EU should target zero-C02 emissions power supply by 2050

Global energy demand – and C02 emissions – is expected to double by the middle of the century as a result of rising population and per-capita consumption.

Such a development is unsustainable:

- Climate change will prevent humanity from continuing along the energy pathway of the past. Business as usual will put the very existence of human civilisation at risk.

- Oil and gas reserves will progressively reach depletion in the course of the century and become very expensive. So will coal reserves, but coal is even less acceptable from a climate perspective.

Humanity has therefore no alternative but to save energy and look for alternative sources. We master the key technologies to that end: Water, wind, biomass, nuclear and carbon capture/storage will be the main technologies of the future. Waves, tidal and geothermal might play a complementary role.

The challenge for humanity is no less than replacing essentially all fossil energy sources by sustainable alternatives. This is technically possible, provided we tackle the challenge systematically and comprehensively with a long-term policy approach. But even then it will be very, very difficult!

Never before did humanity have to face such an array of inter-connected and extremely complex challenges: climate change, depletion of fossil resources, loss of biodiversity and the need to provide better living conditions for 9 billion human beings, which are likely to inhabit the earth by the middle of the century.

To cope with these challenges we can no longer afford to take a laisser-faire approach and hope to find solutions as the problems will arise.

When the problems will become apparent, it will be too late to control them.

We need to look far into the future and try to visualise the energy system for 2050 that will satisfy human demand without destroying our ecosphere.

There is a broad scientific agreement today that humanity will need to reduce its green house gas emissions by at least 50 percent until 2050 in order to prevent average global temperatures from rising by >2 centigrade.
There is equally broad agreement on the need for developed countries to bear the brunt of these reduction efforts, at least during the next 20 years. This is a matter of global equity. The developed countries are responsible for up to three quarters of the accumulated green house gas emission in the atmosphere; and their average per capita emissions are five times as high as in developing countries (10 tons vs. 2 tons).

Countries like the USA, Canada, Australia, and Saudi Arabia with exorbitantly high per capita emissions of 20 tons must reduce them by 90 percent, the EU, Canada and other countries with 10 tons per capita emissions by 80 percent until 2050! That is the only way for reaching the 2 ton average per capita consumption that we need to achieve for averting a climate catastrophe in the second half of the century. These bitter truths have not yet trickled into the minds of our citizens!

The EU has recognised its responsibility, following from this basic asymmetry. Until 2050 it aims at cutting C02 emissions by at least 80 percent compared to 1990. This target has been endorsed by the European Council in 2009. But very few citizens have taken note of it; and hardly anyone realises its profound implications for Europe's energy supply and our way of life. And the EU has still to outline the road map for implementing such an ambitious objective.

The most recent Kerry-Lieberman US Senate draft for an "American Energy Act also envisages an 83 percent reduction of emissions!

China and most other emerging countries continue opposing the principle of any emission reductions. They consider being entitled to further increase their emissions, fearing – wrongly – their reduction would put their economic development at risk. As long as this fundamental discord exists the conclusion of an effective international climate agreement will not be possible.

The EU will therefore have to lead the way unilaterally. In doing so it should not be excessively concerned by alleged competitive handicaps resulting from higher energy costs. Its sophisticated economy has ceased to be very sensitive to energy costs; and the costs of fossil and alternative energies will converge in the coming three decades, thanks to fast technological progress and economies of scale of wind, solar and CCS - generated power.

It is possible for the EU to run its economy without fossil energies, without impairing the quality of life of its citizens, provided it and pushes alternative ways of power generation and raises energy efficiency

Decarbonisation and energy efficiency need to become the twin priorities for the future.

Power generation must be 100 percent decarbonised by 2050. This is the *conditio sine qua non* for reducing C02 emissions by at least 80 percent, as it will be more difficult to decarbonise industrial processes, buildings, agriculture and transport by aircraft, ships and vehicles. These sectors will still be partially dependent on oil, gas and coal beyond 2050.

Power is the easiest sector to decarbonise. We have a very long experience, starting with large-scale hydro-electric power in the 1930s, following with nuclear, wind and solar from the 1960s onwards and experimenting with carbon capture and storage during the last 10 years, not to forget biomass, the oldest of all renewable energy sources.

It is possible to supply 100 percent of European electricity from wind, solar, hydro, biomass, CCS and nuclear by 2050.

But it will require a massive expansion of Europe’s renewable generation capacity and limited use of nuclear power and carbon capture and storage.

