



ASSOCIATION
négaWatt

négaWatt scenario 2017-2050

A blueprint for a successful
energy transition
in France

A systematic
approach based
on sufficiency,
efficiency,
renewables

Proven
economic,
environmental
and social
benefits

Reaching
100%
renewable energy
is possible

Passing down benefits and incomes to future generations rather than burdens and debts

www.negawatt.org

An energy transition scenario

The négaWatt Association has developed an energy scenario for France. The future it explores and describes is not a prediction, but represents a viable option. It paves the way for a better, more sustainable energy future, and provides solutions to achieve the transition. It aims at **encouraging and helping decision-makers to incorporate long-term imperatives into short-term decisions**.

Context and challenges

The consequences of past energy choices - climate change, tensions linked to energy supply, as well as health and technological risks - are becoming harder and harder to cope with.

In order to transition to a more sustainable energy system, increased action is urgently needed, especially in France. The 2017–2050 négaWatt scenario offers a pathway **to significantly reduce all environmental impacts and technological risks linked to our energy system**.

International and national commitments



Paris Agreement: Keep global warming well below + 2°C.

In France (2015 Energy Bill):

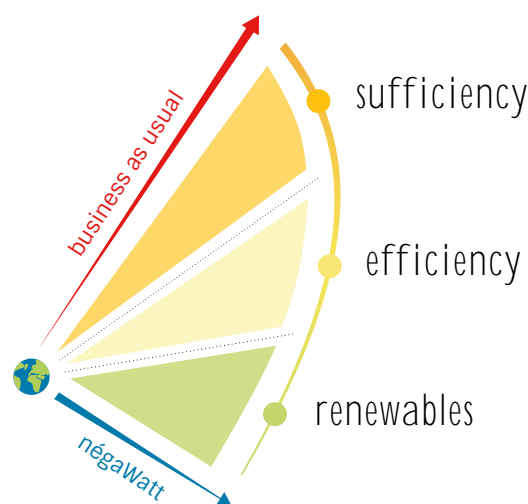
- Reduce greenhouse gas emissions by 75% and halve final energy consumption by 2050.
- Reduce the share of fossil and nuclear energy, and increase the use of renewable sources.

Approach

The 2017–2050 négaWatt scenario applies the ‘négaWatt approach’ to the energy system. It consists in:

- **Prioritising essential needs** in individual and collective energy uses, through **sufficiency** (e.g. suppressing wasteful uses, reducing packaging, etc.).
- **Reducing the amount of energy** required to cover each need through **energy efficiency** (e.g. insulating buildings, improving the performance of appliances and vehicles, etc.).
- **Developing renewable energies**, as they are the most environmentally-friendly sources and never run out (they are based on energy flows, rather than finite resources such as coal, oil, fossil gas and uranium).

The négaWatt scenario is not utopian, and does not require radical **technological, economic or societal breakthroughs**. Significant changes are required, but they will not be implemented abruptly.



The négaWatt® approach

The négaWatt scenario is underpinned by a solid and detailed analysis of energy consumption in each sector (buildings, transports, industry, agriculture), and of energy production (renewables, fossil, nuclear) to evaluate the possibility for change in a credible way. A socioeconomic and environmental impact assessment of the scenario has also been carried out.



Buildings

Making deep renovation a priority

In France, the building sector accounts for more than 40% of the energy consumption. Almost a third stems from heating houses built before 1975.

Overview of our assumptions

Sufficiency

- A **reasonable trend inversion** in the **number of people per dwelling**, fostered by new ways of living (e.g. student/senior house sharing)
- A **reduction of the share of detached houses** in new construction (20% in 2050 compared to 46% in 2015)
- A priority to the **rehabilitation of existing buildings** instead of new construction in residential and tertiary sectors
- A **more careful use of appliances**, to avoid energy waste

Efficiency

- Efficient thermal renovation** of almost all existing buildings by 2050 (780,000 dwellings and 27 million m² of tertiary sector space renovated per year)
- An obligation to **make new buildings nearly zero energy**, and built with low-embedded energy materials (wood, unbaked earth, natural insulation, etc.)
- Systematic promotion of the **most efficient electrical appliances** on the market

Heating: Much wider use of efficient heat pumps and wood as a source of energy, allowing a significant increase in the use of renewables.

