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The Climate Divide: Who Bears the Costs?

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In the face of climate change, households and firms are neither exposed to the same risks nor equally able to protect themselves against them. While recent economic research has led to a substantial upward reassessment of long-term climate damages, their distribution remains insufficiently documented: the geography of hazards is increasingly well understood, but little is known about the characteristics of the populations and firms affected and their resilience to them. Drawing on original empirical analyses, this Note sheds light on these divides in order to guide mitigation and adaptation policies.

There is no single social profile of overexposure: relatively affluent households, often homeowners, are more exposed to clay shrink-swell and forest fires, whereas low-income households are more exposed to coastal flooding. For firms, sector and location are decisive. Yet being exposed does not mean having the same means of protection: at comparable exposure, damages depend on sensitivity and adaptive capacity. Age, health, housing quality and financial resources matter for households. For firms, financing constraints and the option of moving activity to another site are decisive. Heat, which will affect the entire country, brings these inequalities into particularly sharp relief, both at home and at work.

Three guiding principles must shape public action. First, the price signal is indispensable for decarbonisation, but it must be combined with a significant redistribution of the revenue it generates, particularly in view of the entry into force of the new European emissions trading system for buildings and road transport (ETS 2). Second, private adaptation must be complemented by public intervention wherever there are market failures and equity concerns. Finally, public intervention should be assessed in terms of the social value of each public euro spent, taking into account its distributional effects and budgetary constraints.

In particular, the Note proposes strengthening protection against heat: incorporating summer thermal comfort into the energy performance certificate and renovation subsidies, giving priority to social housing, and making heat in the workplace a subject of collective bargaining. The natural catastrophe insurance scheme (CatNat) should preserve national risk-pooling for the existing building stock and strengthen prevention. New construction in high-risk areas should be restricted, notably through a tax. Public support for agriculture and crop insurance should accompany the transformation of production systems and the reduction of their climate vulnerability. These measures are complemented by proposals to improve information on risks and to target support for firms more effectively.

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Introduction

Summer 2026 was the hottest on record since 1900, with an average temperature of 24.0°C, i.e. 3.6°C above the 1991-2020 average,[1] and 53 heatwave days, compared with 33 in 2022.

It is too early to assess the full consequences of these climate events, but initial estimates suggest that the 2026 heatwave reduced annual GDP growth by at least 0.1 percentage points, mainly attributable to the fall in agricultural output.[2] The heatwave also put pressure on infrastructure, notably the nuclear fleet and the rail network, as well as on business activity. In terms of health, every heatwave period of the summer showed excess mortality, particularly the period from 17 June to 2 July, with 5,764 excess deaths.[3]

These consequences offer a foretaste of the macroeconomic damage that climate change will cause if we do nothing and, beyond that, they raise the question of how this damage is distributed across the population.

Potentially very large macroeconomic damages

Recent work by Adrien Bilal and Diego Känzig[4] – of which an application to the French and European contexts is presented in Focus no. 152 – leads to a substantial upward reassessment of the macroeconomic damages of global warming.[5] These damages are caused by the gradual rise in average temperature and by the increasing frequency and intensity of extreme weather events. Beyond the direct destruction caused by these events, heat affects productivity, health, learning, capital accumulation, water availability and the ecosystem services on which we depend. The damage to France and the European Union will be substantial, with long-term losses in GDP per capita that could reach as much as 20 to 30% per degree of global warming. The gains from decarbonisation are therefore considerable. Naturally, decarbonisation is preferable if coordinated among as many countries as possible. However, the research presented in Focus no. 152 shows that, contrary to received wisdom, Europe gains even if it acts unilaterally: the damages it avoids exceed the cost of its efforts.

> **Finding 1**. Given the considerable damage that global warming will cause if it is not contained, it is in the European Union's interest to implement an ambitious climate policy, even if it has to act unilaterally.

Adaptation is not, however, a substitute for mitigation.[6] The greater the warming, the higher the adaptation expenditure required, with some losses becoming irreversible. Ambitious mitigation and adaptation policies must therefore be pursued together, preventing damage as far as possible rather than merely reacting to extreme events.

The costs of mitigation and adaptation are not borne evenly. Their distribution depends not only on economic agents' exposure to climate change, but also on their vulnerability to its effects. In this context, who pays for the climate divide(s)?

One or more climate divides?

Climate change affects households unequally, in terms of their income, wealth, health and working conditions. Firms and territories are also unequally affected.

Three dimensions of the climate divide can be distinguished.[7] The first is a divide in exposure: households and firms do not all live and produce in the same places. The second is a divide in sensitivity: controlling for exposure, damages depend on the quality of buildings, on people's age and health, on working conditions or on firms' position along the supply chain. The third is a divide in adaptive capacity: access to

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[1] Météo-France (2026): 'Bilan climatique de l'été 2026' [Climate review of summer 2026], Météo-France, 18 pp.

[2] Insee (2026, 10 September): 'Vue d'ensemble – Vigilance orange sur la croissance' [Overview – Amber alert on growth], *Note de conjoncture*, Insee, p. 22.

[3] Santé publique France (2026, 22 July): 5 764 décès en excès en France durant la période de canicule du 17 juin au 2 juillet' [5,764 excess deaths in France during the heatwave period from 17 June to 2 July].

[4] Bilal A., Känzig D. R. (2026): 'The Macroeconomic Impact of Climate Change: Global Versus Local Temperature', *The Quarterly Journal of Economics*, no. 141(2), pp. 889-944. For further details on the French application of the model, see Bilal A. (2026): 'La France à l'ère du changement climatique' [France in the era of climate change], Focus du CAE no. 152, November 2026.

[5] For a meta-analysis of earlier work on damage functions, see: Howard P. H., Sterner T. (2025): 'Methodology Matters: A Careful Meta-Analysis of Climate Damages', *Environmental and Resource Economics*, vol. 88, pp. 3289-3327.

[6] Adaptation policies aim to reduce the vulnerability of populations, economic activities and ecosystems to the current and future effects of climate change. Mitigation policies aim to curb climate change by reducing greenhouse gas emissions.

[7] We adopt the terminology of the IPCC: IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability. The literature also refers to vulnerability, which is determined by sensitivity to damage and the capacity to cope with it, i.e. adaptive capacity.

information, credit, equipment, insurance or mobility is highly unequal[8].

