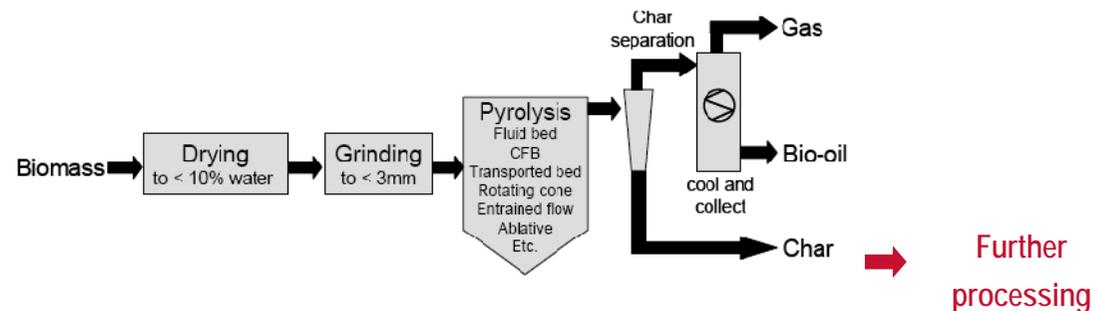
Achieving a net CO₂ sink: biochar production (3/10)

- ▶ **Biochar production: turning biomass and organic wastes into biochar (carbon based co-product) by thermal decomposition under limited supply of oxygen at a relatively low temperature (slow pyrolysis technology)**
- ▶ **In conventional use of biomass for fuel, biomass is harvested and burned and releases CO₂ back to the atmosphere, biochar avoids large CO₂ emissions and is a robust way to store massive amounts of carbon in soils**
- ▶ **Synergetic and complementary objectives motivate biochar to be applied to soil:**
 - ◆ **Climate change mitigation by direct carbon sequestration**
 - **Diverting 1% of annual net plant uptake into biochar would mitigate 10% of current anthropogenic C emissions**
 - ◆ **Soil productivity improvement, filtration of percolating soil water and pollution reduction**
 - **Biochar provides an opportunity to improve soil fertility and nutrient-use efficiency**
 - ◆ **Waste management**
 - **Biochar reduces volume and weight of waste such as animal and crop wastes from agriculture, green urban and paper mills wastes, etc.**
 - **Biochar production avoids CH₄ and N₂O emissions released during decomposition of conventionally managed biomass**

To go beyond what is achievable through CO₂ emissions reductions and sink: biochar production coupled to energy production (4/10)

▶ Biochar and energy production

- ◆ During pyrolysis, biomass is converted into biochar, non condensable gases and bio-oil.
- ◆ Depending on pyrolysis mode, the quantity of produced bio-oil may vary from 30 to 70 %. This bio-oil can be further processed to produce fuels or chemicals.



- ▶ Pyrolysis technologies can be deployed on an industrial scale but is also amendable to community scale
- ▶ However, with respect to biochar, some key aspects are to be verified and some more studies should be carried on (biochar production, end use of biochar, impact of biochar on agricultural emissions, cost effective approach, etc.)
- ▶ All that doesn't deserve worldwide award because very well known.

Different ways to avoid net CO₂ emissions (5/10)

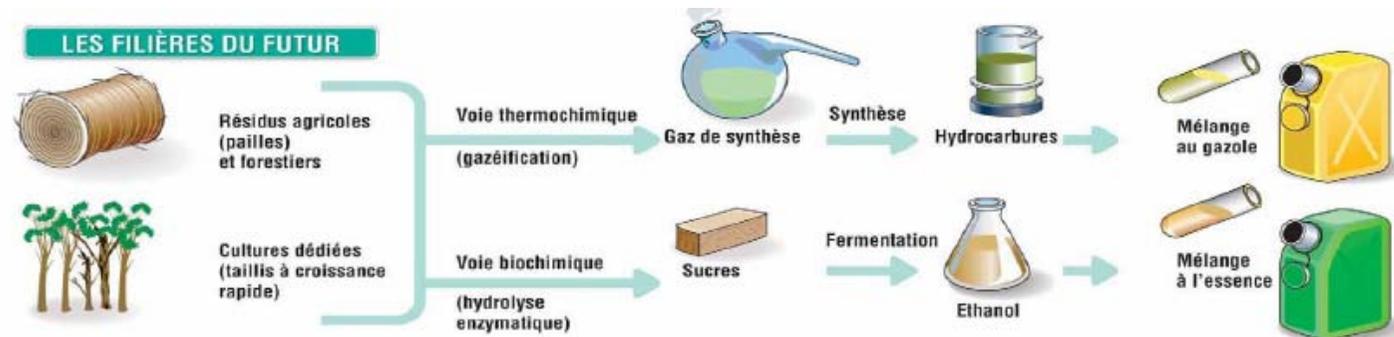
► Net CO₂ avoidance: alternative chemicals and fuel production

- ◆ First generation biofuels technologies are proven and established
 - Bioethanol production from starch and sugar (cane, beet, corn, wheat, etc.) fermentation
 - Biodiesel production from vegetable oils (rapeseed, soybean, palm, etc.) and animal fat transesterification



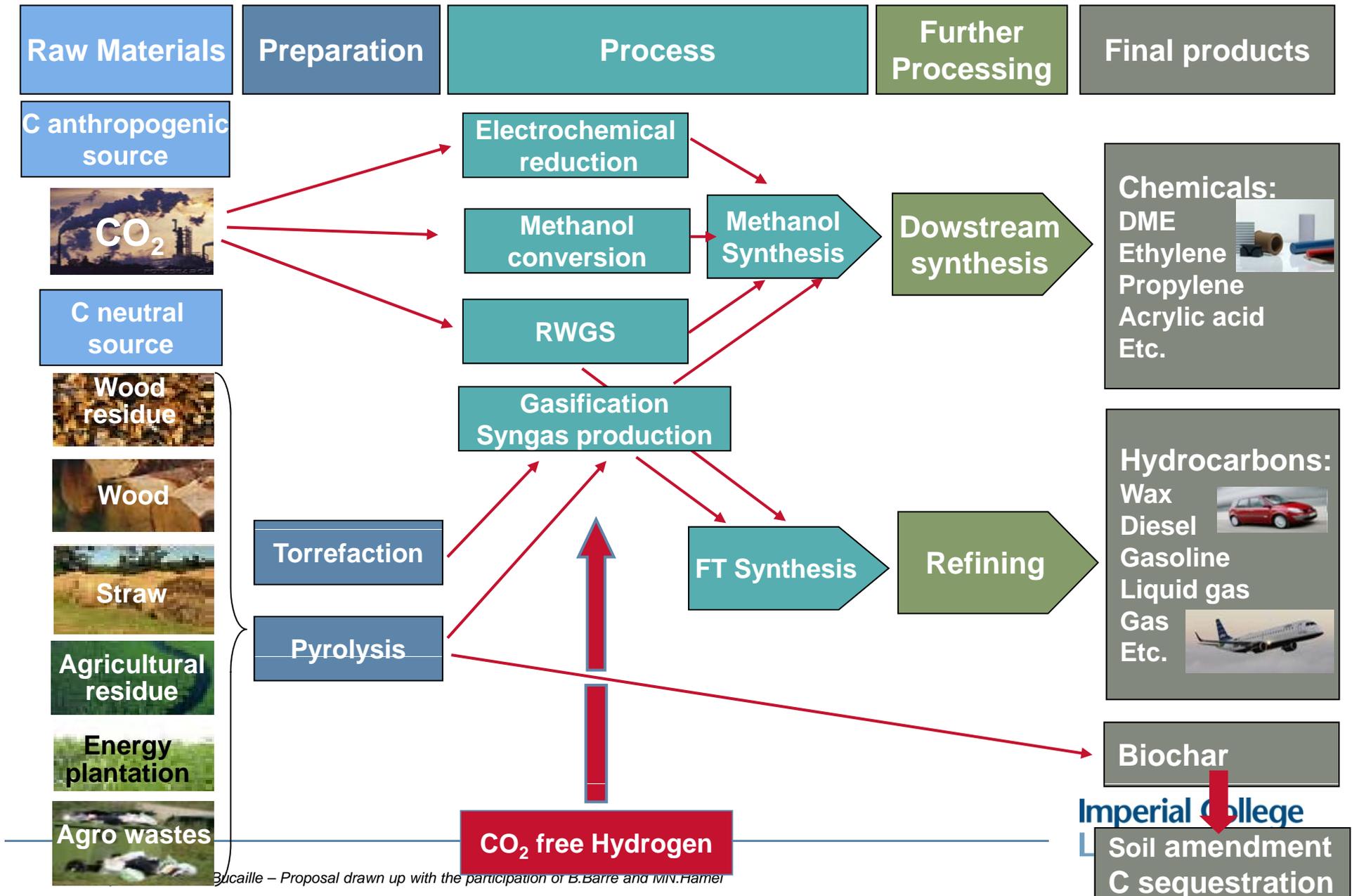
But are suspected to compete with food production and have low productivity

- ◆ Biomass (wood, complete plants, agro-residues, energy plantations) and organic wastes are the only renewable carbon sources not competing with food for organic chemicals and fuel production (2nd generation biofuels including BtL)
 - Thermochemical or biochemical ways are under development



- ◆ Thermochemical fuel and organic chemicals production
 - Syngas (CO + H₂) is a key intermediate for further processing
 - Introduction of hydrogen produced by water electrolysis or thermo-chemical processes increase production yield, and avoid CO₂ production from classical hydrogen production processes

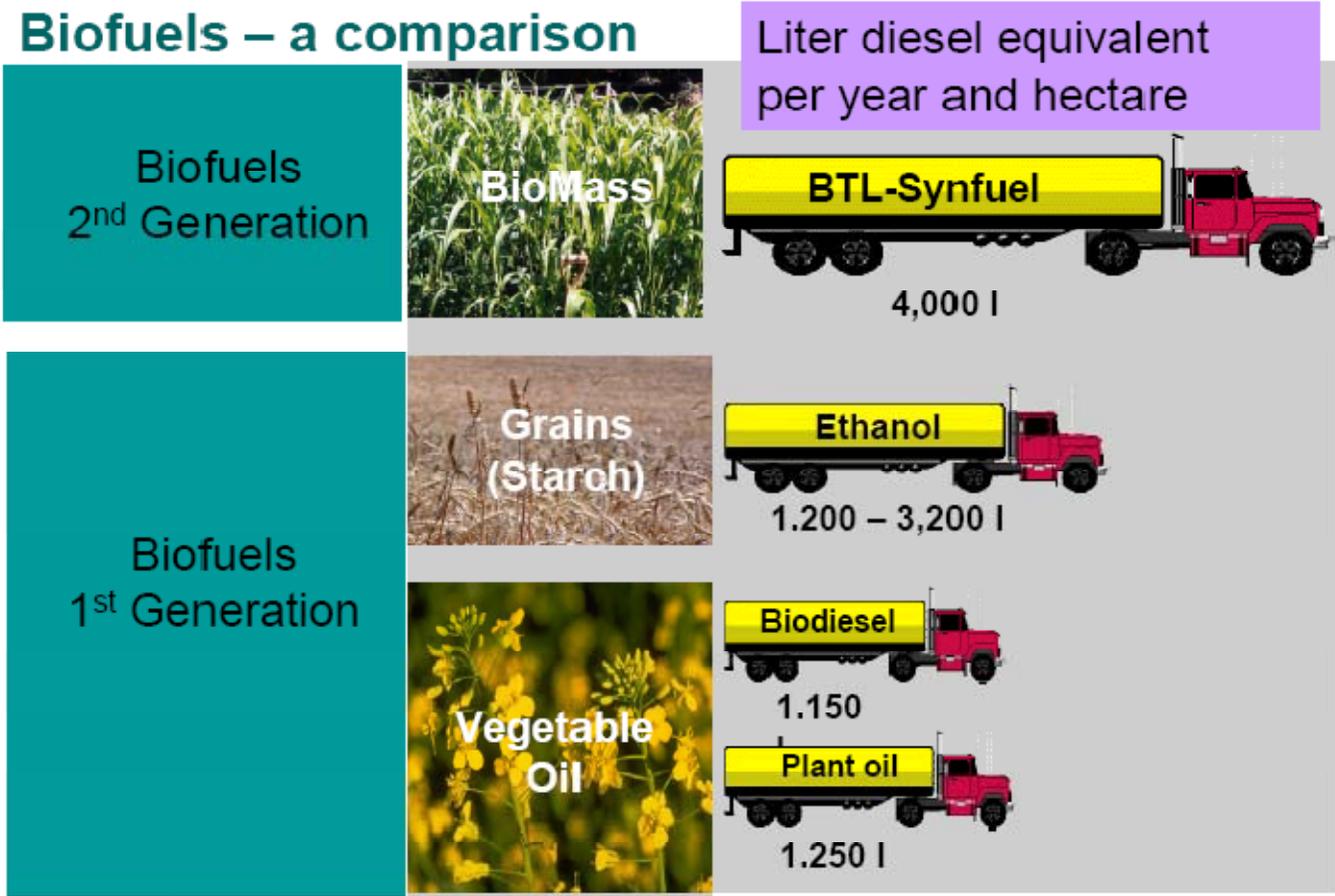
From Carbon species to chemicals and hydrocarbons: illustrations (6/10)



Biofuels productivity (7/10)

Much higher BioMass productivity

Biofuels – a comparison



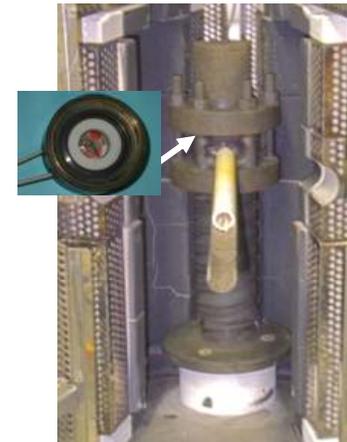
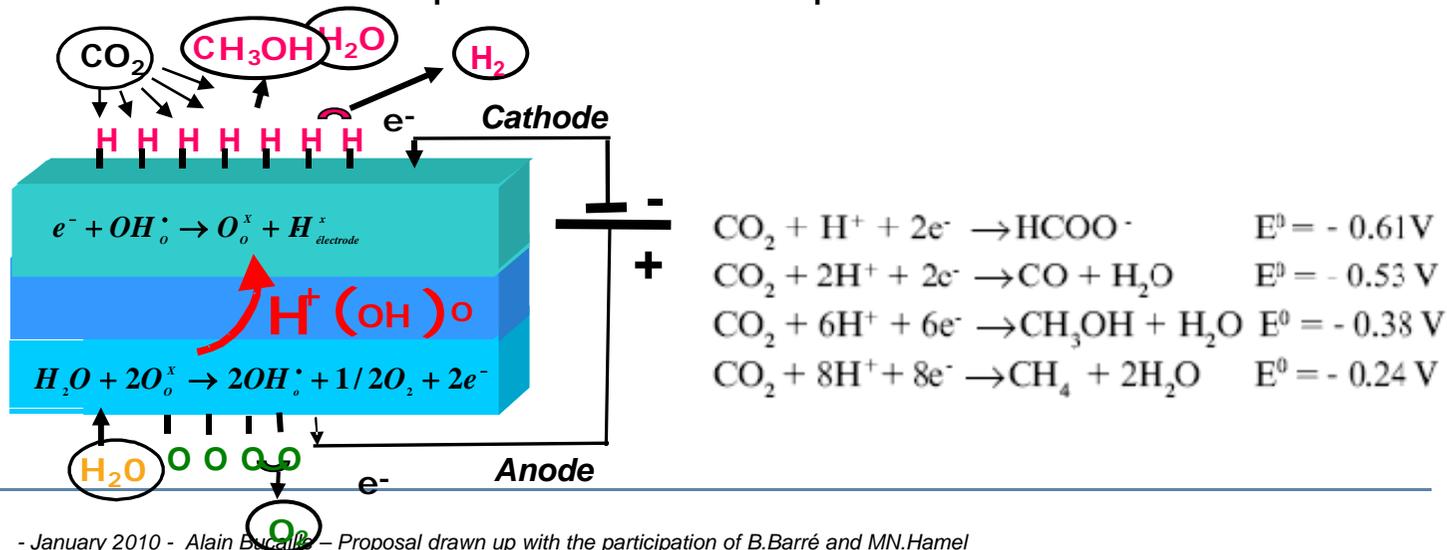
Source: Lurgi

Biochar technology production flexibility (8/10)

Mode	Conditions	Liquid %	Char %	Gas %
Fast	Moderate T ~ 500°C Short steam residence time ~ 1 s	75	12	13
Moderate	Moderate T ~ 500°C Moderate steam residence time ~ 10-20 s	50	20	30
Slow	Moderate T ~ 500°C Very long steam residence time ~ 5-30 mn	30	35	35
Gasification	High T > 750°C Moderate steam residence time ~ 10-20 s	5	10	85

CO₂ Co-Electro-Reduction (9/10)

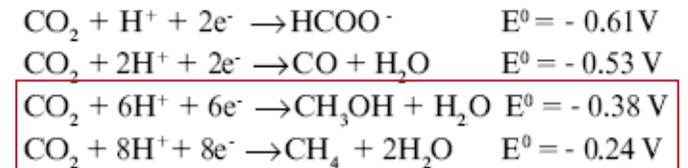
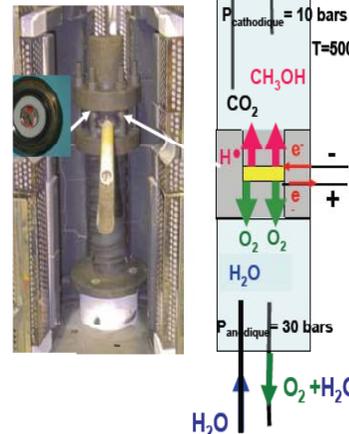
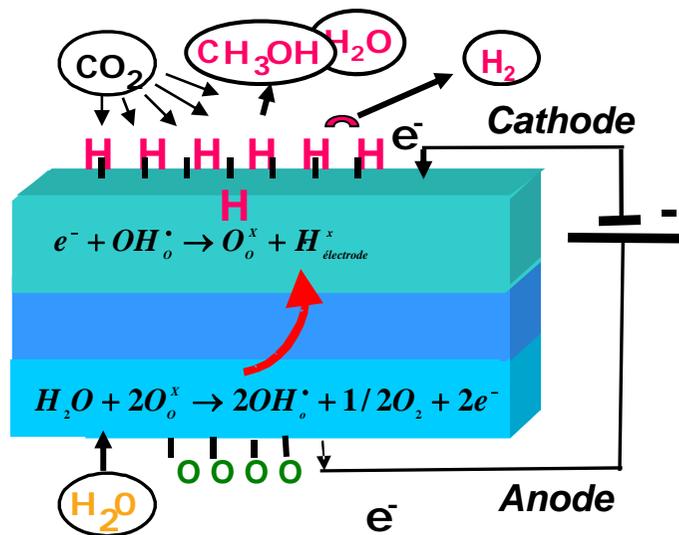
- ▶ Principle: Potential E monitors the reduction of CO₂ and compound synthesis
- ▶ After last year first promising results
 - ◆ A 3 years program
 - ◆ Patented process
 - ◆ Scale up pilot test (x10)
 - ◆ Electro-reduction in potentiostatic mode to select the synthesis of each compound versus the potential.