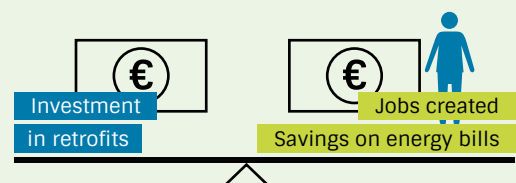
Cooking: Switching to efficient electrical kitchen appliances, leading to a strong reduction in gas use.

Key policies

- 1** Making the renovation of existing buildings progressively compulsory, starting with the most energy-intensive ones. This obligation could be implemented when property changes ownership or tenancy.
- 2** Improving the training of building sector workers in global and efficient renovation.
- 3** Implementing simplified funding schemes, allowing each household to finance renovation work through the savings made on energy bills.
- 4** Developing urban planning policies that regroup buildings on areas which have already been built on (densification of habitable areas) and **opt for collective accommodation** rather than detached houses.

Energy retrofit: a worthwhile investment

An ambitious renovation programme would cost up to 50 billion Euros per year, but would allow savings of several billions per year on energy bills and would create almost 500,000 local jobs!





Transports

Prioritising public transport, cycling and walking

The transport sector, which for decades has seen large increases in road traffic, currently represents the main source of greenhouse gas emissions in France.

Overview of our assumptions

Mobility



All vehicles switch from oil to gas (which will fuel 75% of distances travelled by 2050) and electricity (25%), both from renewable sources.

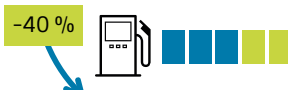
Sufficiency

- A **reduction of the speed limits** on roads
- A **significant shift** from car and air travel to **public transport and active mobility** (walking, cycling)
- A **reduction in distances travelled**, for example through the promotion of homeworking
- An expansion of **car-sharing schemes**

Efficiency

- A **reduction** of almost 60% of **the average fuel consumption** of cars by 2050

Freight transport



All HGVs switch from oil to 100% renewable gas.

Sufficiency

- A **reduction in tonnage** transported
- **Higher loading rates** for HGVs
- A **progressive shift** from road to **rail and water freight**

Efficiency

- A **reduction** of over 40% of **the average fuel consumption** of HGVs by 2050

Key policies

- 1 **Reducing the maximum speed limits** on roads (80 km/h outside urban areas) and on highways (110 km/h).
- 2 **Dropping all plans for new roads and airports**, in favour of massive investments in urban public transport and rail networks.
- 3 Introducing a **vehicle mileage tax** on road freight.
- 4 **Expanding the gas-powered vehicle sector** (firstly fossil, then renewable) through partnerships involving vehicle manufacturers, fuel suppliers and vehicle fleet managers.
- 5 **Prioritising land planning that encourages alternatives to the use of private cars** (cycle paths, dedicated public transport lanes, car-sharing zones, etc.).
- 6 **Revising fuel taxes and ending air transport subsidies.**

Improving air quality and purchasing power

Reducing oil consumption would allow not only to reduce greenhouse gas emissions, but also increase the country energy independence, enhance individual purchasing power, reduce national trade deficit and improve air quality and health.