The mission entrusted to the French Council of Economic Analysis (Conseil d'analyse économique, CAE), carried out with the support of the Igas, the IGEDD and the IGF, aims to identify these divides and to propose policy responses. It draws on original research, set out in seven complementary Focus papers: a new estimate of the macroeconomic costs of climate change, a mapping of the main climate hazards to which households and firms are exposed, an analysis of original data on flooding in northern France, and an analysis of the Housing Survey data on household air-conditioning equipment. It also draws on reviews of the academic literature on household exposure to climate hazards, on the distributional effects of mitigation policies and on agricultural adaptation.

The divides identified are no reason to abandon climate action. On the contrary, they call for policies that are better targeted according to differentiated vulnerabilities, for stronger adaptation that takes account of its distributional effects and of the externalities it generates, and for the restoration of an effective price signal on greenhouse gas emissions, while organising support for the most vulnerable.

An economy that is already highly exposed

Summer 2026, which broke all heat and drought records in France, revealed – if proof were needed – just how vulnerable the French economy is to the effects of climate change.

Widespread exposure, without a single fault line

Focus nos. 154 and 155[9] document in detail the exposure of households and firms to extreme weather events according to their socio-economic characteristics. This work is part of the mapping approach recommended by the Third National Climate Change Adaptation Plan (Troisième plan national d'adaptation au changement climatique, PNACC-3) and pursued by numerous institutions (Météo-France, the Centre for Studies and Expertise on Risks, the Environment, Mobility and Urban Planning (Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement, Cerema), the French Geological Survey (Bureau de recherches géologiques et minières, BRGM), etc.).

Every part of France will be affected by at least one climate hazard, but in very different combinations. Heatwaves will intensify everywhere; fires will spread in the South-West and around the Mediterranean; the impacts of river flooding will remain concentrated in densely populated areas along watercourses; and coastal flooding will affect coastal areas.

The most exposed households differ from one hazard to another. According to work by the French National Institute of Statistics and Economic Studies (Institut national de la statistique et des études économiques, Insee)[10], clay shrink-swell and forest fires mainly affect relatively affluent owners of detached houses in peri-urban or rural areas: 76% of households exposed to clay shrink-swell are owner-occupiers, while owner-occupiers account for only 54% of households. Coastal flooding, by contrast, affects low-income households more (1.4% of the first decile compared with 0.7% of the top decile). Taking all hazards into account, 35% of households in the first decile and 53% of those in the ninth are exposed, but this gap is almost entirely due to clay shrink-swell and does not give an accurate picture of differences in household exposure.

Summary of firms' estimated exposure to climate hazards under the current climate

Climate hazard considered	Share of value added exposed	Share of employment exposed (FTE)	Over-exposure of occupational categories and sectors
More than 20 heatwave days in 2050	53.9%	60.5%	Occupations: manual workers, clerical and service workers
River flooding (10-year return period)	9%	7.5%	Occupations: managers and professionals Sectors: information and communication, industry
Coastal flooding	0.6%	0.7%	Occupations: manual workers; Sectors: retail and industry
Areas highly sensitive to forest fires	2.5%	2.6%	Occupations: seasonal workers Sectors: industry, construction

Note: Exposures are not directly comparable across hazards, as the zoning is not based on uniform thresholds. These data cover metropolitan France. How to read: 54% of value added and 60.5% of employment will be exposed to more than 20 heatwave days in 2050. Manual workers and clerical workers will be over-exposed.

Sources: Focus no. 155 for further details.

Firms' exposure is high overall but varies across territories. The risk of a 100-year flood (with a 1% probability of occurring each year) concerns 12.7% of market value added (and 11%

[8] Carleton T., Duflo E., Jack K., Zappalà G. (2024): 'Adaptation to Climate Change', in Barrage L., Hsiang S. (eds), Handbook of the Economics of Climate Change, vol. 1.

[9] Henriet F., Huang L., Jodogne-del Litto K., Seilles P., Spratt E. (2026): 'L'exposition des ménages aux risques climatiques' [Household exposure to climate risks], *Focus du CAE* no. 154, November; Fontaine F., Jodogne-del Litto K. (2026): 'La fracture écologique productive : les entreprises face aux chocs climatiques' [The productive ecological divide: firms facing climate shocks], *Focus du CAE* no. 155, November.

[10] André M., Moutachaker I., Nass S., Sixou J. (2026): 'Exposition aux aléas climatiques des ménages et de leur patrimoine immobilier : une évaluation de la situation française' [Exposure of households and their property assets to climate hazards: an assessment of the French situation], Insee.

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of employment), but 50-60% in certain employment areas (Le Havre, Bollène-Pierrelatte, Montbéliard), without taking into account the public policies in place. The risk of coastal flooding affects only 0.6% of national value added, but 64% in Calais and 38% in Dunkirk. Firms that will experience more than 20 heatwave days in 2050 account for 54% of value added and 60% of employment. Some territories face multiple hazards, which limits the scope for simple adaptation. Exposure also depends on sector and occupation. Industry accounts for 22.4% of value added, but around 31% of the value added exposed to coastal flooding, and it is also over-exposed to river flooding. Manual workers and temporary agency workers are over-exposed to coastal flooding, seasonal workers to fires, and managers and professionals to river flooding (29% of exposed employment, compared with 23.6% of total employment). Sector and geography are the main variables explaining variation in firms' exposure to climate hazards – not their size, productivity or indebtedness.

> **Finding 2**. There is no single socio-economic profile of over-exposure to hazards. For households, the over-exposed profiles vary according to the hazard. The most exposed are sometimes relatively affluent households that are often homeowners (clay shrink-swell, forest fires), and sometimes low-income households (coastal flooding). For firms, exposure varies mainly according to location and sector, and very little according to size or financial health.

Highly unequal vulnerabilities

Beyond exposure, vulnerability – which determines the extent of the damage suffered for a given exposure and hazard – depends on both the sensitivity and the adaptive capacity of economic agents. For households, sensitivity stems first and foremost from individual characteristics: older people, young children and people with chronic illnesses are more vulnerable to the health effects of heatwaves or forest fires, regardless of their economic situation. Adaptive capacity, on the other hand, depends largely on financial means. A flood increases the probability of leaving one's municipality within two years by around 30%, but this increase is concentrated among middle-income households, as the poorest stay for lack of means[11]. A loss represents 20% of the property wealth of a single-property owner, compared with 3% for a multiple-property owner[12].

