

A negawatt scenario for 2005-2050

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Abstract

The sad perspective of climate change combined with the foreseen depletion of fossil energy in the coming decades impose a radical change in the way we collect, transform, distribute, use and save energy in our modern economies.

Over the past few years, many European Governments have made calls and announced plans to reduce by 60 to 80% their national Greenhouse Gas emissions by 2050.

The present paper summarises the approach, the assumptions and the findings of a scenario performed by an interdisciplinary team for defining a sustainable energy path for a major European country. The scenario uniquely relies on three complementary steps: energy sufficiency, energy efficiency and renewable energy.

The analysis clearly indicates the importance of engaging major energy conservation programmes now and in all sectors of the economy if we want to indeed influence greenhouse gas emissions in the medium and longer term. The paper describes and discusses the key policies that need to be put in place for each sector in the short term.

The paper concludes on side benefits of renewed energy conservation efforts (like perspective on local employments) as well as the complementarities and the synergies of policies and measures between local, national and European levels.

Introduction

Our energy policies are based upon an intangible dogma: supplying more and more to consume more and more. However, it appears as an emergency to break down the unsustainable growth of our consumptions and to share our resources with a greater sense of solidarity. If we don't change now, a major energy crisis is ahead of us: resources shortage, major environmental risks, international conflicts and deeper inequality.

A group of energy efficiency and renewable energy experts have decided to join forces in order to assess the full potential of a sustainable energy system. They have elaborated the “NegaWatt” approach comprising three steps: first by being more sober in our behaviours vis-à-vis energy, then by working towards a greater efficiency in the way we use energy, finally by supporting the development of renewable energies.

They have developed a business as usual scenario for France's energy supply and demand, up to 2050. They have then applied the three steps (energy sufficiency, energy efficiency and renewable energy) to every sector of the economy in order to assess the strength of the negawatt scenario. The most promising policies have been identified to promote the optimal implementation of a sustainable energy path.

Despite all efforts on the supply and demand sides, the carbon emission at national level can be reduced by more than 63% in 2050, just short of the official 75% carbon reduction set by the French government in 2002.

Planet Earth is limited, and its biosphere is fragile

Regular oil spills in oceans, acid rains, nuclear wastes, air pollution, ozone layer, Asian brown cloud, soils desertification, increasing of the greenhouse effect: our production and consumption of energy are responsible for most of the environmental risks. The available stocks of fossil fuels are derisory considering the future of humanity. The pace of our actual consumption is so high that we are left with only a few decades of oil and gas, a little bit more of coal. Even before those deadlines, the massive use of these fuels has begun to disturb the greenhouse effect, this so fragile natural condition of our survival. This phenomenon is already threatening the climate balance: our planet has experienced since 1990 ten of its hottest years ever. The increase of the greenhouse effect is a reality and its effects might possibly lead to dramatic and irreversible impacts.

Even the most 'optimistic' predictions of the World Council for Energy estimate up to 8 percent maximum the share of nuclear energy in the world mix in 2050, and the stocks of Uranium will run out before the end of the century. So nuclear energy is a solution neither to global warming nor to the end of fossil stocks. Whatever will its contribution represent in the future, the issue of nuclear wastes and the risk of a major accident will remain a considerable threat, and the risk of radioactive materials proliferation a hindrance to peace.

There are little chances that technology breakthroughs provide us an sustainable energy supply despite several fancy research projects such as nuclear fusion, orbital solar power plants, fast-breed reactors. None of those will exist before at least half a century. If we could trust their promises, will such enhanced technology be affordable and cost effective in tomorrow's world? Humankind cannot bet to just wait.

From inequality to energy wars

Without energy, there is no life and no development. But today, over-consumption is next to the most drastic shortages: inequality between rich and poor countries shows a ratio of

1 to 40. The threat of energy shortage leads us straight to future wars over resources control, leaving aside even more the poorest peoples.

To stop with this logic of risks and inequality, we need to reduce our greenhouse gases emissions by a factor 4 or 5, stop wasting energy, accelerate the transition towards a world of energy efficiency and renewable energies.

To succeed in that, we have an obligation which is also a reason for hope: changing the way we consider energy.

The NegaWatt approach

Changing drastically the way we usually consider energy needs to question first the issue 'how to consume better' before answering 'how to produce more'.

