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Booklet for sub-national stakeholders heading towards the COP 21

Key concepts

on the impacts of climate change, climate policies and economic tools: insight from French territories

I4CE INSTITUTE FOR CLIMATE ECONOMICS

METEO FRANCE

ONERC Observatoire national sur les effets du réchauffement climatique

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE
Ministère de l'Écologie, du Développement durable et de l'Énergie

in collaboration with:

afd AGENCE FRANÇAISE DE DÉVELOPPEMENT

ADEME Agence de l'Environnement et de la Maîtrise de l'Energie

GROUPE Caisse des Dépôts

Booklet for sub-national stakeholders heading towards the COP 21
November 2015

Since most of the material used for this booklet is based on French work and experience, original web-sources are provided when no English version is available.

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Preface

At a time when the international community is striving to construct an overall framework for the future fight against climate change, regional actors have already been taking measures for several years to mitigate their greenhouse gas emissions and adapt to the changing climate.

The purpose of this booklet is to present **the situation, tools and actions of French local authorities** in this field. It will attempt to offer open, direct and informative access to the most up-to-date knowledge on climate change to encourage and facilitate the continuation of these approaches.

It has been jointly produced by I4CE - Institute for Climate Economics, ONERC and Météo-France, in partnership with ADEME and AFD which have also contributed to developing its content.

DGEC and research laboratories such as CIRED and the CSTB also contributed with their expertise.

This booklet is aimed at local authorities, as well as public and private actors working alongside them, and addresses three themes identified by colour:

- **The impacts of climate change**
- **Climate policies at a global, European and French level**
- **Economic tools available to local authorities**

It includes two types of factsheets, identified by icons: (i) factsheets to **«understand»** the local, national or supranational context of the themes addressed (ii) factsheets to **«act»**, setting out the main principles, systems and tools to offer responses to the problems raised at a regional level.

The **«act»** factsheets are accompanied by good practice illustrating the type of approaches and measures implemented in French regions, which are in operation and can be reproduced in France or around the world. These illustrations have been selected as being interesting examples among others.

The **«further information»** boxes indicate documents, websites and reference tools to obtain more in-depth information on the themes addressed.

Throughout the files, specific or technical terms are indicated in bold and defined in a glossary at the end of the booklet.

Most of the content of this booklet is sourced from analyses and exchanges carried out since 2008 in the context of Club ViTECC (the Cities, Subnational Governments & Climate Change Club) coordinated by I4CE - Institute for Climate Economics with Météo-France and ONERC (the National Observatory of Climate Change Effects)/ DGEC-MEDDE). This club offers mediation of scientific knowledge and discussion to better understand major issues, identify local climate change challenges and define action and financing resources available to regional actors. Most of the examples and «good practices» mentioned in this booklet stem from feedback presented by local authorities, their service provider companies and public institutions which are members of Club ViTECC.

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Members of Club ViTECC in 2015:
Local authorities: the Conseils Régionaux of Bretagne, Ile-de-France, Haute-Normandie, Provence-Alpes-Côte d'Azur, and Rhône-Alpes; the Conseils Généraux of Seine-et-Marne, Val-de-Marne, and Oise; Brest Métropole Océane, Communauté de l'Agglomération Havraise, Métropole de Lyon, Montpellier Méditerranée Métropole, Communauté d'Agglomération de Plaine Commune, GRE-Liège, Nantes Métropole, Métropole Nice Côte d'Azur, Ville de Paris and Saint-Malo.
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SHEET 1

UNDERSTAND

Climate change and its causes

Definition of climate change

The **Intergovernmental Panel on Climate Change (IPCC)** defines climate change as «a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer».

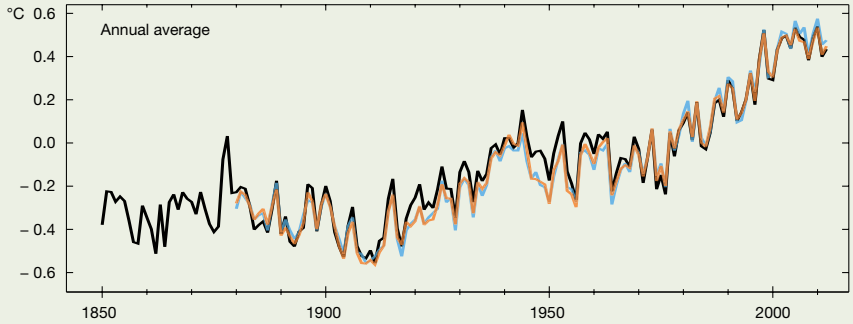
It therefore refers to a long-term, measurable phenomenon which disrupts the balance of natural and human systems.

Causes of climate change

- Climate change may result from alterations to the Earth's energy balance due to natural and anthropogenic processes.
- According to the IPCC, it is an increase in the concentrations of **greenhouse gases (GHGs)** resulting from human activities which, by trapping more and more energy in the atmosphere, is a major cause of recent climate change. Carbon dioxide, methane, halogenated hydrocarbons and nitrous oxide are the main contributory gases.

The IPCC therefore concludes, in volume one of its fifth Assessment Report, that it is extremely likely that human influence is the main cause of the warming observed since the mid-20th century.

Changes in the annual global average temperature compared with the period 1961-1990 according to three observation datasets



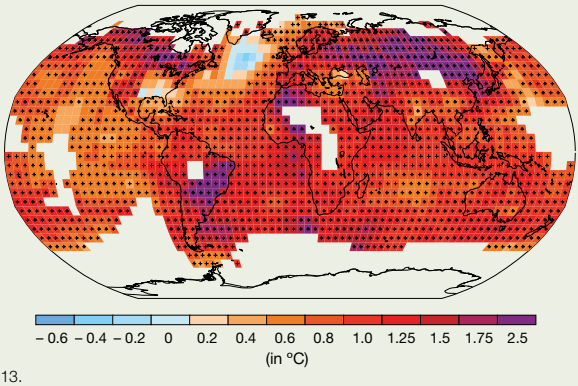
Source: IPCC, 2013.

Unequivocal global warming

Many changes recorded since the 1950s are unseen in the past decades and beyond. A range of observations gives a coherent image of the warming of the climate system:

- Significant increase in average surface temperatures, of 0.85°C between 1880 and 2012 – 19 out of the last 20 years, for instance, are among the top 20 hottest years since 1850.
- Warming of oceans and increase in their level: between 1901 and 2010, the average global sea level increased by 17to 21cm, mainly due to melting ice sheets and expansion due to the increase in the water temperature.
- Reduction in the cryosphere (water in its solid state): the Arctic ice pack in particular shrank at a rate of between 3.5% to 4.1% per decade during the period 1979-2012.

Changes observed in the surface temperature of the Earth between 1901 and 2012



Source: IPCC, 2013.

Further information:

IPCC, 2014: Fifth Assessment Report, Vol. 1 and 2, summaries for policymakers
http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf

SHEET 2

UNDERSTAND

Socio-economic impacts of climate change

Definition and main impacts

The socio-economic impacts of climate change can be positive or negative and affect infrastructure, sanitary conditions, economic activity and biodiversity.

Over the past decades, all continents and oceans have been impacted by climate change. The second volume of the fifth IPCC Assessment Report presents an overview of the impacts observed and specifies the level of certainty with which these impacts can be attributed to climate change:

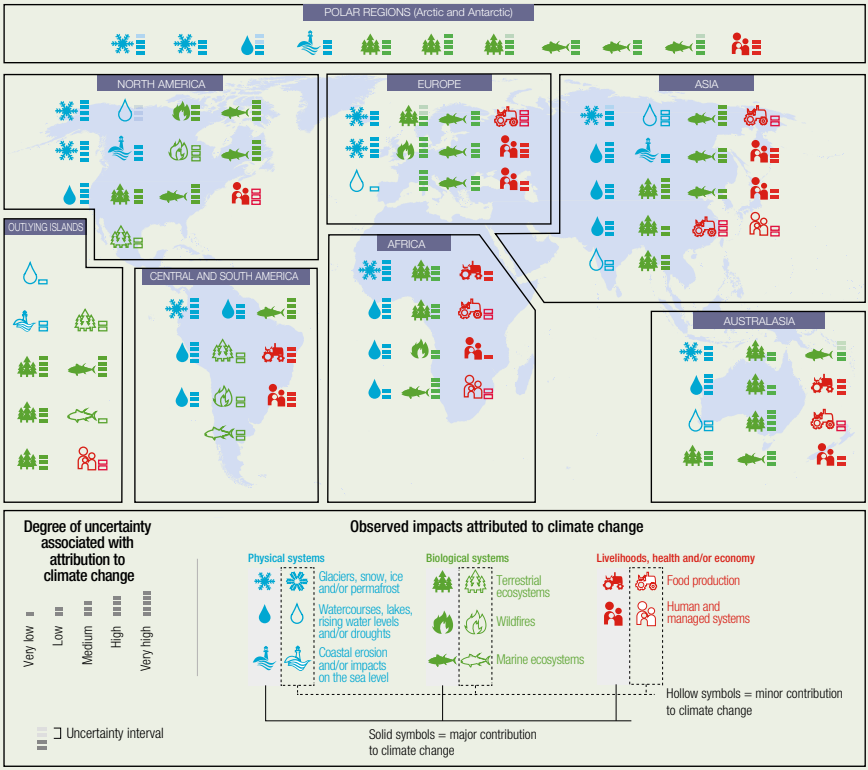
- **Water resources:** in many regions, changes to rainfall or snow and ice melt are affecting the quality and quantity of water resources (level of confidence: medium).
- **Ecosystems:** many animal and plant areas are adapting to changes in climate conditions, habitats, seasonal activities, migration patterns and the abundance of populations.
- **Agriculture:** negative impacts on crop yields have been recorded more frequently than positive impacts (level of confidence: high).
- **Health:** possible impacts on health have been identified although insufficiently quantified.

Unequal distribution

Significant geographical disparities, for instance, have been recorded in terms of climate risk. Institutional, political and cultural conditions, as well as social and economic inequalities influence the different systems' degree of vulnerability and exposure to these impacts. Recent extreme events such as flooding, cyclones and heatwaves have revealed that there is already significant vulnerability to current climate conditions.

These impacts have major social implications, since they increase other stress factors such as access to water, food and safe housing, particularly for the poorest populations. Violent conflicts further aggravate this vulnerability.

Map of climate change impacts recorded in scientific literature



The studies used to produce this map were published between 2007 and 2013 but include the results of previous analyses.

The symbols indicate the type of impact, the relative contribution (minor or major) of climate change to the impact and the level of confidence with which each impact can be attributed to climate change, particularly considering natural climate variability.

Source: IPCC, 2013.

Further information:

IPCC, 2014: Fifth Assessment Report, Volume 2, summary for policymakers
http://ipcc-wg2.gov/AR5/images/uploads/WG2AR5_SPM_FINAL.pdf

SHEET 3

UNDERSTAND

IPCC reports and forecasts

The role of the Intergovernmental Panel on Climate Change

The **IPCC** was formed in 1988 by the **World Meteorological Organization (WMO)** and the **United Nations Environment Programme (UNEP)**, in order to provide «comprehensive Assessment Reports about the state of scientific, technical and socio-economic knowledge on climate change, its causes, potential impacts and response strategies.» It is an intergovernmental body with 195 States as members. It brings together researchers from all backgrounds and nationalities to jointly study advances in scientific literature published on the climate. The IPCC does not carry out any research itself.

The Assessment Reports published by the IPCC every five to seven years and its Special Reports serve as scientific guidelines, particularly during international negotiations.

The Fifth Assessment Report (2013-2014)

With 2,500 scientific contributors, including 830 authors, the latest report has three volumes and a synthesis report:

- Volume 1 «The Physical Science Basis» presents the results of climate science.
- Volume 2 «Impacts, Adaptation, and Vulnerability» details recorded impacts and potential future impacts as well as related risks and adaptation possibilities in two sections: a thematic section and a methodological section, as well as a section covering major regions.
- Volume 3 «Mitigation of Climate Change» analyses scenarios compatible with the 2°C target.

The projections used in the report are based on global climate modelling exercises using models from some 30 laboratories around the world and a set of four Representative Concentration Pathways (**RCPs**), each corresponding to a scenario of potential atmospheric concentrations of **GHGs**.

Socio-economic scenarios are also used to study a variety of economic and political «pathways» resulting in these GHG concentrations.

Some key messages from scientists

Volume 1 asserts that the human influence on the climate has been clearly established. Depending on the scenario studied, it reports average levels of warming of between +1°C and +3.7°C by 2100 compared with 2005, accompanied by an increase in sea levels of between 40cm and 63cm. These forecasts are more pessimistic than those of the previous Assessment Report.
By way of comparison, the difference in the global temperature between an ice age and a period such as the one in which we are currently living, over a cycle of around 100,000 years, is no more than 3°C to 8°C.