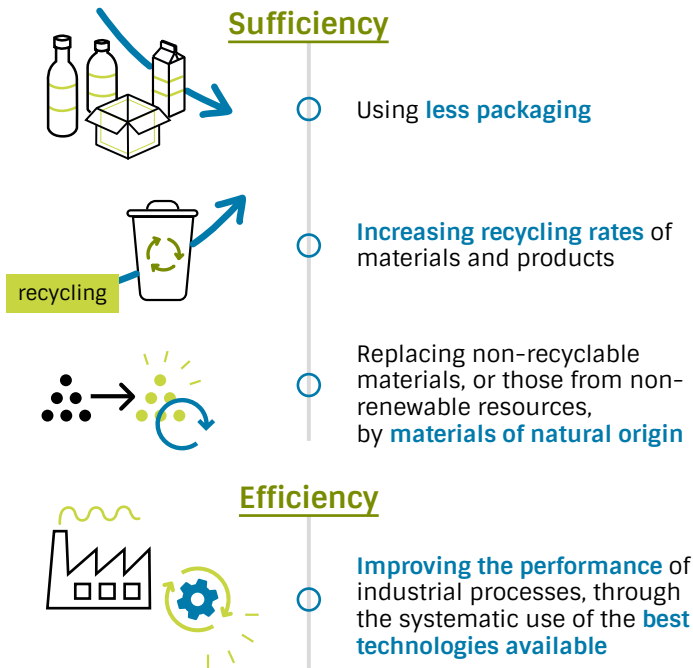


Industry

Towards longer-lasting and greener goods

Industry is the only sector which has reduced its energy consumption in France in recent years (due to offshoring, amongst other factors). However, significant progress in energy savings is still achievable.

Overview of our assumptions



Key policies

- 1 **Increasing the lifespan of equipment**, particularly through better design and extended warranty periods.
- 2 **Encouraging re-use**, by making glass and certain types of plastic returnable.
- 3 **Tracing the origin of materials and semi-finished products**, to increase consumer awareness.
- 4 **Incorporating embedded energy** (used in the manufacturing stage of products) **as a criterion** in public tenders.



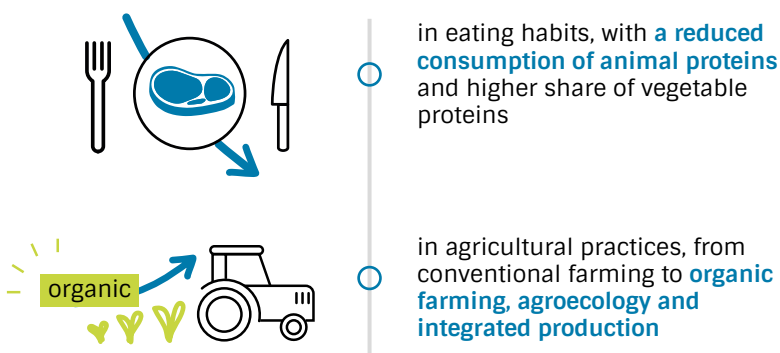
Agriculture and food

New agricultural practices for new diets

The agricultural sector consumes little energy but emits large amounts of greenhouse gases (particularly livestock farming). A change in our agricultural system is essential to support the objectives of a successful energy transition.

Overview of our assumptions

The Afterres2050 scenario on food and agricultural transition - used as an input to the négaWatt scenario for this sector - is based on a progressive change:



Afterres2050

Developed by the French association Solagro and consistent with the négaWatt approach, the Afterres scenario proposes a **systemic approach for the use of land and biomass, with the aim of establishing a new balance** between food for human or animal consumption, production of energy and materials, and conservation of ecosystems, biodiversity and soils.

Under this scenario, agricultural production is maintained at its current level, but practices and the way products are used undergo significant changes.



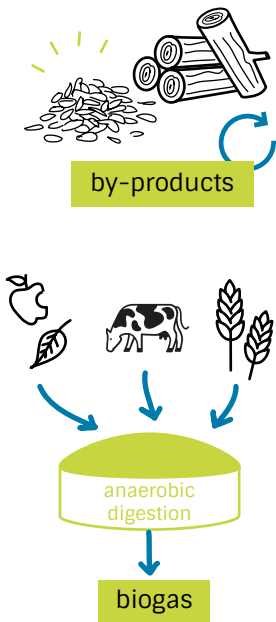
Renewable energy

A balanced and realistic use of renewable energies

Under the *négaWatt* scenario, renewable energy production is increased in an ambitious but realistic way, in order to cover 100% of our remaining energy needs by 2050.

Overview of our assumptions

Bioenergy: The leading source of energy by 2050



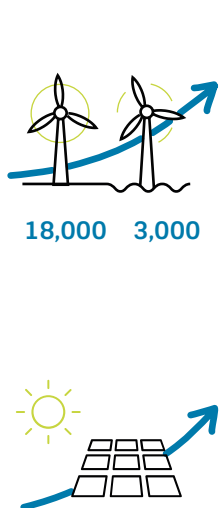
- Solid biomass**
Wood used for energy will mainly come from materials derived from other uses, for example **by-products from industry** (furniture, paper/cardboard, etc.) or construction.
- Biogas**
Biogas is produced **from crop residue, livestock waste, bio-waste and cover crops**. The latter have an agro-ecological benefit and will be extended to almost all arable land by 2050. Anaerobic digestion plants will also play a key role in the transition, particularly in replacing synthetic nitrogen (currently produced from fossil gas) by **nitrogen of natural origin**.