Presently some 20 percent of EU electricity supply comes from renewables, essentially hydro, and another 20 percent from nuclear power. It should be relatively easy to reach 100 percent up to 2050, if the EU continues to rely as much as today on nuclear power and continues subsidising renewable energies.

Thanks to higher efficiency, Europe should not require a major expansion of its power capacities. But it will have to replace 200 GW of old coal-fired power plants until 2020. It is essential to replace these by zero-

emission plants, with a combination of wind, nuclear and CCS. Solar thermal energy (CSP) will not yet be ready for large-scale power supply by 2020. And PV will only make a small contribution to decentralised electricity generation.

As Europe has ample supply of unexploited renewable energy, especially wind and sun, it should build a minimum of additional nuclear capacities.

In order to reach zero-emission electricity generation by 2050 and avoid economic costs by premature closure of existing coal-fired power plants the EU should stop commissioning new coal-fired power plants unless they capture and store their C02 emissions, which will be expensive in terms of investment and cost per kWh.
This is increasingly understood by industry, as it faces rising popular opposition against new coal-fired power plants.

CCS technology is about to reach maturity; but in Europe CCS will play only a secondary role unlike in China, USA, Australia or Russia, where coal-fired power plants will continue to dominate electricity generation for a long time to come.

The more we rely on wind and solar the more back-up and storage capacity will be necessary to guarantee a 99 percent flawless power supply throughout Europe. The main storage should come from “pump hydro”, high pressure underground gas, molten salt, nuclear and CCS power plants. We shall have to build many more decentralised pump storage hydro-power plants in the Alps, Norway and Sweden.

Above all, Europe must transform its power grid in order to cope with

- the regional fluctuations of supply inherent in wind and solar electricity generation;
- The daily and seasonal variations of supply and demand of electricity.

To address the first issue we need a powerful continental grid (high voltage direct current).
This is overdue in order to balance the varying supply of wind and solar electricity from different regions, including North Africa.
The higher the percentage of wind and solar electricity the more urgent a continental grid will become.

To address the future supply and demand structure, the grid must also become “smart”. With tens of thousands small scale suppliers it must

inter-connect big numbers of decentralised producers and optimally adjust them to the constant variations in supply and demand.
To facilitate such adjustment, fluctuating electricity prices must constantly send the right signals to millions of consumers and induce them to increase or decrease their power use in response to short-term price fluctuations. To this end, electricity users need to dispose of smart meters allowing them to respond to changing tariffs electricity in real time.
These changes will require unprecedented investments in transmission lines.

The planned North Sea interconnections for wind power, which will rely on Norwegian hydro pump-power plants for back-up, will constitute the first crucial chunks of a European-wide smart grid. The European Network of Transmission System Operators estimates that 42 000 km of power lines will have to be upgraded or extended until 2020, which might require investments of €23-28 billion. In view of the very long lead times and the popular resistance to new high tension power lines the EU will have to pass clear messages to the public and national authorities to speed up the planning and authorisation process. Here lies the potential bottleneck for Europe's low emission energy system of the future

Electricity demand is expected to increase relative to kinetic and heating energy. Rising electrification will become a defining feature of the future energy system.

We shall use emission-free electricity to run machines, heat buildings, drive automobiles, buses and, of course, trains. This process is gaining momentum: Electric automobiles, heat pumps or reversible air conditioners are a few conspicuous examples.

We shall witness a revolution in the way we drive cars. The venerable 100 year old internal combustion engine will no longer be the dominant engine used in 2050. A rising percentage of automobiles will run on hybrid engine systems and at a later stage fully battery-driven electric motors, charged from the grid. The switch of road transport to electric cars is still fraught with unresolved technological obstacles starting with the formidable challenge of finding equivalent power storage for the conventional gas tank. Without a dramatic improvement of batteries` energy intensity the car industry will not win the battle for the electric car.

And we have to solve these problems for some 2- 3 billion cars expected to be running globally by 2050!
But humanity cannot continue operating an individualised transport system invented 100 years ago, when nobody had a clue of climate change and congestion?

For distances up to 1000 km, transport should increasingly rely on trains because they are more energy efficient. Europe has to step up completing its network of trans-European high-speed railway connections.

We have to profoundly rethink the way cities operate. With two thirds of the world population living in bigger and bigger cities we have to equip each of them with mass transport systems running on electric power. Humanity will have to build mass transport systems for a few thousands cities in the next decades in order to reduce urban pollution/congestion and reduce global C02 emissions.