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CO₂ Co-Electro-Reduction (10/10)

- ▶ Hydrocarbon and chemical intermediates production
- ▶ Principle: Electro-reduction of CO₂ in potentiostatic mode to select the synthesis of each compound versus the potential.
 - Through electro reduction of CO₂ in a steam electrolysis
 - Without petrochemical unit: huge CAPEX reduction



Key proposals

With the challenge of combating climate change in mind, the most powerful countries should, as of 2015, no longer roll out coal-fired power plants that emit more than 600g of CO₂ per Kwh.

The three main objectives for the G20+ could therefore be:

- ◆ *2012-2020: a new fleet of power plants built to supply base-load electricity comprising plants emitting less than 250g of CO₂ per KWh, vs an average twice higher today in developed countries.*
- ◆ *By 2030: this objective could be made even stricter by applying a limit of 250g of CO₂ per KWh to the entire installed fleet . If captation and sequestration of CO₂ is industrially proven by 2020, this target could be strengthened as half of the world should be able to make use of it (proposal 16).*
- ◆ *We target less than 100g CO₂/Kwh around or in 2050 timeframe.*

It goes without saying that international negotiations could see this figure change and what counts is the basic idea behind the proposal. It is easy to say that we want to do better but the problem lies with whether it is industrially possible or not. On EURELECTRIC's initiative (association of European electricians), studies are being held at the University of Athens, which should give more details of it by beginning of 2010.

Developments to be made

Here, we need to be upfront about the fact that this proposal involves four major developments by the international community:

- ◆ Stop believing in or promoting the idea that we can get by without a significant nuclear power renaissance. This is neither targeted at Washington, nor Beijing, Bombay, Tokyo, London, Moscow, etc.
- ◆ Stop constantly referring to carbon capture & storage as a future possibility, but then putting off implementation until after 2020. **It makes it hard to get people mobilized when we talk about its merits while at the same time explaining that it won't come to much by 2025.**
- ◆ ***Strike the right balance between free market trading and capping regulations, while maintaining competition between energy forms for base-load electricity (proposal 17).***
- ◆ ***Stop confusing base-load electricity and semi base-load/peak electricity (proposal 18).***

Some principles to be kept in mind

Generation of base load electricity (available 24/7 in developed countries) must meet the following three criteria for the next hundred years:

- ◆ **Be based on reserves that are sufficiently distributed or abundant as to allow investment in production resources.**
- ◆ **Emit as little CO₂ as possible.**
- ◆ **Do not block hinder competition:**
 - **competition should continue to function,**
 - **without lapsing into naivety: market economics perform best when value is optimized over 15-20 years and not quite so well when investments are considered over 50-60 years.**

We all remember the problems and tension caused in the past over oil well enough not to want to relive them over electricity.

And other types of electricity

Hydroelectricity, which is unevenly distributed around the world, could represent 7% to 10% of its electricity.

Renewables could generate at least 15%, or even 25%, of the world's electricity, i.e. over 50% of the total semi-base load and peak load (proposal 19).

Depending on the country, the principal renewables could be wind power and biomass. This contribution should not be confused with the heat produced by renewables. Hydro-electricity should not be forgotten.

So it is clear the amount of electricity generated in the G20+ countries today from fossil resources, with no carbon capture and storage, could be reduced from 75% to less than 25% in 25 to 30 years' time; this represents an improvement factor of at least three (proposal 20).

In economic terms

As calculations by the end of 2009 will show, such substitution would not cost – for all the G20+ – more than 25% of the value of the sale of electricity in those countries, or less than 1% of their GNP.

And this calculation would be conservative as it will not completely take into account the full effect of such measures on the future price of fossil fuels.

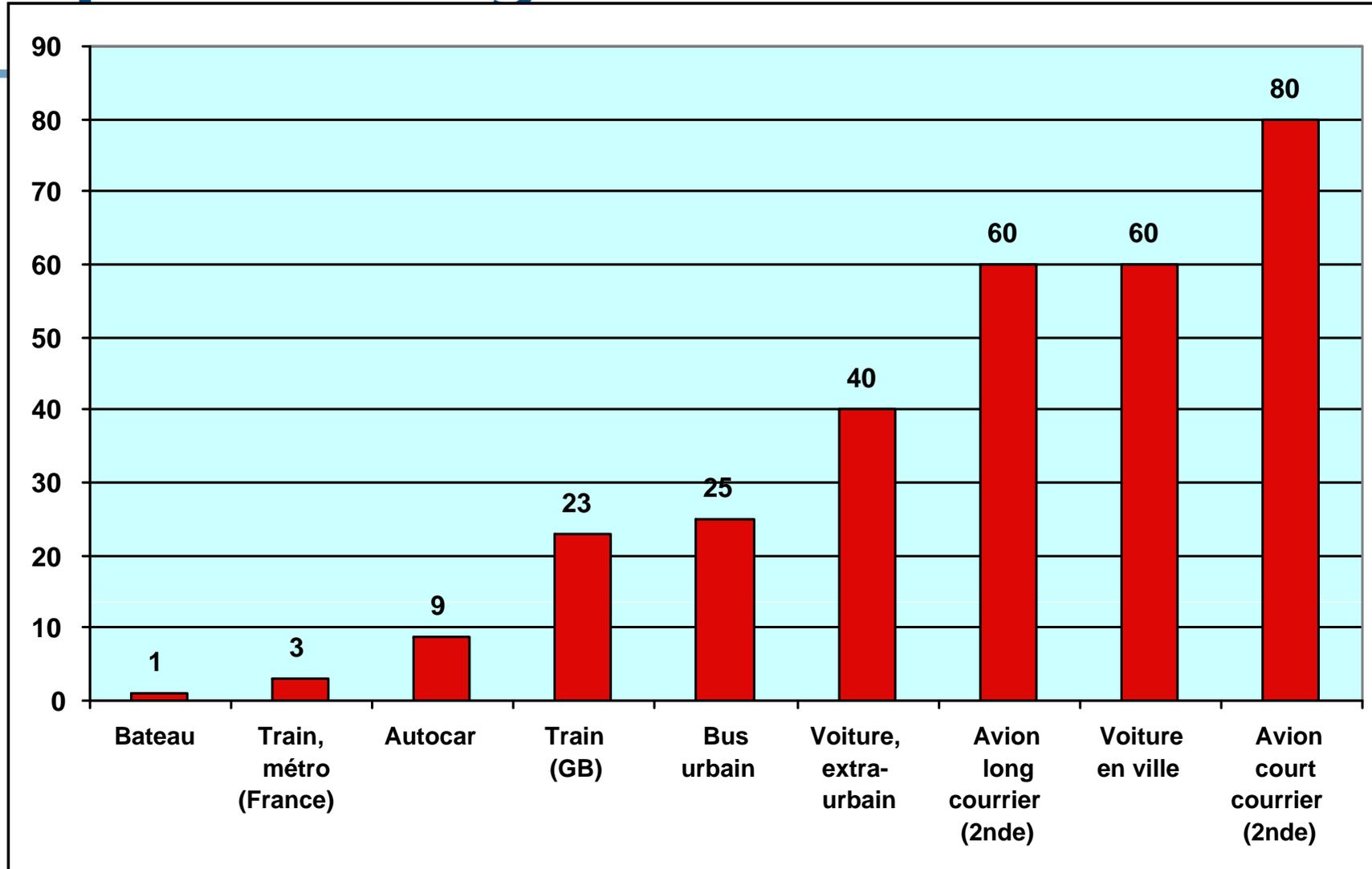
B-4
The challenge of transport

The challenge of transport (1/2)

The transport challenge facing us is three-fold:

- ◆ **Personal road transport will in all likelihood increase as the population grows and, in China, India and elsewhere, aspires to own a car. TV images have shown us the American dream , and we would be naive to underestimate future growth.**
- ◆ **Merchandise transportation is also growing with economic globalization. As we benefit today from its low cost, there is nothing holding back its growth.**
- ◆ **Finally, when all's said and done about geopolitical risks, it is clear that if the entire economy depends more and more on access to Middle-Eastern oil and gas resources in order to operate, and if this part of the world remains plagued by violent tensions and the obsession with oil and gas income, then political instability may continue and even intensify to the point where climate change is always pushed back as a lesser priority.**

Even though not fully intersubstitutable, means of transportation deserve a comparison (2/2).



GHG emissions per passenger for 1 km (assuming for the car the average number of passengers). Source: INRETS, INFRAS, ADEME, IFEN, Jancovici, 2001 to 2004

The shape of change for road transport (1/3)

Only in recent years have automakers been proposing more economical and less polluting cars. Now we have:

- 1. The Honda Civic hybrid, which emits around 105 g of CO₂/km.**

An electric motor provides additional power to the combustion engine without ever being the only power source. Deceleration energy is used to recharge the batteries. The system aims at reducing consumption by 10-20% and using an engine with lower power and capacity thanks to the extra power delivered by the electric motor.

- 2. The Toyota Prius uses a more powerful electric engine than the Honda, which can drive the car on its own at low speeds. Energy management is optimized according to driving conditions to, in theory, reduce consumption by an average of 50%.**

The shape of change for road transport (2/3)

- 3. Other models have been 'driven' by EC regulations, such as the 90 hp Citroën C4 Diesel or C3, both of which emit less than 100g of CO₂/km without the use of an actual electric engine. These models use a stop-and-start system that automatically cut their combustion engines at a standstill (e.g. red lights and queues) then restarts them when drivers release the brake.**
- 4. In late 2007, Citroën unveiled its new position with the C-Cactus, a hybrid-diesel concept car with a 30hp electric motor for urban driving and a small 70hp combustion engine for highways. The result is a very small appetite of just 2.9 liters of fuel per 100 kilometers, and CO₂ emissions of around 78g per km.**

The shape of change for road transport (3/3)

In Europe and Japan, we have clearly entered a new era combining:

- ◆ lighter cars,**
- ◆ developments in electric town vehicles,**
- ◆ developments in rechargeable hybrid vehicles.**

All of the major automakers are predicting that markets will possibly develop in this direction. Obviously, those that perform less well or are less likely to keep up with the new requirements will suffer as environmental concerns increase.

This challenge of eco-driving is also far from secondary. Tests carried out in these fields have shown that these practices, especially in or around cities, enable customers to save 20-30% in fuel.

And so (1/3)

In this context, the EC decided to cap cars sold in Europe to 160g of CO₂ per km, with a view to reducing this further still by 2012 to 120g and introducing a penalty for every gram of CO₂ above 90g emitted per kilometer, increasing over 4 years (20€, 35€, 60€, 95€).

Given the industrial capacities of the world's automakers, this kind of objective will not be achievable in all G20+ countries within the same timeframe. However, there is no reason why these objectives (no more cars sold that emit more than 160g of CO₂/km, and penalty system for emissions above 90g) cannot be taken up within the G20+ by 2016, insofar as the best can set the example for others to follow.

We will therefore opt for these same provisions for all G20+ countries as our proposal 21.

And so (2/3)

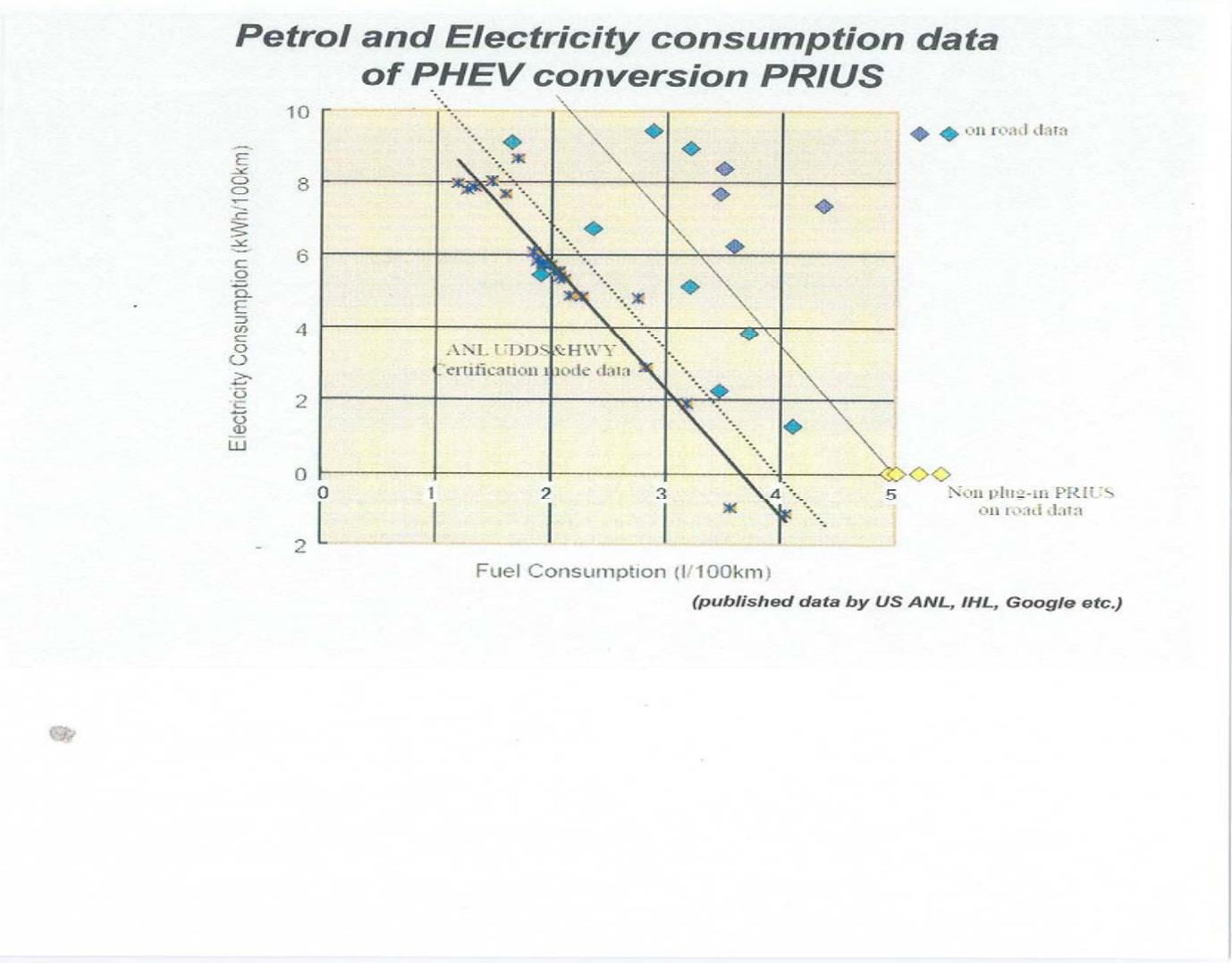
The most ambitious automakers have launched initiatives to produce electric cars that can run for at least 150-200 kilometers, for use in towns and/or for short distances. These vehicles should come on the market before 2012, and we could see electric vehicles making up 20-25% of all new vehicles by 2025.

By 2025, we could all possibly have fully- or part-electric vehicles (30-40% of the market?), with the remaining combustion vehicles emitting less than 100g of CO₂ per 100 kilometers.

While it is not certain, Toyota is leading us to believe that by 2015, we could be seeing a rechargeable hybrid vehicle that consumes around two liters per 100 kilometers. Assuming we manage to blend electric and combustion engines in a single vehicle.

The objective of an average of 65g CO₂/kilometer for cars sold between 2020 and 2025 is therefore not unrealistic even if ambitious (proposal 22).

And so (3/3)



Eco-friendly motoring (1/2)

While awaiting such technical progress or progress which will have similar consequences, *vigorous eco-friendly motoring training must be put in place at least within the G20+ (proposal 23).*

We all learned how to avoid accidents when driving and how to go quickly from A to B. There was even a time on highways where we wanted to drive as fast as possible.

If gasoline becomes really expensive and CO₂ emissions a real worry and a true priority, we are not only going to having to check that are tires are correctly pumped up (inadequately pumped tires consume up to 10% more fuel) we are also going to have to learn how to drive to minimize fuel consumption.

Eco-friendly motoring (2/2)

We should use our cars not live them or suffer because of them. It would great to simply have a car and use it like we would a hammer or microwave. Too many of us "are" our cars. We fantasize about our cars themselves just as much as we do a powerful engine.

I want a car that is sleek and energetic, its purring gives me the shivers, it has its own sounds and smell. I internalize its propulsion engine which externalizes my dreams of power. This is why it is so difficult to regulate this capricious person from the outside, to subject it to rational choices, guided by the principle of precaution and a realistic calculation of costs and benefits.