Key policies

- Simplifying, clarifying and stabilising the legal and economic frameworks** for all types of renewable energy.
- Reforming the grid operator legal practices** to ensure that all renewable energy producers and consumers are treated fairly.
- Giving renewable energy a status of public interest.**
- Encouraging local groups and citizens to contribute financially** to new renewable energy production methods.

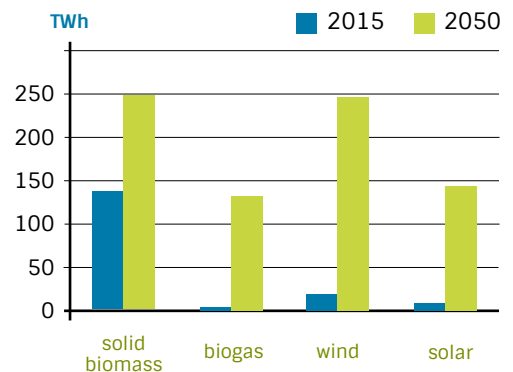
+ Afterres2050 does not allocate any land exclusively for energy production. There is **no competition between different uses** (food, materials, etc.); **they can rather complement each other.**

Renewable electric energy: a huge potential still to be tapped



- Wind**
Wind energy will be the main source of electricity by 2050, with a production growing steadily both onshore and offshore. **By 2050, the onshore wind energy** infrastructure will undergo a 3-fold increase from 2015, reaching **a total of around 18,000 turbines**. This is still far less than the 29,000 turbines already installed in Germany in 2015. 3,000 offshore wind turbines will also be built.
- Solar**
Solar energy will also be **significantly expanded**, through small solar plants on individual houses, medium-sized structures on larger buildings, parking shelters, or large ground-based solar farms on brownfield sites or unused land unsuitable for agriculture.

Main sources of renewable energy under the *négaWatt* scenario



Comparison of the main sources of renewable energy production in 2015 and 2050 under the *négaWatt* scenario.



Fossil and nuclear energy

Towards a complete phase-out

The development of renewable energies, combined with the reduction in energy demand, should allow for nuclear energy production to be phased out by 2035 and fossil fuels by 2050.

Overview of our assumptions

Nuclear energy

Under the négaWatt scenario, none of the 58 reactors currently in service in France need to be maintained beyond a working lifespan of 40 years. The rate of their shut down takes into account:

- **energy issues:** the objective is to avoid any fall back on coal-fired plants or cause power cuts.
- **safety issues:** the absolute priority must be nuclear safety, as the ageing of nuclear reactors is currently a matter of growing concern.
- **industrial, economic and social issues** related to the nuclear sector.

Furthermore, the construction of the Flamanville EPR reactor, which has experienced serious conception problems and is becoming more and more expensive, is definitively dropped under the négaWatt scenario.

Fossil energy

As energy consumption decreases and renewable energy production increases, fossil energy (oil, gas and coal) will progressively fall out of use. This applies to energy production and particularly to heating buildings and road transport.