Exposure and vulnerability may, moreover, work in opposite directions. Home ownership, for example, can be a factor of greater exposure, as in the case of clay shrink-swell or when wealth is tied up in a high-risk area, but it can also be a factor of lower vulnerability because it facilitates certain investments. Current income is not the sole determinant of vulnerability.

For firms, damage operates through several channels and extends beyond the destruction of capital and the site affected. Heat reduces productivity, increases absenteeism and damages health (see below). Water restrictions can cause significant production losses: in France, they reduce the output of concerned establishments by around 7%, amounting to more than €3 billion in losses in 2022-2023[13]. After a flood, firms may close, relocate, or cut jobs and wages. Floods have lasting effects: five years on, firms in an affected municipality have a 2% higher exit rate and 8% lower sales[14], and local employment falls by 1.7 to 2%[15]. These effects spill over to suppliers, local public finances and social protection schemes. The losses are also transmitted to neighbouring firms up to around 20 km away, as well as to customers: a supplier hit by a disaster reduces its customers' sales growth by 2 to 3 percentage points[16].

As with households, the extent of damage depends, for a given exposure, on each firm's capacity to respond, which is highly unequal. Affected firms are 12 percentage points more likely to need credit and 5 points more likely to be refused it[17]. Job losses after a flood are greater for single-establishment firms, which cannot shift their activity to another site. Finally, although French firms do factor their expectations of warming into their investment decisions[18], the smallest and most financially constrained firms adapt less.

[11] Le Thi C., Millock K. and Sixou J. (2025): 'Inondations et mobilité résidentielle en France' [Floods and residential mobility in France], *Documents de travail*, no. 2025-06, Insee, April.

[12] Bézy T. (2025): 'Real Estate Wealth Inequality and Exposure to Natural Disasters', *World Inequality Lab Working Paper*, no. 2025/16.

[13] Tarabbia T. (2026): 'Impacts of Droughts and Water Restrictions on Industrial Production', PSE.

[14] Berardi N., Vertier P., Zapha C., Malhaire E., Tapin J. (2026): 'The Impact of Floods on Firm Performance and Relocation', Working Papers, no. 1047, Banque de France.

[15] Salem A. (2025): 'After the Flood: The Impact of Flooding on Employment and Wages in French Firms', PSE.

[16] Barrot J.-N., Sauvagnat J. (2016): 'Input Specificity and the Propagation of Idiosyncratic Shocks in Production Networks', *The Quarterly Journal of Economics*, no. 131(3), pp. 1543–1592.

[17] Benincasa E., Betz F., Gattini L. (2024): 'How do Firms Cope with Losses from Extreme Weather Events?', *Journal of Corporate Finance*, vol. 84, 102508.

[18] Guillet M. (2024): 'Trois essais sur l'adaptation au réchauffement climatique en France' [Three essays on adaptation to global warming in France], doctoral thesis, PSL.

Finding 3. For equal exposure, potential damages depend on sensitivity to damage and on adaptive capacity, both of which are highly unequal. Low-income households have less room to absorb a loss or to leave a high-risk area. Small, single-establishment and more financially constrained firms are the most fragile. Economic shocks spread across the local area and along value chains.

The special case of heat

Heat differs from other hazards in that it will eventually affect the whole country at the same time. By 2050, almost all value added would be exposed to at least 10 heatwave days[19] a year, compared with 4 to 6 today, and 54% of value added and 60.5% of employment to more than 20 days a year. For households, 65% of the population would be exposed to more than 20 days a year.

At the national level, household exposure shows no marked social differences. Inequalities emerge at the neighbourhood level: within urban areas of more than 50,000 inhabitants, social housing accounts for 32% of dwellings located in climate zones susceptible to urban heat islands, compared with 21% of all dwellings[20].

Housing conditions widen these gaps. 42% of the social housing stock (Habitations à loyer modéré, HLM) is estimated to be poorly adapted to heatwaves, compared with 16% of owner-occupied dwellings[21]. Low-income households are also less likely to have fixed air conditioning or to have access to a cooler place of refuge. In 2003, controlling for exposure, excess mortality was twice as high in the most deprived cantons of the Île-de-France region[22]. Age plays a decisive role – older households are not over-exposed but account for most of the excess mortality (+60% among those aged 75 and over, compared with less than 30% among those aged 50-74 in 2003); in 2026, however, the percentage increase was greater among 45-64-year-olds (+55.4%) than among those aged 75 and over (+33.3%)[23].

Heat is also endured at work. 9.7 million workers, or 36% of total employment, already report being affected by high temperatures[24]. Workers who cannot telework – more often clerical workers, manual workers and women – face cumulative exposure at home, in transport and in the workplace. For firms, heat reduces productivity – an additional day above 32°C lowers total factor productivity by around 0.56%[25] – and increases absenteeism. It weighs more heavily on small establishments and can alter the local structure of the productive base in favour of the firms best able to finance their adaptation.

Summary of household exposure under the current climate

Risk	Exposure	Social profile and occupancy status	Geography
Clay shrink-swell	34% of dwellings	Over-exposure of middle and upper deciles and of house owners	Rural
Heat	65% of the population >20 days/ year by 2050	No simple national gradient, but tenants and social housing (HLM) over-exposed within cities	Urban / dense
River flooding	3.5% to 7.3% of dwellings, 500-year flood	Over-exposure of ground-floor owners. Over-representation of tenants in at-risk areas.	Large urban centres / intermediate centres
Fires	11.4% of households, all sensitivity classes	Over-exposure of affluent households, especially homeowners	Rural / peri-urban, South-West / Mediterranean
Coastal flooding	≈ 1% of dwellings, low-lying coastal zone	Primary residences: less affluent households; second homes: more affluent households	Coastal tourist areas

Note: Exposures are not directly comparable across hazards, as the zoning is not based on uniform thresholds. These data cover metropolitan France.
Sources: see Focus no. 154 for further details.

[19] According to Insee, which adopts Météo-France's definition, a heatwave is 'a sequence of at least three consecutive days during which the national average temperature does not fall below 23.4 degrees, with at least one day above 25.3 degrees'.