Projected consequences of climate change in the period 2081-2100 compared with the period 1986-2005 (global averages)

Scenario	Surface Warming	Rise in the Level of Oceans
RCP2.6	From 0,3 to 1,7°C	26 to 55cm
RCP8.5	2,6 to 4,8°C	45 to 82cm

Volume 2 emphasises that the highest priority adaptation measure is to reduce current risks and that adaptation planning should involve all relevant stakeholders and decision-making tools in order to promote **climate-resilient development solutions.**
Volume 3 demonstrates that scenarios compatible with the 2°C target require negative emissions by 2100, implying major technical, economic, social and institutional challenges, including significant investment in low-carbon energies and energy efficiency, as well as behavioural changes, etc.

Implications for cities

The IPCC's fifth report is the first to include two chapters on cities, which are treated as a system. The first, devoted to mitigation, encourages the incorporation of climate policies into housing and transport policies in order to promote urban densification, the construction of low-energy housing, the development of low-emission transport systems and the search for co-benefits, for example in healthcare. A chapter on adaptation emphasises the vulnerability of cities and the importance of building resilient infrastructure.

Further information:

IPCC, 2013-2014: Fifth Assessment Report, www.ipcc.ch/report/ar5
MEDDE : www.developpement-durable.gouv.fr/-GIEC-et-expertise-climatique

SHEET 4

UNDERSTAND

Climate models and impacts in France

Climate modelling for France

A mission lead by climatologist Jean Jouzel has produced a summary of climate modelling for France. This regional view of overall climate simulations, based on **RCP scenarios** of changes in atmospheric **GHG** concentrations, magnifies the scale of around 200km, used in the **IPCC** reports, to a scale of 12km for the regional models of **Météo-France** and the **Institut Pierre Simon Laplace**.

In the short term, the conclusions' degree of certainty mainly depends on climate variability. And in the longer term, on the models and scenarios used.

Impacts of climate change in France between 2021 and 2100

Volume 4 of the report, *«The Climate of France in the 21st century»*, presents projections of the main potential changes compared with the 1976-2005 average, according to either a small or a large increase in atmospheric GHG concentrations.

By 2021-2050

- Average increase in temperatures of between 0.6°C and 1.3°C, particularly in the south-east of France in the summer, where it could reach 2°C. This increase could be equivalent to the warming recorded in France throughout the whole of the 21st century (around 1°C).
- Increase in the number of days of heatwave in the summer, particularly for south-eastern regions.
- Reduction in the number of unusually cold days in the winter, particularly in the north-east of the country.

By 2071-2100

- A significant increase in temperatures, varying by a factor of 1 to 4 depending on the scenario considered (+0.9°C to 3.6°C in the winter and +1.3°C to 5.3°C in the summer), and particularly pronounced in the south-east, where it could be well above +5°C in the summer.
- Significant increase in the number of days of heatwave in the summer.
- Reduction in extreme cold weather in winter.
- Sharp increase in extreme rainfall, as well as the in risk of drought, which could spread to the whole country.

Schematic map of potential impacts of climate change in France by 2100

FOR ALL REGIONS:
More accute warming in the summer and in the South-East region
- High increase of the number of days of heatwaves in the summer
- Evaporation with low water flows and reduced water resources available for agriculture
- Negative consequences on farming yields
- Shift of popular touristic areas

CITIES:
- Heatwaves: increase in local pollution, with an impact on health and energy consumption (building renovation required).
- Urban flooding: overflowing of drainage network.

FIRES:
- Extension in the risk of forest fires towards the north of France

MOUNTAINS:
- Reduction in the surface area of ski slopes, leading to a reduction in tourism - heightened natural risks of flooding, avalanches and landslides.
- Biodiversity: changes to phenology and reduction in the number of species in valleys.

COASTS:
- Coast threatened by erosion and/or submersion
- Risks of more frequent partial submersion of polders and sand barriers.
- Ports and associated industries threatened by flooding.
- Change to the distribution of fishery resources with an increase in the north.

Source: I4CE, 2015, based on IPCC (2014), MEDDE (2014 et 2015), ONERC (2010) and Météo France.

Overseas Territories

For all French overseas regions, the results of simulations, based on a single model, reveal:

- An increase in the average temperature of between 0.7°C and 3.5°C by 2100.
- A decrease in average rainfall, particularly during the dry season.
- A possible change in cyclone activity, particularly towards the end of the century, with similar or less frequency but potential increases in average rainfall and maximum winds.

Further information:

Drias, les futurs du Climat : www.drias-climat.fr

MEDDE - Mission Jouzel : www.developpement-durable.gouv.fr/-Rapports-climat-de-la-France-au-.html

Météo France : www.meteofrance.fr/climat-passe-et-futur/changementclimatique/projections-climatiques

ADEME : Outil Impact' Climat

SHEET 5

ACT

Drias service – climate futures in France

Presentation of «Drias, climate futures»

Drias offers an online information portal facilitating access to regional climate projections for French cities and overseas territories. It allows web-users to easily view and obtain data and outputs from digital climate simulation models, as well as support via a hotline.

Drias was developed by **Météo-France** in collaboration with the **CERFACS**, **CNRM-GAME** and **IPSL** laboratories. It was launched in 2009.

Information available on the Drias portal

The portal has three areas:

1. A «Discovery» area offering interactive maps and a range of climate indicators for immediate viewing and initial analysis;
2. A password-restricted « Data and products access « area offering free ordering and downloading of regional climate projections in digital format. This area is mainly designed for experienced users wishing to use the information for impact studies, for example;
3. A «Support» area offering explanatory texts, a FAQ and a hotline.

A wide range of projections for the climate in France is available:

- Drias offers forecasts based on various emissions scenarios and the output from a number of models.
- 35 standard climate parameters and indicators are accessible based on temperature and rainfall projections: *minimum, average and maximum temperatures, number of days of high temperature, number of days below 0°C, number of days of heavy rainfall, total rainfall, daily rainfall, etc.*
- Their values are represented per month, season and year.
- The spatial resolution represented varies between 300km and 8km.
- Several time horizons are offered: short-term (2035), medium-term (2055), long-term (2085) and beyond.

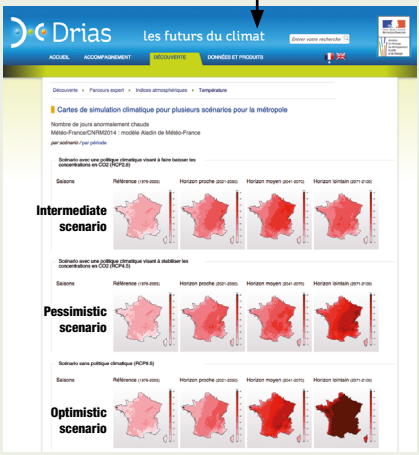
The «Drias, climate futures» service is regularly updated and the subject of a continuous improvement approach, with new indicators made available in response to demand.

Drias portal

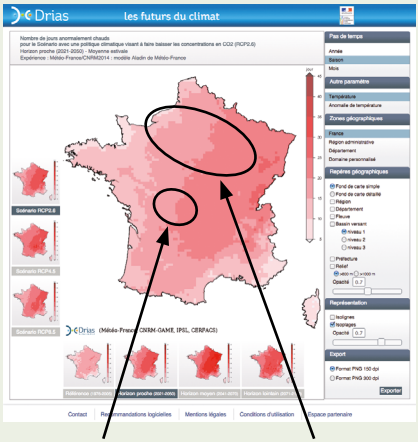
Expert pathway

Selection form

- Number of unusually hot days (maximum temperature more than 5°C higher than normal) in summer
- 1 model (CNRM: Aladin model from Météo-France)
- 3 scenarios (optimistic, intermediate, pessimistic)
- 3 time horizons (short term, medium term and long term)



Source: «Drias, climate futures»



Analysis: According to the most optimistic scenario by 2021-2050, the number of days of high temperature in the Limousin region will be around 15 to 20 in summer. The increase is higher for the long-term horizon and even more pronounced with other scenarios. Comparison with the projections from other models will allow an estimation of the uncertainty of this analysis.

Analysis: : For the period 2021-2050, the increase in the number of days of high temperature will be greater in Champagne than in Normandy for the optimistic scenario. Since this analysis is confirmed by other scenarios, it can be considered robust.
Comparison with the projections from other models will allow an estimation of the uncertainty of this analysis.

Good practice: Identification of the City of Strasbourg's areas of vulnerability

The City of Strasbourg worked with the local urban planning agency on adaptation to climate change in the region. The first stage was to identify the main areas of vulnerability at a local level. To do this, several indicators taken from the Drias portal, such as number of days of extreme heat or intense rainfall, were used. Historical data were compared with various regional climate scenarios to reveal significant changes that are already perceptible or expected for the future. The next stage was to compare these physical indicators with regional factors of a known sensitivity. This made it possible to identify how various public policies such as transport could be affected and therefore adapted accordingly. A final stage associated these data with satellite images to study the effects of urban cool islands. To find out more : www.adeus.org/

Further information:

Drias, climate futures: www.drias-climat.fr

MEDDE - Jouzel project: www.developpement-durable.gouv.fr/-Rapports-climat-dela-France-au-.html

Adaptation to climate change

Definition of climate change adaptation

Adaptation is a response to the impacts of climate change. According to the **IPCC** (2001) *«adaptation is the process of adjustment to the current and forecasted climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.»* An adaptation measure may be:

- Spontaneous or planned (particularly by public authorities);
- «Soft» (information, prevention or organisational changes) or «hard» (protection infrastructure, re-dimensioning of networks, etc.);
- Incremental (based on actions which safeguard the system's initial integrity) or transformational (which agree to transform the system)
- Reactive (implemented once changes have been recorded) or anticipating changes.

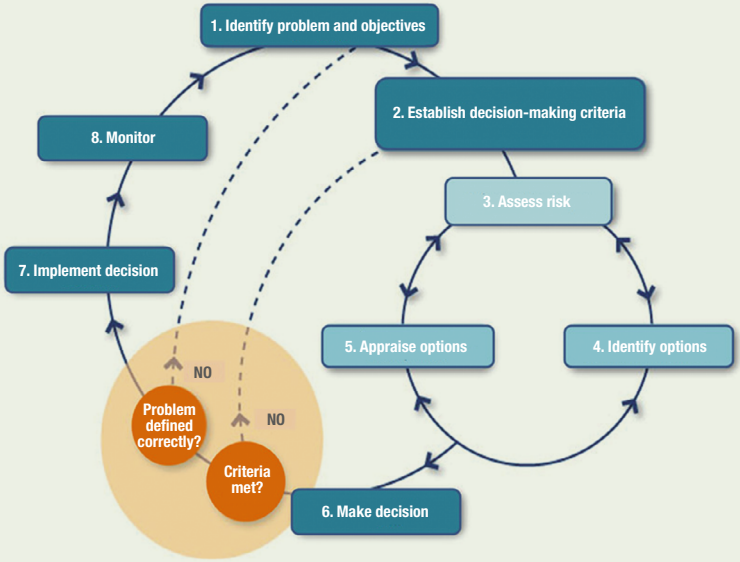
Adaptation aims to reduce the climate risks facing systems by addressing their exposure to uncertainty or their vulnerability – *i.e.* the degree to which the system can be negatively affected by an impact. Adaptation also makes systems more resilient, *i.e.* better prepared to absorb shocks.

Implementation of strategies and adaptation measures

It is necessary to act at all levels by implementing iterative and progressive adaptation strategies (see diagram below). Prioritising adaptation actions is a research field which is still being explored, although several principles can already be applied:

- Combine «soft» and «hard» adaptation measures;
- Promote no-regrets measures, i.e. beneficial even without climate change, adjustable over time (flexible) and robust, i.e. effective in a broad spectrum of possible futures;
- Avoid **maladaptation** which occurs when an adaptation measure increases a region's vulnerability, is ineffective or exacerbates climate change;
- Prioritise the most immediate, important and certain impacts;
- Involve all stakeholders in decisions and actions;
- Systematise climate risk analysis based on future projections for long-term investments.

Diagram of a typical adaptation process



Source: UKCIP, Willows, R.I. and Connell, R.K. (2003).

Adaptation in international discussions

At a global level, adaptation costs may reach $150bn (€120bn) by 2030 and $500bn a year by 2050, under **scenario 2°C**. According to **UNEP**, expenses could even double if the current GHG emissions trend is not reduced. The cost of inaction highlighted by the **Stern Report** in 2006 and the financing of adaptation, particularly in developing countries, are a major focus of international negotiations. The **UNFCCC** has dedicated working groups to the subject and specific financial tools such as the **Adaptation Fund** have been set up. The **Green Climate Fund** is expected to devote 50% of its capitalisation, to adaptation.

Further information:

IPCC, 2014: Fifth Assessment Report, Volume 2, ipcc-wg2.gov/AR5

UNEP, 2014 : *The gap between needs and outlooks in relation to adaptatio* (Adaptation gap report)

ADEME : Objectif'Climat tool

ONERC : www.onerc.gouv.fr

Focus on impacts in cities

Climate risks in cities

Cities – home to more than half of the world's population and economic activities – are particularly affected by the consequences of climate change, in particular:

- Heatwaves and the formation of urban heat islands;
- Droughts with issues of scarcity and quality of water resources;
- Urban and coastal flooding mainly due to the vulnerability of urban areas to rising sea levels, rising water levels in watercourses and heavy rainfall;
- Sanitary risks : increase in air pollution linked to ozone (source of asthma) and the development of infectious diseases (particularly in developing countries in the tropics).