Key policies

1 Closing each existing nuclear reactor 40 years at the latest after commissioning.

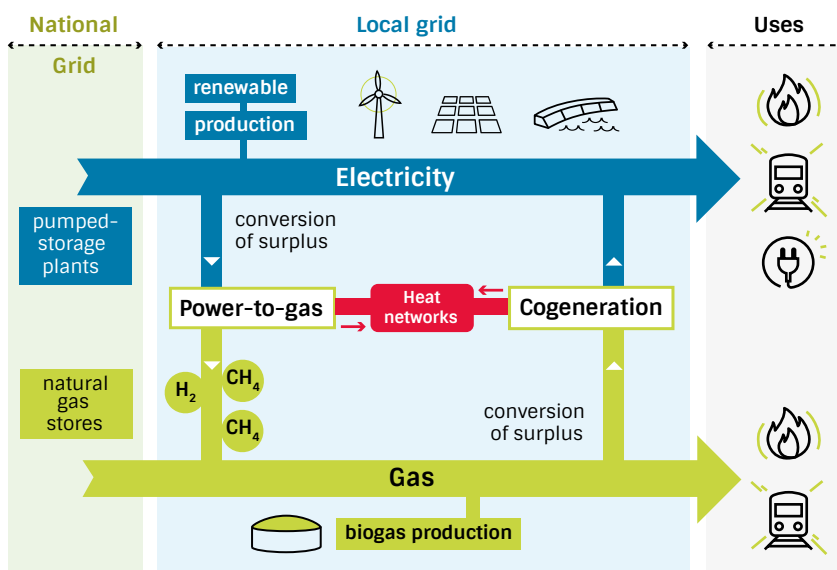
2 Setting up **career transition plans** for nuclear sector workers.

3 Fully reorienting energy taxation to stop supporting fossil and nuclear energy, and encourage the development of renewable energies instead.



Balancing the electricity grid

Developing power-to-gas technologies



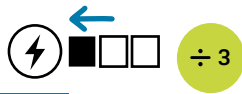
négaWatt has checked that all these assumptions are compatible with a constant balance between electricity supply and consumption, on an hourly basis until 2050. A key condition in achieving this balance is the development of power-to-gas (converting electricity to gas – hydrogen then methane).

Using renewable electricity surplus that appears in the scenario around 2030, power-to-gas provides grid stability and storage capacity. It allows for a massive increase in the installed capacity of wind and solar energy, and contributes to the security of the electricity system.

In addition to the possibility of storing this type of gas using existing infrastructure (gas network), renewable methane produced in this way can also be added to biogas from anaerobic digestion to supply various needs: transport, heating, electricity production, etc.

The French energy mix in 2050

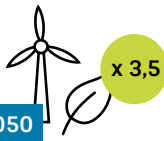
Significantly lower consumption, 100% covered by renewable energy



2050

100% renewable energy is achieved by reducing **primary energy consumption*** by two-third by 2050 and increasing **renewable energy production** 3.5-fold.

* energy contained in resources in their natural state (oil, uranium, wind, sun, etc.)



2050



2035

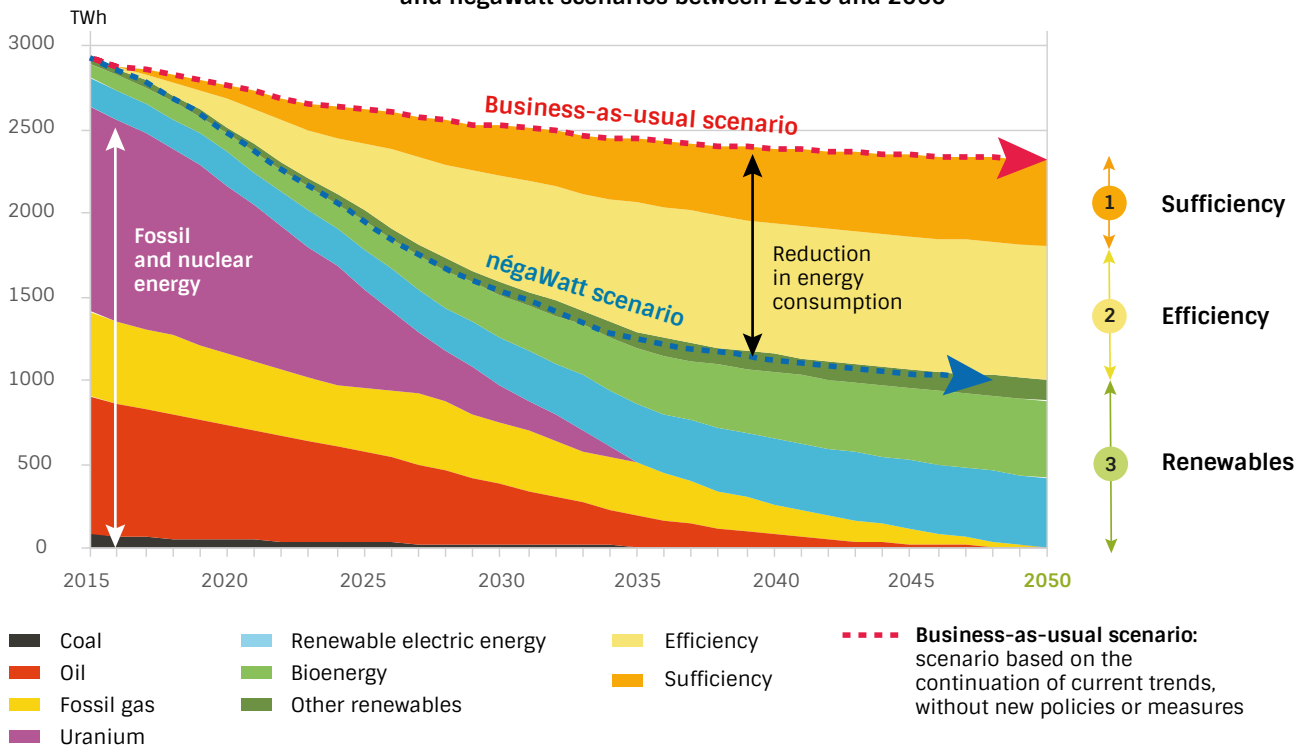
In 2035, **the last nuclear reactor is shut down.**