It is time (proposal 24) for motoring programs to include this issue to thwart what is simply no longer compatible with the conservation of our planet.

Additional measure for the old fleet of cars

Given the strictness of the market, it is important to gradually replace the old fleet of cars by much cleaner cars.

We should ensure that the sale of new cars which emit more than 180g of CO₂/km is prohibited from 2016, more than 165g of CO₂ as of 2017, more than 150g as of 2018, 135g as of 2017, 120g as of 2020 and 100 g between 2020 and 2023 (proposal 25).

Similarly, from 2017 to 2030, an increasing tax – to be determined in each G20+ country – should be put in place so that by 2030 all cars sold before 2010 which emit more than 110g of CO₂/km will have disappeared from circulation. (proposal 26).

To conclude, technical progress supported by true training of consumers should divide by three emissions/km, which in itself would be major progress. Much more will be required though as by 2050 there will be four times more cars than today.

Other possible regulations (1/4)

With regard to lorries, countries could commit to stabilizing emissions between 2010 and 2015:

- *By encouraging biofuels wherever possible with a clear objective more than 2 net T_{ep} produced per hectare ? (proposal 27)*
- *By encouraging piggybacking for long-distance transport (more than 150 km). This assumes that the corresponding technologies are available. (proposal 28)*
- *Promoting electric or fuel cell transport for short distances (proposal 29).*

A stabilization proposal of at the most 25% more than current emissions is possible but inconceivable without any real international willingness.

If by 2020, States and constructors have not put together a scenario with regard to this ambition, it should not be excluded that individuals within the G20+ find themselves in court (proposal 30).

Other possible regulations (2/4)

With regard to the climate and legally speaking at the very least OECD countries should adopt an environmental charter (see part C)

With regard to road travel, all of these measures could be supplemented by a series of provisions by amplifying the effect:

- 1-2% reduction in obligatory deductions for carbon taxes on energy in order to get the community to pay points for what transport costs it (proposal 31),

- reduced tax on the manufacture of biofuels capped at 10% and insofar as this leads to a net production of less than 2 Toe/hectare ... on location, where it does not compete with some other biomass uses. (proposal 32)

Other possible regulations (3/4)

Other measures could apply a tax of at least 50€/T of CO₂ emitted from fossil fuels used to produce refined oil products (proposal 33)

This measure is far from being anecdotal as the probable exploitation of crude oils, asphalt sands, oil shale as well as the addition of the hydrogen up until now obtained from the reformation of methane, is likely to use more than 20% of fossil resources just to simply generate refined products.

All of these measure should have an actual cost of more than 15% of the total current bill for automobile and road transport. There is not point in fooling ourselves into thinking they are free. But this bill could be estimated for the current G20+ at less than 15% of the GNP.

Other possible regulations (4/4)

The cost of radical change in technologies will likely represent less than 2.25% of the GDP. These figures will become clearer our interviews with experts who agree to the principles.

What is already undoubted is that we already have to hand all the technologies available to no longer need to increase CO2 emissions due to road transport and maybe even the technologies required to reduce these as of 2030.

The difficult issue of air travel

- ▶ According to the French institute for the environment (IFEN) average airplane emissions are 140g/km/passenger as opposed to 100g for car travel (taking 1.6 passengers per car). This makes sense as an airplane travels faster (900km/h) and at an altitude (between 10,000 and 12,000m) which requires a lot of energy. These two parameters alone (speed and altitude) thus make air travel the most energy greedy of all forms of transport and thus the type most responsible for global warming.
- ▶ Global air travel represents 2.5% of global CO₂ emissions linked to the consumption of fossil fuels (burning 1kg of kerosene would emit 3.1kg of CO₂).
- ▶ CO₂ is not the only gas given off by airplanes. The engines of planes are designed to run for 20,000 hours (8 years) and have parts that heat to 1000°C. The high combustion temperature of the fuel causes the oxygen and nitrogen molecules in the air to form nitrogen oxide. Nitrogen oxide emissions aggravate the impact of CO₂ emitted by planes by 60%.
- ▶ *The most serious proposal in this context is surely to give ourselves a set date (2015? 2017?) to look at the industrial prospects of R&D (proposal 34).*

B-5
Effective agriculture and forestry

Promoting agricultural and forestry activities that are more in keeping with climate objectives (1/5)

As Al Gore says in his book "Earth in the balance":

"Wherever rainforest are found they are under siege. They are geing burned to clear land for pasture; they are being clear-cut with chain saws for lumber; they are being flooded by hydroelectric dams to generate power. They are disappearing from the face of the earth at the rate of one and a half acres a second, night and day, every day, all year round.

And for a number of reasons the destruction of tropical rain forests is still picking up speed: the rapid population growth in tropical countries is leading to relentless pressure for expansion into marginal areas: shortages of fuel confronting an estimated 1 billion people in large areas of the Third World lead many to ravage the surrounding forests.

Promoting agricultural and forestry activities that are more in keeping with climate objectives(2/5)

There are three great stretches of rain forest left in the world: the Amazon rain forest, which is by far the largest; the central African rain forest in Zaire and surrounding countries; and the Southeast Asian rain forest, which are now largely concentrated in Papua New Guinea, Malaysia, and Indonesia. Other important remnants of rain forests are found in Central America, among Brazil's Atlantic coast, along the southern edge of the sub-Saharan portion of Africa's bulge, on the eastern coast of Madagascar, in parts of the Indian subcontinent and the Indian peninsula, in the Philippines, and on the northeastern edge of Australia. Still smaller remnants can be found on islands from Puerto Rico to Hawaii to Sri Lanka."

The liability of states could be called upon in the light of such a challenge.

Any international loan of more than \$50 million should be the subject of an impact study on the effects of the planned location on climate deregulation. If this study were to yield negative results, a counter-study could be requested by the party petitioning. If this second study should also turn out to be negative, the loan should be suspended. Of course, international bodies which adhere to this objective must make such a commitment public (proposal 35)

Promoting agricultural and forestry activities that are more in keeping with climate objectives (3/5)

As we already know and as noted a long time ago by the National Academy of Science in the US (1991):

"We must provide firm political support and large-scale financial support to long-term forest conservation operations, to provide the necessary training for managers and employees and to set up organizations dedicated to the conservation and management of genetic forestry resources...This cannot fall upon just some nations. We will only succeed if the whole planet works together (proposal n° 36).

Promoting agricultural and forestry activities that are more in keeping with climate objectives(4/5)

Worldwide and ad hoc international bodies should support:

- ***Recent developments in irrigation systems which simultaneously reduce water consumption, increase yield and make ground affected by salination fertile once again.***
- ***New techniques based on low external cost management which makes it possible to considerably reduce the degradation of the ground but maintains yield and reduces production costs.***
- ***Progress made in vegetation genetics through which cultures can be given natural resistance to certain illness and certain predators without having recourse to large quantities of pesticides or herbicides.***
- ***New culture rotation methods and poly-utilization of land including agroforestry can replace the usual practice in the third world of seasonal burning.***

(proposal 37)

Promoting true reforestation (5/5)

Today, countries that want to put a stop to deforestation and commit to reforestation have no incentive to do so.

Any country which wishes to put in place a reforestation plan representing at least 5 million metric tons of CO₂ over the next ten years should be helped out, in particular by companies under conditions to be determined later.

To make such plans even more of an incentive, we could even consider that a reforestation plan – in addition to reforestation expenses - could be supported by up to one third of its value in irrigation or agroforestry expenses essential for agricultural development (proposal 38).

B-6
The pivotal role of nuclear



The nuclear renaissance is a reality

- ▶ **In 2007, 60 countries representing three-quarters of the world's population openly chose to maintain or reconsider the nuclear option, and the list is getting longer all the time.**
- ▶ **All the major countries in the world (USA, Japan, China, India, and Russia) now have strong, ambitious nuclear policies.**
- ▶ **By 2035, China and India will account for at least 35% of the world's nuclear power plants.**
- ▶ **There is a reason why so much interest has been aroused, and ignoring or denying this would be irresponsible.**

Three reasons for this refocus

- ▶ **Firstly, due to general changes in energy issues:**
 - ◆ **Increased climate threat**
 - ◆ **Potential sky-rocketing price of hydrocarbons, or ups and downs**
 - ◆ **Geopolitical uncertainties (Middle-East, Russia)**
 - ◆ **Coal consumption for its own transportation**
- ▶ **Secondly, due to the competitiveness/price and fairly stable predictability of the cost of nuclear electricity.**
- ▶ **Thirdly, the undeniable great strides in nuclear safety over the last 20 years, and above all the availability of remote Instrumentation & Control and the fact that the best international experts can be called upon immediately.**

The declarations made by Britain's Tony Blair are perfectly clear

- ▶ **“Essentially, the twin pressures of climate change and energy security are raising energy policy to the top of the agenda in the UK and around the world”**
- ▶ **“The facts are stark. By 2025, if current policy is unchanged there will be a dramatic gap on our targets to reduce CO₂ emissions, we will become heavily dependent on gas and at the same time move from being 80% to 90% self-reliant in gas to 80% to 90% dependent on foreign imports, mostly from the Middle East, and Africa and Russia.”**
- ▶ **“These facts put the replacement of nuclear power stations, a big push on renewables and a step change on energy efficiency, engaging both business and consumers, back on the agenda with a vengeance. If we don't take these long-term decisions now we will be committing a serious dereliction of our duty to the future of this country.”**

***Address to the CBI, May 16,
2006***

MR BLAIR TOLD MPS: "IF WE WANT TO HAVE SECURE ENERGY SUPPLIES AND REDUCE CO₂ EMISSIONS, WE HAVE GOT TO PUT THE ISSUE OF NUCLEAR POWER ON THE AGENDA."

The Independent, May 2007

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London**

Improved nuclear plant safety (1/2)

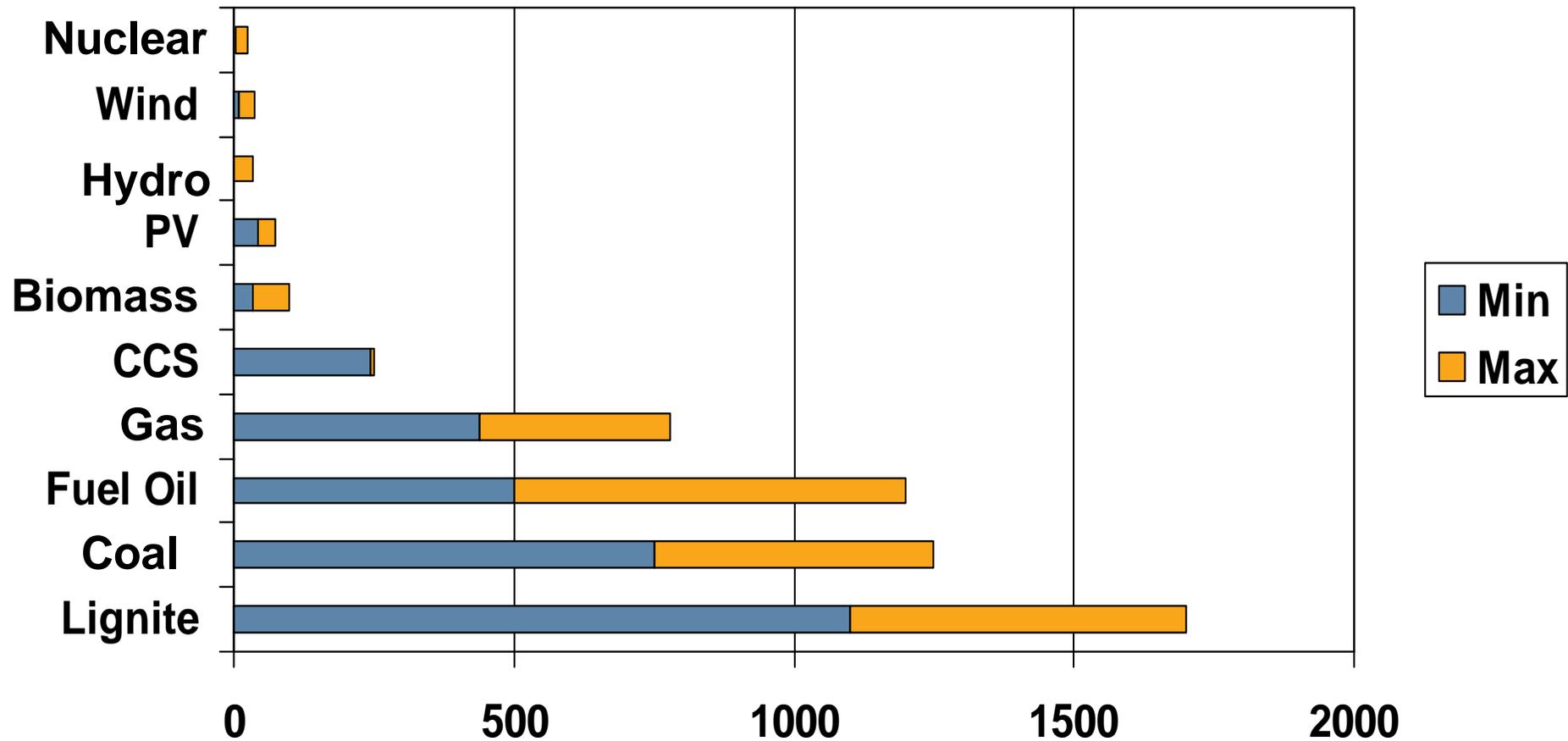
- ▶ **Since Chernobyl in April 1986, the approach to reactor design has changed, *driving the advent of the “Third Generation.”***
- ▶ **Generation I & II plants were designed to minimize the possibility of core meltdown, but not designed to manage such an occurrence.**
- ▶ **In those days, a risk could be considered so remote that the potential consequences of any such accident made it “acceptable”.**
- ▶ **In Generation III plants, it must be demonstrated that, *whatever the risk*, any such accident would not lead to massive environmental contamination.**
- ▶ **In the event of core meltdown, radioactivity would not escape the fully sealed “containment” area.**

Improved nuclear plant safety (2/2)

- ▶ **Two possible strategies in the event of core meltdown:**
 - ◆ **The molten core is cooled and solidified *in situ*, inside the primary vessel (solution adopted for mid-size reactors like the AP 1000 and SWR 1000)**
 - ◆ **The molten core is captured if it escapes the vessel, then solidified within the containment area in a suitable spreading area (EPR)**
- ▶ **In any event, containment is guaranteed to withstand the damage caused by the accident itself.**
- ▶ **Furthermore, containment is considerably strengthened to withstand damage *from the outside*, be it natural (e.g. earthquakes, hurricanes, flooding), accidental or malevolent.**

Life-cycle Analysis: GHG Emissions, $g\ CO_{2eq}$ per kWh_e

D. Weisser IAEA May 2006



The brackets reflect differences between the evaluation methods, thermal efficiencies, perimeters of life-cycle analyses, etc.

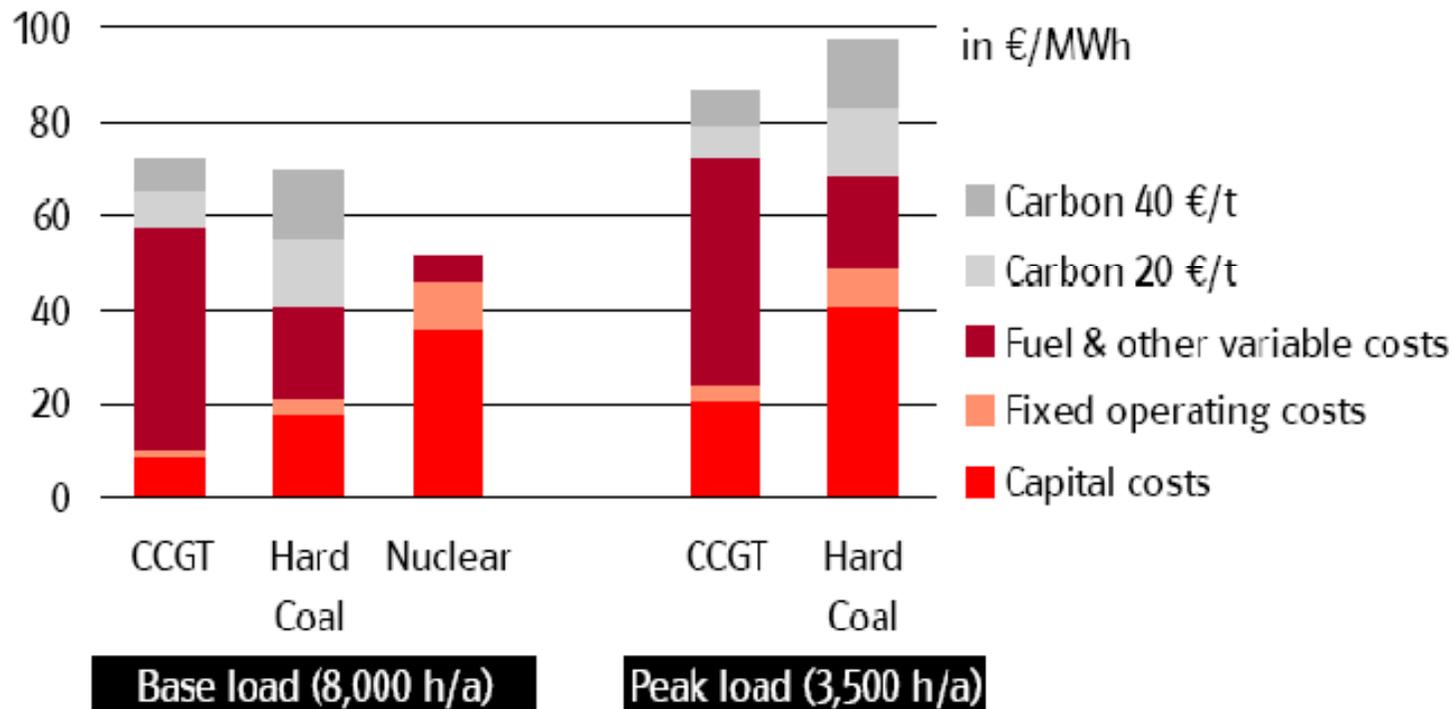
Nuclear costs topic is clarified

- ▶ **The statements of many European electric Utilities in 2008 are clear about their intention to invest into new nuclear capacities : EDF, E-ON, ENEL, GDFSUEZ, FORTUM, CEZ, ALPIQ, AXPO.**
- ▶ **Common decisive factors : plants in use are profitable, CO₂ cost is expected to rise, within the context of the Directive voted in 2008, worries on gas supplying.**
- ▶ **On sight of compared costs nuclear/gas/coal presented by EDF and E-ON to the financial analysts (nuclear cost production around 55 Euro/MWh) competitiveness is secured with an oil price over 50 \$/bl, and CO₂'s above 20 Euro/t.**
- ▶ **In the US, nuclear competitiveness is confirmed by estimations recently published by EPRI (Integrated Generation Technology Options, Nov. 2008), CERA (Power Market Fundamentals, Jan. 2009) and MIT (Update on the Cost of Nuclear Power, MIT-NFC-TR-108, May 2009)**
- ▶ **Those estimations agree to a nuclear production cost of \$80/MWh, competitive with coal plants production cast as soon as CO₂'s price is 25 \$/t.**
- ▶ **In China and India, the AIE (World Energy Outlook 2008) confirms the nuclear competitiveness vs gas; nevertheless coal stays cheaper without any CO₂ penalty.**

EON the key German Utility.....