For example, considering the sunshine effects when deciding on the orientation for a new house can lead to a 15% to 30% reduction in heating needs. Another example: replacing an ordinary light bulb (of 100 Watt) by a low-consumption bulb of 20 W leads to an electricity consumption 5 times lower for the same result. The needed power capacity is then reduced by 80 W. So to say, changing this light bulb leads to '80 Watt unused': that is what we call 'achieving 80 negaWatt'.

NegaWatts are generated via a more sober and efficient use of energy. Priority is to reduce our energy needs, while maintaining the same quality of life: consuming better rather than producing always more.

Sources of NegaWatts are tremendous: as a first step, with today's reliable and known solutions, NegaWatts could represent more than half of the actual world energy consumption. 'Generation of NegaWatts' has enormous advantages: no pollution, no nuisance, local benefits and jobs creation.

The NegaWatt approach in three steps

Sufficiency: energy sufficiency means suppressing absurd and expensive energy wastes in each level of our society and in our individual behaviours. Becoming sober does not mean austerity or rationing: it answers the actual need to base our future on less compulsive overconsumption, more sustainable and fairer energy needs. It requires 'sensible' behaviour of all players, from producers to citizens.

Efficiency: energy efficiency means reducing as much as possible the losses of energy for a certain use. The potential improvement of our buildings, transportation means and everyday life appliances is tremendous: it is possible to reduce from a factor 2 to 5 the energy consumption and resources needed with existing technologies.

Renewables: actions of sufficiency and efficiency can reduce our energy needs at their source. What still needs to be produced shall be brought by renewable energies, coming from amongst others our only true natural and everlasting source of energy: the sun. Well dispatched, decentralized, with a low impact on the environment, renewable energies (solar, hydro, wind, biomass) are the only sources that can help us find a sustainable balance between our needs and the available planet resources: why delay our way towards such a vital balance?

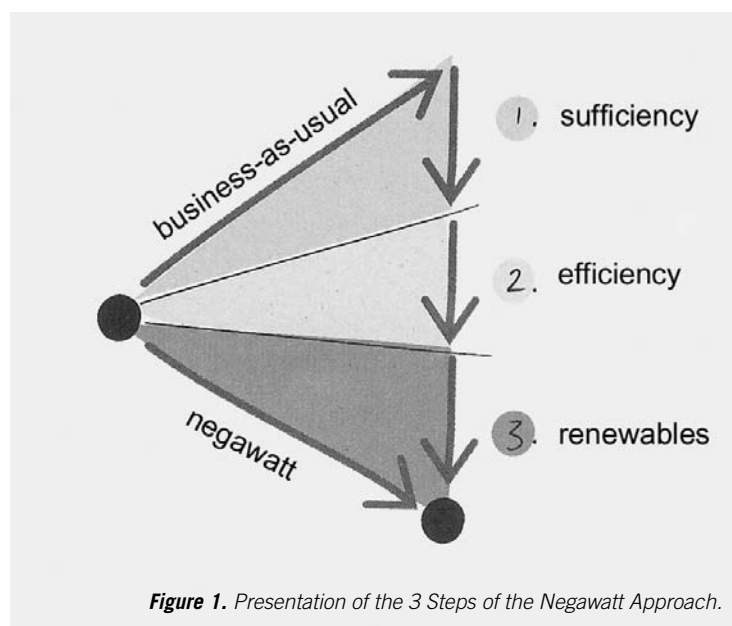


Figure 1. Presentation of the 3 Steps of the NegaWatt Approach.

A NegaWatt scenario for France

May a NegaWatt approach be successfully implemented in a country like France?

A first study has been conducted in order to identify the possible impact of an energy policy based on such an approach for the next 50 years (2000-2050).

This scenario-making is of course limited and relies on several hypotheses. However, it allows to better understand the importance of the efforts needed and gives precious pieces of information about the feasibility of such a global objective: a more efficient and less dependent country, endowed with a low carbon emissions energy system, based mainly on renewable energies.

Main Hypothesis of the Scenario

Two scenarios, a 'business-as-usual' (BAU) and the NegaWatt one have been realized. Both start from the same hypothesis of population growth and the use of known or highly probable technologies (without bet on a hypothetical major technology breakthrough).

The present paper does not intend to describe the series of historical data, the details of the assumptions, and the algorithms that have been developed to perform the scenario: the reader is invited to consult the following web-site: www.negawatt.org for accessing such background information. Unfortunately those background elements are available only in French language¹. The authors apologize for that.