Adaptation of cities

Adaptation measures may be based on the construction of protection infrastructure or renovation of existing infrastructure («hard» adaptation measures), on organisational changes, such as the establishment of warning and evacuation systems or prevention campaigns («soft» adaptation measures) or on vegetation-based solutions. In some extreme cases, measures to relocate certain activities to less vulnerable areas may need to be decided.

Examples of climate risk adaptation measures

Impacts concerned	Type of measures	Type of adaptation*	Exemples
Coastal flooding	Coastal management, warning system, definition of unbuildable zones	Soft	Sydney, Rotterdam
	Coastal preservation: shoreline armouring, construction of seawalls	Hard	St-Malo, New Orléans, Alexandria
Flooding (all types)	Prevention system (risk mapping, awareness raising)	Soft	Orléans, New York
	Construction or expansion of infrastructure (reservoirs, drainage networks and pumps), elevation of bridges and roads	Hard	New York, London, Seattle, Copenhagen, Venice, Rotterdam
Heatwaves	Alert system, changes to organisation of work	Soft	Paris, Tokyo
	Construction using new materials, adaptation of parks and roads	Hard	Chicago, Los Angeles, Tokyo, Toronto
Drought	Advice for the population, measures to restrict water use	Soft	Barcelona, Quito, Melbourne
	Construction of reservoirs, water desalination and treatment plants, modernisation of networks	Hard	Barcelone, Durban, Quito, Melbourne, Beijing

Source: I4CE, 2010.

Vulnerability and resilience factors

The main vulnerability factors of cities stem from the interdependence and proximity of the various critical components of the urban system, particularly infrastructure:

- Drainage systems, the re-dimensioning of which will be an important contributor to the cost of adaptation to climate change according to the **IPCC**;
- Transport networks which are vital in the functioning of urban economies and highly exposed to flooding and heatwaves;
- Telecommunication and energy networks, particularly the stability of the power grid, which is vulnerable to the widespread use of air-conditioning;
- Population density and ageing;
- Interdependence with extra-urban systems (food, water, etc.);
- Proximity of coasts or floodable areas.

The implementation of adaptation strategies in cities requires the adoption of a cross-functional approach taking into account significant interactions between the components and participants in an urban system. The establishment of resilient infrastructure – i.e. capable of restoring or maintaining normal operation after an impact or change to transport, housing or certain economic activities – can also have important synergies with GHG emissions reduction measures.

Good practice: Integrated water management in Rouen

The risk of submersion by the Seine and the increase in extreme rainfall events were taken into account in the design of the Luciline ZAC (urban development zone) - Rives de Seine, an eco-district in Rouen, with 1,000 homes and 50,000 m^2 of retail space. A «flood chamber» was created and a threshold defined for evacuating inhabitants. Water is therefore at the heart of the adaptation strategy with integrated rainwater management encouraging infiltration, renovation of a source to create more vegetation and the use of geothermal power to feed a cold water network and offset the heat island effect in summer. To find out more: www.rouen-seine.fr/luciline/

Further information:

IPCC, 2014: Fifth Assessment Report, Volume 3, chapter 8, www.ipcc.ch/report/ar5/

ONERC, 2010 : Villes et adaptation au changement climatique (Cities and Climate Change Adaptation)

The New Climate Economy, 2015 : Section 1 : cities, 2015.newclimateeconomy.report/wp-content/uploads/2014/08/NCE2015_workingpaper_cities_final_web.pdf

EEA, 2012 : *Urban adaptation to climate change in Europe*

Heatwaves

Risk of heatwaves

Regardless of the **GHG** emissions scenario that is considered, climate projections forecast an increase in the risk of heatwaves in the coming years with a high level of certainty.

One of the most recent examples of a heatwave in France was in 2003. It caused an abnormally high death toll of 14,800 people in the country between August 1st and 20th, mainly elderly people. Climate change makes this type of event more likely, with heatwaves becoming recurrent and normal by the end of the century, according to certain scenarios.

Adaptation measures

Vulnerability to heatwaves depends in particular on the infrastructure in place, urban planning, the type of housing and lifestyles. Widely varying measures exist to tackle the risk of heatwaves, ranging from the establishment of warning and prevention plans to the adaptation of new construction projects and districts and, in some cases, existing buildings. Adapting housing and urban planning means encouraging better thermal comfort in buildings and streets (better protection against heat penetration) and, secondly, tackling the presence of **urban heat islands**. Adaptation measures can be classified according to the spatial scale to which they apply:

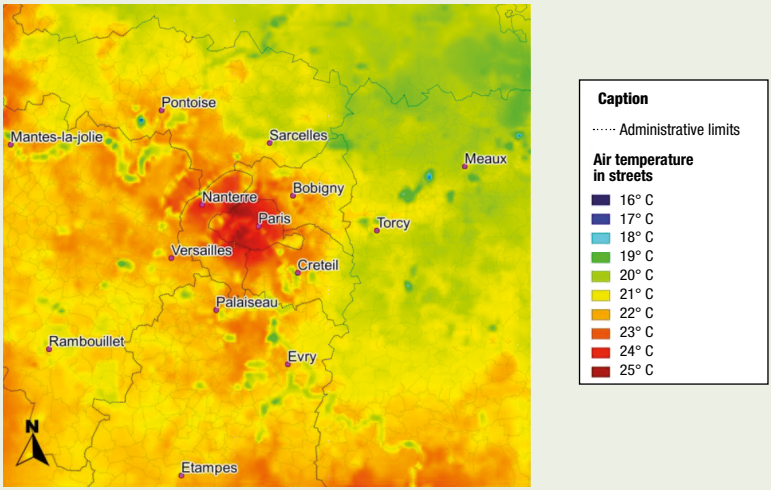
- At building level: optimised ventilation, type and position of glazed surfaces, insulation etc.;
- At district level: increase in reflective properties of walls and road surfaces, awnings hung over streets, as well as urban planning decisions such as building orientation and increased presence of vegetation in towns and cities;
- At agglomeration level: width and orientation of streets to encourage good air circulation, creation of urban parks, organisation of economic activities and lifestyles (opening times of offices and schools, etc.).

Adaptation actions are technological, organisational as well as behavioural (*e.g.* closing shutters on houses and staying hydrated).

Modelling

Modelling exercises provide a better understanding of the interactions between the global climate and anthropogenic systems such as cities. The ANR-VURCA project, for example, analysed cities' vulnerability to future heatwave episodes in order to propose adaptation strategies.

Simulation of temperatures in streets, at the end of the century at 5am, for a heatwave similar to 2003, in a scenario of gradual expansion of the Paris agglomeration



Source: CIRED, CNRM-GAME and CSTB, VURCA project, 2013

Good practice: use of modelling by the City of Paris

Climate projections for the period 2030-2050 have shown that the average temperature in Paris will be higher, summer heatwaves and droughts will be more frequent and more intense, but winters will remain cold. Heatwaves are among the five main climate challenges identified for Paris.

Planned solutions include improvements to insulation and adaptation of buildings' orientation, vegetation and irrigation, the presence of water in the city and, above all, behavioural changes to limit the use of air-conditioning and reduce associated energy consumption.

Further information:

Météo France – CNRM, 2012-2013 : EPICEA and ANRVURCA projects, final reports

City of Paris, 2012 : The city's climate and energy plan

Urban Heat Islands

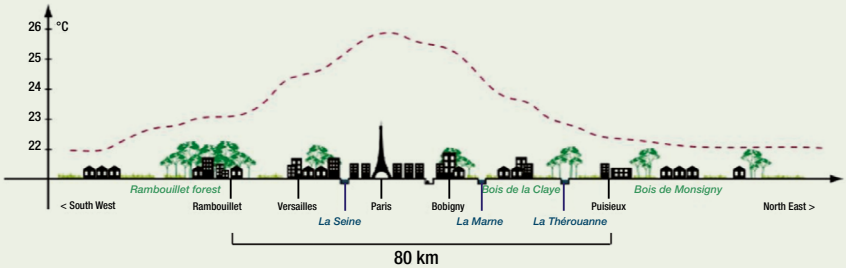
Définition

An **urban heat island (UHI)** is a local microclimate which makes temperatures in cities higher than in the surrounding countryside. The UHI effect is particularly strong at night and can lead to a 10°C temperature increase in the city centre compared with the outer suburbs.

This temperature difference is caused by the structure of cities and the fact that the urban ground cover is artificial, which reduces natural cooling by reducing energy and water exchange (evapotranspiration) with the atmosphere.

The UHI can affect energy demand (for air-conditioning), water consumption (plants, cooling equipment and leisure facilities), health (air quality, heat stress, discomfort, etc.) and the local economy (reduced productivity).

Diagram of the urban heat island effect in Paris



Source: Météo-France, 2008.

The main factors influencing the UHI are the presence of water, vegetation, urban ground cover, buildings' construction materials, urban forms and human activities, *e.g.* transport. Action can be taken to influence these factors.

Measures to mitigate the UHI must avoid **maladaptation** and take into account any other effects which could increase heating needs in winter, for example. The UHI is less intense in spread-out cities than compact cities, which also have other advantages from the point of view of energy consumption and emissions linked to transport.

Adaptation solutions

Various studies (**ANR-MUSCADE, ACCLIMAT**) highlight the potential and complementarity of several forms of adaptation solutions:

- Organisational involving the establishment of warning systems, for example by adapting the operating hours of some economic activities and the functioning of the city and its services (*e.g.* public transport) to reduce thermal pollution;
- Behavioural to reduce the use of air-conditioning and energy consumption, for example by encouraging residents to close shutters during the hottest times of the day and by adjusting the recommended temperature of cooling appliances (*e.g.* an increase from 23°C to 26°C);
- Urban by promoting urban planning to encourage air circulation, shade and solar reflection, based on practices in southern Europe;
- Construction, in particular by improving the insulation of buildings;
- Soft or «green», involving vegetation which, when sufficient irrigation is available, helps to create cool islands via evapotranspiration from plants.

These measures vary in cost, effectiveness and secondary effects. They also have different implementation times.

Good practice: Adaptaclima II

The City and Metropolis of Bordeaux are focusing on planting vegetation in urban spaces as a means of biological cooling to combat the UHI. To understand it better and test its real effects on temperature, the green urban fabric project was analysed in collaboration with the ACMG (Association Climatologique de la Moyenne Garonne et du Sud-Ouest). A clearer picture of the UHI phenomenon in Bordeaux was provided by analysis of satellite data (LANDSAT), resulting in planned changes to the management of green spaces. To find out more: www.adaptaclima.eu

Further information:

APUR, 2012 : Book n°1, *Les îlots de chaleur urbains à Paris (Urban Heat Islands in Paris)*

APC, Météo France, 2013 : *L'îlot de chaleur urbain à Paris : un microclimat au cœur de la ville (The Heat Island in Paris: a Microclimate in the Heart of the City)*

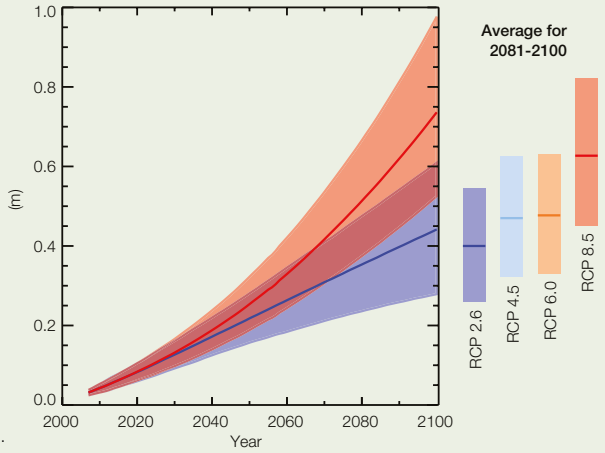
Météo France – CNRM, 2013-2014 : ANR-MUSCADE and ACCLIMAT projects, final reports

Coastal flooding and sea level

The rising sea level – a source of vulnerability

The increase in the level of the oceans is a result of the water becoming warmer (dilatation) as well as melting glaciers and icecaps. This rise accelerated in the 20th century and will continue in the coming centuries at a rate dependent on anthropogenic **GHG** emissions (see figure).
Rises in sea level will vary significantly from one region to another.

Projected average changes in the sea level over the 21st century compared with the period 1986-2005, for the four RCP scenarios



Source: IPCC, 2013.

Situation in France

The French coastline is no exception. In both Brest and Marseille the sea level rose by almost 20cm over the last century, at an accelerating pace.

The rising sea level threatens to increase the exposure of communities which are already vulnerable as a result of coastal risks. These include almost 25% of municipalities in Languedoc-Roussillon, almost 15% of municipalities in Picardie and more than 10% of municipalities in Poitou-Charentes.

Other regions, such as Nord-Pas de Calais, Pays de la Loire and Aquitaine are also at risk.

Main impacts and adaptation strategies

The main impacts linked to the rise in the sea level are:
- Marine submersion and increased frequency of coastal flooding;
- Intensification of coastal erosion;
- Infiltration of salt water into coastal aquifers;
- Damage to coastal and port infrastructure.