2050

By 2050, **oil, fossil gas and coal have disappeared** from the French energy mix.

Change in primary energy consumption in the business-as-usual and négaWatt scenarios between 2015 and 2050



Carbon neutrality

The sufficiency, efficiency, and renewable wedges in all sectors between 2017 and 2050 lead to a massive reduction in greenhouse gas emissions.



CO₂ emissions linked to energy consumption will be 52 times lower.



Methane emissions, which mainly come from the agricultural sector, will be halved.



All greenhouse gas emissions will decrease seven-fold.

The transformation of the agricultural and forestry systems detailed in the Afterres2050 scenario stimulates the role of carbon sinks in farmed lands and forests. By 2050, these will **offset the remaining greenhouse gas emissions and ensure the carbon neutrality of the country.**

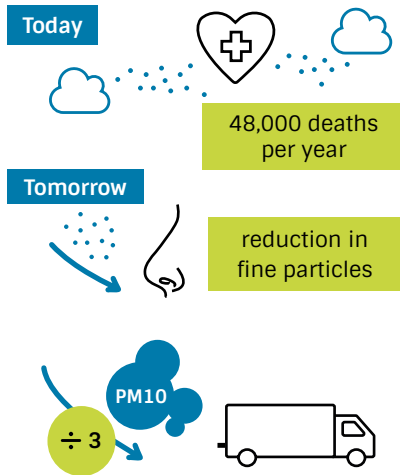
The négaWatt scenario is the first on the table to reach the objective of carbon neutrality for France included in the Paris Agreement.

Carbon sinks

To grow, a tree captures carbon from the atmosphere using the sun energy (photosynthesis). **A growing forest is termed a 'carbon sink' as it captures more carbon than it emits.** By changing agricultural practices, the soil itself can also become a carbon sink. For example, no-till farming allows more carbon to be stored in the soil.

Socio-economic and environmental benefits

Better air quality

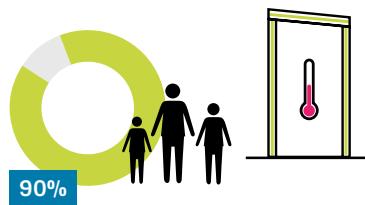


Air pollution is responsible for around 48,000 premature deaths per year in France and represents a major public health issue.

Many of the assumptions included in the négaWatt scenario contribute to a significant reduction in fine particle emissions: reducing road traffic, phasing out diesel, reducing heating needs, modernising wood-burners, changing agricultural practices, etc.

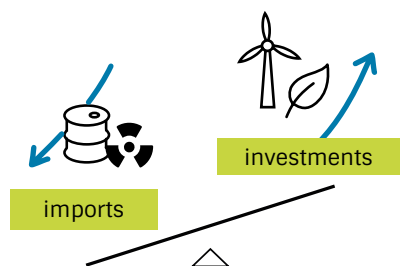
In the road sector, these emissions are halved threefold by 2050. This sector is the biggest emitter of fine particles in areas with the highest concentrations, and therefore the most dangerous.