The BAU scenario presents a continuation of the trends seen in the past years (1973-2000) for energy consumption in major uses (heating, transportation, power). In this scenario, 'every sector of the economy develops as usual'.

The NegaWatt scenario clearly reinforces 3 priorities:

- determined and long-term actions on energy sufficiency,
- a systematic search for the greatest efficiency in the use of energy and in our equipment,
- a priority on renewable energies development for the remaining energy needs.

In this scenario, efforts on sufficiency and efficiency have been quantified in regard to the BAU scenario, so that NegaWatts could be well emphasized compared to the BAU energy production.

Main Findings of Negawatt Scenario

The analysis and the results of the scenario reveal before anything else the tremendous impacts that policies truly based on energy sufficiency and efficiency could create. Figures 2 and 3 present the differences between the BAU and the negawatt scenario on the primary energy disaggregated by usages. Without sufficiency and efficiency, production of primary energy is likely to be 3 times higher in 2050 and carbon emissions could be more than 5 times higher.

Sources of NegaWatts are therefore enormous: they represent 70% of the business-as-usual consumption.

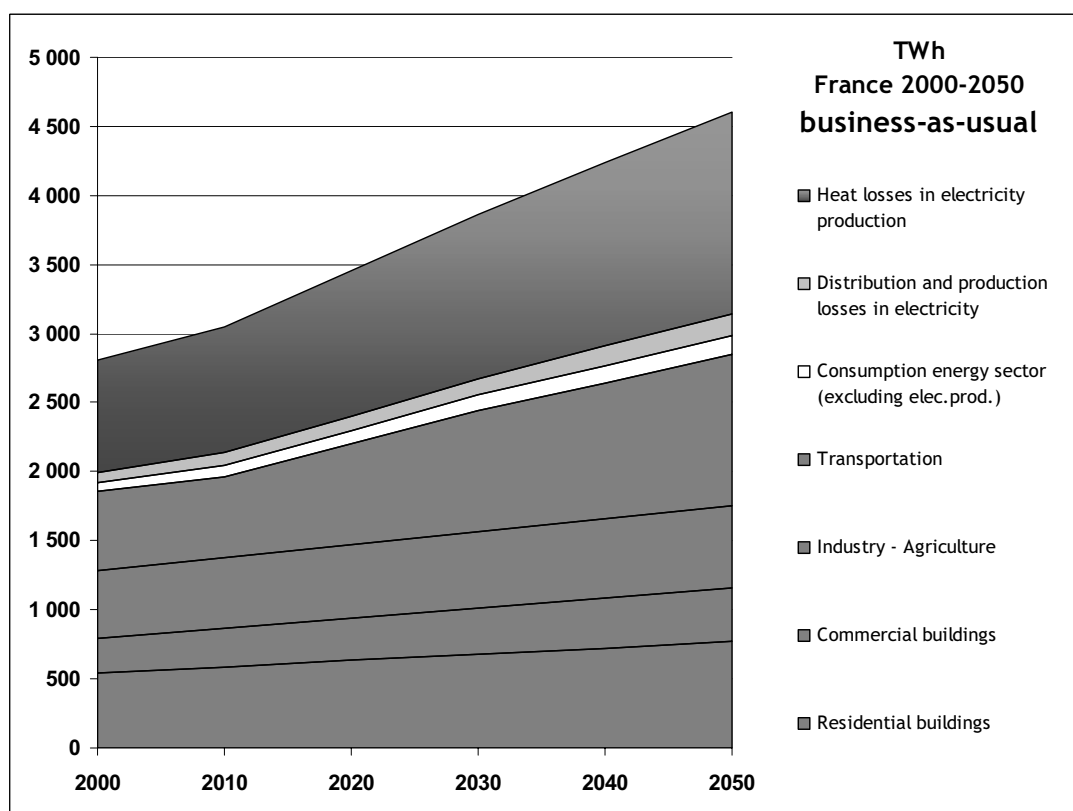


Figure 2. Business as Usual Scenario: Total Primary Energy Consumption by Sector of the Economy.