Different load ranges require different technologies -
nuclear economically most attractive for base load

Long-term new entry costs in Europe¹



1. Investment costs and commodity prices based on E.ON assumptions

35

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The vital Nuclear Safety Authority

- ▶ If a nuclear power plant is to be "safe", it must be:
 - ◆ well designed
 - ◆ correctly built, to a high standard of quality and true to the design
 - ◆ well maintained
 - ◆ run by competent, highly-trained operators with an ingrained "safety culture"
- ▶ While nuclear safety is first and foremost the responsibility of the operator, it is monitored by the State through a Nuclear Safety Authority that is:
 - ◆ completely independent of the operator
 - ◆ competent (it can call on external experts if necessary)
 - ◆ empowered to shut down a plant if it is in any doubt about its safety.

The creation of a Nuclear Safety Authority – with the help of international bodies, if required – is an essential prerequisite to the commissioning of a nuclear power plant, no matter where it is located (proposal 39). To be legitimate, nuclear safety authorities should have been appraised by the IAEA and by another G20+ country with a nuclear safety authority of its own.

What matters is mainly G15/16

- ▶ **The nuclear renaissance sometimes raises a few concerns: can we quickly increase the number of nuclear countries without compromising the essential issue of plant safety?**
- ▶ **In order for nuclear power to contribute significantly to reducing greenhouse gasses, not all UN countries need to use it. Of those 16* countries that account for:**
 - ◆ **60% of the world's population**
 - ◆ **69% of the world's GDP**
 - ◆ **69% of the world's CO₂ emissions**

only three do not already generate nuclear electricity (Italy, Australia and Indonesia). Of these, perhaps only Indonesia will be unable to offer the qualities needed to develop a nuclear industry with full reliability.

(* USA, China, UK, Germany, France, Italy, Spain, Japan, Russia, Mexico, Indonesia, Australia, Brazil, Canada, South Korea, India

Nuclear waste: a true or false problem? (1/7)

- ▶ **In Europe and the USA, people react very strongly against the idea of irreversible geological waste disposal.**
- ▶ **Scientific and technical communications are guilty of over-confidence, and the nuclear industries of all countries underestimated the need to demonstrate actual progress, rather than highly likely progress. Besides, nobody understood why people thought the way they did.**
- ▶ **Anti-nuclear organizations, at least those in Europe, have managed to make people and opinion leaders believe that right now there is no solution to the issue of nuclear waste.**

What has happened since 1990 (2/7)

- ▶ **In France**, a parliamentary vote (the ‘Bataille’ law of 1991) was needed to carefully examine this matter calmly and democratically.

The left- and right-wing governments between 1991 and 2006 applied this process unquestioningly, until a law was voted in 2006 enabling the issue to be de-dramatized.

- ▶ **Finland and Sweden**, through dialog with local communities, managed to reach a consensus. In Finland, geological disposal was adopted; this is reversible up to 125 years, and shall remain so until there is no reason not to make it irreversible.
- ▶ **The United States** succeeded with the WIPP (irreversible salt storage in a virtually desert area) and failed with Yucca Mountain (through lack of professionalism and willingness to do it).

Natural complementarity between recycling and long-term interim storage (3/7)

Contrary to what is still sometimes believed, recycling technology poses no threat to people living hundreds of years in the future.

Once used fuel is recycled, the ultimate residual waste is encased in glass; there is no reason why this could leak whatsoever, provided it is not attacked by water from the outside.

Seven hangars measuring 50 meters by 75 meters are needed for the interim storage of 200-300 years' worth of waste from the entire fuel cycle of a major industrialized country. Very small containment surfaces are therefore needed.

Should we wish to limit ourselves to managing the waste of the next 1000 years, this is all the solution we need!

Glass and interim storage properties (4/7)

- ▶ **Detecting and completely protecting ourselves against radiation is simple – the main thing is to ensure the emitting radioactive products are immobilized.**
- ▶ **The best way to immobilize radioactive waste is to encase it in glass blocks, whereby the radioactive atoms are incorporated just as lead atoms are in crystal.**
- ▶ **The glass is “amorphous”, i.e. it incorporates all radioactive atoms regardless of size.**
- ▶ **The glass is highly resistant to water corrosion, which is the only way the imprisoned radioactive atoms could be “released” over time.**
- ▶ **When poured into thick, stainless steel cylinders, the glass blocks are easy to handle, transport and store.**

A long standing error (5/7)

The properties of these types of glass are widely unknown, because the waste issue has focused for a long time on the question of irreversible geological disposal, as if the aim was only to demonstrate scientific certainties for hundreds of thousands, if not millions, of years.

This was a mistake for three reasons:

- 1. Over 90% of people cannot conceive of time beyond 1000 years (some of us can imagine the Middle Ages, but most often three centuries, or even one century, are “unthinkable”).**
- 2. The concept of deep burial stirs fundamental fears from mythology or religion. Although burial can mean protection on a physical level, for our imaginations it’s something quite different.**
- 3. For most people, radioactivity is a kind of eternal evil that can break free from any prison.**

Focus on France (6/7)

- ▶ **Clear possible complementarity between disposal of vitrified waste containers at La Hague and reversible geological interim storage.**
- ▶ **It has been demonstrated that:**
 - ◆ **To solve the waste problem for the next 1000 years, today's solution does not need to be quite so temporary.**
 - ◆ **To solve the problem going much further into the future, our impermeable clay structures are of such quality as to make a decision on reversible geological storage highly feasible.**
- ▶ **And there is no rush to decide on a solution:**
 - ◆ **Recycling rids us of the need to decide on creating underground facilities and, better still, the cooling of the packages will reduce their volume over time.**

Conclusion for waste (7/7)

- ▶ **We are able to prove the reliability of geological waste disposal in salt (WIPP in the US), highly impermeable clay (Bure, France) or extremely compact granite (Okiluoto, Finland), and make this reversible for 200-300 years.**
- ▶ **Waste can also be placed in interim storage in easy-to-protect facilities and taking up very little surface. The same has been done for plenty of other products on Earth, and the Earth has not disappeared!**
- ▶ **Above all, we know that technology is constantly improving. It is therefore false to state that nuclear waste management is more of an obstacle than any other.**

Proliferation: sensitive civil nuclear energy technologies

Not all technologies used to generate nuclear energy present major proliferation risks. Without going into too much detail, the true risks are in the following stages of the fuel cycle:

- ◆ **Isotopic uranium enrichment by centrifugation. This technology is discrete, and needs little major alteration to go from “civil” uranium enrichment to high enrichment to make bombs.**
- ◆ **Reactors that can be reloaded without outage. With these, it is possible to unload slightly irradiated fuel, containing plutonium without many unwanted isotopes in arms manufacture (^{238}Pu , ^{240}Pu , ^{241}Pu and ^{242}Pu). These reactors are being phased out internationally.**
- ◆ **Plutonium extraction from used fuels (especially combined with slightly irradiated fuel, above), which can be used to make ‘dirty’ bombs.**

Proposals being examined by the IAEA

In view of the likely nuclear renaissance, the IAEA hopes to limit the use of enrichment and used fuel treatment technologies to those few countries already in possession of many reactors and/or mastering these technologies. In exchange for renouncing any efforts to acquire such facilities, all other countries will be able to demand service supply guarantees from those that have them.

Finally, recycling should develop to maximize avoidance of those stages in the process where plutonium is present in its pure state, even in plants located in countries with nuclear weapons (proposal 40).

We can only take this proposal on board ourselves.

Sensitive countries must therefore be dissuaded from acquiring or developing centrifugation, used fuel treatment and in-service reloadable reactors. Clearly, for us this means prohibiting transfers of such technologies.

What about sensitive countries?

Inspection, telesurveillance and detection must be heightened around the less sensitive facilities in the countries in question.

At international IAEA level, it could be useful to:

- ◆ ***Switch from intermittent inspections to continuous inspections, with measurement devices on site, linked to a remote international surveillance center which processes real-time information and constantly matches this information***
- ◆ ***Create a system which alerts the remote international surveillance center of any unauthorized local maneuver***
- ◆ ***Create controls which can be activated from the remote international surveillance center (proposal 41)***

Raising the issue of economic sanctions for pulling out of the non-proliferation treaty

The compartmentalization of institutions often means that things are dealt with in isolation, even within the UN itself.

Given the fact that this topic is to a large extent related to oil and gas, the major developed countries would do well to consider the following:

- ◆ R&D on synthetic oils between now and 2020 (cf Supra)
- ◆ ***See if the IMF and World Bank will no longer grant loans to countries that pull out of the non-proliferation treaty (proposal 42)***
- ◆ Take effective measure to limit the use of fossil fuels for heating homes in the long term (cf. Supra)

Reactors and nuclear resource sustainability (1/3)

There has been much narrow-mindedness on this matter, as with many others in the nuclear field. And yet:

- 1. It is entirely possible to recycle used fuel at least twice.**
- 2. Once plutonium is separated, it can be combined with depleted uranium or thorium in tried-and-tested ‘high temperature’ reactors (750°C), or even classical reactors that are operated today.**

Both of these tried-and-tested technologies alone could enable us to save at least 50% of the world’s uranium resources.

Furthermore, today’s PWR and BWR reactors generate bi-products that could be used to fuel fast reactors over a very long period.

Treatment and mineral resources (2/3)

Over 40 years, a four-loop PWR produces:

~ **6000 t of depleted uranium**

~ **10 t of plutonium**

A self-generating fast reactor could run itself using 12 metric tons of plutonium.

It would therefore consume ~ 1 metric ton of depleted uranium per year.

***Mineral resources in no way limit the
“sustainability” of nuclear power***

Fast reactors (3/3)

The world's major countries (USA, China, India, Japan, Russia) are all preparing to go ahead with a fast reactor prototype between 2010 and 2020, in the knowledge that, economically, there'll be no need to bet on this technology before 2030... and more likely after 2040.

The schedule makes more sense when we take a closer look.

A demonstrator model decided upon by 2015 can be operational by 2020-2022, followed by the completion of nuclear safety specifications by 2026-2027, then the decision to go ahead with an industrial prototype from 2028-2029, and finally commercial availability from 2040.

In conclusion, competitive nuclear power is reliable... subject to stringent nuclear safety

- ▶ **Nuclear is therefore a relevant option for base-load electricity (24 hours a day).**

Its competitor will be coal, with carbon capture & storage, provided this can be achieved and at a controlled cost.

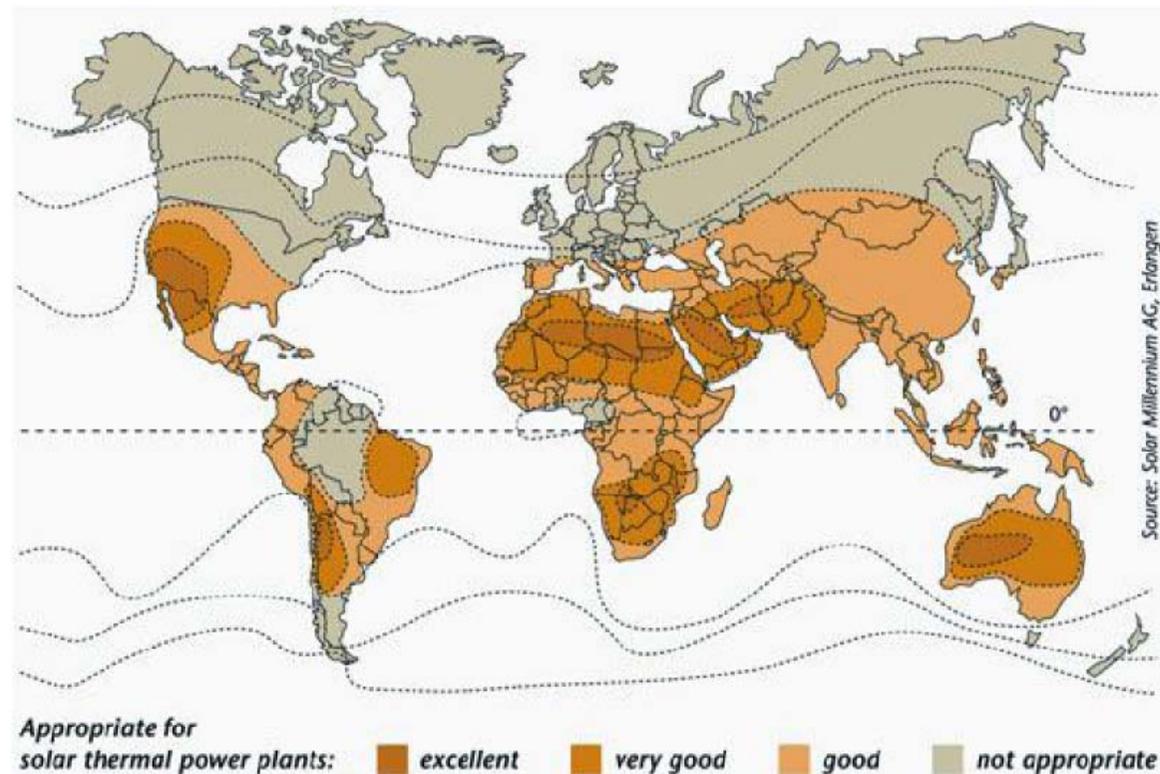
- ▶ **However, nuclear power should not be an option in countries that do not have:**
 - ◆ **independent nuclear safety authorities,**
 - ◆ **a high level of technical training (three years to train a plant operator).**

B-7
Renewable Energies

Solar Resources

► Tremendous potential

- ◆ Average solar reaching earth = 340 W/m^2
- ◆ 70% of it makes it to ground level
- ◆ Equivalent of 120 Million GW, or approximately 1 billion TWh/yr, i.e. 90,000 Gtoe



- ## ► If only 1% solar could be harnessed with a 10% efficiency, this could represent an installed capacity of 120,000 GW, producing 1,000,000 TWh/yr

Two main ways of exploiting this potential (1/2)

▶ 1) Decentralized Solar Energy

- ◆ Thermal or solar panels connected to water heating or heat pumps
- ◆ Integrated into buildings
- ◆ To create a positive energy building strategy
- ◆ Huge potential, but it will take time to modify all buildings



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Two main ways of exploiting this potential (2/2)

► 2) Concentrated Solar Power

- ◆ Large plants including energy storage: future baseload plants for utilities
- ◆ Able to convert 3% of incident energy - much better than photosynthesis
- ◆ Costs currently reasonable: \$140 – 180 per MWh
- ◆ Even factoring in long distance electricity transport, solar electricity is affordable today
- ◆ Combined with HVDC technology, major desert projects could be considered

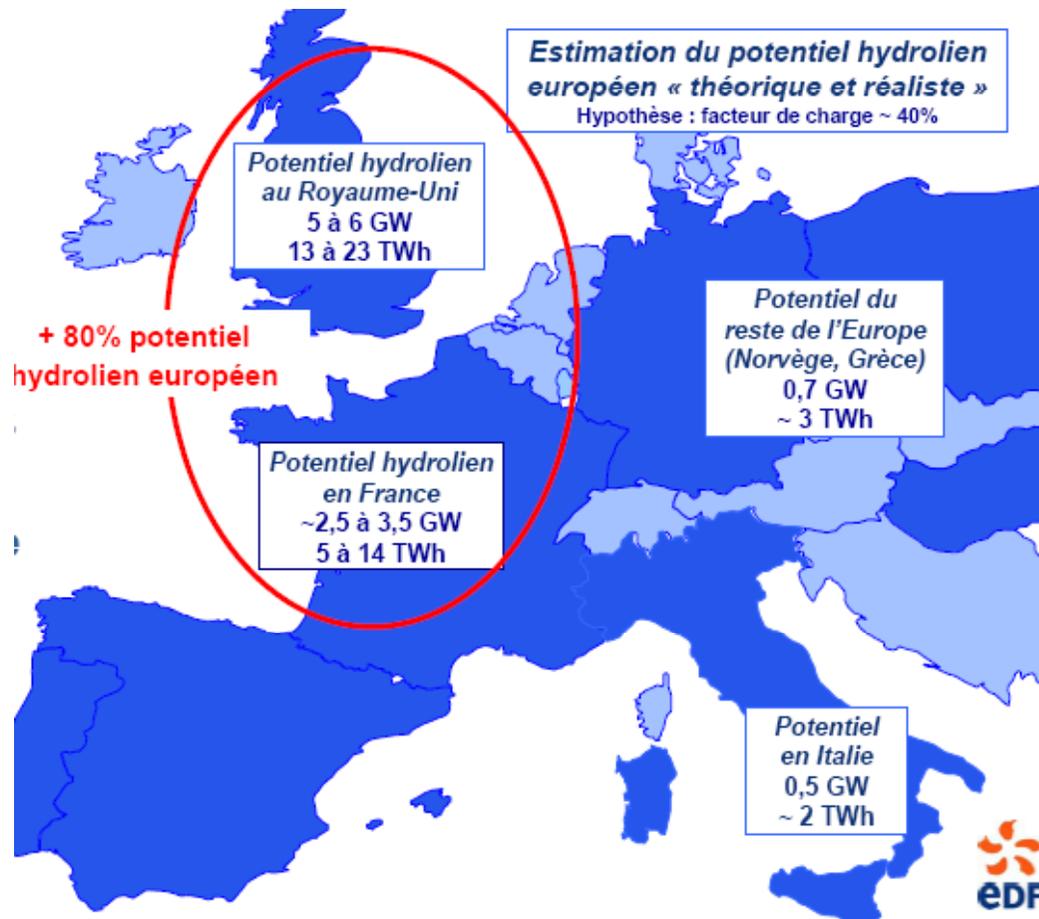


- January 2010 - Alain Bucaille - Proposal drawn up with the participation of B.Barré and MN.Hamel