According to a recent study, in the absence of adaptation, between 0.2% and 4.6% of the world's population, representing tens of millions of people, could suffer from coastal flooding each year if the sea level rises by between 25cm and 123cm by 2100.

Various adaptation strategies can be implemented:
- Strengthening of maritime warning and monitoring systems;
- Modification of urban planning rules to reduce construction in at-risk areas;
- Reinforcement of coastal protection solutions, such as wetlands and dunes;
- Strategic withdrawal decisions, i.e. relocation of buildings and existing activities to behind a new line of defence.

Good practice: the Sète sand barrier

From Sète to Marseillan, the coast road has been moved inland by 2km in order to create a beach side broad enough to mitigate the effects of the swell. In Le Grau-du-Roi, part of the hospital has been rebuilt 50m inland with raised floors to reduce the risk of flooding. These facilities have been protected by reconstruction of the dune barrier. To find out more:
www.thau-agglo.fr/-La-sauvegarde-du-Lido-de-Sete-a-.html

Further information:

The IPCC's Fifth Assessment Report, volume 2, 2014: www.ipcc.ch/report/ar5/

IPCC, 2014: Fifth Assessment Report, Volume 2, ipcc-wg2.gov/AR5

Jouzel project, 2015: *Le Climat de la France au XXIe Siècle* (The French Climate in the 21st Century), Volume 5: Changement Climatique et Niveau de la Mer : de la Planète aux Côtes Françaises (Climate Change and Sea Level: from the Planet to the French Coast)

MEDDE: coastal risks, www.developpement-durable.gouv.fr/Les-risques-littoraux

Droughts

Definition of drought

Different types of drought are traditionally identified:

- **Meteorological drought:** when rainfall is lower than average for a prolonged period.
- **Agricultural drought:** when the moisture level in the soil becomes too low for crops, which is not only the result of rainfall but also evaporation from the soil and transpiration from plants.
- **Hydrological drought:** when water reserves in aquifers, lakes and reservoirs become scarcer and river flow falls significantly.

The average intensity of droughts and the time of year when they occur have a major influence on the impacts on ecosystems and economic activity, particularly farming.

Changing trends concerning droughts in France

France is particularly affected by the risk of an increase in the frequency and intensity of droughts linked to climate change. The results of the CLIMSEC study on possible changes concerning droughts in cities in the 21st century indicate a consistent trend:

Impact of climate change on droughts in the 21st century

- 2020s:

No particular change in the characteristics of meteorological droughts compared with the period 1961-1990 but a worsening of agricultural droughts.

- 2050s:

Very significant changes in agricultural droughts and risk of unusual droughts in terms of geographical extent and intensity. Severe droughts ,similar to those, experienced in 1990 could become steadily worse.

- 2080s and the end of the century:

More extreme meteorological droughts, events such as experienced in 1976 becoming steadily worse and a more severe situation in relation to agricultural droughts. Climate projections indicate that a large part of the territory could experience very long periods of drought, with normal conditions based on the current climate becoming extremely rare.

Source: findings of the CLIMSEC project, based on a range of climate projections, 2010.

Adaptation strategies – major levers in farming practices

Agricultural uses represent 70% of the water used at a global level.
This sector is therefore particularly impacted by droughts, but also has adaptation levers:

- **Choice of species and varieties,** avoiding varieties that have a critical growth phase that coincides with droughts (e.g. winter crops, bringing forward sowing dates and planting of early varieties) or opting for drought-tolerant species.
- **Mixed agriculture and forestry** – trees planted at regular intervals on arable land – which has demonstrated a positive effect on the water stress of crops, particularly at the end of the summer.
- **Irrigation** from water reserves in aquifers, watercourses and artificial reservoirs to offset the lack of natural water and therefore limit impacts on activities. This measure is increasingly controversial, however, due to the depletion of some aquifers and greater conflicts of use during periods of drought. Irrigation methods and practices may evolve to tackle different local situations.
- **Management of conflicts of use** via collaborative governance in relation to the watershed, involving all stakeholders and water users (hydroelectric power, agriculture, nautical activities, tourism, biodiversity, fishing, etc.)

Good practice: The Garonne 2050 project

As part of its development of the SDAGE (Water Development and Management Master Plan), the Adour-Garonne water agency conducted a prospective study on changing needs and availability of water resources in the watershed. Having carried out a current-state assessment, the impact of several climate change scenarios was opened up to water users for discussion. This allowed an action strategy to be developed, with a particular focus on more proactive management of water, including development of storage, promotion of water savings, improvements to rainwater management, modernisation of networks to reduce leaks, etc. To find out more: www.garonne2050.fr

Further information:

INRA - Drought and agriculture

Météo France – CNRM, 2011: CLIMSEC project

MEDDE: water resources, www.developpement-durable.gouv.fr/-La-ressource-en-eau

ONERC, 2014: Annual urban drought index

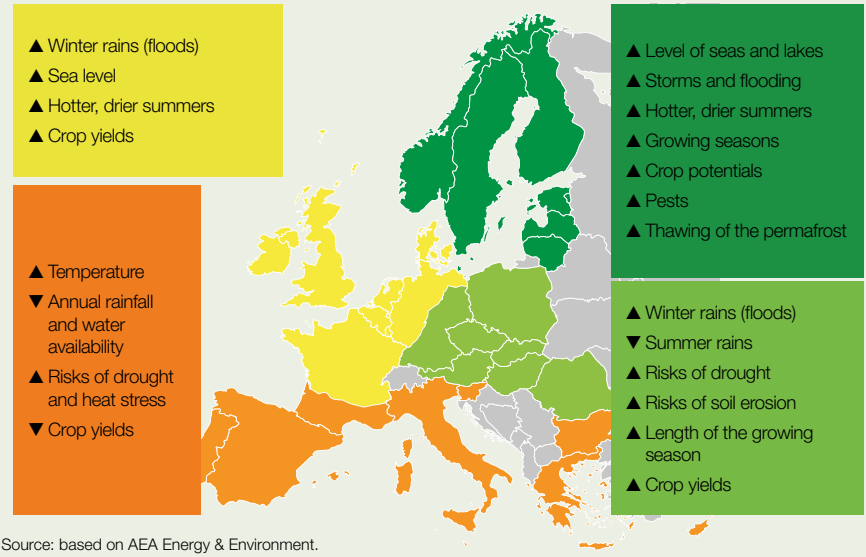
Agriculture

Factors impacting the agricultural sector

The agricultural sector is affected by several factors linked to climate change:

- Changing trends: the increase in the prevalence of CO_2 and other **GHGs**, the rise in temperatures, new precipitation and evaporation as well as drainage and run-off patterns, and changes to cloud cover and therefore to sunlight levels are bioclimatic developments which influence the functioning of ecosystems and can therefore have an impact on agricultural systems.
- Accentuation of climatic extremes: an increase in the frequency and intensity of extreme climatic events such as droughts, storms, heatwaves and heavy rainfall can impact the quantity and/or quality of agricultural production.
- Indirect effect of pests: a link between global warming and an increase in pests is also strongly suspected although it has not yet been demonstrated. The consequences of these changes are highly variable depending on regions, at both a global and European level (see map).

Projection of the impact of climate change on various agro-climatic zones in Europe



Source: based on AEA Energy & Environment.

Impacts on yields

In most regions of the world, a stagnation in agricultural yields has been observed for certain crops. In France, wheat yields have remained at the same level since the 1990s, despite having previously risen sharply since the 1950s and ongoing agronomic and genetic improvements.

The increase in the frequency of extreme events will also have consequences for agricultural yields. The heatwave in Europe in 2003 and the droughts of 2010 in Russia and 2012 in the United States had an impact on global production, pushing up prices. Climate change is therefore among the direct external factors of agricultural price volatility.

The IPCC's Fifth Assessment Report is more alarming than the previous one regarding crop sensitivity to the accentuation of climate extremes. It also predicts a change in the geographical distribution of vines, a decrease in dairy production in the Mediterranean due to heat stress (level of confidence: medium) and an increase in irrigation needs, as well as highlighting risks to global food security.

Tackling climate risks to regions

The main adaptation strategies for cropping systems are:

- Agricultural: crop diversification and changes to cropping and/or varietal practices;
- Governance-related: better water management, from the field to the regional level, including consideration for conflicts of use;
- Economic: better management of residual risks (*e.g.* via the storage of production, insurance systems, national solidarity funds, etc.).

Further information:

IPCC, 2013-2014: Fifth Assessment Report, Volume 1 and synthesis report, www.ipcc.ch/report/ar5/

OECD, 2012: *Comparative study of risk management in agriculture in a context of climate change*

I4CE, to be published in 2016: *Climate Report – Management of climatic risks in the agriculture sector*

Kyoto Protocol

Implementation of the Kyoto Protocol

The United Nations Framework Convention on Climate Change

The text adopted in Kyoto in 1997 is an additional protocol to the **United Nations Framework Convention on Climate Change (UNFCCC)**. Signed at the Earth Summit in Rio in 1992, the UNFCCC was the first international climate change treaty. It draws on three principles: 1) the precautionary principle, 2) the principle of common but differentiated responsibilities and 3) the right to development. Since 1992, the **Conferences of the Parties** to the agreement (**COP**) have met each year to stipulate targets and implementation procedures.

Kyoto Protocol targets

- The **GHGs** from the 38 most industrialised countries (listed in Annex B to the Protocol) must be reduced by at least 5% during the period 2008-2012 compared with 1990. The targets are differentiated by country.
- The emissions taken into account cover six anthropogenic GHGs: CO_2, CH_4, N_2O, HFC, PFC, SF_6 and, since 2013, NF_3.
- Non-Annex B countries have no GHG emissions reduction commitments.

Implementation

The Protocol came into force in 2005 after ratification by Russia, meeting the quorum of 55 States, representing 55% of Annex B emissions in 1990.

Results

In 2012, the overall targets of the first period of the Protocol were reached despite Canada's withdrawal and the absence of the United States, thanks to the use of flexibility mechanisms. Participating countries reduced their emissions by 24% compared with the reference year (generally 1990).

However, without the United States and following the withdrawal of Canada, the first commitment period was only binding on 36 countries representing just 24% of 2010 emissions, while global emissions increased by 30%, particularly due to growth in developing countries. Since the Kyoto Protocol is non-binding on the main countries responsible for emissions, it has not been sufficient to stabilise GHG emissions.

A second commitment period while awaiting a new international agreement

The principle of a second commitment period of the Kyoto Protocol, extending from 2013 to 2020, was adopted in Durban in 2011. The Doha Amendment, which prolonged the Protocol, was ratified by only 53 of the 144 Parties required for it to enter into force. It is therefore not binding and the pledges are, for the time being, voluntary.

Declarations of Kyoto emissions reduction targets by Annex B countries compared with 1990

	First period 2008-2012	Second period 2013-2020
EU-15+ [1]	–8%	–20% (UE27, Croatia and Iceland, jointly, in application of article 4 of the Protocol)
Croatia	–5%	
Iceland	10%	
Hungary, Poland	–6%	
Switzerland	–8%	–15.8%
Ukraine[3]	0%	–24%
Norway	1%	–16%
Australia	8%	–0.5%
Belarus[3]		–12%
Kazakhstan[3]		–5%
New Zealand	0%	
Japan	–6%	
Russian Federation	0%	
Canada[2]	–6%[3]	
United States[2]	–7%	

1. UE-15 + Bulgaria, Czech Republic, Estonia, Latvia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia.
2. Canada and the United States decided not to ratify or withdraw from the Kyoto Protocol and are therefore not bound by it.
3. Ukraine, Belarus and Kazakhstan may not commit to the second period.

Further information:

UNFCCC: unfccc.int/

MEDDE : Kyoto Protocol www.developpement-durable.gouv.fr/Le-Protocole-de-Kyoto,13782.html

I4CE, 2014: Climate Report n°44 - *Ex-post evaluation of the Kyoto Protocol : Four key lessons for the 2015 Paris Agreement*

SHEET 14

UNDERSTAND

Summary of climate negotiations towards post-Kyoto

Several rounds of negotiations have taken place since 2005 to prepare for post-Kyoto. In 2007, the Bali road map provided a framework for discussions around four main themes: mitigation, adaptation, development and technology transfer, and financing. Since Copenhagen (2009), the reduction in GHG emissions to limit warming to **2°C** has remained the key target of the process.