1. Salomon T., Couturier C. Jedliska M. « Les Hypothèses du Scénario Négawatt »; Available on www.negawatt.org

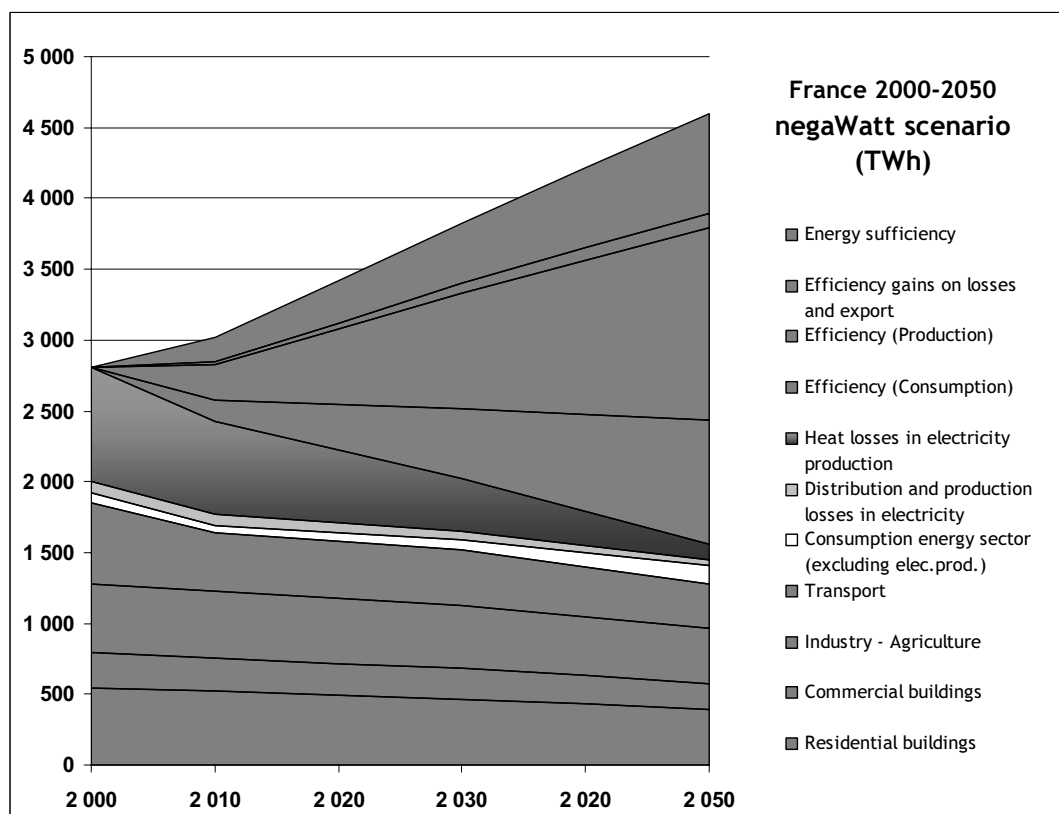


Figure 3. Negawatt Scenario: Total Primary Energy Consumption by Sector of the Economy.

In other words, 7 kWh out of 10 of business-as-usual energy needs in 2050 could be replaced by NegaWatts and only the remaining 3 kWh would need to be produced by energy plants.

In the France of NegaWatt, the economy is not static: cars still run, but with less energy (assumption in the negawatt scenario is that cars on average consume 3.5 litres per 100 km with an annual distance of 11 000 km per car in place of 6.1 litres per 100 km for an annual distance of 13 000 km in the business-as-usual scenario that does comprise a steady improvement in the efficiency of the car fleet. The growth of energy needs in transport is first stabilized and then reduced to 60% of its actual value.

The France of NegaWatt is not totally covered by wind-mills or solar panels. The production of renewable sources has been evaluated carefully according to the potential: less than a square meter per capita for heating solar panels and the equivalent of a parking lot per capita for photovoltaic solar systems (corresponding to a surface of 7 m²). The corresponding areas are already available on top of our buildings and infrastructures: there is no competition for land use.

The France of NegaWatt does not turn back to stoves or candlelights: houses are more efficient and need less energy for heating (50 kWh/m² on average compared with 200 kWh/m² in primary energy) after a wide renovation of existing buildings, and the final power consumption for electric devices and appliances remains close to its BaU value (-8%).

Figure 4 and Figure 5 compare the energy resources between the two scenarios.