Ocean energy also has a huge theoretical potential

- ▶ **Several forms of ocean energy can be harnessed**
 - ▶ **Exact resources are hard to estimate, but the potential is indeed huge:**
 - ◆ **Ocean wave: 8,000 – 80,000 TWh/year**
 - ◆ **Tidal current: ~ 800 TWh/year**
 - ◆ **Salinity gradient: 2000 TWh/year**
 - ◆ **Ocean thermal energy conversion: 10,000 TWh/year**
- (IEA data 2006)**
- ▶ **This resource is less intermittent than wind**

Current marine resources



Horizontal axis turbine



Vertical axis turbine

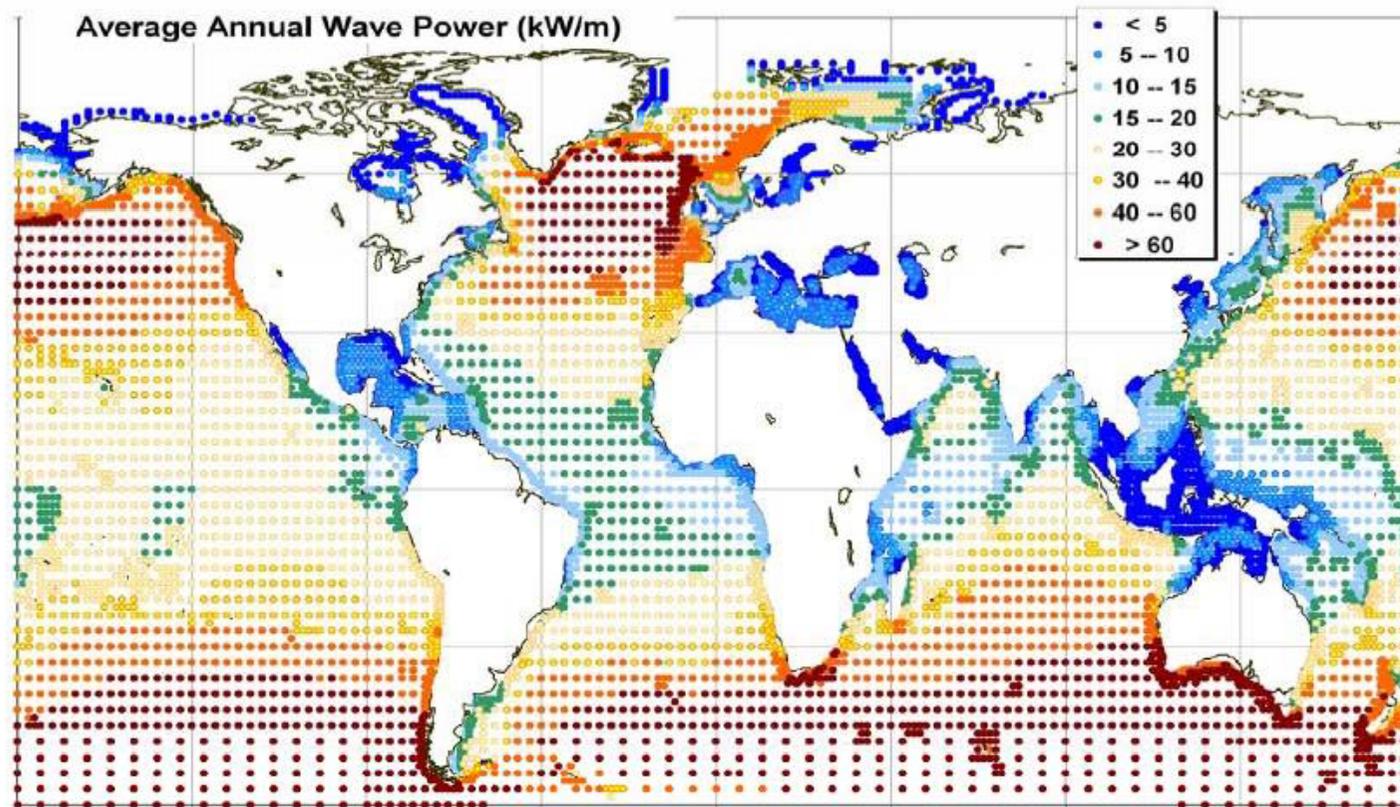
► Potential tidal current not yet well known

- ◆ Between 50 and 100 GW worldwide
- ◆ About 10 GW for Europe, with UK and France accounting for 80%
- ◆ Possible Europe-wide generation of 19 and 42 TWh
- ◆ Load factor about 40%

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Wave Energy Resources

- ▶ Huge wave potential still not well known
 - ◆ 8000 to 80 000 TWh/yr globally
 - ◆ 50 to 90 MW/km around Irish coastline
- ▶ 2000 TWh/yr can practically be extracted on the west coast of North America

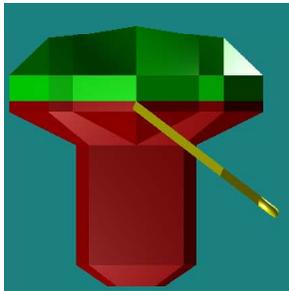


© WorldWaves data/OCEANOR/ECMWF

Technology Status

- ▶ **Ocean energy conversion technologies are less mature than other renewable energies:**

Many technologies still at the prototype stage.



- ▶ **Today's costs are around 350-400 €/MW (still substantially higher than wind, but normal in the prototype stage).**
- ▶ **Combined with almost unlimited resources**
 - ◆ **Connection costs will grow with distance from coast**
- ▶ **This technology can be seen as a safety belt**
 - ◆ **By investing more, we can generate enough electricity for everyone**

***10% of global energy, 20% of the electricity
can certainly come from renewables at less than 130
€/MWh***

▶ **In addition to the traditional use of biomass**

▶ **At current prices, we could generate**

◆ *5% of global electricity using onshore wind for less than 80 €/MWh*

◆ *2% of global electricity using offshore wind for less than 100 €/MWh*

◆ *5% of global electricity using biomass for less than 110 €/MWh*

◆ *5% of global electricity using concentrated solar for less than 140 €/MWh,
even then 120/MWh in 5 years time.*

▶ **Making a total of:**

◆ **17% of global electricity**

◆ **10% of global energy.**

▶ **And all this for an extra 10% in global energy investment**

◆ **With a 60 €/MWh (=102 €/bl) reference cost for energy**

◆ ***Significant improvements in solar power productivity could increase
this figure to 15-20%.***

***In the very long term (22nd century),
50% of global energy could come from renewables***

- ▶ **The resources are there**
- ▶ **Already, for less than 400 €/MWh, we can harness**
 - ◆ **Concentrated solar & solar thermal 20%**
 - ◆ **Waves & currents 15%**
 - ◆ **Offshore wind 10%**
 - ◆ **More 10%**
 - ◆ **Geothermal Energy 5%**
- ▶ **It is a matter of price, not volume.**
- ▶ **Mean global cost of energy: 230€/MWh**
 - ◆ **With a 60 €/MWh (102 €/bl) reference cost**

We have made several proposals relating to renewable energies:

- ▶ ***Promote the use of heat in housing (proposals 6 and 11)***
- ▶ ***Put a 20% cap on the use of fossil fuels for heating by 2020 (proposal 5)***
- ▶ ***Use at least 50% of renewable energies for generating semi-baseload and peak electricity (proposal 19)***
- ▶ ***Promote biofuels up to 2 TOE net per hectare, provided this is not to the detriment of other possible uses of biomass (proposal 27).***

So what (2/3)

- ▶ *At 10 offices in each of the G20+ countries to report on at least fifty ways of combatting climate change. Develop an Internet site in the form of a clickable film and which outlines the possibilities in each language of the G20+, in at least one such place per country in the G20+ (proposal 43)*
- ▶ *Assess the potential of solar power every five years (proposal 44)*
- ▶ *Each year, G20+ countries publish information on companies' awareness and the fifty projects most supported by public research with regard to renewables*

Extend this measure to those US states that are willing to contribute (up to 15 projects per state) (proposal 45).

So what (3/3)

- ▶ *Assess renewable energy generation every four years as of 2012 under the authority of the IAE (proposal 46)*
- ▶ *Parliamentary offices of each G20+ country to assess wind power prospects (proposal 47).*

B-8
Involving companies

Involving companies

Countries such as the US have drawn up a roadmap of technological progress. All G20+ countries could do the same either separately or as a group.

These countries could also earmark *a percentage of their R&D expenditure into projects aimed at combatting climate change (proposal 48).*

If this works towards saving the planet, such an objective would be well worth it.

US technologies for climate change

	NEAR-TERM	MID-TERM	LONG-TERM
Transportation	<ul style="list-style-type: none"> • Hybrid & Plug-In Hybrid Electric Vehicles • Clean Diesel Vehicles • Alternative and Fuel-Flexible Vehicles • Improved Batteries, Energy Storage • Power Electronics • Engineered Urban Designs • Reduction of Vehicle Miles Traveled • Improved Air Space Operations 	<ul style="list-style-type: none"> • Fuel Cell Vehicles and H₂ Fuels • Efficient, Clean Heavy Trucks • Cellulosic Ethanol Vehicles • Intelligent Transport Systems • Integrated Regional Planning • Low Emission Aircraft • Intercity Transport Systems 	<ul style="list-style-type: none"> • Zero-Emission Vehicle Systems • Optimized Multi-Modal Intercity & Freight Transport • Widespread Use of Eng. Urban Designs & Regional Planning • Very Low Aviation Emissions (all GHGs)
Buildings	<ul style="list-style-type: none"> • High-Performance, Integrated Homes • Energy Efficient Building Materials • High Efficiency Appliances • Solar Control Windows 	<ul style="list-style-type: none"> • "Smart" Buildings • Solid-State Lighting • Ultra-Efficient HVACR • Intelligent Building Systems • Neural Net Building Controls 	<ul style="list-style-type: none"> • Energy Managed Communities • Low-Power Sensors with Wireless Communications
Industry	<ul style="list-style-type: none"> • Improved Processes in Energy-Intensive Industries • High-Efficiency Boilers and Combustion Systems • Greater Waste Heat Utilization • Improved Recyclability and Greater Use of Byproducts • Bio-Based Feedstocks 	<ul style="list-style-type: none"> • Transformational Technologies for Energy-Intensive Industries • C&CO₂ Managed Industries • Superconducting Electric Motors • Efficient Thermoelectric Systems • Advanced Separation Technologies • Low-Emission Cement Alternatives • Water and Energy System Optimization 	<ul style="list-style-type: none"> • Integration of Industrial Heat, Power, Processes and Techniques • High-Efficiency, All-Electric Manufacturing • Widespread Use of Bio-Feedstocks • Closed-Cycle Products & Materials
Electric Grid & Infrastructure	<ul style="list-style-type: none"> • Distributed Generation • Smart Metering & Controls for Peak Shaving • Long-Distance DC Transmission • High-Temperature Superconductivity Demonstrations • Power Electronics • Composite Conductor Cables 	<ul style="list-style-type: none"> • Energy Storage for Load Leveling • Neural Net Grid Systems • Advanced Controls and Power Electronics 	<ul style="list-style-type: none"> • Superconducting Transmission and Equipment • Standardized Power Electronics • Wireless Transmission

Europe, Japan and the other G20+ countries could put together programs with a similar scope. These should be recognized as such and be regularly assessed and evaluated at international conferences (every three years?).

Involving companies using a regional mechanism

The extent of the challenge and the issues related to solidarity between nations call for a unique form of proactive involvement from businesses. Innovation could therefore be considered and proposed.

Public limited companies in the G20+ will be invited to adhere to the climate change pact by 2012 (proposal 49). Those who do shall commit 0.5% of their value added as of 2014, to one of the following:

- ◆ ***Financing R&D***
- ◆ ***The aforementioned funds dedicated to modernizing homes***
- ◆ ***Half of CCS costs***
- ◆ ***The aforementioned reforestation plans.***

At least half of their expenses should be outside the OECD (proposal 50).

Companies' commitment to the climate change pact should take the form of seven-year renewable periods (proposal 51).

B-9
So What?

Technologies exist to meet this challenge (1/6)

Technologies to rise to these challenges already exist or are highly likely to exist by 2015; the proposed climate pact offers the possibility of implementing them:

- ▶ **Technologies for coal-fired plants which reduce emissions by one third exist already but no-one is forced to implement them. Even before 2015 it is possible to have coal-fired plants which emit 600 g CO₂/KWh as opposed to 1000 for plants sold since 2000.**
- ▶ **The average car emissions vary from area to area from 160g CO₂/km to 280 g CO₂/km, yet we already know how to manufacture five-seaters which generate less than 110 g CO₂/km.**
- ▶ **All the necessary technologies (roofing, insulation, glazing) to reduce the demand for heating and cooling by at least 35% in old housing.**

We know how to cut lighting consumption tenfold without losing more than 3% in brightness.

Technologies exist to meet this challenge(2/6)

Heat pump/solar water heating are used by two thirds of the planet to provide up to 50% of heating requirements from solar power and earth heat. Wood heating and/or electric heating could improve this figure even more.

- ▶ **Hydro-electric power is only used to 30% of its potential and where there is wind onshore wind turbines are of a major interest for the coming years. Geothermal power has also been used very little up until now.**
- ▶ **Experimental technologies to capture/sequester CO₂ will exist by 2020; regulatory constraints are what is delaying the financing of any large scale operations. On the other hand, geology alone is preventing CO₂ capture and sequestration in at least half of Asia.**
- ▶ **Technologies to produce synthetic fuels at less than 150\$/barrel exist but with a 5% interest rate on investments, which nobody is discussing.**
- ▶ **Long-distance electricity transportation technologies (HVDC and AC) will exist by 2010.**

Technologies exist to meet this challenge(3/6)

- ▶ **If we would recycle nuclear used fuels on a large scale, we would easily counter the limited availability of uranium ore to develop reactors which have proven themselves in terms of safety to meet an increasing demand for nuclear energy. Fast breeders are another likely technology.**
- ▶ **Concentrating solar thermal power costs less than 150, possibly 120€/MWh in areas that receive a lot of sunlight.**
- ▶ **Electric trains could be developed extensively.**

Technologies exist to meet this challenge(4/6)

- ▶ **The technology already exists to manufacture cars (high performance thermal engines for light vehicles and more especially rechargeable hybrids) which can travel at the same speeds and give off at least three times less pollution than current cars which account for 15% of the world problem.**
- ▶ **If 30% of the world's baseload electricity is provided by coal-fired plants (600 g CO₂/KWh), 30% by nuclear, 30% by coal-fired plants with CCS, and 10% from hydroelectricity and renewable energies, and if semi-baseload and peak electricity which makes up 40% of total electricity is increased to 50% by renewables, CO₂ emissions due to electricity would be divided by four per kWh produced, compared to now. And this accounts for 40% of the world problem.**

Technologies exist to meet this challenge (5/6)

- ▶ **Agroforestry which represents at least 15% of the issue in the longterm is a matter of organization and not technology.**
- ▶ **We can assume that we can manufacture natural gas and synthetic oil by recycling carbon materials. Finetuning such technology is not a major problem.**
- ▶ **In so-called polluting industries which use a lot of heat, electricity could technically replace fossil fuels. This is a matter of relative cost.**
- ▶ **On the other hand 15% of the topics are dependent on national situations and public willingness to rise to the challenge, in particular to make energy savings in old buildings and to develop collective transport.**

Leading the average citizen to believe that the development of long-term technology is the indispensable but uncertain condition for meeting these challenges amounts to deceit.

False ideas regarding technology (6/6)

Some believe that technology, by its very nature, will progress in leaps and bounds and save the day. Unfortunately this is wrong or wishful thinking :

- ◆ **Technical progress will likely help solar power to progress but it won't make the sun shine at night!**
- ◆ **We may be able to travel 200 km in electric cars by 2015, but we have no scientific knowledge which allows us to hope to mass store enough electricity to cover the needs of several days of consumption in a country.**

Other key topics have been identified in the technological roadmaps of the major countries but success depends more on how quickly things are put in place on an industrial level than on new breakthroughs in fundamental research.

Pretending or presuming that the opposite is true amounts to weakness or carelessness.