[20] See Focus du CAE n° 154 and 155.

[21] ObSoCo, Ademe, Grand Paris Aménagement, RTE (2026): 'Observatoire des usages et représentations des territoires' [Observatory of territorial uses and perceptions], wave 5.

[22] Rey G., Fouillet A., Bessemoulin P., Frayssinet P., Dufour A., Jougla E., Hémon D. (2009): 'Heat Exposure and Socio-economic Vulnerability as Synergistic Factors in Heat-Wave-Related Mortality', *European Journal of Epidemiology*, vol. 24(9), pp. 495–502.

[23] Santé publique France, 2026 (heatwave of 17 June to 2 July 2026; this was the first heatwave of the summer – the figures differ for subsequent ones).

[24] Benhamou S., Flamand J. (2023): 'Le travail à l'épreuve du changement climatique' [Work put to the test by climate change], France Stratégie, *Note d'analyse*, no. 123.

[25] Zhang P., Deschênes O., Meng K.C., Zhang J. (2018): 'Temperature Effects on Productivity and Factor Reallocation: Evidence from a Half Million Chinese Manufacturing Plants', *Journal of Environmental Economics and Management*, vol. 88, pp. 1–17.

Finding 4. Heat affects the whole country, but inequalities in exposure emerge within urban areas through urban heat islands. Controlling for exposure, low-income households, older people and workers who can neither telework nor adjust their working hours are particularly vulnerable. As for firms, the productivity shock caused by heat weighs more heavily on those that are less geographically diversified, more financially constrained and unable to shift their production elsewhere.

Adaptation policy suffers from a lack of localised information, which complicates the targeting and prioritisation of interventions. Many tools on climate risks already exist (Géorisques, Météo-France's DRIAS portals, Facili-TACCT for local authorities and, since 2026, the Banque de France's tool for firms). The PNACC-3 plans to supplement them. These tools provide information on the average exposure of locations and on impacts at the territorial level, sometimes for sectors such as agriculture, but they do not speak to which households and occupational categories are most exposed within a territory, nor to the share of employment and value added concerned, nor do they identify combined exposure and vulnerability. Yet it is at this fine-grained level that inequalities appear. The work carried out for this Note shows that such cross-referencing is possible by matching geolocated tax, social and accounting data to hazard maps. Such work nevertheless remains ad hoc and incomplete: protective infrastructure, land-use planning policies, past losses and adaptation expenditure are poorly accounted for. Yet prioritising public investment requires a distinction to be drawn between exposure, vulnerability and the value of damage avoided. Following the example of the stress tests used in the financial sector, we recommend combining different climate scenarios with data on exposure, on vulnerability of economic agents and on existing protective infrastructure, in order to identify the populations, firms and territories most likely to suffer damage.

Recommendation 1. Establish a public system of territorialised climate stress tests to assess the differentiated effects of climate hazards and the effectiveness of adaptation policies on a large scale and at a fine-grained level.

Combining environmental effectiveness and social equity

Structural tensions

Mitigation and adaptation policies must tread a fine line. They must ensure social acceptability without sacrificing environmental effectiveness, pool risks without weakening incentives, target support while maintaining the universality of certain protections, and allow private adaptation to operate while taking care of the adaptation that falls within the scope of public action. These tensions cannot be resolved by a single instrument. They call for an architecture combining a price signal, targeted support, regulation, collective investment, insurance and evaluation.

Mitigation: restoring the role of carbon pricing while using revenues to support households

Mitigation policies are potentially regressive, particularly when they lead to a uniform increase in fossil fuel prices that weighs disproportionately on the incomes of low-income households[26]. In 2024, energy expenditure accounted for 16.5% of the income of households in the bottom tenth of the standard-of-living distribution, compared with 3.2% for the top tenth. Within each decile, however, this share varies by a factor of two, as it depends on location and equipment: car dependency and the type of heating, for example, leave rural or low-income households particularly exposed.

Access to low-carbon alternatives is highly unequal, for both financial and non-financial reasons. First, low-income households have a lower capacity to invest: they are often unable to invest quickly in a renovation or a clean vehicle. Excluding subsidies, half of the investment needed by first-decile households cannot be financed, particularly in the case of electric cars. Other obstacles further complicate the transition for these households: a lack of suitable public transport, decisions that rest with the co-owners' association or the landlord, and a limited supply of second-hand electric vehicles (3% of sales in 2025)[27]. These barriers, though well documented, remain difficult to measure household by household, and therefore to incorporate into the targeting of support.

Since the Gilets jaunes ('Yellow Vests') crisis, mitigation policies have paid closer attention to their distributional effects. These effects, however, depend heavily on the choice and calibration of instruments. The regressivity of an increase in fossil fuel prices does not justify abandoning the price signal,

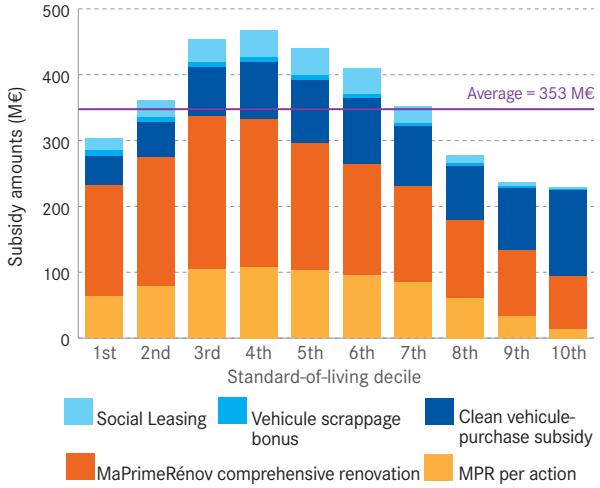
[26] Part of the observed regressivity stems from the fact that the reasoning is based on current income rather than total consumption: affluent households save a larger share of their income, which mechanically makes the expenditure appear heavier as a proportion of income for low-income households. With a life-cycle approach, regressivity relative to income is reduced but remains substantial.