2009 Copenhagen

COP 15

Agreement between 28 countries outside the **UNFCCC** framework

Recognition of the **+2°C target**

Voluntary commitments by countries, maintaining a distinction between industrialised and developing countries

Principle of establishing a **Green Climate Fund**[1]

2010 Cancún

COP 16

Reintegration of the 2009 decisions into the UNFCCC framework

Launch of negotiations for a second commitment phase to follow the Kyoto Protocol

Target for developed countries to raise $100bn a year in climate finance by 2020 for developing countries

2011 Durban

Extension of the Kyoto Protocol until 2020

Creation of the «**Durban platform**» to negotiate a post-2020 agreement by 2015

Establishment of an executive committee for technology transfers and an adaptation committee

1st Green Climate Fund mechanisms defined

2012 Doha

COP 18

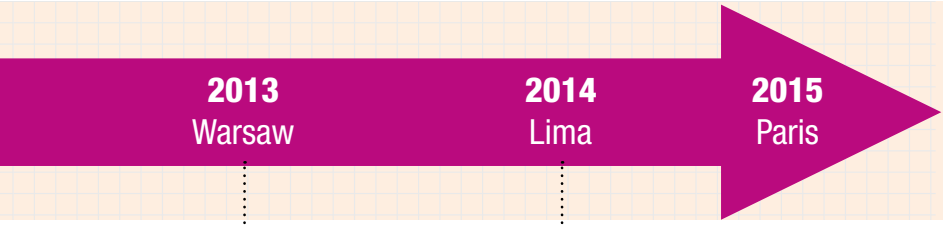
The rules of the Kyoto Protocol's second commitment period are fixed

Conclusion of the negotiation cycle initiated in Bali and setting a next deadline of 2015

Launch of a «**losses and damages**» work programme

1. This Green Climate Fund is designed to finance mitigation and adaptation projects in developing countries. It is set to significantly contribute to the $100bn a year financing target for 2020 (target set in Cancún).

Faced with the difficulty of reaching a new agreement involving all countries by the Kyoto Protocol deadline, it was extended until 2020. This decision to set a new time horizon enabled a single negotiation process to be launched for post-2020, which is expected to reach a global agreement in Paris in 2015.



COP 19

Little progress on the issue of financing (€100m for the **Adaptation Fund**)

Technical progress on points such as mechanisms for monitoring, reporting and verification (**MRV**) of emissions

Finalisation of the **REDD+** mechanism on deforestation discussed since 2009

COP 20

Definition of a framework for the submission of national emissions reduction contributions

Presentation of a draft negotiation text to form the basis for 2015 discussions leading up to Paris

Further information:

UNFCCC: unfccc.int

French government, 2015: official site of COP21, www.cop21.gouv.fr

French Ministry of Foreign Affairs: http://www.diplomatie.gouv.fr/en/french-foreign-policy/climate-7436/2015-paris-climate-conference/

French Ministry of Ecology: http://www.developpement-durable.gouv.fr/-Les-negociations-climat-post-2012-.html

I4CE, 2014-2015: Climate Briefs no. 24, 33 and 37 on international negotiations

SHEET 15

UNDERSTAND

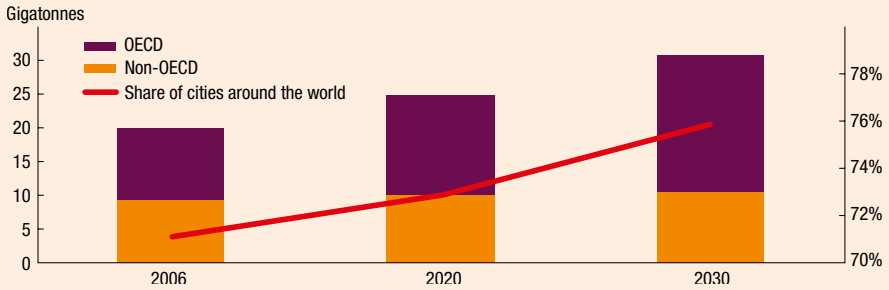
Local authorities and climate negotiations

Local authorities mobilised at an international level

Local authorities are not signatories to the **United Nations Framework Convention on Climate Change (UNFCCC)**, but exert pressure on their respective governments and are key players in demonstrating the feasibility and effectiveness of mitigation and adaptation actions.

They are involved in major international meetings, like the Copenhagen summit in 2009. Their role was explicitly mentioned for the first time in an official document in Cancun in 2010, along with the private sector and civil society. It is also recognised by the **Solutions Agenda**, initiated by the UN Secretary General Ban Ki-moon, and since chaired by Peru and France following COP20 and as part of the Lima-Paris Action Agenda (LPAA). The Solutions Agenda aims to promote cooperative work conducted by non-State actors with significant climate co-benefits.

CO_2 emissions linked to energy consumption worldwide: the increasing share of cities



Source: IEA, 2008.

Promoting their actions and conveying their demands

By taking part in these discussions, local authorities seek to promote their ability to undertake action and to act as testing grounds. The necessary skills often exist at a local level to implement actions and serve as a testing ground.

Their main demands are:

- Recognition of their role and strengthening of their resources
- Access to financing, including international financing such as climate funds (e.g. **Green Climate Fund and Adaptation Fund**) and project mechanisms.

Initiatives by local authorities and local networks leading up to Paris 2015

In addition to sharing experiences and mobilising local stakeholders, networks of regional authorities such as **ICLEI**, **UCLG** and **C40** may make public declarations :

- The World Summit on Climate and Territories declaration (2015): signed by 50 regional stakeholders' organisations, it stresses the importance of taking a regional approach to combating climate deregulation and the inseparable link to development.
- The Nantes declaration (2014): in this document, local mayors and subnational leaders encourage stakeholders to make a firm commitment and cooperate to achieve a global climate commitment in 2015. They offer their expertise in drafting and implementing local policies and call on governments to provide them with sufficient access to resources and financial mechanisms to allow them to take action.
- The Paris declaration (2013): this document combines resolutions by local authorities and companies, in order to promote national commitments by highlighting local efforts.

Public figures are also bringing the message of local authorities to the attention of other participants in the negotiations. In 2014, for instance, Ban Ki-moon appointed Michael Bloomberg, former New York mayor and president of the C40 network, to assist in consultations with local officials and encourage cities to become involved. Anne Hidalgo, mayor of Paris is meanwhile a special envoy for C40 for the 2015 Paris Climate Conference (COP21).
In 2013, French senators Ronan Dantec and Michel Delebarre were commissioned by the government to draft a report on regional authorities ahead of COP21.

Further information:

UNFCCC: actions by subnational actors, climateaction.unfccc.int
Local governments for sustainability (ICLEI): www.iclei.org
United Cities and Local Governments (UCLG): www.uclg.org
Climate leadership group (C40): www.c40.org
Regions of climate action (R20): regions20.org
World Summit on Climate and Territories 2015 : en.rhonealpes.fr/1202-world-climate-summit-2015-fr.htm
NAZCA Platform: Solutions agenda http://climateaction.unfccc.int/

Overview of carbon prices

Putting a price on carbon

Three main economic instruments are usually proposed to reduce **GHG** emissions at lower costs. These involve attributing a price to GHGs in order to pass on the costs of the damage they cause to those responsible for producing them and thereby giving those producers an incentive to reduce their emissions. The three instruments are based either on price (taxes), or volumes (standards and markets):

- **Carbon tax:** tax added to the sale price of products such as fossil fuels depending on the quantity of GHGs released during use (see table).
- **Emissions standard:** this standard, fixed by the regulator, defines a limit on the quantity of GHG emissions which can be released, *e.g.* gCO_2/km for a car.
- **Carbon market:** the regulator defines an emissions cap and distributes a certain number of emissions quotas to market participants. Participants must ensure that they have enough quotas for the number of tonnes of GHGs they release. Market players can buy quotas to offset any surplus emissions or sell their quotas in the event that they achieve further reductions – thereby determining a price for carbon based on supply and demand (see map).

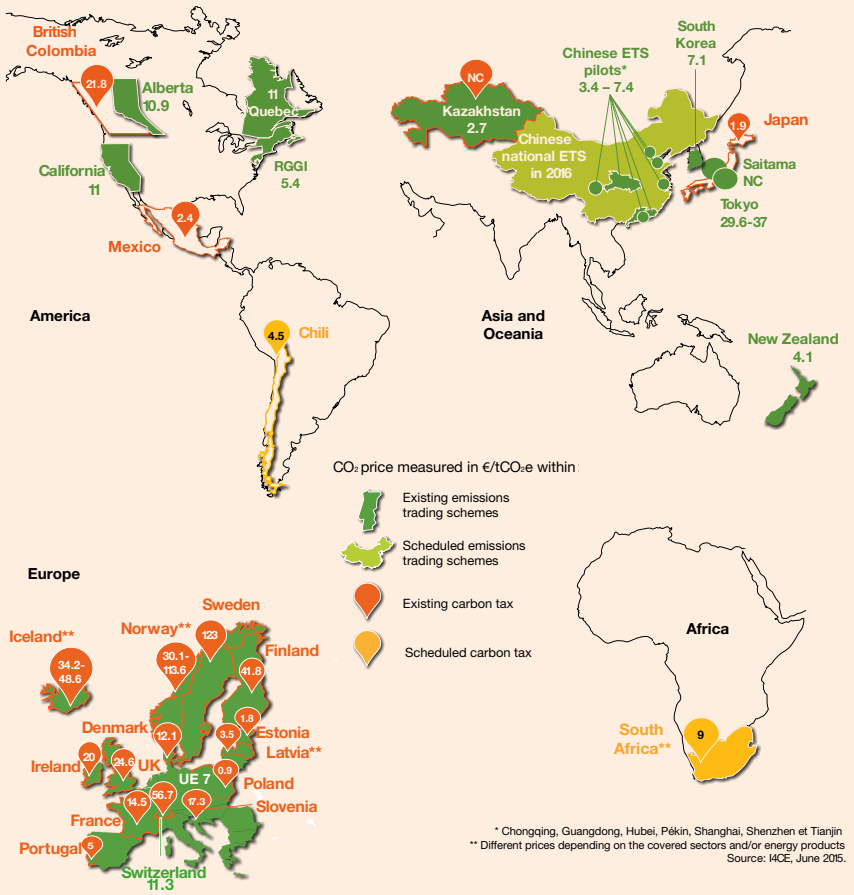
GHG emission reduction project mechanisms may be considered as complementary to these instruments. These include, for example, the **Clean Development Mechanism**, **Joint Implementation**, the Japanese bilateral offset crediting mechanism and the voluntary offset mechanism.

■ Characteristics of the carbon markets in the world (June 2015)

Region	Goals	Price per tCO_2e (in €)	Covered sectors
European Union	–20% in 2020 compared with 1990	7	Energy, and industry
Switzerland	–20% in 2020 compared with 1990	11.3	Energy, and industry
Kazakhstan	–7% in 2020 compared with 1990	2.7	Energy, and industry
Quebec	–20% in 2020 compared with 1990	11	Electricity, industry, and road transport (fuels)
California	Reduce emissions to 1990 levels by 2020.	11	Energy, industry, and road transport (fuels)
RGGI	–45% (at least) in 2020 compared with 2005	5.4	Energy
New Zealand	–5% in 2020 compared with 1990	4.1	Energy, forestry, industry, transports (fuels) and waste
South Korea	–30% in 2020 compared to a "Business As Usual" scenario	7.1	Energy, and industry
China (7 pilot regions)	–40 –45% per unit of GDP in 2020 compared with 2005	3.4 – 7.4	Energy and industry (additional coverage variable - depending on pilot)
Tokyo (Japan)	–25% in 2020 compared with 2000	29.6 - 37	Buildings (heating and electricity consumption)

Source : I4CE, 2014.

■ Carbon pricing world map 2015



* Chongqing, Guangdong, Hubei, Pékin, Shanghai, Shenzhen et Tianjin
** Different prices depending on the covered sectors and/or energy products
Source: I4CE, June 2015.

Source : I4CE (30.06.2015).

■ Further information:

World Bank, 2014: State and Trends of Carbon Pricing

Bureau of the UN Global Compact, 2009: Carbon markets explained

I4CE - IETA - EDF, 2015 : http://www.i4ce.org/go_project/put-a-price-on-carbon-different-models-of-carbon-pricing-around-the-world/

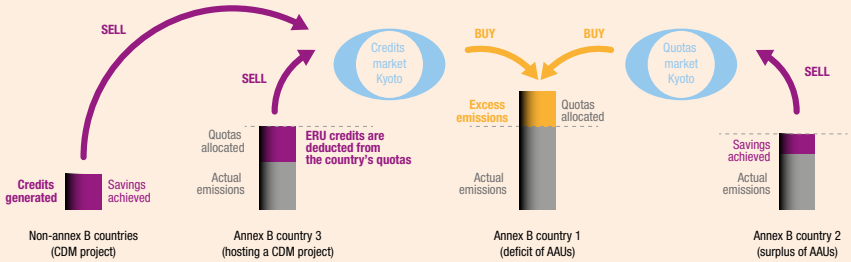
Kyoto Protocol flexibility mechanisms

Definition and operating principle

The **GHG** emission reduction targets applicable to developed countries which ratified the Kyoto Protocol (listed in Annex B) correspond to a number of carbon quotas attributed to each country. Annex B countries must return as many carbon assets as GHG emissions they have produced, based on national inventories submitted annually to the **UNFCCC**. In order to be compliant, they can reduce their emissions internally as well as using the three flexibility mechanisms:

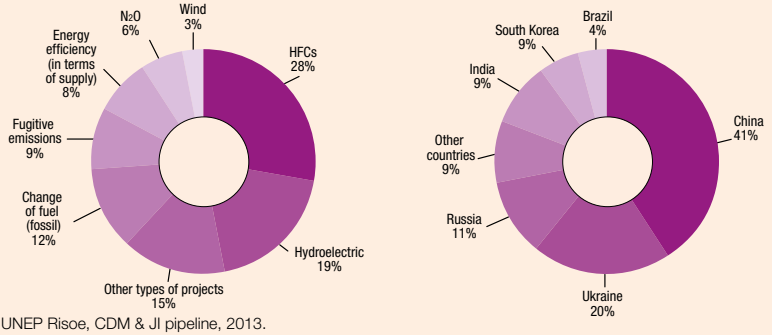
- Buying Kyoto quotas from countries with a surplus,
- Buying credits from **CDM** (Clean Development Mechanism) projects,
- Buying credits from **JI** (Joint Implementation) projects.