So what? (1/4)

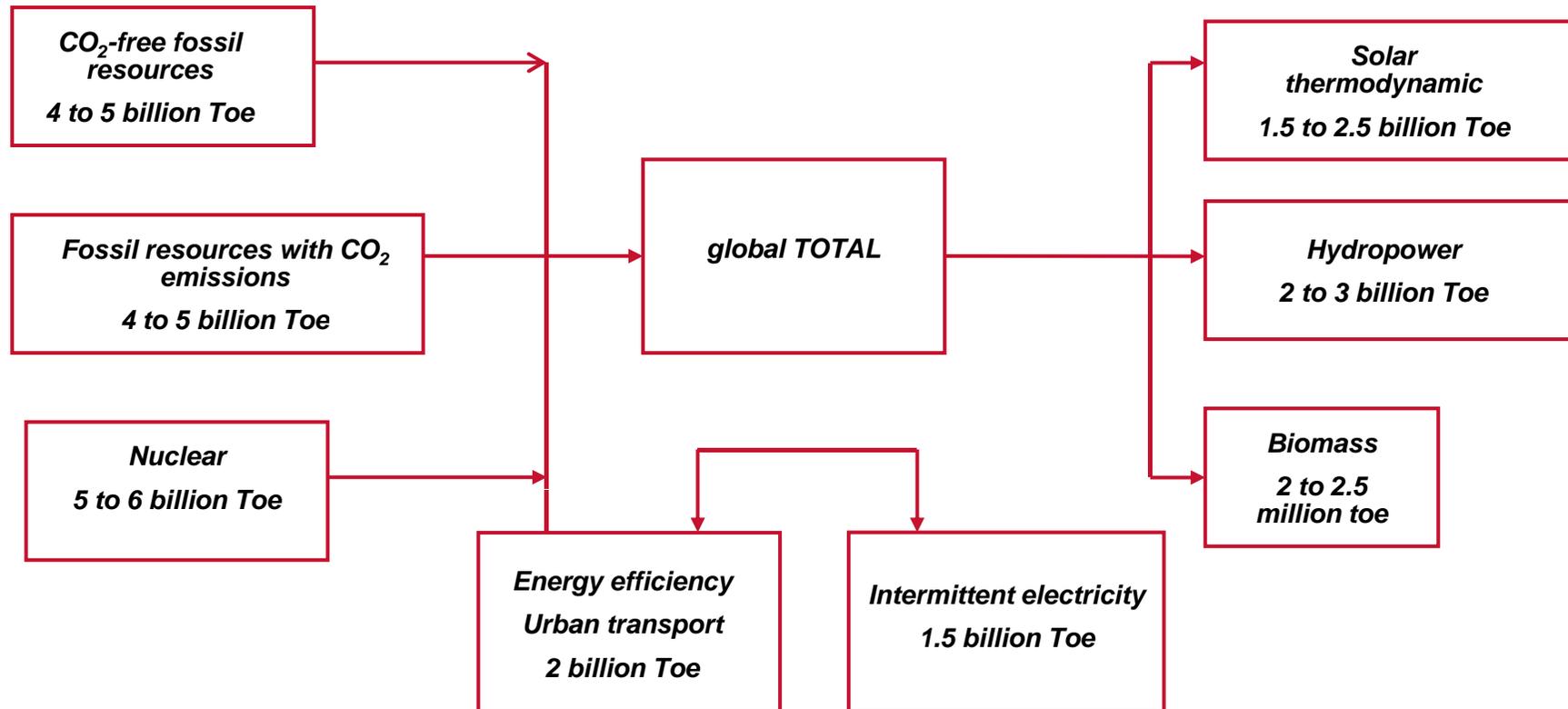
It is thus possible to technically win this challenge on climate

It is easily feasible to put in place regulations which do not curb economic growth or which even stimulate a new type of growth leading to the following in the G20+:

- ◆ ***15% lower emissions by promoting energy and heat savings by 2015***
- ◆ ***Stabilizing emissions due to electricity generation between 2017 and 2020 before reducing them by at least one third if not by half***
- ◆ ***Triggering a virtuous circle for transport which should mean that emissions due to these activities would not have to increase beyond 2020 (proposal 52)***

And so what? (2/4)

Looking forward.... to a date we cannot quite pinpoint (2060, 2070?), the scenarios we have just seen could result in the following:



A mix that's up to the challenges (3/4)

Such a scenario would truly enable us to meet GIEC objectives.

While this long-term perspective is reassuring – we can find a way out – critical changes must be made by 2020 at the latest (proposal 53).

The aim of our contribution is neither to forecast nor recommend such a mix. However, once such prospects have been graded it is perfectly logical:

- ♦ ***To see if the law can promote such a mix***
- ♦ ***To ensure that this law does not curb as-yet unforeseeable innovations***

It goes without saying that if we suddenly invented a way of mass storing electricity, we would make major progress with regard to a sustainable mix for centuries to come.

C – Being synthetic

Three levels of global principles

Three principles appear set to serve as a basis for a global law concerning all G20+ countries (proposal 54)

▶ Principle 1: Energy

From what we have seen we can conclude that:

Energy plays an essential role in meeting essential needs: food, drink, housing, health, heating, transport, communications. As such, it is part of sustainable development. Without access to energy, sustainable development is not possible as there would be no development at all; nonetheless over a billion and a half people today do not have access to electricity. Starting today and even more so tomorrow, fresh water requirements will demand even more energy.

Three levels of global principles

Like any human activity, the production and use of energy generates pollution, but a shortage of energy is worse. Major progress has been made to reduce traditional energy-related pollution but an even greater threat is rearing its head: climate change due to the uncontrolled discharge into the atmosphere of greenhouse gases mainly as a result of burning coal, oil and gas and which would have critical effects in terms of water (shortage and/or flooding).

Given that over three quarters of energy used by man comes from the major fossil fuels, sustainable development is faced with a formidable challenge: how can we increase the quantity of available energy while reducing greenhouse gas emissions?

Meeting this challenge will require a range of measures on worldwide level – as the problem is worldwide – while taking into account the various degrees of development which exist today in the different regions of the world. Regardless of the form it will take, carbon tax will inevitably be part of this package.

In developed countries, we must first improve how effectively we use energy. We must also help developing regions to adopt a development approach which, through the use of technical progress, will consume less energy than the approach we used. Some countries' energy mix will have an effect on the mix in other countries.

We must develop energy sources which do not emit greenhouse gases (i.e. nuclear, wind and solar power, etc.) and perfect the capture of these gases at the source, all under reasonable economic conditions and without creating any new pollution.

Developed countries have the resources to implement such a policy; if they refuse to do so, it will be to the detriment of the three quarters of humanity which does not have the same possibilities. But if the contribution made by India and China and other major emerging countries is only small, the efforts made by developed countries will not be enough to meet the challenge.

▶ Principle 2:

The effects of our actions must be truly compatible with the existence of human life on earth forever.

We must see nature as belonging to all human beings.

And such a statement must be the recognition that we are all connected to our environment.

This connection is unlike other relationships usually recognized by the law e.g. between a landowner and a plot of land or a forest, between a consumer and the goods and products he uses, between farmer and the fields he harvests or an industrial company which localizes production activities.

▶ **This recognition should itself have three major implications:**

- ◆ **The environment is key to human life and must often be considered to be shared property rather than something we can split and share. With regard to the climate – just like the ozone layer in the past – this property is shared by humanity; it goes beyond the boundaries of countries and governments.**
- ◆ **This notion of property also means that the environment is recognized as a set of natural resources which can run out if used carelessly.**

We should also consider on a cultural and psychological level that the beauty of landscapes, the contemplation of nature and sense of marvel at the diversity of life are all part of a balance and even the well-being of mankind.

It would be paradoxical if all G20+ countries couldn't come to this same conclusion legally, as they have culturally. Indeed, not doing so would be to deny common cultural knowledge.

At a time when the commitment or non-commitment of China and India to a worldwide pact is an issue, it would be a good time to remind ourselves that the Chinese Tao or and Hindi Dharma both presume or require that the roots of our cultures be taken into account.

▶ Principle 3 – Charter against climate change

General public law should ensue. The G20+ nations should recognize themselves in the following principles: *(proposal 55)*

- ◆ *Nations (and at least those from the G20+) organize their sustainable development i.e. development such that resources and techniques are used in such a way as to ensure that current generations take into account the ability of future generations to develop.*
- ◆ *They guarantee the principle of solidarity among generations so that each generation commits to enriching the property transmitted by the previous generations while avoiding that future generations pay the price for meeting their needs. Each generation must transmit to the following an enriched economic, social and culture property.*

- ◆ ***Nations must thus ensure that scientific research is developed – an essential condition behind sustainable and urgently required given the recent and current growth in the world’s population.***

Each G20+ country must thus rally around a shared text such as “our people, given that

- ◆ ***Resources and natural balance were key to the emergence of mankind***
- ◆ ***The future and very existence of mankind depends on its natural environment***
- ◆ ***The environment is the inheritance of all human beings***
- ◆ ***The coexistence of planetary movement and economic and demographic development now poses a serious threat to the sustainability of our development***

- ◆ *The personal fulfillment of individuals and progress of human societies can be affected by certain types of consumption or production and by the excessive use of natural resources*
- ◆ *Threats are all the more dangerous if they occur several years or even centuries after the phenomena that caused them*
- ◆ *The preservation of our planet should be sought out just as much as the fundamental interests of nations*
- ◆ *In order to ensure sustainable development, the choices made to respond to requirements should not compromise the capacity of future generations and other peoples to meet their own needs, proclaim:*

Article 1

We all have the right to live in an environment which respects the future of our Earth.

Article 2

Each person, company and institution has the duty to do their bit to preserve and improve the environment.

Article 3

Each person, company and institution must anticipate actions likely to harm the environment or at least limit the consequences. They must contribute to repairing any damage they cause to the environment.

Article 4

So that these actions cannot contribute to postponing to post-2030 worldwide stabilization in greenhouse gas emissions, public authorities shall adopt proportionate measures in order to overcome the damage.

Article 5

Education and training on climate issues (issues and responses) shall contribute to the application of the rights and responsibilities outlined in this charter.

Article 6

Research and innovation shall lend its support to preserving our Earth and the fight against climate change.

Article 7

In line with its political system, each country can adapt its organization by taking the following guideline into account:

Laws can be referred to a sustainable development board before promulgation, either by the executive power or by at least 20% of parliament members.

Provisions contrary to the interest of future generations cannot be promulgated or put into application.

The sustainable development board can be referred to by a petition within the scope of a dispute calling into question the application of the sustainable development charter. This petition must include at least 500000 signatures and/or 1% of the population from within the country.

A country's sustainable development board sums up the legal decisions taken within a G20+ country and communicates the most important of these to sustainable development boards in other G20+ countries.

Why emissions permits alone are not the right solution on a planet-wide scale

Emission permits (companies sell or buy rights to emit CO₂ under medium-term global objectives set by governments) do not appear to be a suitable regulatory tool.

- **Such a tool presumes that, every five to seven years, governments will be capable of imposing upon themselves shared emission reduction objectives. The recent past leads us to doubt in this capacity.**
- **Emission permits don't fall within the political choices that countries such as India, China or even Russia would be willing to implement; they would demand solidarity from other countries as the problem was created well before their economies took off.**
- **If half of the problems to be dealt with can be at a cost of 50€/T CO₂, work carried out by the IEA shows that the remaining half should cost between 80 and 150 €/T CO₂. The first of these figures would not be enough to deal with the issue while the second would curb any revival in economic growth.**
- **Such technocratic tools do nothing to mobilize the general public.**

Towards a new equilibrium in incentives and constraints(1/3)

We can only hope to tighten the noose by using a combination of incentive and regulatory tools.

Incentive: To stimulate the economy, ensure that the number of cars grows in relation to demographics, promote energy savings and recourse to heat in housing in developed countries to a maximum, incite companies to break from their current R&D priorities (less than 3% of the world R&D budget is currently devoted to climate change!), get utilities and their shareholders on board to plan their investments in line the with global objective of stabilization by 2030, give countries outside of the G20+ the option of adhering to the global climate pact.

Regulatory: Because public finance will not be enough to trigger a true change in energy choice, because time is running out – global inertia last a minimum of thirty years – and because developments that are continuous and progressive can only be designed in the medium term.

Towards a new equilibrium in incentives and constraints(2/3)

The proposed system of governance makes provision for a means of a constitutional call to order because the planet is in danger, obliging the various governments to mutually communicate on their choices.

If the problem is a planet-wide one and is recognized as such, governments should at least recognize it to be so on a political level.

Let's not forget that morals and the economy can join forces. What is involved here is the fact that by doing something to save the climate and the planet, the economy will also survive. Because the issues involved are starting to merge. Our economy is joining our survival.

Fines under the proposed system (3/3)

It is based on three main ideas:

- ▶ Countries which do not adhere to the global climate pact will be subject to a tax of 50€/TCO₂ to these countries in the G20+.**
- ▶ Sectors outside of housing, energy, transport, agro-forestry (20-25% of the problem) must, by 2015, submit plans to stabilize their emissions by 2025, under the control of the IEA.**
- ▶ Regardless of where they are situated, companies which export more than 50 M€ to a G20+ country may have to simply pay fines of up to 50€/TCO₂ emitted, in proportion with revenues generated, if their policy is deemed contrary to parliamentary decisions taken in application of the constitution (like traffic fines when you run a stoplight).**

A true geopolitical and moral problem (1/2)

From a geopolitical point of view:

- ▶ **Each powerful or leading state in globalization wants to continue to make money and not be held back by new constraints.**
- ▶ **In India and China, energy is the only thing curbing growth and everyone is dreaming of having a car and electricity like those in the developed world; television has played its part.**
- ▶ **Governments are judged on criteria that are so complex that it is difficult for them to look 20-25 years into the future.**
- ▶ **For the past twenty years because developed societies have not been successful for positioning international negotiations....., they are not in a position to suddenly do what it takes to put the topic on the top of their agenda.**
- ▶ **The whole oil issue and all that goes along with it (Islam, the West and terrorism) has taken too much of a toll over the past ten years for us not learn some lessons: we will gradually have to relax the climate energy/climate issue if we want more peace in the world.**

A true geopolitical and moral problem(2/2)

From a moral point of view:

- ▶ **The disappearance of the world as an unlimited source of marvel would threaten the well-being of mankind and all that its arts, sciences and cultures have taught him.**
- ▶ **Through its flexibility, the proposed system avoids the pitfalls of negotiations with 200 countries; it addresses an issue much more difficult than free world trade which, in a time of general growth, took over twenty years to put in place.**
- ▶ **Just in case some governments would refrain from thinking about it, countries which are trying to delay world negotiations would sense the warning.**

Let's recap on what we have seen, topic by topic.

I - A pact can be proposed by 2013 to the G20+ based on what we have talked about and which has the following objectives:

- ◆ *As of 2020, stabilize CO₂ emissions with the G20+*
- ◆ *Reduce CO₂ emissions in the G20+ by 15% between 2025 and 2035*
- ◆ *Further reduce emissions by 35% between 2035 and 2045 and 50% between 2035 and 2055 (proposal 56).*

G20+ countries must sign up to this pact. Otherwise they will either be:

- ◆ *Subjected to an automatic carbon tax of 50€/t CO₂ for trade with other G20+ countries, or*
- ◆ *Excluded from the WTO (proposal 57).*

2. Other countries will have the choice between:

- ◆ **Adhering to the climate change pact**
- ◆ **Paying a minimum and uniform tax of the carbon value of their exports to G20+ countries as of 2020, and of 50€/T CO₂. (proposal 58).**

To adhere to the pact, non-G20+ countries must either:

- **Commit to stabilizing their carbon emissions by 2025 at the very most by 30% above their 2000 level, or**
- **Commit to generating at least 35% CO₂ -free resources by 2030.**

These countries will have to make their decision known before 2015 (proposal 59).

And so what?

3. By 2025, 60% of electricity generated in the G20+ should be based on:

- ◆ **Nuclear**
- ◆ **Fossil fuels with CCS**
- ◆ **Renewables**
- ◆ **Hydroelectric power**

By 2035, this figure should be 80% (proposal 60).

Countries may decide to be more specific in their regulations and separate baseload electricity from semi-baseload and peak electricity (proposal 61).

4. G20+ countries shall commit to having less than 20% of their heating expenses from fossil fuels generated without CCS (proposal 62).

5. In conjunction with decisions within the G20+ negotiations should be opened with automobile manufacturers which sell more than 100,000 cars in the G20+ with a mandate to hold these negotiations in the IAE (proposal 63).

This should lead to commitments like those recommended for the G20+:

- ◆ ***Penalty system by 2015 for vehicles which emit more than 90g of CO₂/km and a ban on selling vehicles which emit more than 160g of CO₂/km (proposal 21)***
- ◆ ***Between 2020 and 2025 an average objective of 65 g CO₂/km (proposal 22)***
- ◆ ***By 2030 no more vehicles which emit more than 110g CO₂/km(proposal 26)***

6. With regard to energy savings in buildings, each country – at least in the OECD – will have to make every effort to reduce by at least a quarter its electricity consumption in buildings.

Democratic states could be prosecuted by their own courts if they don't make the corresponding regulatory or normative decisions (proposal 64).

7. The production of vegetable biofuels should be stimulated to see if it could represent:

- ◆ **10% of global fuels**
- ◆ **An average fabrication price of less than 150 \$/barrel or at worst 200 \$/barrel.**

If it turns out that the transformation of biomass into charcoal is more relevant – a non-biodegradable product – we should not hesitate to say that it makes much more sense to intensify the capture of CO₂ using plants rather than wanting to transform plants into biofuels (proposal 65).

More generally speaking all G20+ countries should agree to a surcharge of 2.5% of the total energy bill as of 2020 to finance:

- ◆ **Actions to value biomass to more than 2 Tonne/ hectare**
- ◆ **Any action to generate electricity at less than 100€/MWh**
- ◆ **Any valuation of biofuels with a production cost of less than 150 \$/barrel (proposal 66).**

- ◆ ***Similarly in all the G20+ countries, a surcharge of the energy bill should be applied to any reforestation carried out within or outside of the G20+ and providing at least a significant amount in terms of t CO₂ /ha (proposal 67).***

8. G20+ countries should also collectively commit to making at least 5% savings in global emissions through reforestation (proposal 68).

9. OECD countries should undertake to increase obligatory deductions for transport by 2015 at the latest and by at least 1% of their GDP – even if this means a tax reform without increasing the tax level (proposal 69).