[27] For further details on the importance of second-hand electric vehicles in decarbonising the car market, see Chassang S. (2025): 'Véhicule électrique : ne pas rater l'occasion' [Electric vehicles: not missing the (second-hand) opportunity], Note du CAE, no. 85, July.

whose effectiveness is well established[28], especially as standards and regulations can be just as regressive[29]. It does, however, require that the revenue from any new carbon tax be redistributed. Part of this revenue may be sufficient to offset the regressive effect in terms of income, by means of targeted transfers to low-income households[30]. These transfers, however, only imperfectly correct the inequalities linked to location and adaptive capacity. Part of the revenue can therefore also be used to remove the constraints that prevent constrained low-income households from accessing low-carbon alternatives.

The redistributive effect of subsidies depends on their targeting (Figure 1). Targeting has improved, but some poorly targeted schemes remain only weakly redistributive: in 2024, the bottom three income deciles received only 20% of the ecological bonus (the French clean-vehicle purchase subsidy), whose deadweight effect is around 80%[31].

Figure 1. Total subsidies by standard-of-living decile



Notes: This chart does not include all subsidies (e.g. energy savings certificates, reduced VAT on certain works, the eco-PTZ zero-interest loan, etc.). It covers 2024 and therefore does not reflect recent developments.

Sources: CGDD, SDES (RSVERO), ASP, Anah, Fidéli (Insee). See Focus no. 157.

Finding 5. The regressivity of energy taxation can be mitigated by direct transfers to low-income households. The fairness of subsidies for low-carbon investment depends on their targeting, which has gradually been strengthened. Households in the first decile, who are less often homeowners and replace their vehicles less frequently, nevertheless receive less than the average.

The forthcoming entry into force of ETS 2, which will introduce new carbon pricing on fuels used in buildings, road transport and small businesses, makes these issues particularly important. The acceptability of the scheme will depend both on the visibility of compensation and on the ability of agents to actually reduce their fossil energy consumption. ETS 2 revenue (the Social Climate Fund and national revenue) should therefore be used primarily to finance direct transfers, paid in advance where possible, in the form of a 'carbon dividend' that is either uniform or income-dependent. These transfers could be supplemented by targeted subsidies for investment in low-carbon alternatives: social leasing of electric cars, and support for the purchase of heat pumps by low-income households.

Finally, it should be borne in mind that it is the total price of energy, and not only taxation, that shapes behaviour. The introduction of ETS 2 will therefore need to be coordinated with the climate-energy contribution[32], by temporarily adjusting the latter if energy prices are very high, with a timetable for its restoration announced from the outset, in order to secure the acceptability of ETS 2 without abandoning the long-term objective of harmonising carbon prices across Europe. A credible multi-year carbon price trajectory reduces uncertainty, steers investment and gives value to low-carbon alternatives.

Recommendation 2. Prepare for the introduction of ETS 2 and allocate the revenue primarily in the form of a direct and visible 'carbon dividend', in order to improve the fairness and acceptability of the system. Complement this transfer with subsidies for investment in low-carbon alternatives for low-income households.

[28] See, for example, Metcalf G., Stock J. (2023): 'The Macroeconomic Impact of Europe's Carbon Taxes', *American Economic Journal: Macroeconomics*, no. 15(3), pp. 265–286.

[29] On this point, see the 2019 special issue of the Journal of the Association of Environmental and Resource Economists, and the qualification provided by Leard B., Linn J., Springel K. (2023): 'Vehicle Attribute Tradeoffs and the Distributional Effects of US Fuel Economy and Greenhouse Gas Emissions Standards', RFF Working Paper Series, no. 23-04.

[30] Redistributing part of the revenue would make the bottom six deciles better off on average, as well as 90% of households in the bottom three deciles. See Bureau D., Henriet F., Schubert K. (2019): 'Pour le climat : une taxe juste, pas juste une taxe' [For the climate: a fair tax, not just a tax], Note du CAE, no. 50, March.

[31] Conte M., Dutronc-Postel P., Malgouyres C., Sukhdeo T. and Tô M. (2026): 'Le bonus-malus écologique : quelle efficacité, quelle équité ?' [The ecological bonus-malus: how effective, how fair?], in *Perspectives budgétaires*, chapter 4, Institut des politiques publiques.

[32] The climate-energy contribution (contribution climat-énergie, CCE) is the carbon component of taxation on fossil fuels. Introduced in 2014, it increased gradually until 2018, reaching €44.60/tCO2.

Remedying the shortcomings of private adaptation

Private adaptation, undertaken directly by households and firms, can reduce exposure or sensitivity to hazards when agents have reliable information, sufficient resources or access to credit, and consistent incentives. It fails when risks are underestimated, when the benefits are diffuse, collective or long-term, when the insurance market fails, or when individual action creates negative externalities[33]. Air conditioning illustrates these potential negative externalities: while it very significantly reduces heat-related health damage[34], it leads to refrigerant emissions and waste heat discharge. In Paris, this discharge could raise local air temperatures by up to 2.4°C during a heatwave comparable to that of 2003[35]. Access to air conditioning is, moreover, socially unequal (see below). Irrigation is another example of the limits of spontaneous adaptation: while it effectively protects crops from drought, it raises the problem of the efficient sharing of a scarce resource[36].

Finding 6. Private adaptation reduces damage when agents have information, resources and consistent incentives. However, the most vulnerable do not necessarily have access to it, and it may create negative externalities.

Public intervention is justified to provide collective investment that falls outside the individual sphere (construction of flood-protection dykes, renaturation, urban greening, district cooling networks, water management), to correct market failures and to address equity concerns. It should complement private action rather than replace it. Conversely, the recourse of the most affluent households to private solutions may reduce their contribution to collective solutions and leave the poorest without protection[37].

Risk prevention in France has historically followed a territorial and sectoral logic, prioritising high-risk areas or those housing critical infrastructure, without the exposure of the most vulnerable populations being used as a targeting criterion[38]. The PNACC-3 now sets the objective of not increasing social and territorial inequalities, but it remains largely built on the continuation of existing prevention policies. More generally, the distributional dimension of risk prevention and adaptation policies has received little study, even though it could inform the prioritisation of interventions.

Finding 7. Natural risk prevention policies primarily target the most exposed territories. Adaptation policies still take little account of social vulnerabilities.

Assessing the social value of each public euro

Climate policies are often compared on the basis of their gross budgetary cost or the volume of emissions avoided. These indicators are insufficient: they ignore the differing value of a euro depending on the beneficiary, effects on behaviour, environmental externalities and fiscal returns.