Market mechanisms resulting from the Kyoto Protocol



Source: CDC Climat Research, 2014.

Sectoral and geographical distribution of certified carbon credits (CDM and JI) over the period 2008-2012 (% of the total, ± 2 $GtCO_2e$)



Source: UNEP Risoe, CDM & JI pipeline, 2013.

Joint Implementation (JI)

This mechanism concerns emissions reduction projects established in Annex B countries. They can be carried out by investors from Annex B countries in another Annex B country. The financial incentive involves the issuing of a number of emissions reduction units (ERUs) corresponding to the GHGs avoided.

Projects can be undertaken in most business sectors, provided they are not already covered by the European Union Emissions Trading Scheme (**EU ETS**). JI projects need to be validated then recorded by the UNFCCC secretariat based on precise criteria and methodologies.

Clean Development Mechanism (CDM)

This mechanism concerns emissions reduction projects implemented in developing countries, excluding Annex B. An Annex B country, or a project coordinator based in an Annex B country, can obtain Certified Emissions Reductions (CER) by financing emissions reduction projects in a developing country (excluding Annex B). The number of CERs received corresponds to emissions avoided by the project. CDM projects also need to be validated then recorded by the UNFCCC based on precise criteria.

Use of these mechanisms by local authorities

Worldwide, fewer than 10% of registered projects concern cities. The ones that do are mainly energy generation projects involving landfill gas, energy efficiency or reducing energy consumption. A few projects have also been developed in the water and transport sectors.

Further information:

UNFCCC: cdm.unfccc.int and ji.unfccc.int

I4CE, 2012: Climate Report 33 - JI: a frontier mechanism within the borders of an emissions cap and Climate Report 37 – 10 lessons from 10 years of the CDM

OECD - I4CE, 2011: *Cities and Carbon Market Finance: Taking Stock of Cities' Experience with CDMs and JIs*

European Climate and Energy Package

From the Climate and Energy Package 2020 to the Climate and Energy Package 2030

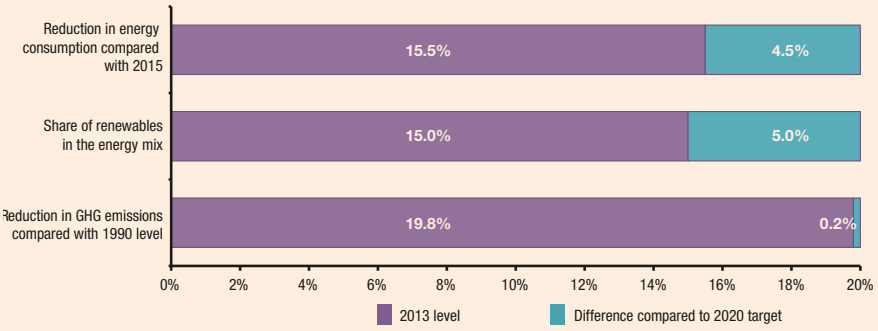
The **European Climate and Energy Package (CEP)** is restrictive legislation setting the European Union's targets for combating climate change and strengthening energy security. It is also the basis for the EU's climate commitments in international negotiations.

Objectives for 2020 were defined by the European Council in 2009 based on «3 x 20» targets: 20% renewable energies in the European energy mix, a 20% improvement in energy efficiency (i.e. a 20% reduction in primary energy consumption compared with a baseline scenario) and a 20% reduction in **GHG** emissions compared with their 1990 levels.

These targets were updated and revised for 2030 at the European Council meeting in October 2014 which agreed on:

- A strict GHG emissions reduction target in the EU of at least 40% compared with 1990 levels;
- A target of at least 27% for the share of renewables in EU energy consumption. According to the European Commission's impact assessment, an emissions reduction target of 40% automatically requires this share of renewables in the EU energy mix;
- An indicative energy efficiency improvement target of at least 27% compared with the 2007 reference scenario, which will be revised in 2020.

EU's progress towards the 2020 targets in 2012



Source: I4CE, 2015.

Tools to meet the Climate and Energy Package objectives

The EU's main tools to achieve these targets are:

- An emissions trading scheme (with a target of a 43% reduction by 2030 compared with 2005 levels). Changes to the scheme were proposed in July 2015, integrating a Market Stability Reserve;
- National emissions reduction targets for non-**EU-ETS** sectors (for a reduction target at European level of –30% in 2030 compared with 2005 levels);
- National renewable energy development targets defined in the «Renewable Energies» directive (directive 2009/28/EC) which sets out the general target for each sector;
- An energy efficiency plan and directive (directive 2012/27/EU) committing States to define national targets;
- Preparations are currently underway to establish an Energy Union. This is based on five areas: security of supply, a fully-integrated European energy market; energy efficiency to control demand; emission reductions; and, finally, research and innovation.

Achieving the 2030 GHG emissions reduction target relies on principles of flexibility, solidarity and fairness between Member States and takes account of specific national characteristics.

In 2014 (see figure), the EU had nearly met its GHG emission reduction targets and was on track to meet the renewable energy targets by 2020.

Achieving the energy efficiency target seems more difficult however.

In the longer term the EU has an energy Road Map for 2050, particularly including a reduction.

Further information:

European Commission: Climate and Energy Package 2020 and Climate and Energy Package 2030

MEDDE: Climate and Energy Package 2030, www.developpement-durable.gouv.fr/Paquet-Energie-Climat-2030-Par-l.html

SHEET 19

UNDERSTAND

European carbon market: EU ETS

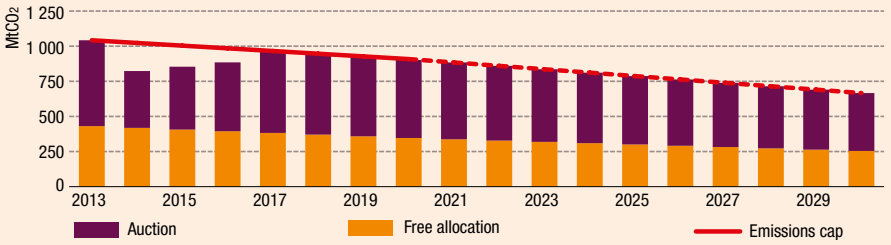
Description and functioning of the European Union Emissions Trading Scheme (EU ETS)

EU ETS is a regulated system for exchanging CO_2 emissions quotas, called **EUAs** (European Union Allowances) concerning approximately 12,000 facilities representing 50% of European CO_2 emissions. Established by directive 2003/87/EC and implemented in 2005, it is one of the EU's main tools to achieve its GHG emissions reduction targets of 20% by 2020 and 40% by 2030.

Functioning since 2013

- An emissions cap is set for industrial facilities in four main sectors: energy production, (main sector), ferrous metals, mineral industries and the paper industry.
- Most facilities are allocated a certain number of emissions quotas free of charge (1 quota = 1 tCO_2), according to the performance grids established with the 10% of existing facilities responsible for the least pollution (benchmark method). Industrial companies in the power sector, meanwhile, have been obliged to buy all their quotas at auction since 2013.
- Each year before 30 April, operators must return the number of quotas corresponding to their CO_2 emissions in the previous year or pay a fine of €100 per missing quota and submit the missing quotas the following year. Players who are able to reduce their emissions at a low cost can sell their surplus quotas to those with high reduction costs. The system therefore ensures economic efficiency through minimisation of overall costs for a fixed emissions level.

Change to the EU ETS emissions cap



Source: I4CE, 2015.

Assessment of the first phases

The EU ETS is now in its third phase of operation:

- Phase 1, preparatory: 2005-2007 with a target of a 5% reduction in European emissions compared with 1990;
- Phase 2: 2008-2012, –10% compared with phase 1;
- Phase 3: 2013-2020, in the framework of the Climate and Energy Package 2020, to achieve 21% reduction in emissions compared with 2005.

At the end of phase 2, the mechanism had led to a 12% reduction in European emissions between 2005 and 2012. Emissions have been reduced in all countries (except Malta and Estonia) and all sectors. Most sectors had an overall quota surplus, with only power generation having a deficit.

Changes and structural reform

The scope of the EU ETS was gradually expanded (inclusion of new GHGs and sectors), the emissions cap was lowered and the proportion of quotas auctioned increased.

However, the EU ETS continues to suffer from structural weaknesses that limit its effectiveness. Uncontrolled interactions with renewable energy development policies, the influx of international loans and the lack of flexibility concerning supply in the event of variations in demand have led to a significant surplus in quotas. This has pushed down prices over the long term and damaged the mechanism's credibility.

Although the central role of the EU ETS appears to have been confirmed by preparations for the **Climate and Energy Package 2030**, where a new target of –43% in emissions compared with 2005 was set for the sectors in question, the need to reinforce the mechanism's resilience by pursuing structural reforms was also highlighted. A proposal was made to create an instrument to stabilise the market.

■ Further information:

European Commission - Directorate-General for Climate Action: EU ETS

I4CE, 2015 : a video explaining how the European carbon market works www.i4ce.org/how-does-the-european-carbon-market-work/

I4CE : Carbon Trends www.i4ce.org/publication-type/tendance-carbon/

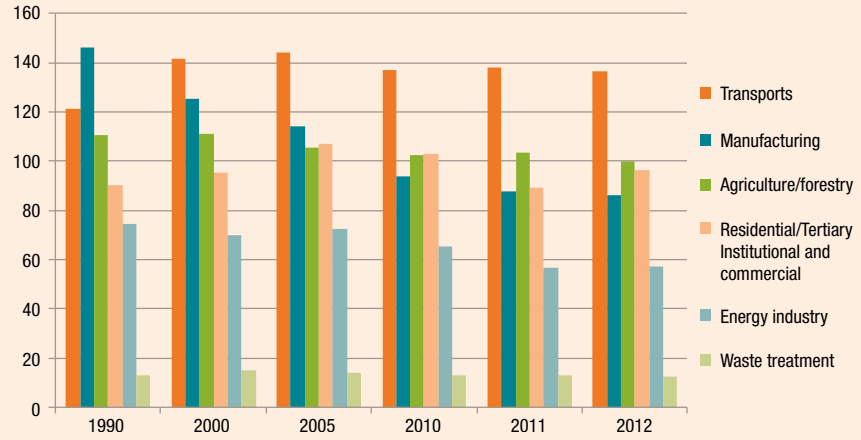
GHGs in France

National emissions inventory

France produces a relatively low level of **GHGs** per inhabitant and per GDP point compared with the average for **OECD** countries. It is responsible for 1.2% of global emissions and contributes 4.2% of total GDP.

This advantage is largely explained by the low proportion of coal and gas in the French energy mix, which has a higher percentage of nuclear and hydroelectric power.

Changes in direct GHG emissions by sector in France from 1990 to 2012



Source: Citepa, 2014

Sectoral analysis: The transport sector was responsible for the largest share in GHG emissions in France in 2012, as it had been since 1998. Several other sectors also make very significant and fairly close contributions, including agriculture, residential/tertiary and manufacturing.

Achievement of targets: In 2011, emissions were 12% lower than in 1990, falling from 557 to 490 Mt CO_2 eq. while GDP increased by almost 40% over the same period. GHG emissions have fallen by an average of 2% a year since 2005 and the Kyoto target has been met. This result is not yet sufficient to meet the target of quartering emissions by 2050 compared with 1990, which would require a 3% reduction each year.

Sectoral changes

The most significant changes since 1990 have been recorded in the manufacturing industry (–41%), which has reduced **energy consumption and** taken **energy efficiency** measures, as well as being impacted by the economic crisis in recent years. The second highest reduction has been seen in the energy industry (–23%).

The transport sector's emissions increased by 9% overall between 1990 and 2012, although they reached a peak in 2004 and are currently falling by 0.5% a year on average. The main mitigation levers have been improvements to infrastructure, the development of alternative means of transport to rival roads and new standards applicable to petrol and diesel vehicles.

Emissions from the residential and tertiary sectors are highly dependent on weather conditions. The new thermal regulations and a range of tools to assist with building renovations are designed to minimise this phenomenon.

Factor 4 trajectories: ADEME scenarios

ADEME has presented two energy scenarios as part of the energy transition debate:

- the first, looking ahead to 2030, involves a 40% reduction in emissions based on trends in voluntary actions, half of which concern the energy efficiency of buildings;
- the second, looking to 2050, sets out the conditions for achieving **factor 4** (quartering of emissions) and relies, among other things, on increased efforts in the transport sector.

The energy mix is also likely to evolve, through greater use of biomass for example. Agriculture and industry also play a key role.