In the negawatt scenario, renewable energies represent 59% of the primary production in 2050, therefore strongly reducing the dependence on fossil fuels (oil, gas, coal and Uranium). 70% of the electricity is provided by a combination of renewable energies (photovoltaic, wind, hydro, cogeneration and geothermal power), the remaining part (less than 20% of our actual consumption) comes from highly efficient natural gas plants.

The whole national energy system becomes much more efficient, in particular with

the closure of nuclear power plants which present low thermodynamic efficiency and no heat recovery (86% of the actual power plant have an efficiency not higher than 38%).

Finally, the NegaWatt scenario enables a stabilization then a decrease of the national primary energy need to 51% of its BaU rate in 2050. Greenhouse gases due to energy consumption are limited to 2.1 tonnes of equivalent CO₂ per capita, compared to a figure of 6.2 now, a reduction of 63%. Figure 6 presents the forecasted emissions of carbon for each scenario.

The findings compare well to other European Scenarios

Such results are not an exception: some European studies on 'societies with low carbon emissions and energy consumption' have shown similar figures in Germany (-80% carbon emissions achievable by 2050), in Switzerland (-60% by 2030), in the Netherlands (-80% in 2050) and in Great Brit-

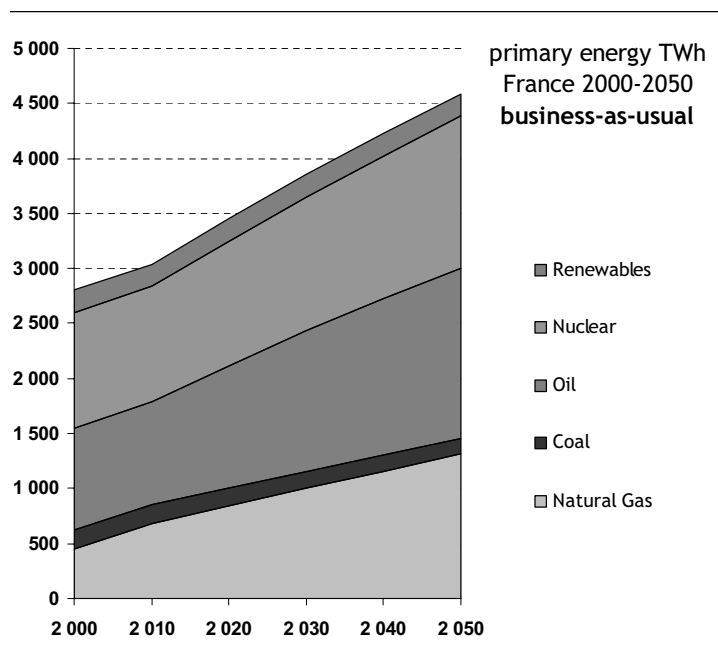


Figure 4. Business as Usual Scenario: Total Primary Energy Consumption by Energy Resources.

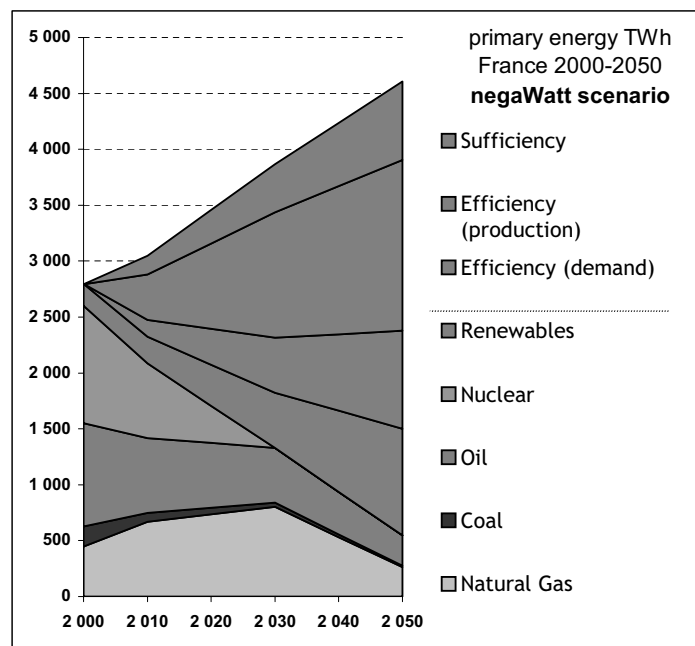


Figure 5. Negawatt Scenario: Total Primary Energy Consumption by Energy Resources.

ain (-60% by 2050)². All of them end up with a similar conclusion: a NegaWatt scenario might be implemented if only we start right now to switch to different energy use and production systems.