A huge reduction in energy poverty



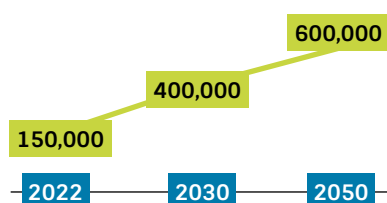
Energy poverty hits 10% of French households with low incomes, who are affected by high energy costs due to poor housing conditions. They often have difficulty heating their homes all winter long. By significantly reducing heating needs, and therefore heating bills, building renovation provides a sound solution to this problem. The négaWatt scenario lifts almost 90% of the affected households out of energy poverty.

Saving 400 billion Euros



Over the 2017–2050 period, the négaWatt scenario fosters energy savings worth of around 400 billion Euros, in comparison with a business-as-usual scenario. These savings mainly come from the large reduction in fossil fuel imports, and are much higher than the investments needed to implement the energy transition.

600,000 jobs created by 2050

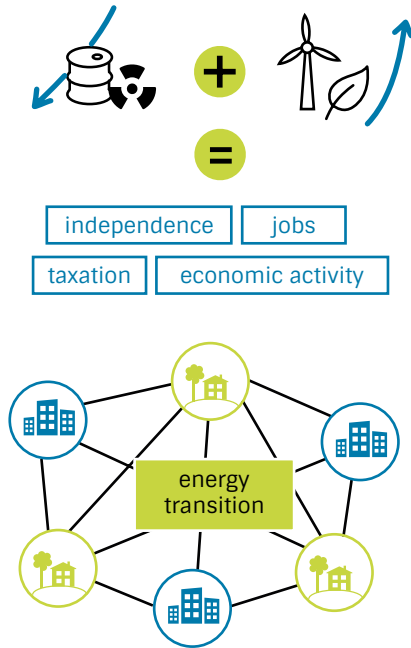


In the négaWatt scenario, the renovation and renewable energy sectors experience major growth rates. In contrast, the automobile and nuclear sectors will decline. Combined, the net result on jobs is positive compared to a business-as-usual scenario – more than 150,000 jobs created in 2022, 400,000 in 2030 and 600,000 by 2050.

From local to global benefits

The négaWatt scenario is based on an approach encouraging local energy resources and activities, which should improve the balance between the local and national levels in terms of positive impacts and governance.

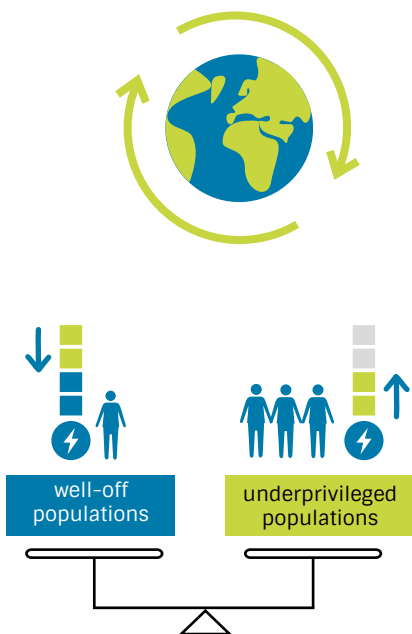
A local project for all regions



The beneficial effects of reducing fossil energy and uranium imports at national level, combined with higher renewable energy production, can be transposed at the local level, contributing to a greater energy independence of regions. Beyond this direct effect, **the energy transition described in the scenario will have a significant impact in terms of tax distribution, economic activity and jobs, that will benefit local economic and social stakeholders.**

The unbalanced distribution of resources and needs between urban and rural areas paradoxically paves a way for more cooperation between these two entities which too often mistrust each other. The energy transition provides an opportunity to re-establish solidarity between territories of different nature.

