January 2017

ASSOCIATION négaWatt

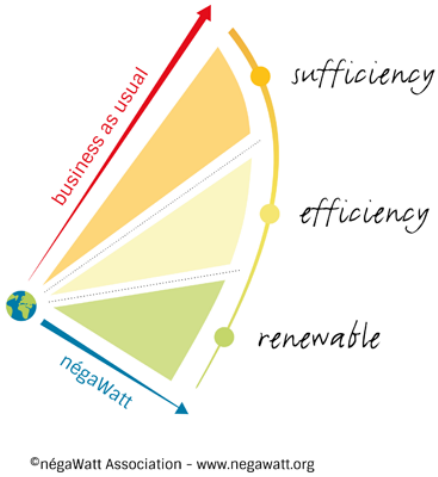
The 2017-2050 négaWatt Scenario

Executive Summary

For 15 years, the négaWatt Association has published renowned energy transition scenarios for France.

They are meant to envision a different energy future in which environmental risks (climate change, biodiversity loss…), technological risks (e.g. nuclear accidents), and dependency on foreign resources is history. They are based on three main pillars:

- Sufficiency: reducing the overall need for energy-using services, through better sizing, using, and sharing equipment, better organising land and society, etc.
- Efficiency: avoiding as much energy losses as possible all along the chain in the way energy services are provided, through improved equipment, buildings, and vehicles.
- Renewables: prioritising green energies for supplying the remaining energy demand.



A renewed scenario

The previous négaWatt energy scenario was issued in 2011. Since then, the economic, technological and energy contexts have dramatically changed. The so-called 'energy transition', that négaWatt helped to popularise, is now underway and reinforced by the Paris Climate Deal.

The French Energy Transition bill passed in Summer 2015 even refers to the négaWatt principles: sufficiency, efficiency, and renewables. It includes ambitious goals, notably a reduced share of nuclear power in electricity supply – from the current 75% down to 50% by 2025 –, a 32% share for renewables in energy use by 2030, and a 50% cut in final energy demand by 2050. However, the strength of resistance to change in areas such as nuclear or Diesel industries undermines its implementation and the associated operational policies are both insufficient and weakened, jeopardising the achievement of the targets.

The new 2017-2050 scenario aims at:

- Updating and strengthening the modelling and forecasting, notably to better quantify the scenario impacts and characterise its consistency and robustness
- Informing the policy debate in France, in an electoral period of importance for putting the energy transition into practice
- Supporting stakeholders with data and information facilitating designing, implementing and evaluating energy transition measures.

12 key points

1. The energy consumption trend has already reversed

Energy consumption has diminished in OECD countries for several years. In France, the demand curve is now close to the one envisaged by négaWatt already in 2003. The country's greenhouse gas emissions have declined, not only nationally but also considering those emissions embedded in imported goods: the trend is not just due to the economic crisis or offshoring, it is structural and not temporary.

2. Sufficiency and efficiency play a key role for the energy transition

The négaWatt scenario models the implementation of energy sufficiency and efficiency actions in all sectors (buildings, transports, industry). It leads to a potential halving of the final energy consumption by 2050, with still a high level of energy services.

3. The possibility to reach a 100% renewable future is confirmed

All remaining energy needs can be supplied by renewable energy sources by 2050. Solid biomass is the top contributor, closely followed by wind, then solar and biogas. This allows to progressively shut down the country's nuclear reactors with no life extension over 40 years. The last one terminates in 2035.

4. Net zero emission in 2050: a carbon-neutral France

Combined with the Afterres2050 scenario developed by Solagro on agriculture, food and land use, the négaWatt scenario reaches a level where remaining greenhouse gas emissions (mostly from agriculture) are fully offset by national carbon sinks. Then the amount of carbon in soils flattens, and carbon sink potentials finally diminish over 2050-2100, leaving open the issue of further action.

5. The complementarity between gas and electricity is a must

By 2050, they may represent more than 70% of the final energy consumption as liquid fuels go down. They should be seen as complementary rather than competitors. The storage of renewable electricity in the form of synthetic methane (power-to-gas) is one of the pillars of the energy future envisioned by négaWatt.

6. Land use has a significant importance

Agriculture and forest management has a major role to play to provide renewable resources, store carbon, and reduce its own greenhouse gas emissions. It justifies the relevance of the négaWatt approach to the food chain: sufficiency in diets, efficiency in production processes, production and use of renewable energy.

7. Circular economy, the fuel for industrial revitalization

To support the evolution in consumption needs away from current unsustainable overconsumption, industry will have to focus on more durable goods, with less embedded energy and materials. The growth of repairing, recycling, and reusing activities can halve raw material needs, even if the development of renewables that will need some resources is taken into account.

