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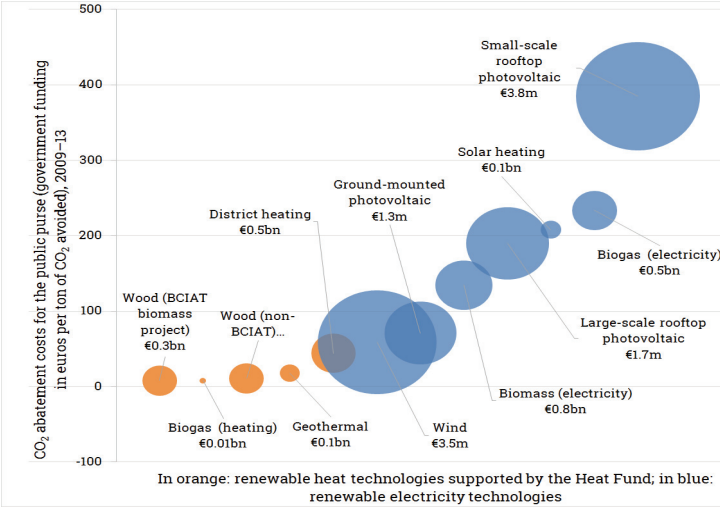
Renewable energy sources for heating

- In France, energy consumption for heating accounts for nearly half of final energy consumption. Energy for heating still largely comes from fossil fuel sources (with more than 60% of energy for heating coming from natural gas, fuel oil and coal), making this sector a crucial battleground for decarbonising the economy.
- Fuelwood, mainly used to produce heat, is currently the leading renewable energy source in France, ahead of hydropower. However, France is lagging behind on its renewable heat targets: in 2016, 20.7% of heat was produced using renewable energy sources, compared to a target of 25.5%.
- Renewable heat technologies are generally cost competitive with fossil fuel sources (i.e. gas and oil). Therefore, they offer a relatively low cost per ton of CO_2 avoided, below that of renewable electricity sources such as wind and solar power (see the chart below).
- The main driver for renewable heat is the implementation of a high carbon price. The 2018 Budget Act adjusted the trajectory for the carbon component of energy taxes upwards. This component will rise to €86.20 per ton of carbon in 2022, making renewable heat technologies much more competitive.
- Nevertheless, investment barriers persist (including a lack of information and difficulties obtaining funding). This situation warrants energy performance standards for buildings, as well as continued government incentives, notably through the Heat Fund (*Fonds Chaleur*) and the Energy Transition Tax Credit (*Crédit d'impôt pour la transition écologique*, CITE), provided such incentives are targeted to the most efficient technologies.

CO_2 abatement costs of technologies supported by the Heat Fund (2009-13) and amount of government funding (2009-14)



Source: Heat Fund, Government Audit Office and DG Trésor. DG Trésor calculations.

See L. Grazi and A. Souletie (2016), "Renewable energies: public policy challenges", Trésor-Economics no. 162.

1. Overview of renewable energy sources for heating in France[1]

1.1 Heating accounts for half of energy consumption and still mainly comesfrom fossil fuel sources

Energy consumption for heating accounts for nearly half of final energy consumption in France. In 2015, final energy consumption in mainland France (including electricity and transport) totalled 149 million tonnes of oil equivalent (TOE),[2] with consumption for heating of 70 million TOE, i.e. 47% of the total. Energy for heating still largely comes from fossil fuel sources. In 2015, nearly two-thirds of production came from a combination of natural gas (41%), fuel oil (17%) and coal (8%, for heating in the industrial sector). The remaining third came from electricity (17% – French electricity production produces very low carbon emissions) and renewable heat sources (18%). The latter category encompasses a wide array of technologies for space heating and sanitary hot water:

- Biomass (mainly wood) is used to heat one or more rooms. It can also be connected to a central heating system or a water heater via a boiler (either in detached houses or multidwellings).
- Biogas is produced through fermentation (anaerobic digestion) of waste (including household waste, sewage sludge or farm waste).
- Solar heating yields sanitary hot water and can, in some cases, contribute to heating buildings. The most common such technology is the individual solar water heater.
- Geothermal involves tapping heat energy in the ground. Underground temperatures increase with depth (temperatures ranging from 10°C to 100°C can be exploited for geothermal purposes).
- A heat pump is a thermodynamic device that transfers heat energy from a colder space (e.g. outside a home) to a warmer space (e.g. inside the home). Heat pumps can be "air source" (using air as a source of heat) or "ground source" (using the ground or a body of water as a source of heat).
- Heat recovery units transfer heat generated as a by-product of other processes. Such heat comes from a wide variety of sources: factories and industrial sites, commercial buildings, data centres, or waste treatment facilities.
- In district heating systems, a central boiler station generates heat (in the form of hot water or steam), which is then distributed to residential buildings or businesses via a network of underground pipes within a district or city. Whether or not such systems are renewable depends on the fuel source for the central boiler station.

1.2 France is lagging behind on its renewable heat targets

Directive 2009/28/EC set a target for France to generate 23% of its gross final national consumption[3] from renewable energy sources by 2020. In 2016, renewable energy sources accounted for 15.7% of France's gross final consumption, compared to the 18.0% forecast in the indicative trajectory (see Table 1). The gap was notably due to a substantial lag in renewable energy for heating and cooling, which accounted for 20.7% of energy consumption for heating and cooling, compared to a target of 25.5%.

The 2010 national action plan on renewable energy laid out targets and trajectories for the various renewable energy sources for heating. However, only heat pumps have surpassed their target. The other renewable sources are behind schedule: biomass is at 75% of the target, and the other technologies are below 50%.

Table 1: Renewable energy sources as a percent of gross final energy consumption in 2016

	2016 actual figures	2016 indicative trajectory target	2020 target
Heating and cooling	20.7%	25.5%	33.0%
Electicity	19.1%	21.5%	27.0%
Transport	8.7%	8.4%	10.5%
Total	15.7%	18.0%	23.0%

Source: CGDD, "Les énergies renouvelables en France en 2016" (2017, available in French only).

(1) See A. Souletie (2018), "Les énergies renouvelables thermiques", *Les Documents de Travail de la DG Trésor* no. 2018/2.
(2) Final consumption only takes into account the energy actually delivered to consumers (namely households and businesses) for end consumption, whereas primary energy also includes the energy used in the energy production process.
(3) I.e. not adjusted for weather fluctuations.

1.3 Production costs for renewable heat technologies are similar to those for fossil fuel sources

For detached houses, wood heating is, in some cases, as cost efficient as gas condensing boilers (which are the most cost-efficient fossil fuel heating technology). In 2016, the cost of wood heating was €54-100/MWh vs. around €84/MWh for gas-fired boilers.[4] Heat pumps were more costly (€116-145/MWh), but still competitive with electric condensers (€154/MWh). Conversely, solar heating was much more costly than gas-fired boilers (between €181 and €366 per MWh).

However, for multidwellings and for the industrial and tertiary sectors, renewable heat technologies were systematically more costly than gas-fired boilers in 2016. In some cases, the cost differential was slight, for instance for industrial biomass (cost ranging from €46 to €96 per MWh, vs. €40-75/MWh for industrial gas-fired boilers), ground-source heat pumps (€56-114/MWh), or deep geothermal heating systems (€74-99/MWh).

Lastly, while the cost of energy from district heating networks varies widely, these networks are generally cost competitive, notably networks that use renewable energy sources (which generated energy at an average cost of €68/MWh in 2015).[5]

2. Government support for renewable heat involves various approaches

The most effective instrument for encouraging the ramp-up of renewable heat is to set a high carbon price. This increases the relative cost of fossil fuel technologies compared to clean technologies, thereby fostering the adoption of clean technologies at a lower cost for the public purse while ensuring technology neutrality. In this respect, the upward revision to the trajectory of the carbon component of energy taxes, included as a provision in the initial 2018 Budget Act, will substantially boost the competitiveness of renewable heat technologies. The carbon component of energy taxes stands at €44.60/tCO2 in 2018 and will rise to €86.20/tCO2 in 2022. A carbon tax at those levels will raise the cost of energy produced from natural gas by €10/MWh in 2018 and €19.40/MWh in 2022 compared to a baseline scenario with no carbon tax.