Further information:

CITEPA: www.citepa.org/fr/

MEDDE: Greenhouse effect and climate change, www.developpement-durable.gouv.fr/-Effet-de-serre-et-changement-.html

MEDDE, 2015: *Climate and energy efficiency policies: summary of France's commitments and results*

ADEME, 2012: *Contribution to development of 2030-2050 energy scenarios*

Objectives and governance in France

Climate and energy policies in France – background

French climate and energy policy is based partly on nationally transposed European regulations and targets.

A series of planning and implementation laws have been developed in recent years to define principles, targets and tools for these policies.

Legislation made the fight against climate change a national priority in 2001 and the first national climate plan was adopted in 2004. This has since been updated four times.

In 2005, the **POPE** law fixed strategies to secure energy supplies, improve environmental preservation, ensure a competitive energy price and access to energy for all.

The main French climate and energy targets

	GHGs (compared with 1990)	Energy efficiency	Renewable
EU			
CEP 2020	14% reduction between 2005 and 2020 in sectors not covered by the EU ETS	20% (Energy Efficiency directive) adapted into national action plans (NEEAPs) in 2008 and 2011	20% of final consumption
National legislation			
POPE law	Quartering of emissions by 2050	Target of a 2% reduction in energy intensity by 2015 and 2.5% by 2030	10% of energy needs by 2010 (21% of electricity)
Grenelle laws	Previous target confirmed	Adaptation into sectoral measures and targets	23% of final consumption by 2020
The Energy Transition for Green Growth Act	–40% by 2030 (+ reduction in the share of nuclear to 50% of electricity generation by 2025)	–20% in 2030 and –50% of final energy consumption by 2050 compared with 2012	32% by 2030 (with –30% of primary consumption of fossil fuels)

Source: I4CE, 2015.

The Grenelle environmental pact (2007-2012)

Initiated in 2007, the **Grenelle environmental pact** established a multi-stakeholder governance combining the government, local politicians, social partners, companies and NGOs. These were split intoworking groups examining a range of themes, including combating climate change and energy demand, biodiversity and resources, production and consumption modes, ecological democracy, employment and competitiveness.

The proposed measures are divided into the Grenelle I (2009) and II (2011) legislation as well as into more than 250 decrees. The main implications for local authorities include the establishment of **SRCAEs** (regional climate, air and energy plans) and **PCAETs** (regional climate and energy plans) and of regulatory GHG assessments.

Energy transition (2012-2015)

Since 2012, the energy transition approach has taken over, with the organisation of national and regional debates on energy transition. **The Energy Transition for Green Growth Act** was definitively adopted in August 2015.

The law addresses transport, the circular economy, renewable energy and building renovation. A governance aspect is also included, notably introducing a national carbon budget – *i.e.* emissions cap – and a multi-annual energy programme.

In parallel, an environmental conference has been organised in November each year since 2012, to collectively discuss environmental topics to be prioritised and define the working plan for the following year.

Further information:

National Climate Plan: www.developpement-durable.gouv.fr/Le-plan-climat-de-la-France-plan-d,14496.html

Monitoring of Grenelle measures: www.developpementdurable.gouv.fr/Le-suivi-du-Grenelle-de-l.html

The ecological transition on the French Environment Ministry's website: www.developpement-durable.gouv.fr/-Qu-est-ce-que-la-transition,7312-.html

Climate and energy efficiency policies: Summary of France's results and commitments, 2015

SHEET 22

ACT

Energy efficiency in France

Definition and objectives

Improving energy efficiency involves reducing the energy consumed to produce the same end service. Energy efficiency targets have been reinforced since the early 2000s:

National policies:

- In 2005, the **POPE law** fixed a 2% annual reduction target for French **energy intensity** until 2015 and 2.5% a year until 2030.
- The Grenelle laws made a significant contribution to efforts in the construction sector.
- The **Energy Transition for Green Growth Act** raises and extends final energy consumption reduction targets to a 50% reduction by 2050 compared with 2012.

The European framework: the 2012 energy efficiency directive sets a European target of a 20% energy efficiency improvement by 2020 compared with a baseline scenario. The text requires States to define a national indicative target, adopt a plan for the construction sector and establish a system of energy saving obligations for energy suppliers.

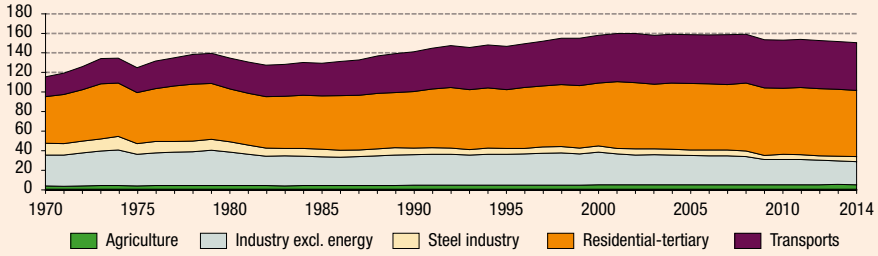
France's contribution to this European objective is based around two targets:

- A reduction in final energy consumption from 155 to 131 Mtep,
- A reduction in primary energy consumption from 260 to 236 Mtep.

Energy efficiency improvement tools

The **national energy efficiency action plan (NEEAP)** submitted by France to the European Commission in April 2014 sets out the main measures implemented sector by sector. Construction and transport account for a significant proportion of efforts (see table).

Changes in final energy consumption in France by sector (tep)



Source: based on SOeS, 2014.

Main French measures in favour of energy efficiency

Sector	Measures or policies in place	Estimated gain in 2020
Construction	Eco-loans (social and zero-interest housing) Thermal regulations 2012 Sustainable development tax credit	1.22 Mtep 1.15 Mtep 1.08 Mtep
Transport	Improvements to the energy efficiency of vehicles (ecological «bonus-malus» scheme, etc.) Modal shift incentives (e.g. ecotax on heavy goods vehicles)	2.2 Mtep NA
Industry	European carbon quotas market Regulatory measures and incentives to develop more efficient technologies	NA
Agriculture	Farms' energy performance plans: energy savings and conversion to renewable energies; Plan to modernise livestock buildings	NA
Energy	White certificates Eco-design (light bulbs, televisions, etc.) Waste prevention Domestic consumption tax on energy products	9.29 Mtep 1.05 Mtep 2.53 Mtep (2010) 4.4 Mtep

Source: I4CE based on NEEAP, 2014.

Some tools, such as white certificates, are directly available to regions to carry out or support projects to improve energy efficiency. Local authorities also have action levers such as public procurement, e.g. via **energy performance contracts**, *or supporting regional actors by establishing structures such as thermal renovation clusters and energy and greenhouse gas observatories.*

Good practice: positive energy regions

212 regions were selected following a «Positive Energy Regions» call for projects launched by the French government in 2014 to identify and support operational actions in a number of fields, including mobility, buildings, agriculture, food, etc. The aim is to encourage reduced energy consumption and energy efficiency and meet demand as far as possible using local renewable energy. A grant of €500,000 was allocated to each winning project. The Energy Transition for Green Growth Act calls for 200 positive energy local experiments to be launched by 2017.

Further information:

EU: Energy efficiency in Europe, europa.eu/legislation_summaries/energy/energy_efficiency

MEDDE: Ecological transition http://www.developpement-durable.gouv.fr/Qu-est-ce-que-la-transition.html

MEDDE, 2014: France's energy efficiency action plan and Controlling energy demand and promoting energy efficiency

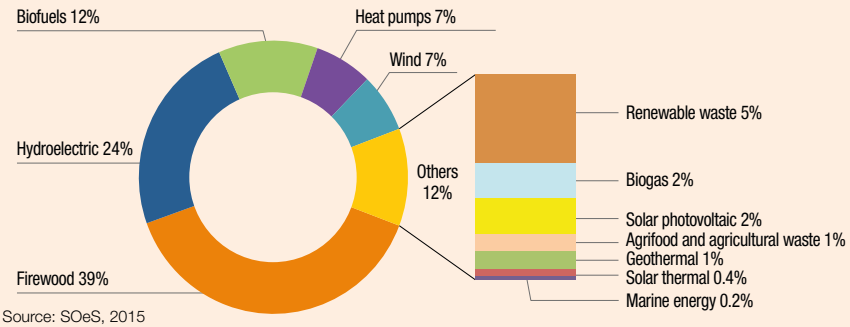
MEDDE, 2015: Climate and energy efficiency policies: summary of France's commitments and results

Renewable energies in France

French position and targets

France has significant potential in terms of hydroelectric, wind and geothermal power, making it the second-largest producer of renewable energies in Europe after Germany, the 14th largest consumer and a net exporter. In 2013, primary production of all renewable energies in France was 24.8 Mtep, reflecting a continued upward trend of +9.2 Mtep between 2005 and 2013.

Production of primary energy per renewable energy sector in 2014 (in Mtep)
2014 share: 22.4 Mtep



Source: SOeS, 2015

In 2008, in the context of the **Climate and Energy Package 2020**, France committed to achieving a 23% share of renewable energy in its final consumption by 2020, up from 14.2% in 2013. Achieving this target should lead to an 18 Mt CO_2eq. reduction in annual emissions from 2020.

The **Energy Transition for Green Growth Act** raises the bar by doubling the share of renewable energy production within 15 years, to meet 32% of total energy demand by 2030.

Tools and policies

To achieve its targets, several sectoral policies have been put in place, including a methanisation plan, calls for tenders for offshore wind and solar projects, additional remuneration, a heat fund, a regional biomass scheme, modernisation of the fleet of hydroelectric plants, financing assistance, simplification of procedures, etc.

Measures currently being implemented are set out in the national renewable energy action plan submitted to the European Commission in 2010.

Role of local authorities in the development of renewable energies

The renewable energy development targets can only be met with significant support from regional authorities.
In France, these targets have not been rolled out at local level, although the Grenelle laws and the Energy Transition for Green Growth Act delegated a large share of responsibility for local development of renewable energies to local authorities via the requirement to produce a **PCAET** and a **SRCAE** setting production targets and actions to achieve them. The SRCAE also features an appendix – the regional wind power plan – which assesses the development potential of onshore wind energy in each French region. French regional authorities can become involved in all aspects of energy:

- In relation to awareness-raising and support for inhabitants and, more broadly, regional actors, by supporting and structuring sectors via information for users and training for professionals.
- In relation to energy consumption, firstly in terms of their own portfolio (property and vehicles), as well as the whole region via development, urban planning, housing and transport policies.
- In relation to electricity and heat production.
- In relation to the distribution of electricity, gas and heat.
- In relation to funding, by contributing to the capital of renewable energy companies.

Wind power and renewable heating – accounting for a half and a quarter respectively of the Grenelle target – are particular priorities.

Good practice: producing electricity from biomass in Martinique

In Martinique, energy production is highly dependent on petroleum products, with almost all electricity produced (94 %) being generated by thermal plants. The Albioma-Galion 2 cogeneration plant, which runs on various types of biomass, aims to provide the region with clean and stable energy, and will be capable of meeting half the annual demand from Martinique households. Built on a site adjacent to the Le Galion sugar refinery, the plant will operate on various types of biomass including wood pellets and bagasse from the neighbouring refinery. In exchange, the refinery will operate on part of the energy produced by the plant.

Further information:

CGDD, 2014: Repères, *Chiffres Clés des Energies Renouvelables (Key Renewable Energy Figures) http://www.cdcclimat.com/IMG//pdf/key_figures_on_climate_2014_cdc_climat_research_medde-eng-hd.pdf*

MEDDE, 2010: National renewable energy action plan

Renewable energy observatory: www.energies-renouvelables.org

Renewable energy syndicate: www.enr.fr

ADEME, 2012: French expertise in the field of renewable energies

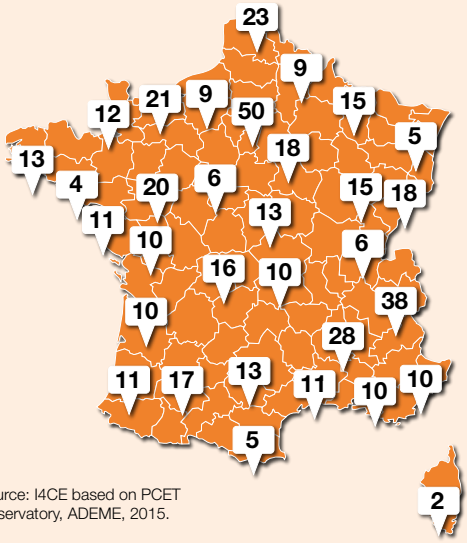
Local energy and climate planning

Two key planning documents for regional climate policies

• **The «Schéma Régional Climat Air Énergie»** (SRCAE – regional climate, air and energy plan): SRCAEs are drawn up by each region. They set strategies for 2020 and 2050 to develop renewable energy production segments, improve air quality, and they are coherent with the national climate change adaptation plan. They are designed to ensure the coherence of regional public policies in relation to climate and energy. Introduced by the NOTRe law, published in August 2015, the **Regional Schema for Planning, Sustainable Development and Regional Equality (SRADDET)** includes the SRCAE as part of an integrated approach to other themes (intermodal travel, waste, etc.) and is prescriptive.