8. Multiple benefits for health and the planet

The négaWatt scenario helps improving air, water and soil quality, as well as biodiversity. In particular, particulate matters from fossil fuels and emissions from agricultural ammonia are strongly reduced.

9. The energy transition, a gift for the economy and employment

The cost of the négaWatt scenario over 2017-2050 is on the whole lower than the business-as-usual trend, even with a flat price hypothesis on imported energy resources. It leads to much more job creations: 400,000 net by 2030 in France, in line with previous assessments. The country also becomes much more resilient to foreign energy shortages or price increases.

10. More solidarity and responsibility

The implementation of négaWatt principles provides local territories with activities and wealth that is more fairly distributed accross the country. It can also significantly reduce the rate of energy poverty. With such an energy plan, France would send a triple message to the world: one of responsibility in taking its fair share to fight global warming, one of exemplarity in promoting sustainable development pathways, and one of solidarity with countries where energy demand still needs to grow.

11. Time is of the essence

No hypothetical energy dreams nor petty fixes, the priority in the next five years is to genuinely enforce the principles and policies supporting the energy transition, which have been very insufficiently implemented so far. A clear agenda is necessary at all levels, confirming the long-term objectives and putting in place the required measures. The fight to save the climate is not lost yet, however each year of procrastination drastically reduces the chance of success.

12. The négaWatt scenario gives direction and tempo

In all communities, stakeholders of various nature (citizens, entrepreneurs, politicians) have started acting to build this new energy future. The négaWatt scenario provides a path and tool to guide and give the proper rhythm to action – as a contribution to the tremendous and vital project of the energy transition.

Methodology and assumptions

The scenario is based on a thorough analysis of thousands of parameters related to energy usage and energy supply, going down to the details of every equipment and process. Hypothesis on future evolutions reflect the implementation of an energy transition agenda, yet they exclude speculative breakthroughs. They build on sufficiently mature solutions and innovations at a high degree of technology readiness level, to ensure they can be deployed in time at a massive scale.

The modelling takes into account physical and environmental limits, and favours cost-effective solutions. Yet it does not run on micro or macro-economic equations, as traditional economic modelling often overlooks long term considerations and externalities of energy use. Nevertheless, an ex-post economic evaluation has been carried out on the scenario output.

Building sector

The scenario envisages a more sufficient attitude towards soil artificialisation and urban growth. Tertiary areas do not expand more quickly than population, still leading to 1.1 billion m^2 being occupied by 2050 compared to 950 million m^2 today. In the residential sector, average surfaces per occupant also stabilises at 42 m^2 due to e.g. measures stimulating apartment sharing and compact urban planning.

The top priority to save energy remains a massive and deep retrofit program of all existing buildings. Despite urgent calls, no such plan of relevant magnitude has been implemented in France yet, and every delay requires tougher measures if we are to renovate the whole stock by 2050. Retrofits must reach 780,000 residential buildings and 3.5% of tertiary areas each year. Current policies would only ensure a fraction of this.

In terms of energy-using equipment, heating and water heating can move towards much more efficient and renewable solutions. For other appliances, generalising best technologies and more responsible behaviours could save 15% on the country's electricity consumption without excessive efforts. Besides, it helps reducing peak demand, with has positive effects on the sizing of energy grids, production and storage means.

Mobility

The transport sector is the most worrying. 65% of all travelled kilometres in France are done by car, often the poorest solution in terms of energy use. Deeper evolutions are necessary to reverse current trends. Through more adequate space planning limiting urban sprawl, and favouring home and co-working, the scenario foresees an ultimate 17% cut in travelled km. Non-motorised and efficient public transports are prioritised and developed so that only 50% of trips are car-based by 2050.

The improvement of car engines should also be pursued, from hybrid to electric light vehicles (the latter becoming dominant in city areas). Occupancy rates are increased from 1.6 today to 1.8 through car-sharing. Other services (e.g. car renting systems) will also help using the right vehicle for the right use. The scenario adds a further reduction of speed limits on roads.

Agriculture and food

Linked with the Afterres 2050 scenario on agriculture, forest and land use, the scenario carefully investigates food chains that currently emit more than a third of the total national greenhouse gases. Food waste (200 kg per capita per year today) is significantly reduced by 2050. Proportions of meat and vegetables in average diets are progressively switched. It means halving the current meat consumption, a trend that has already started. There is also potential to move food production towards more agro-ecological and organic practices.

Industry

The core principle is to minimise the need for non-renewable raw materials. A high degree of recycling is the first option. It significantly reduces the energy used along the life-cycle of metals, plastics, and papers. There is potential to increase recycling rates by a factor two or three by 2050. Using renewable materials and fluids is another way, e.g. wood in the building industry, biosourced matters, hydrogen produced from renewable electricity for certain industrial processes, etc. The use of petrochemicals is restrained, so that the amount of fossil fuels used for non-energy applications is more than halved by 2050.