The public spending efficiency index relates the social value or cost of a policy to its net cost or yield for the State. It allows comparisons between very different schemes by simultaneously incorporating efficiency, distribution and public finances. Box 1 accordingly compares the public spending efficiency index of air conditioning in schools with that of the car bonus in order to determine which has the higher social efficiency.

Box 1. Two examples of public spending efficiency indices

Air conditioning in schools. The impact of days above 27, 32 and 36°C on learning (valued in terms of expected future earnings) is set against the installation and running costs of air conditioning. Result: €1 spent on air-conditioning schools in Paris generates a social benefit of around €2. Other cooling measures could be compared using the same method.

The ecological bonus on vehicles. The transfers received – in practice mainly by affluent households – and the carbon savings genuinely attributable to the bonus are valued and set against the net cost to public finances (including lost fuel tax revenue). Result: €1 of net spending generates a social benefit of around €0.88.

Comparing these two indices reveals the relatively low efficiency of the ecological bonus, whose social value is lower than its cost to public finances. It might be preferable to reallocate the resources devoted to it to other instruments pursuing the same goal, such as social leasing, whose public spending efficiency index should first be assessed (see Focus no. 154 for details).

[33] Fontaine F., Gales A., Henriet F., Huang L., Schubert K., Seilles P., Spratt E. (2026): 'S'adapter au changement climatique : quels rôles pour les acteurs privés, la puissance publique et l'assurance ?' [Adapting to climate change: what roles for private actors, public authorities and insurance?], *Focus du CAE* no. 156, November 2026.

[34] See Barreca A. et al. (2016): 'Adapting to Climate Change: The Remarkable Decline in the US Temperature-Mortality Relationship over the Twentieth Century', *Journal of Political Economy*, no. 124(1), pp. 105–159; Heutel G., Miller N. H., Molitor D. (2021): '*Adaptation and the Mortality Effects of Temperature across U.S. Climate Regions*', *The Review of Economics and Statistics*, no. 103(4), pp. 740–753; Sera F. et al. (2020): 'Air Conditioning and Heat-Related Mortality: A Multi-Country Longitudinal Study', *Epidemiology*, no. 31(6), pp. 779–787.

[35] Viguié V. et al. (2020): 'Early adaptation to heat waves and future reduction of air-conditioning energy use in Paris', *Environmental Research Letters*, vol. 15(7), 075006.

[36] Thomas A. (2026): 'Les agricultures françaises face au changement climatique : risques, inégalités et adaptation' [French agriculture and climate change: risks, inequalities and adaptation], *Focus du CAE* no. 158, November 2026.

[37] This is the 'private solution trap' identified by Malthouse E., Pilgrim C., Sgroi D., Accerenzi M. et al. (2026): 'The Private Solution Trap in Collective Action Problems Across 34 Nations', Proceedings of the National Academy of Sciences, no. 123(12).

[38] Henriet F. et al. (2026): Focus du CAE n° 154.

Recommendation 3. Make the evaluation of mitigation and adaptation policies by government departments systematic, using a public spending efficiency index. Evaluations should set out the distribution of beneficiaries, the actual impact on behaviour, environmental externalities and the effects on public revenue and expenditure. Redirect resources towards policies that achieve decarbonisation and adaptation objectives efficiently and in a socially fair manner.

Four priority adaptation policies

Four adaptation policies illustrate how the principles set out above can be put into practice: adaptation to heatwaves, support for firms' adaptation, reform of the natural disaster insurance scheme (Catastrophes naturelles, CatNat) and the adaptation of agriculture. These cases were selected because they combine significant distributional issues with new needs for empirical expertise.

Heat: making thermal comfort in summer a pillar of housing policy

Heat is arguably one of the climate risks for which the threat of a social divide is clearest. It particularly affects dense urban areas, with the emergence of heat islands, and flats, where the scope for adaptation is more limited than in houses. Its consequences also depend heavily on the characteristics of the dwelling and on the health, age and resources of its occupants. Beyond the question of summer comfort, heatwaves call into question the very habitability of certain dwellings.

France has been adapting since the 2003 heatwave: alert plans and the organisation of the health system have helped to reduce mortality among older people. Yet summer comfort remains a blind spot in building policy. The French energy performance certificate (Diagnostic de performance énergétique, DPE) does not include heat in its main rating; renovation subsidies still provide only marginal support for solar shading, ventilation or certain reversible equipment. The policy of phasing out gas, a priority for decarbonising heating, does not take summer comfort into account: social leasing for air-to-water heat pumps, launched in October 2026 for low-income households heated by oil or gas, covers heating only. The regulations governing new construction (Réglementation environnementale 2020, RE2020) do not prohibit reversible heat pumps in new buildings, but the cooling function increases the theoretical consumption taken into account in the regulatory calculation, requiring additional efforts on the building envelope: current incentives encourage the decarbonisation of heating without, at the same time, encouraging protection against heat. The heritage protection framework can also hinder the adaptation of existing buildings: near listed historic monuments, the mandatory approval of the Architectes des Bâtiments de France (ABF) can hinder the installation of heat pumps, shutters or external insulation[39].

Air conditioning is an effective measure against heat stress, but access to it is socially unequal. The study based on the 2013 and 2020 Housing Surveys on fixed air conditioning[40] shows an equipment rate that depends heavily on the climate (37% of dwellings on the Mediterranean coast in 2020, compared with less than 3% in the North) but also, for comparable exposure, on occupancy status (owners are better equipped than tenants, and social housing far less so than private housing) and on standard of living (households in the top decile are around twice as likely to be equipped as those in the first decile). Age and the presence of children, although factors of physiological vulnerability, do not translate into better protection[41]. Air conditioning also creates negative externalities (waste heat discharged into the street and, depending on the electricity mix, greenhouse gas emissions), hence the value of a coherent hierarchy of solutions – passive solutions (solar shading, appropriate insulation, night-time ventilation, materials and shading) should be prioritised, as they determine its effectiveness; collective solutions (district cooling networks, greening in the medium term) should be used as a complement where they are cost-effective. Finally, air conditioning should be targeted at the places and people for whom the health, educational or social benefits are greatest.