- 10. Under the control of the IEA a list should be drawn up of those sectors (excluding transport, energy and housing) that produce more than 0.5% of global CO₂ emissions.**

We have shown that tools which are conventionally talked about (carbon tax, emissions permit) are not the best option, be it for cars, baseload electricity, agro-forestry or energy saving in buildings.

For other industrial sectors which represent around 20% of the earth's problem, the best option would be sector plans, probably based on the notion of emissions permits.

These sector plans should be proposed by 2015 at the latest (Proposal 70)

Sector plans and emission permits

- ▶ **The G20+ shall examine the plans and consequences by 2014 at the latest.**

A global export tax of 30 €/t CO₂ by 2020, 50€/tCO₂ from 2030 should at the very least be imposed on these sectors (proposal 71).

- ▶ **For goods transport and public transport, all the tools used by the various governments are contributing factors We would be kidding ourselves to think that we could define a global solution.**

11. Any company - regardless of where the head office is situated – which generates more than 50 M€ in revenues in any G20+ country and whose product policies obviously go against the objectives of the climate change pact should be prosecuted in G20+ countries and be made pay fines of up to 50€/T CO₂ (proposal 72), as of 2020.

The funds collected in this manner shall be used:

- ◆ **Half for developing collective transport in the country of the court which lay down the sanction or to the fund which facilitates modernization plans for private housing**
- ◆ **Half toward development aid actions, education and health in countries outside of the G20+ which have signed the climate change pact (proposal 73).**

A general communications and awareness action

12. It is difficult to talk about this action at planetary level.

However, we know that it is because of the education and training in particular of our elite class that we have taken the risk of a dead-end for the future of our planet.

To combat this risk, it would be better to remedy the situation before it's too late and without being prejudiced towards what other States could propose, we suggest:

- ◆ ***Any university, management school offering a masters or doctorate program and with more than 30% of its students who have job openings in the market economy should be able to justify that at least 1% of its classes are dedicated to teaching about the sustainable development of our planet. This objective should be included in the international assessments in force (proposal 74).***

Such an objective is essential if we really want to change the relationship between our economies, our civilizations and our planet.

- ◆ ***Planetary news channels likely to make world citizens aware of the issues linked to the fight against climate change should be launched by a call for bids within the next five years. (proposal 75).***

An overall communication plan is needed

It is also needed to get out of the idea that we can only take up the challenge with restrictions, without being proactive or even be delighted to participate to this collective ambition.

Every citizen should be able to have details on request about his main energetic choices (transport, accommodation) in a way to participate to the collective efforts.

Every country should organize contests, once a year, to reward the most creative first thousand initiatives. Communication would be then delegated via TV media (proposal 76).

13. Monitoring the proposed plan

- ◆ *A global environment agency should be set up by 2015 to monitor the application of this plan (proposal 77).*
- ◆ *Three international independent assessments teams every three years (proposal 78).*
- ◆ *A parliamentary debate every five years in all G20+ countries and broadcast on TV in all of these countries (proposal 79).*

It should be reexamined by 2022 at the latest if the value of 50€/TCO₂ should be re-estimated and brought up to 70 or 75€/T CO₂, if initial values are not enough to force the required change (proposal 80)

Conclusions (1/4)

Each and every plan starts off with an overall vision and a series of hypotheses and the broad outlines proposed for the action.

Our analysis led us to recommend a host of ideas to global powers. Those which are managerial and structuring must be given special consideration:

- ◆ **Common environmental law proposed within the G20+**
- ◆ **A link between all these measures and WTO regulations.**
- ◆ **Incentive provisions for saving energy in buildings**
- ◆ **Regulating baseload electricity within the G20+, not through an energy mix but through emission objectives in grams of CO₂/KWh.**
- ◆ **Technological progress objectives, in particular for road transport, otherwise this simple topic could lead others off the rails.**

Conclusions (2/4)

- ◆ **Adopting carbon capture/storage and transformation to alleviate the Middle East, providing this is combined with a move towards electric vehicles in road transport.**
- ◆ **Inviting the businesses to commit to a process to combat climate change which is necessary to force solidarity between former industrialized countries and future powers, in particular India and China.**
- ◆ **A clear and forceful statement on the role of renewables for the end of this century and the start of the next (we know how to solve the problem of volumes).**
- ◆ **Eliminate the sterile opposition between renewables and nuclear energy, in places where civil nuclear can be safely developed.**
- ◆ **A dual plan of action as regards reforestation (support for ambitious plans, possible sanctions for slip ups through international loans).**

Conclusions :

If we have to do better than stabilizing CO2 emissions by 2030 and halving them by 2050 (3/4)

Some people believe that the climate challenge is even tougher than the IPCC forecasts and that the curve representing the increase in ocean temperatures is already on red alert. If this is the case, we believe that the following action should be taken:

- ◆ **Take a tougher stance on obliging individuals to use heat as much as possible in first world countries (solar water heating, heat pump, etc.), give a five-year deadline for insulating all housing used more than three months per year, give the public authorities the possibility of using satellite-borne photographs to alert those who consume the most, etc.**
- ◆ **Oblige all those in the G20+ countries to scrap cars which give off more than 100 g of CO₂/km by 2020 and not 2025. Now that would result in general outcry!**

Conclusions :

If we have to do better than stabilizing CO₂ emissions by 2030 and halving them by 2050 (4/4)

- ◆ **Force the industrial sectors which are responsible (for their type of activity) for more than 1% of world CO₂ emissions to submit their sector plans by 2012 and not 2015.**
- ◆ **Impose by 2015 international comparison of all means of capturing CO₂(direction transformation of vegetation into charcoal + hydrocarbons, direct transformation of CO₂ into synthetic oil, co-electrolysis of CO₂ and water) and any resulting norms with regard to the percentages of oil to be produced using these technologies.**

Philosophy and climate change: Which relations ?

Alain Buaille

In an age when no-one seems very sure about anything, it may seem rather daring to set out a philosophical reflection in just 60 minutes. And yet that is what I am going to try to do, in the time you have entrusted to me, and in very close connection, in intimate connection with all the questions surrounding the sustainability of our planet.

This somewhat acrobatic exercise only makes any sense if we allow, from the outset, that my treatment of the subject will not be exhaustive, that I simply endeavour to make a contribution, that there are more than enough of you to have ideas complementary to my own.

What I now want to submit to you is more a set of ideas than a synthesis. If only two or three of these ideas may capture your interest, then this brief overview will have been of great use.

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Let me begin, if you will forgive me, by making a few obvious statements:

- Rationalism places trust in the senses, in reason and in the heart as foundation for Man's happiness. The senses are what root him in the world, proving to him truth of his existence, revealing to him how absurd it would be to lie down prostrate and miserable on this earth. Reason is the faculty for order: it imposes its clarity on physical nature and on the moral world, on all the interrelating interests and the intermixed desires.

The senses and reason are not there to fight each other. Quite the reverse, the gift of happiness will go to those who can reconcile pleasures, wisdoms and ... vitality of the heart, because, without heart, life among men is not worth living. But why do I say this? It's because I believe that when we look at this issue of climate change, we do so either with our reason only, or also with our senses and our heart. And yet the two readings can be very close.

- There has always been much discussion as to the possible definitions of man: “I think therefore I am”, “I love therefore I am”, “I exist therefore I am”, and so on... I am not at all sure these definitions exhaust the subject. I do believe on the other hand, that if we added ”I admire therefore I am”, this slogan would be far from secondary or derisory. Our world is not only the world in itself, with its laws, its realities, its history... It is also the sum of our admirations.

- In many cases, it is not possible to admire without also admiring nature of which we are part. Many artists have, indeed, confessed that their inspiration often came from this very thing nature, and many poets have sung of nature. I will quote but three poems, in support of this assertion, yet they speak for themselves:

- ◆ Je ne veux pas me faire belle,
disait la rose,
J'y suis forcée

(Eugène GUILLEVIC)

***“I don’t want to make myself beautiful
said the rose,
I just can’t help it”***

- ♦ Nature is a temple where living pillars
Let escape sometimes confused words;
Man traverses it through forests of symbols
That observe him with familiar glances.

Like long echoes that intermingle from afar
In a dark and profound unity,
Vast like the night and like the light,
The perfumes, the colors and the sounds respond.

There are perfumes fresh like the skin of infants
Sweet like oboes, green like prairies,
—And others corrupted, rich and triumphant

That have the expanse of infinite things,
Like ambergris, musk, balsam and incense,
Which sing the ecstasies of the mind and senses.

(Charles BAUDELAIRE)

I believe a leaf of grass is no less than the journey work of the stars,

And the pismire is equally perfect, and a grain of sand, and the egg
of the wren,

And the tree-toad is a chef-d'oeuvre for the highest,

And the running blackberry would adorn the parlors of heaven,

And the narrowest hinge in my hand puts to scorn all machinery,

And the cow crunching with depress'd head surpasses any statue,

And a mouse is miracle enough to stagger sextillions of infidels.

(Walt WHITMAN)

- Speaking in general terms, we can assert that there can be no point of equilibrium or sustainable wealth without a constant search for balances between Being and Having. The power and the role of the economy have transformed the relationship to Having. Life expectancy has progressed in spectacular fashion in developed countries. But riches are just as much in our hearts and our heads ... as in our wallets. Everyone is not equally conscious of that, even though all cultures have arrived at the idea.
- Beings have an individuality, but they are also –at every point in time- the sum of the relationships that they have with others. So the individualism that is assumed by the economy, and even desired by it, is partly an illusion.
- Moral reflection can also teach us a lot. We know, after the German philosopher Kant, that one of the first principles to take on board is that man must as far as possible be considered **as an end, and not simply as a means** that may be used by some other will. The principle that follows from this is very clear: “So act as to treat humanity, whether in your own person or in that of any other, in every case as an end, and never solely as a means.” This principle is quickly followed by two others: “Act as if the maxim of your action were to become by your will a universal law of nature”, “Act always as if you were both lawmaker and subject in a republic of free wills . »”

That is the price to pay, Kant tells us, for man to deserve and exercise his freedom. Morality enables freedom. And freedom could only turn to confusion or anarchy, if morality was relegated to the rank of accessory. Nor could someone be worthy of happiness, Kant tells us, if he were to disregard these principles. To put it a different way again, it is not permissible to reduce another to slavery or to be oneself a slave to one's own pleasure.

Before concluding this first introduction, a word must also be said of the Russian born philosopher Levinas.

Levinas tells us that, without the Other, Man is not. Those who are unaware that other people concern ourselves, are quite simply missing one of the major recognised truths that our cultures teach us.

Levinas even goes on to underline that our world is all the more true when it is not only revealing but when it feeds relationships between people.

Along the same lines, Levinas remarks that it is the realization of the existence of others that should help us throw into question the egotism of the "I". Which also leads to a completely new definition of ethics: "Lets call Ethics the putting into question of our spontaneity by the presence of others."

- Still on a philosophical level and in strict continuity with what goes before, it is not difficult to infer that it would be highly anti-philosophical to entertain an economic development that would lead:
 - ◆ On one hand, everyone or practically everyone on the planet to see how the "materially very rich" are immeasurably richer than the less prosperous half of humanity;

- ♦ ... while we had knowingly condemned, without paying attention to the matter, several hundred million people, to die through lack of water or through repeated flooding with all the cascade effects that supposes ...
 - ♦ All of which having, on the pretext of carelessness at best, prolonged a massive squandering of energy in the rich countries, without giving a care in the world for the fact that, without electricity, over two billion people may continue to struggle...
- Are all of these general statements that I've evoked self-evident to your eyes? If so, forgive me for reminding you of all this, but I fear that it is necessary to know all that precedes to be able to take the full measure of what is to follow. If, on the other hand, what precedes appears to you to be highly debatable, I fear that what follows will not make you revise your judgement.

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After having made these general points by way of introduction and to situate the debate, I would like to address the subject much more “head on” and, to this end, propose three specific reflections.

The first will aim to show why the great nations of Asia (China, India, Japan) would be putting themselves in contradiction with their own roots ... were they to oppose the search for a global agreement in the fight against climate crisis.

The second reflection aims to explain what is philosophical in a system advocating at the same time the use of all manner of means of intervention available to states, and also the constitutions of the leading countries, major corporations of the world, populations and their public opinions, in other words, the proposal that we have made to the Virgin Earth Challenge.

Lastly, I would like - though this contribution is obviously more limited in scope– to look at how Albert Camus’s famous novel, The Plague, could help a most welcome idea emerge in the context of this conference.

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So let’s start with Asia, and my little demonstration of the connection between Asian cultures and attitudes regarding climate change.

I’ve been teaching these spiritualities for almost 30 years, so I hope I won’t be either too superficial or too much of a specialist to share them with you in ... and this is quite a wager ... no more than twenty [20] minutes.

We should discuss the Chinese TAO first of all.

The Tao is “Everything of the World”, at once a momentous cause, the process of the world itself, spiritual force, essence of life, identical to and inseparable from the multitude of its creations. A kind of multi-facetted principle, omnipresent, without limits, autonomous and transcending. The Tao is a great Whole, residing in every being and everything, yet beyond beings and things. It is precisely beyond all that can be thought or observed.

Let's suppose that, in western thought, "Everything of the World" denotes something that is at the same time nature, science, the diversity of species and life, and there we would have something of an equivalent of the Tao.

If we accept that this concept is pertinent, then everything is both immanent and transcendent.

We live in this reality, we exist within it and it is only when the being feels – without limits or restrictions – the sympathy that freely materialises between itself and the rest of the universe, that it attains the ultimate reality of the Tao.

When man sees in this way the essential unity that lies beyond multiplicity and diversity..., two fundamental dimensions ensue:

- firstly, he resides in this unity, and experiences genuine simplicity. He tends to see everything on earth as a sign of this everything... and is free to frolic between heaven and earth...
- which can only put us in mind of what Baudelaire told us of the poet!

Happy is he who can with a vigorous wing
Propel towards the luminous and serene realms;

He whose thoughts, like larks,
Free, in the morning take flight,

- Hover over life, and understand with ease
The language of flowers and silent things!

Then, by a building process, as each thing is in resonance with the everything, the spirit constantly searches out the resonance of the finite and the infinite. The smallest of things can enter into resonance with the largest...

Which the English poet William Blake conjured up marvelously:

To see a world in a grain of sand,
And a heaven in a wild flower,
Hold infinity in the palm of your hand,
And eternity in an hour...

In China, like in India in fact, man is praised in his ability to identify with the absolute, and cultures have long offered him union with the infinite as the ultimate goal.

In this way, there is no more opposition for the Tao between finite and infinite, than there is between the visible and invisible. All offer themselves to us in a constantly reciprocating relationship: one serves the other, one becomes the other. Without loss or discontinuity. When the universal energy condenses, the visible appears, has become actual; when the universal energy dissolves, the visible disappears, and what was actual is resorbed. The visible is concrete in the sense that it is always the product of a concretion. But, out of this, in turn, the finite or the infinite can suddenly emerge.

So the Tao is both simplicity – one that cannot contain (nothing particular and nothing identifiable) and the most vast and multiple diversity. Primacy is given neither to existence nor its absence, rather to the infinite totality, that of the tao and of simplicity, indistinct and pregnant with all possibles.

The “illuminated” man sees ten thousand things as though they were one, he sees the unchanging within change and identifies with one as with the other. He sees the essential unity within multiplicity and diversity.

We can easily see that if everyone in the world were to become “out of joint”, then the sickness would also strike this subtle architecture, and undermine one of the two pillars - with Confucius - of Chinese culture.

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Now let us turn our attention to India and Hinduism its Vedas. Unfortunately the Vedas are misused in the political world of today but it doesn't change the understanding of India's roots !

Lets back to philosophy and spirituality.

The Hindu "Vedanta" poses the question of the ends and the meaning of life. This gives rise to four levels of goal pursued by man, which thus give meaning to their life and which have already been clearly summarized by many of our specialists:

1. The fulfillment of the senses (Kama). The end pursued here is pleasure, sexual fulfillment and the satisfaction of sensual desires. Though Kama in theory designates all forms of desires, it focuses above all on the desire and pleasure involved in love.
2. Prosperity (artha). The end pursued is success in work, in the production of useful goods and in the desire for possessions. This includes all material interests and means which make it possible to acquire material riches.
3. Being at the service of the law (dharma). This is the framework within which desires can and should be satisfied. The end pursued, is power, glory and the desire to give rather than the desire to possess. Duty plays a central role here.

4. Liberation (moksha). Neither the desire for fulfillment, the desire for possessions, nor the desire for power are ends-in-themselves. Liberation, first and foremost, is to be found by clearing our lives of all the clutter which is preventing us from discovering our true selves, our hidden "Self", and the supreme end of life, the identity between the personal "self" and the universal, cosmic "self"; between Atman and Brahman.

In human life, there are three legitimate ends: seeking pleasure, seeking prosperity, and seeking righteousness or dharma, and all three culminate in that which is the goal of all life, and to which all others are relative, namely, moksha. Harmony is then to be created in this confrontation and coexistence of ends, within which each of these goals retains its own legitimacy.

Now let's take a look at this in more detail.

- **Dharma** is the entire set of intelligible relations, "laws" which underpin the universe and stop it from collapsing into chaos. It was originally presented as a cosmic order, embracing and going beyond the strict domain of human realities. This, of course, included all institutions, ways of life, rituals and "righteous" forms of individual conduct, and, basically, anything that might appear to have the power to generate peace, stability, harmony and prosperity.

Dharma therefore designated neither what was moral, good, right, or just, nor even what was the law. It was more of a socio-cosmic order, deemed to be good simply because it was necessary to maintain a happy existence for all.

- **Kama:** There is no man alive in this world, no human being that does not desire another human being. The Veda also makes a similar claim, without any complex whatsoever, but also in a way that is free from any obsession, that it is impossible to repress the pleasure of physical love in favour of other goals, deemed to be of a higher nature.