Energy supply

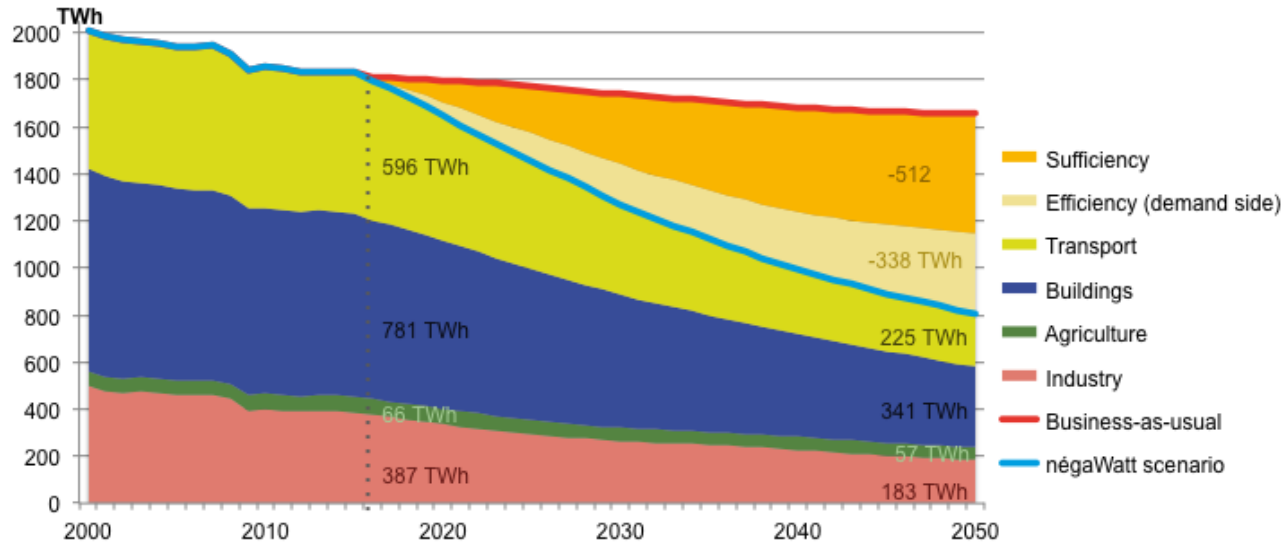
French nuclear reactors will soon start reaching their 40th year of operation one after the other. Extending their life would surely require very costly investments. Considering the risks and available alternatives, the négaWatt scenario excludes this option. All existing reactors are shut down at 40 years, until 2035. The electricity supply is progressively based on renewable sources only. Wind energy comes first, through a steep growth in capacity allowing a 247 TWh electricity production by 2050. 49 GW of land turbines are ultimately installed, using new generation models adapted to moderate winds. It means a tripling compared to today and a total of 18,000 turbines (less than what Germany has already installed!). 28 GW of off-shore wind are added, both fixed and floating. The potential is significant in Atlantic and Mediterranean waters, and could help revitalise sites from the oil and shipyard industries. Solar is also promoted, from household rooftops to large installations on wastelands. The 2050 capacity reaches 140 GW, for a 147 TWh generation. Hydro power (already much developed in France) remains stable, although with a slightly decreasing of production due to climate change.

A major stake is the management of the production variability from new renewable power sources. The main option that is applicable is 'power-to-gas'. It means turning renewable electricity production excess into hydrogen, and eventually synthetic methane. Such methanation is complementary to methanisation as it can help remove excess CO_2 in biogas. Other ways to reuse the heat produced in the reaction can lead to achieving genuine industrial ecology principles.

Alongside electric renewables, energy from biomass is strongly developed. This first comes from wood, mostly from byproducts of forestry. Methanisation of agricultural waste becomes a significant source of biogas (to replace natural gas), as well as nitrogen. 2nd generation biofuels from wood and straw are only favoured for applications where alternatives do not seem feasible, such as aviation.