Finding 8. Air conditioning is an effective adaptation measure, but access to it is unequal: for a comparable climate, equipment depends more on standard of living and occupancy status than on vulnerability to heat. Its use also entails negative externalities, including waste heat discharged outside buildings and, potentially, increased greenhouse gas emissions.

Several of these measures are already under way. The PNACC-3 plans to adapt housing to extreme heat, notably by reviewing the RE2020 summer comfort requirements for new buildings, and to develop renewable cooling. The Finance Act for 2026 (Loi de finances 2026) reduced VAT on district cooling networks to 5.5%. The Green Fund now makes its subsidies for the renovation of public buildings conditional on summer comfort being taken into account, and specific measures target schools and healthcare facilities. The Energy Code regulates the use of air conditioning, which may only operate when the indoor temperature exceeds 26°C.

[39] A national guide, co-written with the ABF, has framed these trade-offs since July 2026, without, however, making the ABF's opinion any less binding.
[40] Henriet F. et al. (2026): Focus du CAE n° 154.
[41] Ibid.

These advances nevertheless remain partial. Summer comfort is not factored into the DPE rating, which triggers renovation obligations, and the PNACC-3 plans to incorporate it into subsidies for major renovations only by 2030. Nor are equipment subsidies linked to passive protection: since July 2026, high-performance air-to-air heat pumps have benefited from a 5.5% VAT rate, with no conditions attached regarding either the dwelling's solar shading or the household's income. Stronger support for such equipment, targeted to low-income households and restricted to dwellings already fitted with passive protection, would make it possible to better protect vulnerable households while limiting the externalities of air conditioning. Finally, investment in cooling public facilities should be prioritised according to its social return (see Box 1).

Recommendation 4. Implement the PNACC-3 measures on summer comfort for new buildings. Incorporate summer comfort into the DPE rating and into renovation subsidies. Create a subsidy for the installation of high-performance air-to-air heat pumps for low-income households, conditional upon the installation of passive protection. Prioritise the cooling of public buildings according to their social return.

The situation of social housing deserves particular attention. Its tenants have very little room to make changes themselves to the equipment in their homes – adaptation therefore largely depends on landlords. The rate of fixed air-conditioning equipment is only 1% in social housing, compared with almost 6% in the private rented sector, which illustrates tenants' limited scope for autonomous adaptation. Unless the adaptation of social housing is accelerated, the protection gap is therefore likely to widen between households able to invest in their homes and those whose adaptation depends on their landlord's decisions.

The French social housing federation (Union sociale pour l'habitat, USH) estimates the funding requirement at €8.6 billion for the entire metropolitan family social housing stock, spread over approximately seven years of renovations. To make this effort sustainable, the USH suggests prioritising investment according to the condition of the housing stock and its exposure, combining subsidised loans with targeted grants.

Recommendation 5. Make the adaptation of social housing to extreme heat a national priority, by conditioning public funding for the renovation of social housing on a heat vulnerability assessment and, in exposed buildings, on the inclusion of works to improve summer comfort.

Firms: targeting support at market failures

Even in the absence of public policy, losses of output and income give firms an incentive to adapt. Such spontaneous adaptation nevertheless remains incomplete when risks are poorly understood and when access to finance is constrained (sometimes following a series of adverse shocks). It may also remain incomplete when firms can capture only part of the benefits of their investment, particularly if these benefits are collective, as in the case of certain infrastructure or of prevention measures that improve employees' health.

While public support may be appropriate, it must avoid subsidising investment that would have been made anyway or favouring the best-informed firms. Green loans, partial guarantees and repayable advances make it possible to target financing constraints and to share risk without fully socialising the cost.

Several instruments are already in place. The PNACC-3 has led to the roll-out of green guarantees, diagnostic assessments and a Banque de France tool enabling each firm to ascertain its exposure to hazards. Recourse to short-time working for recurrent climate-related downturns in activity is now, in theory, subject to adaptation commitments. However, these schemes do not yet explicitly target the firms whose adaptation is of greatest collective importance, nor the territories facing multiple hazards, and their effects have not been evaluated. Support should also distinguish between reconstruction, which restores production capacity, and preventive adaptation, which reduces future exposure. It should likewise avoid supporting sites whose viability is compromised.

Recommendation 6. Extend the PNACC-3 schemes by targeting intervention at firms of major economic or social importance that a clearly identified financing market failure. Favour green loans, partial loan guarantees and repayable advances, conditioned on a vulnerability assessment and an adaptation plan, and systematically evaluate their effects.

Labour regulation is a second lever. The example of heatwaves is particularly telling, as they affect – and will increasingly affect – a very large proportion of employees. Moreover, although there are territorial differences, exposure depends above all on the activity performed.

Finding 9. Occupational exposure to heat is unevenly distributed. By 2050, 60% of employees will work in establishments exposed to more than 20 heatwave days a year, but health risks are particularly high and the scope for adaptation is limited in occupations carried out outdoors, in hot environments or involving heavy physical exertion.

Yet employers only imperfectly internalise the health effects of heat, particularly when these do not immediately translate into lower productivity. General rules exist, but they are difficult to apply without action thresholds, protocols and responsibilities tailored to each occupation. It should be noted that such thresholds cannot be based on temperature alone: the index used must also take humidity and radiation into account.

Recommendation 7. Make heat an explicit subject of collective bargaining in exposed sectors. Agreements should specify thresholds based on objective indices, working hours, breaks, access to water, ventilation, equipment, arrangements for reorganising or halting work, and the protection of seasonal and outdoor workers.

CatNat: preserving solidarity, restoring incentives, prioritising prevention

The CatNat scheme, which organises compensation for damage caused by natural catastrophes, is a major strength of the French insurance model. This model cushions the effects of disasters on households effectively and rapidly. During the 2023 floods in the Pas-de-Calais, it helped avoid falls in consumption or increased drawing on savings[42]. The CatNat scheme pools risks through a uniform surcharge on property damage insurance policies and public reinsurance provided by the state-backed reinsurer (Caisse centrale de réassurance, CCR). Purely actuarial pricing – that is, pricing proportional to risk – would nevertheless be socially and economically problematic[43]: it would cause premiums to soar in some highly exposed areas, sharply depress property values in those areas and create situations of uninsurability, leaving homeowners who did not choose their exposure without coverage. However, because of the uniformity of insurance cost, the pooled system does not directly provide incentives for prevention and adaptation. The associated risk prevention plans only partly remedy this shortcoming, as, in line with their original purpose, they remain targeted at the highest-risk territories.