A message of solidarity and responsibility



What is true at national level is even more relevant at the global scale, where access to energy remains a major factor of inequality. Control over fossil resources is one of the causes behind many armed conflicts, and growing disparities in the world in terms of energy consumption are part of increasing inequality between the richest and poorest populations. **The energy transition alone cannot solve every problem, but is essential to avoid humanity sinking into a downward spiral of endless crises.**

négaWatt sees its approach and scenario for France as an opportunity to also convey a message of solidarity towards the rest of the world. **In a future where conventional energy will probably be scarce, sufficiency policies in developed countries can help freeing up more energy to supply the vital needs of the less privileged populations.** Developing an energy system based on local resources and shared supply ownership is also a way to break with the habit of preying on the poorest country resources, which has shaped our world until now.

The growing success of the négaWatt approach



2017

Publication of the 4th négaWatt scenario (2017-2050)



2015

French Energy Transition Bill for Green Growth

- The first article of the law mentions the **objective of halving energy consumption by 2050**, a target in line with the négaWatt scenario.
- It is the first time a legal text refers to both principles of **energy sufficiency and efficiency** - something the association has been promoting for 15 years through the 'négaWatt approach'.

LA TRANSITION ÉNERGÉTIQUE pour la
CRÉISSANCE VERTE



2013

National debate on the energy transition

- Several members of the négaWatt association are actively involved in various official bodies of the debate (Secretary-General, Expert Committee, National Debate Council...).
- The négaWatt scenario is chosen as **one of the four reference scenarios for this debate**, alongside e.g. the ADEME scenario.



2011

Publication of the 3rd négaWatt scenario



2007

Grenelle de l'environnement (Environment round table)

- The négaWatt Association is a member of three operational committees.
- A number of measures backed at this event are (partially) based on négaWatt proposals, such as **a vehicle bonus-malus scheme** and new **thermal regulation for buildings** (one of the most ambitious measures of its kind in Europe at the time of its adoption in 2010).



2006

Publication of the 2nd négaWatt scenario

négaWatt association attends the Elysée Palace to present its building renovation plan.



2003

Energy Debate in France

négaWatt advocates for two key measures: **an ambitious renovation plan**, and a measure to set standards on the electricity consumption of appliances, introduced at the EU level a few years later.



2003

Publication of the 1st négaWatt scenario



2001

Creation of the négaWatt Association

Become a member or benefactor at www.negawatt.org/soutenir-negawatt

↘ négaWatt Association



ASSOCIATION
négaWatt

The négaWatt Association was founded in 2001 by a group of independent energy experts and practitioners, with the aim of **promoting a more sustainable energy system in France**. Today it gathers a network of over 1,200 members supporting its actions.

The financial resources of this non-profit association mainly come from contributions and donations of its members, as well as contributions from foundations, philanthropists, and other NGOs.

The publication of the 2017–2050 négaWatt scenario was funded through a crowdfunding campaign launched in 2016, and a support from the Charles Léopold Mayer Foundation for the Progress of Humankind.



The négaWatt scenario, like other activities of the association, is mainly the result of a collective effort by volunteers and the sharing of expertise between the members of the association in many areas.

To support the négaWatt Association and its work:

www.negawatt.org/soutenir-negawatt



The négaWatt Association runs the website 'DÉCRYPTER l'ÉNERGIE' which challenges popular misconceptions about the energy transition through **detailed and referenced analysis** (most articles can be accessed in English).
www.decrypterlenergie.org

↘ négaWatt Institute



INSTITUT
négaWatt

The négaWatt Institute is the operational branch of the association and was established in 2009. It aims at preparing and providing support to the energy transition at the local level, based on the principles of the négaWatt scenario. The institute, which has been awarded the status of 'socially conscious company', is an incubator for pilot projects linked to the energy transition. For several years, it has worked through a partnership-based approach on an operational energy renovation scheme for detached houses, known as the Dorémi programme.

www.institut-negawatt.com

Going further

Resources on the négaWatt scenario are available on the following webpages:

In English: www.negawatt.org/en

- An executive summary of the 2017–2050 négaWatt scenario
- A video explaining the role of energy sufficiency in a 100% renewable scenario
- A document presenting the concept of energy sufficiency

In French: www.negawatt.org/scenario-negaWatt-2017

- An in-depth presentation of the négaWatt scenario
- Dynamic graphs: www.negawatt.org/scenario
- A selection of videos



negawatt.org



@nWassociation



[negaWatt.association](https://www.facebook.com/negaWatt.association)



Association négaWatt