A Brief description of key NegaWatt measures

Any new law dealing with energy should be compatible with the three step approach 'sufficiency – efficiency – renewables'. The negawatt approach should be included in all national and European policies.

The necessity to give priority to sustainability versus other considerations should lead to profound, but realistic reforms, a formula to transform the way we consider energy.

A determined effort will have to be undertaken immediately to break down financial, administrative and legal barriers that prevent us today from taking the right path.

The following NegaWatt measures should help achieving this. They represent a vital minimum to be undertaken on a short-term basis.

They are not exhaustive nor exclusive. But they are essential to render consistent and credible any political commitment to sustainable development.

1. Mandatory thermal requirement for the building stock: a Flagship Negawatt Measure.

- The building stock represents the largest potential for energy savings and greenhouse gas reduction. Addressing building stock, and especially constructions built before 1975, date of the first mandatory thermal regulation imposed on new buildings, is a necessary component of

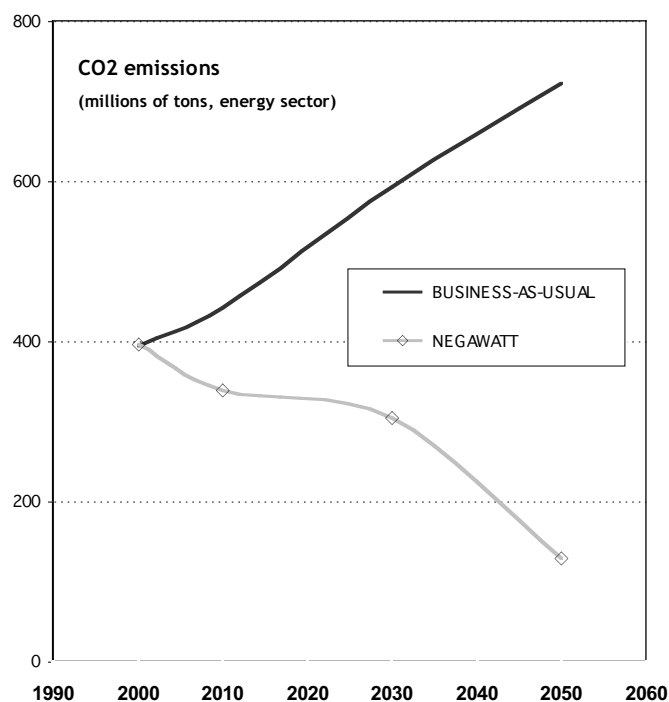


Figure 6. Comparison of the Carbon Emissions for each scenario.

any policy for a sustainable energy economy. Analyses performed during the negawatt scenario show that targeting energy efficiency improvements while buildings are being sold or rented is an indispensable measure for

2. Lebot B., Bertoldi P. Harrington P. "Consumption Versus Efficiency: Have We Designed the Right Policies and Programmes?" ACEEE Summer Study. August 2004. www.aceee.org

short, medium and long term green house gas reduction objective. In France for the residential sector, there are 650 000 buildings being traded (i.e. sold) annually. Roughly 400 000 of them dated prior to 1975 and present little if any insulation. It is therefore proposed to insulate them in order to bring on average the annual space heating consumption down to 50 kWh/m² in primary energy. This requires substantial efforts from the national authorities and the business sector. New owners will receive specific financial support for retrofitting their property through an extra mortgage with long-term and low-interest rate. The European Directive 2002/91/EC for promoting energy efficiency in buildings offers some legal basis for organizing this major market transformation. Mandatory auditing and labeling of the energy consumption of buildings imposed by the directive should be designed to facilitate, stimulate and organize the national 45-year long retrofitting scheme. The retrofitting of 400 000 residences on an annual basis should generate the creation of 130 000 permanent jobs from today until 2050. This negawatt measure had been endorsed by a consortium of building industries and businesses called the “Collectif Isolons la Terre Contre le CO₂” (“Insulate Earth against CO₂”)³. Over the past year this project has gained large momentum not only in the energy efficiency and climate change community, but also at the highest political level. Translation of the scheme into a national programme is currently being discussed.

2. Delivering direct implementations of the ‘NegaWatt vision’

- Giving priority to the approach “sufficiency, efficiency, renewable”, in any public investment and policy.