However, the shift to renewable heat technologies may be hampered by several obstacles (including a lack of information, difficulties obtaining funding, or consumers failing to take into account the long-term gains of a sizeable upfront investment). Hence incentive measures are warranted.

2.1 The Energy Transition Tax Credit (CITE) should target the most efficient technologies

In the case of renewable heat technologies, the CITE gives households a 30% subsidy for the purchase of equipment that uses renewable energy sources (such as wood-fired boilers), heat pumps or connections to a district heating network that uses renewable energy sources. In 2017, the CITE provided €300m in subsidies for renewable heat. Due to their higher fixed costs, renewable heat technologies may have longer payback periods than fossil fuel technologies. Hence, subsidies could provide the proper incentive to consumers who do not want to wait for their investments to pay off. This situation warrants continuing the CITE for the least-costly renewable heat technologies, notably the most efficient wood-fired boilers (i.e. those that generate very low levels of fine particle emissions).

2.2 Building standards can encourage the energy transition

The CITE is not always able to trigger efficient investments due to certain specific constraints – such as the difficulty apportioning financial gains between landlords and tenants. This warrants the setting of standards. The next round of energy performance regulations will set standards for buildings built after 2020. In particular, all these buildings will have to comply with the "positive energy" standard, i.e. their energy consumption will have to be lower than their production of renewable energy. To fulfil this criterion, renewable electricity and renewable heat technologies will be used. Nevertheless, the government must ensure that the future energy performance regulations do not distort the market in favour of renewable electricity technologies because the development of these technologies requires more public funding than renewable heat technologies.

2.3 The Heat Fund finances generally efficient renewable heat technologies at a relatively low cost for the public purse

The Heat Fund provides support to renewable heat technologies (including biomass, geothermal, solar heating, biogas and district heating networks) for multidwellings, local government entities and companies. This fund, which

(4) All cost estimates are taken from ADEME, "*Coûts des énergies renouvelables en France*" (2016, available in French only).
(5) Source: AMORCE, "*Compétitivité des réseaux de chaleur en 2015*" (available in French only).

is managed by the ADEME (environmental and energy management agency) has been endowed with €215m for 2018. It carries out a process to select the most profitable projects by providing subsidies that are tailored so that the projects will be competitive with fossil fuel technologies (in most cases, natural gas). The Heat Fund finances technologies that are very efficient overall, and the amounts allocated seem relatively low compared to the funds granted to renewable electricity projects, which are much costlier (see Table 2). Hence the Heat Fund warrants being continued alongside the increase in the carbon component of energy taxes.

Table 2: CO_2 abatement costs of technologies supported by the Heat Fund (2009-13) and amount of government funding (2009-14)

	Cost per ton of CO2-equivalent avoided (€/t CO_2-eq) over the period 2009-13	Cumulative government funding over the period 2009-14 (€ billion)
Wood other than BCIAT[a]	11	0.3
Wood BCIAT	8	0.3
Geothermal	18	0.1
Biogas	8	0.01
Solar heating	208	0.1
District heating networks	44	0.5
Total heating		**1.2**
Small scale rooftop photovoltaic	235-535	3.8
Large-scale rooftop photovoltaic	190	1.7
Ground-mounted photovoltaic	71	1.3
Biomass	67-202	0.8
Biogas	94-373	0.5
Onshore wind	59	3.5
Total, electricity		**11.7**

a. BCIAT: Biomass Heat for Industry, Agriculture and Tertiary.

Source: Heat Fund, Government Audit Office and DG Trésor. DG Trésor calculations. We assume a 4% discount rate over 20 years.

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