There has been so far only one example of planning a brand-new city no longer relying on fossil power: Masdar City in Abu Dhabi. Its total cost is expected to reach $ 22 billion: That is a huge amount for just 50.000 people! It is an unprecedented planning and engineering challenge. The basic concept will remain valid: we have to transform our cities into low emission places. We have no choice.

Without higher energy efficiency the world will find it harder and more costly to decarbonise.

Humanity squanders unimaginable amounts of energy by using outdated equipment, machinery, appliances, insulation or through pure laziness (standby of appliances, excess production of waste).

According to the IEA it should be possible to reduce global energy demand in 2050 by one third through higher energy efficiency.
Europe and Japan have achieved the highest standards of energy efficiency in the world. But even they could do better. They still should have scope for increasing their energy efficiency by another 30 percent until 2030-50.
It is the speediest and most cost-effective method for reducing C02 emissions. It should therefore get priority over expanding C02 free power generation.

This goes for buildings, industry and transport.

In Europe buildings constitute one of the sectors with low energy efficiency, due to inadequate insulation, inefficient heating equipment, and outdated appliances like refrigerators, TV sets and computers.

All new buildings should be designed as zero-energy buildings. That is necessary considering their life time of up to 100 years.
It is technically possible through appropriate materials, insulation and advanced forms of electrical heating or cooling. It is a huge challenge for governments, architects, planners and real estate developers to get this done.
It is therefore urgent to invest much more in systematic research on zero-energy office and high-rise buildings. The EU has so far neglected this area. It needs to alter its approach.

To reduce the energy demand of existing buildings the EU should launch a 20 year programme for retrofitting its public and private buildings stock and thereby turn these into low-energy buildings. This would substantially reduce C02 emissions, while creating millions of high quality jobs in the next decades.

In the electricity sector co-generation must become mandatory for power plants. Sweden constitutes the example to be followed.

On the consumption side, modern CFL and LED lighting systems will become the rule in offices, factory halls and private homes, due to the EU-wide ban on conventional incandescent lighting.

In industry the scope for further increasing energy efficiency remains substantial. The installation of variable speed drives is an example. It should become a normal standard to match the motors` varying output to the power load. Installing variable speed drives can save up to 60 percent of power.

In order to accelerate energy efficiency governments should set more stringent standards for buildings, automobiles, appliances etc. The EU has pioneered in this role; but implementation on the ground leaves to be desired.

To be globally effective the EU must encourage other countries to follow its example. Spreading its efficiency norms to the rest of the world would be extremely effective to slow further increase of global energy consumption.

In view of attaining the ambitious target of reducing European GHG emissions by 80 percent until 2050 the EU will have to rapidly adopt a convincing 40 year road map for energy efficiency and alternative energies.

It will need to fix intermediate targets for 2030 and 2040. 2050 is too far away for business and citizens to act.

It needs to send strong messages and provide the right incentives.
It is not sufficient for the European Council to define an 80 percent reduction target for 2050. It must also make business and citizens fully aware of its implications for them, including higher prices/taxes for fossil energies, mandatory targets for emissions, higher shares of renewables and even stricter energy efficiency standards. Climate policy must be translated into practical energy policy.

The 20 percent reduction by 2020 is likely to prove too modest for reaching an 80 percent reduction by 2050, unless the EU accelerates the speed of its efforts dramatically immediately after 2020! The EU should go for a 30 percent reduction target by 2020. This will spur efforts for higher energy efficiency and investments in alternative energies. We need to set a higher pace in both areas. The objections coming from European industry are not convincing: the average European industrial company will not lose its competitiveness because of higher electricity prices; and for the few energy-intensive sectors – steel, heavy chemicals, paper and aluminium – it should be possible to find derogations, e.g. exemption from auctioning the emission quotas.

Whatever Europe does, with a share of <15 percent of global emissions it will only have a tiny impact on the climate unless the other main emitter countries – USA, China, and Japan etc. – follow suit.

The biggest external political challenge for the Union is therefore to take these along on the bumpy road toward a carbon-free global society before the end of the century. Climate diplomacy should enter the front stage of EU foreign policy.

The changes ahead of us are gigantic. We should occasionally pause and try to make us aware. To allow all human beings to live in decent conditions each of us will have to be aware of increasing scarcities of land, water, energy, food and raw materials. The 21st century will be marked by growing supply constraints.