3. Setting public administration as an example

- Simplifying and clarifying all administrative procedures in favor of energy savings and renewables: unique contact, subsidiarity, clear deadlines.
- Implementing the NegaWatt approach in public procedures, buildings and equipments.
- Transposing quickly and seriously the European directives on renewable electricity and energy efficiency in buildings.

4. Changing the roles of key actors and modernizing the energy public service

- Encouraging the development of energy services based on the NegaWatt approach by giving priority to local operators and businesses. Stressing the role of local authorities in managing the energy public service and letting them choose their energy suppliers.

5. Train and inform for action

- Increasing engagement of people via ambitious and permanent public information and communication campaigns.

- Implementing a NegaWatt training program in schools, from primary school to college
- Launching a huge NegaWatt training program in all business and industry sectors
- Creating and promoting the ‘NegaWatt consultant’ job, independent from energy producers and suppliers.

6. Redirecting research credits on energy

- The research and development public credits should be in the range of the following indicative ratio: 1/3 for research on energy sufficiency and efficiency, 1/3 for research on renewable energies, 1/3 remaining for classic energies, to improve fossil use performance and security, wastes management, and plants dismantling in the nuclear sector.

Other Negawatt Measures

7. Expand the use of energy labelling in buildings, cars, appliances and equipments which consume energy by choosing a unique and regularly upgraded scale, going from A to G considering the energy efficiency.

8. Promoting ethics and transparency: Submitting advertising and commercial promotion to a ‘NegaWatt charter’.

9. Reinforcing local policies by Inserting a compulsory ‘NegaWatt chapter’ in all urbanistic and space planning plans, with quantified objectives, the consideration of climatic constraints and solutions to integrate renewables in the local architecture. Authorizing electric heating only if no other heating solution is possible.

10. Creating a ‘NegaWatt Fund’ with a 5 Billion Euro annual budget provisioned by taxes on non-renewable energies. Creating a NegaWatt banking instrument, which collected funds will finance NegaWatt investments and renewable energies investments.

11. Fitting taxes according to the A-G score in equipment, buildings and cars: for example adjusting VAT from 0% to 19.6% according to equipment or system energy efficiency,

12. Making power prices more virtuous: Stating the principle of marginal costs in the electricity pricing policy.

13. Decreasing transport needs and make them more efficient.

14. Promoting public transports for people and goods.

15. Adjusting highway tolls according to the number of people in the vehicle and implementing financial incentives for carsharing.

16. Introducing at least a 15% reinforcement every 5 years of the thermal regulation of new buildings (including every use).

3. Cf web site: www.isolonslaterre.org/

17. Statutory and progressive thresholds for energy efficiency of all equipments (including on standby power) and Progressive prohibition of inefficient technologies (halogen lamps, incandescent light bulbs, etc.)

18. Setting a long term target of 0.7 m² of thermal solar panels per capita for generation of hot water.

19. Improving the feed-in tariff system for energies lacking appropriate support (i.e. bioelectricity, micro-hydro, photovoltaics).

20. Spreading fuel taxes exemptions to all kinds of biofuels, with priority to those having the best energy efficiency (crude oil, bioethanol, biogas for vehicles)

21. Introducing a priority of access to electricity, gas and heating networks for local renewable resources.

22. Encouraging Heating Network and the conversion of large and medium heating plants to cogeneration systems.

Conclusion

Choosing an energy vision is never neutral: it is a key component for peace and solidarity and an essential part of the relationship between man and the Earth. On this matter, our personal and collective responsibility is full: we need to invent today a more sober, efficient and renewable energy future. It is possible now, without any major technology gap. It is economically sound and sustainable, because it is always cheaper, on a long term basis, to reduce energy demand rather than to multiply production plants. It is politically difficult, because habits, sectorial interests and short term visions weight a lot: NegaWatts do not rely on a lobby to promote them and the NegaWatt approach is not a good subject for demagogic speeches.

'Our House is burning, and we are looking somewhere else' said President Jacques Chirac at Johannesburg during the World Summit in 2002. *'We need to divide our greenhouse gas emissions by a factor 4 or 5 in our developed countries'* his Prime Minister added few months later. It seems our political leaders only started to understand what is at stake. It is now time our society moves from words to real action.

Let's dare do the first step:

'There is so much beauty in everything that begins.' (Rilke)