In addition, the system is under financial strain. The frequency and severity of insured losses are increasing, and clay shrink-swell weighs heavily on costs. Reform of the scheme should therefore aim to strengthen its incentives and ensure its financial sustainability.

As for incentives, a distinction must be drawn between stock and flow. For existing buildings and for risks that are difficult to avoid individually, the current system is satisfactory. For new construction in high-risk areas, undertaken in full knowledge of the risks, a construction tax modulated according to risk should be introduced in order to limit spatial moral hazard. It is also fundamental to ensure that risks are taken into account in local urban development plans, and risk prevention plans in exposed territories should be updated regularly.

To ensure financial sustainability, the rate of the CatNat surcharge will need to be adjusted regularly in line with changes in claim costs. Furthermore, the scheme should promote prevention, the only means of bringing costs down. Several instruments can be used: modulating deductibles according to efforts to reduce vulnerability; requiring insurers, after a loss, to finance more resilient rather than identical reconstruction (suitable materials, modified foundations, relocating equipment above flood level, etc.); and allocating a greater share of CatNat resources to works on existing buildings. Finally, where protection becomes disproportionate or rare risks become recurrent events, relocation should be planned in advance.

Recommendation 8. Preserve the national pooling of the CatNat scheme and regularly adjust the surcharge to trends in claim costs. For existing buildings, provide more funding for prevention and encourage resilient reconstruction after losses. Plan ahead for relocation where risks become recurrent. For new construction, regulate siting in high-risk areas more strictly, introduce a construction tax there modulated according to exposure, and strengthen building standards in clay-soil and flood-prone areas.

Agriculture: moving from compensation to transformation

Agriculture combines high climate vulnerability with a significant contribution to greenhouse gas emissions. Inequalities within the sector depend on natural conditions, production systems, access to capital, relations with upstream and downstream supply chains, and ecosystem services. Income disparities are very large: over 2017-2022, average income per worker was around €20,000 in beef cattle farming, compared with €55,000 in arable crops and €53,000 in viticulture[44]. Certain types of production, notably perennial crops, vines, vegetables and flowers, are particularly exposed to rising temperatures and evapotranspiration, and their adaptation is often costly and slow.

The transformation of agriculture can be structured around three priorities. First, public support should be redirected to facilitate adaptation. Support currently plays a very different

[42] Fontaine F. et al. (2026): Focus du CAE n° 156.

[43] See Charpentier A., Barry L., James M. R. (2022): 'Insurance Against Natural Catastrophes: Balancing Actuarial Fairness and Social Solidarity', The Geneva Papers on Risk and Insurance, Issues and Practice, no. 47(1), pp. 50–78.

[44] Thomas A. (2026): Focus no. 158.

role depending on the sector – on average, it represents around 200% of income in beef cattle farming, compared with 60% for cereals, oilseeds and protein crops. Its distribution does not reflect climate exposure or vulnerabilities. As noted by the Cour des comptes (the French Court of Audit)[45], current agricultural policy (in particular the European Common Agricultural Policy, CAP) seeks to leave existing systems unchanged rather than to organise their transformation. It should instead target farms that combine low income, high climate exposure and low adaptive capacity, and prevent income and irrigation support from locking in systems that have become unsustainable.

Second, crop insurance should be transformed into an adaptation tool. The share of agricultural land covered by multi-peril climate insurance was around 36% of land excluding grassland in 2024. This low coverage rate is due in particular to the incentives created by public compensation schemes: emergency aid paid after disasters reduces the incentive to take out insurance. Insurance does too little to finance the transition to systems that are less sensitive to drought, pests and extreme temperatures. It would be desirable to make part of public support conditional on vulnerability-reduction assessments and pathways and on adaptation efforts, and to finance more systemic changes rather than merely compensating for losses.

Recommendation 9. Reorient the CAP by making support more closely conditional on the state of resources, on practices and on vulnerabilities. Make it a tool for transformation rather than for keeping unsustainable systems unchanged. Likewise, transform agricultural insurance into an adaptation tool.

Finally, water and soils must be incorporated into vulnerability assessments. Potential evapotranspiration increases by 10-15% per degree of warming, while summer rainfall is expected to stagnate or decline. Moreover, agriculture accounts for around 60% of the water consumed in France, 80% of which is used for irrigation[46]. Contrary to the provisions of the agricultural emergency law (doubling irrigation water storage capacity by 2035), the response cannot be limited to increasing irrigation, as this can become maladaptation if it serves to sustain over the long term crops that have become incompatible with local resources[47]. Furthermore, adaptation depends on the capacity of soils to retain water and, more broadly, on the maintenance of ecosystem services. Their degradation can affect both yields and the scope for diversifying agricultural incomes.

Recommendation 10. Adapt water policy to local scarcity by reducing subsidies for irrigation infrastructure and by adjusting water charges in line with pressure on the resource. Use storage only where it is a transitional solution compatible with future resources. Preserve soils and ecosystems in order to protect agricultural production. Introduce a soil quality assessment.

Conclusion

Climate divides are neither an argument for slowing down the transition nor simply a matter of monetary compensation. They require climate policy to be designed differently. Inaction is itself profoundly distributive – it shifts damage onto households locked into their housing, onto exposed workers, fragile firms and the least well-resourced local authorities. Conversely, a transition based on consistent signals, targeted solidarity, anticipatory adaptation and rigorous evaluation of measures can simultaneously reduce emissions, future damage and inequalities.

[45] Cour des comptes (2026): La mise en œuvre de la politique agricole commune (PAC) par la France [France's implementation of the Common Agricultural Policy], September.

[46] Some types of production are particularly dependent on irrigation: more than 60% of vegetable-growing land, around 50% of orchards, 40% of potato and soya land, and one third of maize land are irrigated. In summer 2022 in the Adour-Garonne basin, yield losses were around 25% on irrigated land, compared with 40-70% on non-irrigated land: Thomas A. (2026): Focus n° 158.

[47] Perrot A., Reynaud A., Saussier S. (2026): 'L'eau sous tension : concilier sobriété hydrique, équité et investissement' [Water under pressure: reconciling water sufficiency, equity and investment], Note du CAE no. 87, January.

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