Results

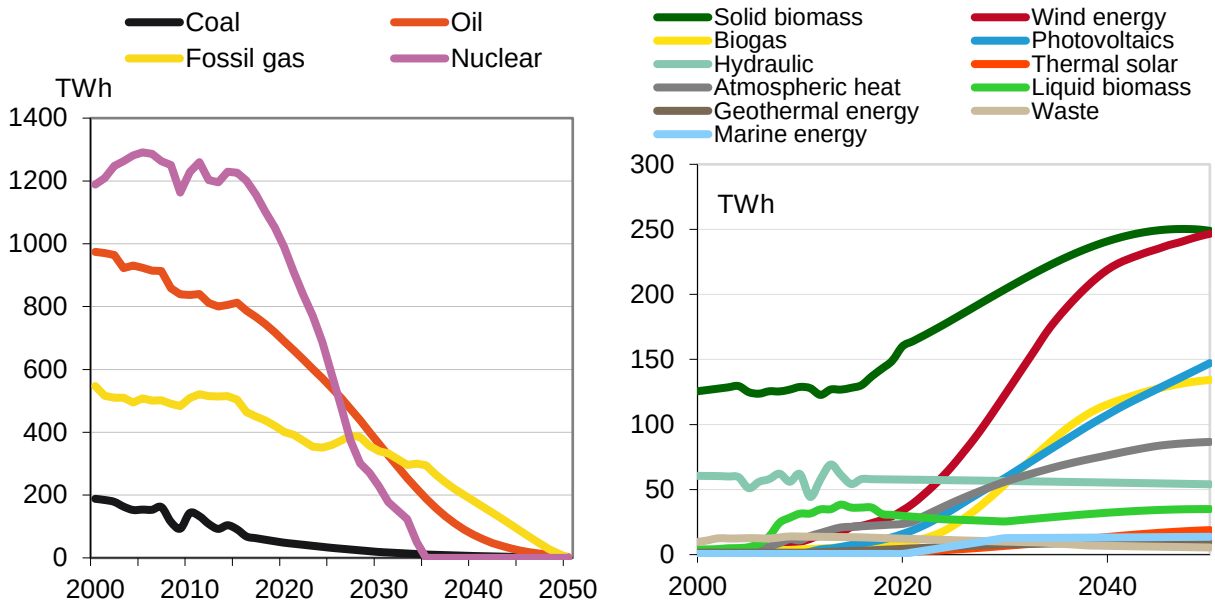
Energy trends



Final energy consumption in the business-as-usual and négaWatt scenarios

The modelling output shows a halving of the final energy consumption by 2050, driven by sufficiency (60%) and efficiency (40%). The contribution of renewable sources to the energy supply is multiplied by 3.4, and allows to cover 99.7% of the primary energy demand by 2050. Half of the supply comes from primary electricity sources, and 40% from biomass. This notably means that the country becomes fully independent for its energy supply, and the production is more homogeneously spread over the country land.

A specific calculation module has been developed to check that the balance of the electricity grid can actually be secured on an hourly basis until 2050, despite the high share of variable renewables. It includes detailed load profiles, daily and seasonal climatic variations, etc. The balance is achieved thanks to the complementarity between renewable sources, the use of thermal plants functioning on biogas, peak-load shifting, and progressive development of storage and of surpluses valuation capacities.



Energy supply in the négaWatt scenario (fossil and nuclear on the left, renewables on the right)

Environmental benefits

By 2050, CO_2 emissions reach close to zero in all sectors, and other greenhouse gases are significantly reduced. In total, emissions drop from 480 to 71 $MtCO_2eq$, while the residual emissions are matched by the country's carbon sinks, so that France becomes fully carbon neutral by 2050.

If the whole world was to implement a similar pace in reducing greenhouse gas emissions, global warming could be contained at around 1.8°C (80% chance to remain below 2°C): the négaWatt way is therefore indispensable to reach the Paris Climate Deal objective!

Other air pollutants are also reduced. Particulate matters are halved in the transport sector. Additional nuclear risks are also completely eradicated, when the last nuclear reactor is shut down in 2035.

Costs and jobs

A detailed economic analysis based on the scenario outputs concludes that its implementation would require around € 1.160 billion investments in the energy sector until 2050, compared to 650 in the business-as-usual trend. But it would halve the national energy bill over the 2017-2050 period, with a net profit of € 1.130 billion.

When including all sectors covered by the energy transition (buildings, transport, etc.), total expenses in the négaWatt scenario are until 2030 quite similar to those in the business-as-usual scenario (first investments are offset by sufficiency and efficiency savings). Then négaWatt starts becoming more economical as early investments deliver their full effect. The cumulative savings until 2050 reach € 370 billion (with a flat energy price assumption). The outcome is favourable for the economy. The overall benefit would only cease to exist if imported fossil fuels were to become twice cheaper than today in the future.

The impact on jobs is clearly positive: a net outcome of 100,000 full-time equivalents in 2020, rising to about 400,000 by 2030 and 500,000 by 2050, mainly due to the stimulation of more job-intensive sectors.

ASSOCIATION négaWatt

The négaWatt Association is an energy expertise and strategy think tank founded in 2001 and established as a French non-profit organisation. Its core objective is to address first the right questions and provide operational answers to switch to a sustainable energy system, and ensure a successful energy transition in France. Its leadership and coordination is managed by the so-called 'négaWatt Company', a group of around twenty experts and practitioners relying on a network of more than 1,000 individual members contributing in kind. The organisation's financial resources principally come from donations and member subscriptions. Several private Foundations, NGOs and business sponsorships also provide support to the work carried out.

www.negawatt.org/en

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