Kama, in Indian mythology, was to some extent the equivalent of our Cupid and Eros. It is the succession of "wishes, desire, carnal satisfaction, fulfillment, love and affection". The Hindu god of love pierces the heart with the flaming desire from his bow with its arrows of flowers. He is the power and the process by which the One renders his Self as man, beast or plant and thus pursues the continued creation of the universe. But he also embraces the entire domain of possible experience in the sphere of love, sex, sensual satisfaction and pleasure.

- **The relation between kama/Artha/dharma**

First and foremost, dharma is opposed to the other goals in the sense that it is the only one which is not sought spontaneously. It acts solely as a way of regulating the interplay between the three other goals: at the individual level, to ensure that the goals are pursued in a harmonious way, and, at the collective level, to reconcile the divergent interests of individuals and groups.

The Hindu approach is thus full of subtleties: "that artha and kama are inferior to dharma does not imply that they must necessarily be subservient to the requirements of dharma. The latter does not present itself as an all-penetrating order of values, but, in the broadest sense, as a way of structuring reality as a whole so as to leave room for the realization of material interests and the physical

desire of love". Kama and artha may be "inferior" goals; but they are not weighed down by the slightest burden of any notion of rules to be followed, and their pursuit is perfectly legitimate from the point of view of dharma. Conversely, the dharma which underpins society places limits on the expression of artha and kama for each motivation.

➤ Moksha

As we have already seen, the conviction that the soul is immortal because its true being exists outside of space and time is something that lies right at the heart of Hinduism. Its relations with the material world – the world of samsara or of perpetual flux – must therefore be transitory and non-exclusive. Moksha can also be interpreted as a means of achieving the union between the self and world. This term therefore refers to a state in which all distinctions between subject and object have been transcended, like a direct experience of the fundamental union between the human being and the infinite.

A person living in the state of moksha also possesses an "I" which embraces all of its parts. The "I" is thus the centre of consciousness and existence in all the situations we experience in life and in all forms of the self. It becomes an unchanging and permanent presence, which transverses the transient states of the self without being affected. In other words, man can hope to attain a divine essence, by invaluablely releasing himself from vices which, otherwise, affect their tangible personalities: subservience to desire and suffering, possessions (artha), fulfilment of desires (kama) and virtues (dharma).

So what does this mean for us?

if India would run away from the responsibility of subscribing to a world climate agreement: "Artha" would then have upset the balance of Dharma and Moksha would itself then be very restricted, if not relegated to an absolute minimal role ... How could we ever think that the individual self could, unashamedly, say that its supreme goal is to identify itself with the universal self?... Unfortunately, these references are not well analysed in the modern world because Vedas have been appropriated by some political parties in the modern India. But it doesn't change the fact that all the considerations on Brahman are connected ... to all that.

Now let's take a look, albeit more briefly, at Japan and its Shinto, Kami and Satori.

Let's start with Shinto and the Kami.

It is more or less true to say that the whole of Japanese nature is holy. This is the very same nature that we know from haikus, Japanese gardens or the prints of Hiroshige, all so precious to the country as a whole.

These cultural points-of-reference tell us that man is here to learn how to contemplate what deserves to be contemplated, which is one of the pleasures and one of the most essential wisdoms consisting of being able relate the infinitely small to the infinitely great. This sense of imbrication between the finite and the infinite, this essential co-dependence between oneself and the surrounding universe stands right at the heart of Japanese culture. How could we retain this richness if the infinite came to be attacked and weakened by a disease for which man was knowingly responsible?

In short, all the major countries of Asia are in the same "cultural" situation and, in this respect, all those who are concerned to move governance in this direction perhaps have a weapon, the significance of which has to some extent been underestimated.

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As we draw close to what may be considered the halfway point of this conference, in this third phase, I would like to return to the philosophical content of our governance proposal. It is much less theoretical than what we have just looked at above, but, broadly speaking, is just as important.

To start with, I genuinely believe that for the first time in our recent history, we are now faced with a question that is truly global: The volume of our emissions cannot be calculated without the emissions of others immediately being added to them, and, all the time, the earth continues to turn: It is therefore impossible to split the earth's atmosphere country-by-country or into different zones. If some have ambitious objectives while others, for whatever reason, try to shy away from their responsibilities, then we will not be able to save our planet.

We are also confronted with a question which is totally new, as it is one which looks to the long term, 20 years, 50 years, or over a century from now, while our corporations, our states, and individuals themselves are rather looking to a horizon of more like the next three months, year, or five years down the line. And beyond that, for 95% of us or more, we seem to be looking into a black hole.

The real priority at a philosophical level seems to be to help these realities be recognized for what they are.

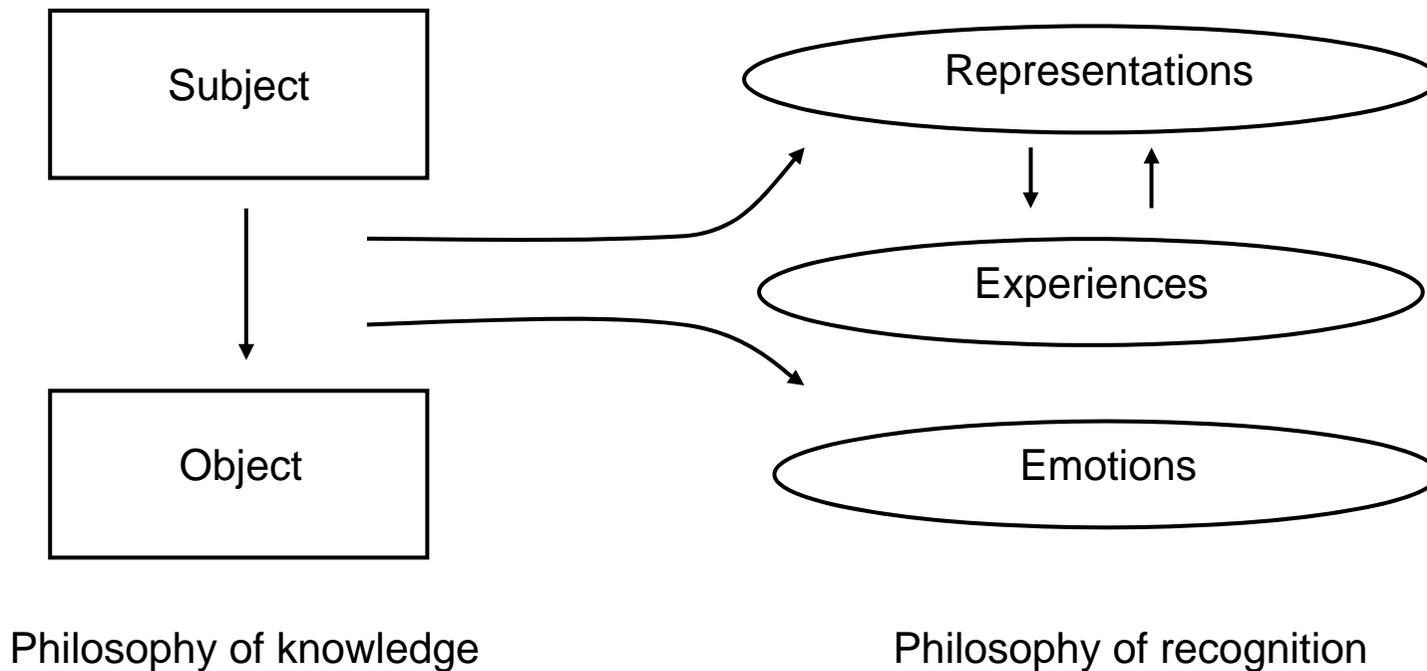
The second priority, at a philosophical level, is to bring all our resources together: The political constitution, the voluntary involvement of a certain number of major corporations and so, the obligation for financial worlds to determine where they stand, with targeted measures affecting every citizen and further education to clearly motivate the world's populations and to galvanize opinion around what we really feel:

- Humanity can rise to meet the challenge;
- No one individual can ignore the fact that they are a stakeholder in all of this;
- It is stupid to want to halt economic development... but it would be just as stupid not to supervise it;
- All those in positions of power must be trained to make a contribution wherever they can;
- Corporations are just as concerned by this as states;
- If everyone is concerned, then democracy must be able to get to grips with the issue... hence, the duty of the G20* countries to mandatorily examine any petition with more than 500,000 signatures and the duty of each parliament to be accountable for its decisions beyond its borders.

In this respect, we cannot afford to hide from the problems with which the modern world is faced to allow each and every one of us to form their own idea of the situation. However, the problem cannot be taken lightly either.

You'll excuse me if I focus on this point a little longer.

We are in fact faced with a change in the status of knowledge.



The philosophy of knowledge has undergone a major upheaval: Once centred on the claimed objective knowledge that man had of things (due to the influence of the "exact" sciences), it has evolved to take on a new status, based, on the one hand, on the interaction at an individual level between representations and the fluctuating basis of emotions, on the other hand. From being uniform and objective, knowledge is something that has taken on many shapes and to some degree become subjective.

This phenomena of recognition is a pre-requisite for knowledge, but it is only once something has been recognized that one can claim to start to have knowledge of it. You can only know what has already been recognized. And not the reverse, though that is what we often believe. Furthermore, you can also recognize what you do not yet know!

And sometimes we may wish to focus on the appearance of things, not out of disregard but out of wisdom: Then we are only filled with emotion, but this doesn't necessarily mean that we should feel guilty of taking a light-minded approach!

As a result, rational thinking has become relative to experience and the idea of an all-knowing, universal reason is no longer credible. The whole of Enlightenment thinking has been called into question. Now more than ever, men appear to be diverse creatures, themselves put into even more diverse environments, with a wide variety of risks and opportunities.

Despite all the contributions of science and the arts, it is therefore the stuff of illusion to postulate a human ideal. The universalism of the Enlightenment age was a universalism of responses offered: It started from the observation that all men are different, but concluded that reason could unite them. When, in fact, what is at least just as universally true, if not more so, is that each of us has a need to be recognized by others, to form an acceptable idea of our own identity and to bring a little more zest into our lives. And the possible responses are infinitely varied, with there even being some extreme examples: When the loop of representations/experiences does not work, emotions can end up gaining the upper hand over everything else, thus becoming the only hope but at the same time, of course, generating a great illusion!

All these are reasons why, for the struggle against climate imbalance to become a truly planetary objective, we will have to go beyond merely measuring our carbon footprint, and, this all the more so, given that – as we have already said in the arguments presented – to do so would only be to hold a mirror up to the larks.

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The third theme of my intervention is much less general. It concerns the lessons we can learn from one of Albert Camus' most important novels, *The Plague*.

What does this novel tell us? What is it about?

The action takes place in the 1940s in Oran, an unremarkable town, without any special history and without any major upheavals, a place where men are satisfied with their daily work, habits and simple pleasures.

However, over a period of a few weeks, an increasing number of rats start to come out of their underground hiding places to die in the streets, houses and public places of the town. Some people start to be worried. An old doctor who had, himself, practised in China clearly tells his colleague, Dr. Rieux that it's the plague.

More well-informed and more concerned than others, Dr. Rieux had for a long time shared their conviction: He did not want to believe it was the plague. And to this day it seems he still does not want to believe: Camus tells us that "Everybody knows that pestilences have a way of recurring in the world; yet somehow we find it hard to believe in ones that crash down on our head from a blue sky... Our townsfolk ... thought that everything still was possible for them; which pre-supposed that pestilences were impossible".

Over time, they are forced to see reason: A pestilence is indeed spreading.

Tarrou, when asked what drives him to risk his life in this way, answers "I don't know. My code of morals, perhaps. – Your code of morals? What code? – Comprehension".

Like Rieux, many have felt the danger approaching and are in a state of alert. But it is the lesson of having the courage to act which it seems to me to be the most important to convey. Faced with such situations, you have to be either mad, blind or a coward not to act.



Rieux manages to tear himself out of his troubled state, his feeling of vertigo. He has to act, take the appropriate measures and, simply, to do his job. He promptly recommends that serious isolation measures be taken and succeeds in having a sanitary commission set up. But despite his efforts, this commission is not prepared to alarm the population and only takes half-measures. Every evening, the town continues to enjoy the joyful and scented buzz of freedom.

The epidemic seems to spread at times and then withdraw again at others. Dr. Rieux continues to emphasize to the Prefect, who is worried by the number of deaths which is continuing to rise day-by-day, that the diagnosis is not worrying, but clear. The Prefect requests orders from the capital of the colony on how he should act. One day, he receives an official telegram: "Proclaim a state of plague STOP Close the town".

Every day, Dr. Rieux, now committed to working on an emergency sanitary plan, has to order and often enforce the hospitalization of new patients (by calling upon the police and then the army), despite the protests. He, of course, feels pity, but what use is pity? He has to do what has to be done.

One day Rieux, however, runs into a genuine problem. His friend Rambert has been separated from his wife who was not in the isolated town at the time the gates were closed: He wants to join her, because neither happiness or love are things that can wait. In the name of public order, Rieux refuses to help him escape. Rambert accuses him of being moralistic and over-abstract, ignoring the real issues; Rieux waives in his intent. The moral path is not always, it seems, a long, calm river.

Rieux also has plenty of dealings with a man who is not a member of the medical profession, Tarrou. To up the ante in the struggle against the disease, Tarrou suggests to the doctor that it would be a good idea to organize sanitary teams formed only of volunteers to fight the plague. Rieux entrusts the task to Tarrou: The plague, as he sees it, is a constant and inevitable defeat but you would have to be mad, blind or a coward to give into the misery which it brings. We have to act, and act according to what we know. To give in would be cowardice.

As we have seen, there are many cultural reasons to suggest that Asia will subscribe to a serious world climate agreement. Does that mean to say that it won't be the same in the West? I would be tempted to say quite the opposite; but we nevertheless have to make the effort to focus our attention if we are to move way from comfortable generalizations and start to deal in some hard truths.

Let us focus our attention now on just that very task.

It is not only in the West that Nature is the space in which all economic activity is conducted, as well as providing the stage for plant and animal diversity, or being the target of tourism. It is the whole set of every thing, which can, at any time, be the object of our admiration or subject to our need for resources.

If this was not the case, do you think we will soon still enjoy walking in the woods, swimming in the sea, trekking in the mountains or deserts, not to mention our gardens or countryside festivals closer to home, as much as we do today?

The whole of Greek and Roman antiquity sung the praises of man's aptitude to find his bearings in this world and re-establish contact with nature, far from the bustle of our civilized societies.

It is enough to read a few lines from Horace ...to bring us to the very heart of this conviction, full of distrust for the worries and troubles that had come to plague the Rome of his time: On the contrary, he affirms that happiness is here, wherever our soul is well-balanced, as long as good sense and wisdom are able to dispel our worries!

Horace also goes on to explain what it is that he finds of benefit in nature: “in the countryside, I am alive. I am master as soon as I have abandoned everything that you have praised and unmasked... If the rule is to live in accordance with nature, if the first thing to do, when you want to build a house is to choose its location, can you think of a happier place than in the countryside? Drive out nature, even by force, and she'll always come running back, silently and with more strength... and will have the upper hand over all scorn and disdain”.

Moving into the modern era, the whole history of European literature stands as testimony to this strange duality of a culture which is built on nature, as something that we are constantly rediscovering throughout the process of our development. It is as if nature and culture stand in some sort of Yin and Yang relationship, in which the mind never seems to stop fluctuating between one and the other.

Furthermore, we now know that the Earth is a living being with a capacity for self-regulation which, usually, makes it possible to maintain conditions which are favourable to life. Until now, the flourishing of organisms made possible by the energy from the Sun has strengthened GAIA. But...that is no longer true today. GAIA is ageing and suffering from the constraints we are imposing upon it. By weakening its resistance, we could be dealing it a series of fatal blows, from which it may never recover, and which, in turn may make our lives incomparably less happy than the lives we lead today.

All this is of course not only of physical and biological, but also of ethical significance. Each of us has our own feeling of what is good.

But that in itself is striking when you look at what the West has had to say about ethics. Kant has told us not to condition the life of whole societies by managing the climate in such way that will condemn them from the outset either to suffer constant drought or to repeatedly fall victim to flooding or afflicting diseases such as malaria. Levinas told us that ethics is to be understood as the calling into question of our spontaneity by the existence of others; the major CO₂-emitting countries could perhaps learn something from that maxim! And Dr. Rieux, the doctor responsible for treating the plague, tells us that it is our responsibility to face up to the threats to our planet... and that it would be immensely cowardly to run away from taking the necessary decisions. Kant, Levinas and Rieux alone should be enough to make our moral duty clear to us.

Of course, you do not need me to tell you how important the questions of climate and energy are. The fact that you have already created a research centre and that you are committed to it becoming a renowned centre of academic learning in the field, prove that your convictions are deep-rooted.

Your desire to articulate and gauge key knowledge in this area is clear. And you know just how hard it is to rise to this challenge.

You will also certainly want to put on record your own reasons for wanting to embark down this path.

After having heard what you have to say, it would certainly be of interest to see in what ways this philosophical analysis may continue to be developed.

For my part, I would like to venture one last intuitive claim: Love and Nature seem to me to be at the origin of that which many artists have drawn upon as inspiration for their characters, intuitions and their own sense of curiosity about the world.

No matter what anthology of poetry you open, at least half of them will make reference to nature.

And if we ever were to enter an uncontrollable phase of climatic development ...

- We would spend our time asking ourselves what the weather might be like in any given week or month... constantly having to worry about climatic instabilities... all of which would be an undeniable source of alienation;
- We would end up planting our gardens with species, according to their resistance to climate change, meaning our gardens would be a lot less rich in diversity, especially in temperate countries;
- There would, of course, be a fundamental upheaval in biodiversity in many countries of the world;
- Tensions between defeatists, those who are indifferent, those who want to put up a fight and the idealists would continue to build.

By way of conclusion, I am well aware that all the arguments accumulated here may be a little difficult to take on board, and may even prove to be almost overwhelming. But I also hope to have convinced you that not only could we have the technologies within our grasp to meet these challenges, but that it is also a philosophical obligation for us to venture to do so.

Thank you for your attention.