• **The «Plan Climat Air Énergie Territorial»** (PCAET – regional climate, air and energy plan): formerly known as the Regional Energy Climate Plan, the 'Air' component was incorporated with the adoption of the **Energy Transition for Green Growth Act**. It consists of a regional project defining attenuation and adaptation to climate change objectives and actions to ensure the region is resilient. Inter-municipal associations with more than 20,000 inhabitants must draft a joint PCAET. The PCAET is based, among other things, upon a **GHG** emission report and a vulnerability diagnosis, and must be supported by a monitoring and evaluation mechanism. It must be compatible with the SRADDET

Map of PCETs identified in France in 2015



Source: I4CE based on PCET Observatory, ADEME, 2015.

In November 2015, the national PCET observatory set up by the ADEME identified 467 PCETs. The observatory is filled on a voluntary basis.

State of progress - 2015

Assessment of first generation SRCAEs

- All French regions have validated and adopted their SRCAE. The plans have been drawn up jointly by the government and regional councils, in many cases following consultation sessions with representatives of socio-economic stakeholders and civil society.
- However, some topics, such as adaptation to climate change, are less well reflected in the documents.
- The Energy Transition for Green Growth Act makes SRCAE responsible for setting a regional energy efficiency programme.
- SRCAEs have chosen different methodologies, making them hard to compare. Their aggregated effect is also difficult to understand.

PCAET

- Out of the 467 PC(A)ETs identified, 62% have effectively been implemented.
- Political backing and coordination of approaches are key factors in the success of PCAETs according to **ADEME**. Current challenges include maintaining commitment over time and monitoring and assessing the effectiveness of PCAET measures.

Good practice: International and European policies

Local authorities elsewhere in the world are also implementing energy and climate strategies at a local level, according to more or less formalised processes . The methodological framework of the PCET is also being experimented outside France, notably in Johannesburg in collaboration with the Greater Paris region, as well as in Minas Gerais, in Brazil.

In Europe, the Covenant of Mayors includes more than 5,000 local authorities that have committed to complying with or exceeding the target of a 20% reduction in their GHG emissions by 2020. Signatories must submit an action plan setting out the resources implemented to achieve this target. The approach adopted by French cities via PCETs fits in very well with this type of approach. To find out more: www.conventiondesmaires.eu

Further information:

ADEME: PCET Observatory, observatoire.pcet-ademe.fr and Le Savoir-faire Français, *« Agir Face au Changement Climatique »* (Acting Against Climate Change)

MEDDE: PCETs and SRCAEs, www.developpement-durable.gouv.fr/Plan-climat-energie-territorial.html & www.developpement-durable.gouv.fr/Schemas-regionaux-climat-air,32879.html

I4CE, 2012: Climate Report no. 36 Regional Climate – Air – Energy Plans: a tool for guiding the energy and climate transition in French regions

European adaptation strategy

Objectives of the European Climate Change Adaptation Strategy

This strategy is designed to reduce the vulnerability to climate change of the European economy, population and infrastructure and better prepare the EU for climate change. It was published by the European Commission in 2013 following a green paper drawn up in 2007 and a white paper released in 2012.
Its aim is to promote inclusion of climate change adaptation in European policies and encourage coherence between adaptation initiatives implemented at different levels. The strategy is accompanied by several technical documents, such as sectoral current-state reports and thematic guides.

A strategy structured around three priorities, broken down into eight objectives:

Priority 1: promote adaptation to climate change among Member States

- **Action 1:** Encourage Member States to adopt comprehensive adaptation strategies
- **Action 2:** Allocate LIFE funds to capacity development and establishment of adaptation actions in Europe in the period 2013-2020
- **Action 3:** Introduce adaptation into the framework of the Covenant of Mayors, concerning cities' approach to voluntary commitments

Priority 2: better inform decision-making

- **Action 4:** Address the lack of knowledge, particularly in respect of damage, costs and benefits, risk assessment methods and monitoring of measures
- **Action 5:** Develop the European Climate-ADAPT platform as a «one-stop-shop» for information and tools linked to adaptation in Europe

Priority 3: target the most vulnerable sectors

- **Action 6:** Facilitate consideration of the future climate in the cohesion policy, the common fisheries policy and the common agricultural policy
- **Action 7:** Make infrastructures more resilient, particularly by identifying standards to revise in the energy, transport and building sectors, and by providing guides to identify investments that are vulnerable to the climate
- **Action 8:** Promote insurance and financial products for resilient investments and economic strategies (green paper on insurance)

Source: based on the European Commission.

Financing for adaptation in Europe

Expenses relating to the climate (mitigation and adaptation) are due to account for 20% of the Multiannual Financial Framework 2014-2020. Structural funds and the **Horizon 2020** and **LIFE** programmes, for instance, are contributing to investments linked to adaptation. The strategy reaffirms the role of financial institutions such as the **EIB** and **EBRD** along with that of the national funds already financing adaptation projects. It also underlines the possibility for each country of using income from auctioning CO_2 quotas to finance adaptation measures.

Tools

Implementation of this strategy's actions involves several initiatives and tools including:

- **The ClimateAdapt platform:** set up by the European Commission and the **European Environment Agency (EEA)**, it contains information about climate change impacts in Europe (observations and scenarios, vulnerability studies, etc.), adaptation policies (national, local and sectoral) and offers decision-making assistance tools.
- **Mayors Adapt:** this initiative by the European Commission aims to involve signatory cities in the development of local adaptation policies, provide practical assistance and provide them with a network.
- **Research networks such as CIRCLE2** bringing together 34 institutions committed to research and knowledge-sharing in the field of climate change adaptation.

The European strategy also encourages the development of national adaptation strategies. In 2014, a report by the EEA identified 21 European States which had adopted such a strategy and 12 with a national adaptation plan. The agriculture, water and forestry sectors, as well as the consequences of climate change on health and biodiversity are of particular interest in these documents. The adaptation actions favoured are often «soft» measures (awareness-raising, information, etc.).

Good practice: The Pyrenees Climate Change Observatory

Structured around a cross-border network of actors in Andorra, Spain and France (laboratories, regional authorities and public institutions), the goal of the Pyrenees Climate Change Observatory is to monitor and understand climate changes affecting the Pyrenees. Partly financed by the European Union, it constitutes a platform for pooling knowledge and has allowed a vulnerability analysis to be carried out for various economic sectors (agriculture, tourism, forestry, etc.) as well as the formulation of joint recommendations to improve adaptation. It offers access to tools including a directory of actors in the Pyrenees, maps, data and climate indicators. To find out more: www.opcc-ctp.or

Further information:

EU: Adaptation to climate change, ec.europa.eu/clima/policies/adaptation/what/documentation_en.htm

Mayors Adapt: mayors-adapt.eu

Climate Adapt platform: climate-adapt.eea.europa.eu

European Environment Agency: www.eea.europa.eu

Circle 2: www.circle-era.eu

National climate change adaptation plan

Presentation of the national climate change adaptation plan

The aim of the PNACC (Plan National d'Adaptation au Changement Climatique) is to improve and share knowledge about the effects of climate change and inform public decision-making at a national level. Its publication in 2011 was coordinated by **ONERC** and follows a national consultation organised in 2010. The first PNACC applies for a five-year period, from 2011 to 2015.

It covers 20 themes:

The 20 themes of PNACC actions files

- Cross-sector actions
- Health
- Water
- Biodiversity
- Natural risks
- Agriculture
- Forestry
- Fishing and aquaculture
- Tourism
- Energy and industry
- Transport infrastructure and services
- Urban planning and the built environment
- Information
- Education and training
- Research
- Financing and insurance
- Coasts
- Mountains
- European and international action
- Governance

Source: ONERC, 2011.

Priority adaptation actions

In light of considerable uncertainty regarding future climate change, the PNACC favours:

- No-regrets measures, which will be beneficial even in the absence of climate change, *e.g.* promotion of water savings;
- An increase in existing safety margins, *e.g.* by extending weather watch maps for areas vulnerable to forest fires or flooding;
- Long-term measures such as integration of climate change into regional forestry strategies;
- Measures which could be adjusted and revised periodically, such as stricter requirements in relation to buildings' summer comfort;
- Institutional measures, such as consideration of climate change in public service contracts.

Assessment and state of progress

The final assessment of the PNACC was initiated in June 2015. The diagnosis highlights:

- Overall satisfactory progress, estimating that 80% of actions will be achieved by the end of 2016;
- Insufficient prioritisation of the recommendations emerging from the consultation groups and the national strategy;
- The need for finalised scientific research and the creation of a technical resource center, as well as the development of economic analyses and demographic outlooks.

The elaboration of the next PNACC will begin in 2016. It will draw upon the diagnosis made by the General Council for Environment and Sustainable Development (**CGEDD**), the fifth **IPCC** assessment report and elements from the COP21.

Regional adaptation at the initiative of local players

Regionalisation of adaptation is not directly addressed by the PNACC but is covered by regional climate, air and energy plans (**SRCAEs**) and regional climate, air and energy plans (**PCAETs**). Several tools have been made available to actors to facilitate operational implementation of adaptation measures:

- **ADEME** offers guides to (i) conduct a vulnerability audit of regions and define indicators; (ii) draw up and implement an adaptation strategy or action plan; (iii) monitor and assess adaptation policies.
- The Wiklimat collaborative platform allows everyone to document their regional climate change adaptation initiatives and publicly share their experience and achievements.

Good practice: National coastline management strategy

One of the measures in the PNACC's «coastline» sheet concerns the adoption of a national coastline management strategy, implemented in 2012. It encourages the development of coastline observation and the establishment of local strategies, particularly enabling better use of urban planning documents to prevent risks. It also develops the doctrine of regional spatial composition by identifying several options, depending on local situations, ranging from coastline maintenance to the preparation of property and infrastructure relocation measures. To find out more: www.developpement-durable.gouv.fr/Strategie-nationale-de-gestion.html

Further information:

ONERC, 2011: National climate change adaptation plan
ADEME: adaptation guides, www.ademe.fr/mediatheque
MEDDE: Wiklimat tool, wiklimat.developpement-durable.gouv.fr

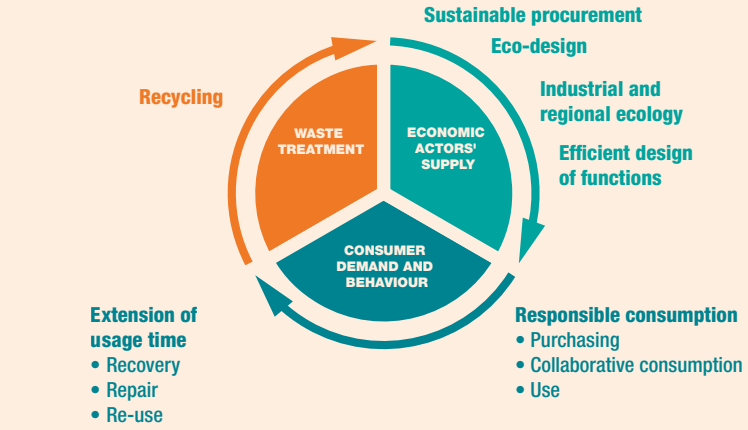
Circular economy

Definition and concept

According to **ADEME**, the circular economy is a *«system of economic exchange and production which, at every stage in the life cycle of goods and services, aims to increase the efficient use of resources and reduce the environmental impact, while developing individual well-being».*

It is based on seven pillars:

Pillars of the circular economy



Source: ADEME, 2014.

The circular economy aims to model itself on natural ecosystems to break the link between economic growth and the depletion of natural resources. Its development is based on creating loops of interconnected materials, involving new value models, with all actors and at every stage in a life cycle:

- **Supply and economic actors** with: procurement optimisation; **eco-design**; industrial and regional ecology initiatives designed to pool the needs of companies in a region by creating synergies and efficient design of functions favouring sequential use;
- **Consumer demand and behaviour** with: the fight against product obsolescence, responsible consumption, recovery and repair;
- **Waste management** favouring recycling.

In France and Europe

In France, circular economy has been incorporated into various public policies such as the National Ecological Transition Strategy Towards Sustainable Development, the Energy Transition for Green Growth Act, as well as sectoral industrial policy agreements concerning reduction targets, waste recovery and the promotion of new economic models.

In Europe, the forthcoming «circular economy» package will contains policies regarding waste and resources with the aim of improving recycling, preventing the loss of resources, creating jobs, demonstrating the effectiveness of new value models and reducing the EU's environmental impacts. The reduction in **GHG** emissions resulting from complete implementation of a first version of the package released by the Commission in 2014, is estimated at 62 Mt CO_2 eq. per year, or 1.4% of European emissions by 2030.

Good practice: Partnerships for a systematic regional approach

Many companies providing services (water, energy and waste) to local authorities are now trying to limit consumption of primary resources and recover waste. Waste from construction sites, household waste and organic waste are therefore being recycled or transformed into energy, *e.g.* in the form of bio-methane injected into natural gas networks for biowaste. Various industrial ecology and regional initiatives are also being developed: 40 projects were identified in the region in 2014 by the Orée association. This new approach to materials chains at regional level is part of a systematic policy in relation to urban flows, allowing collaboration between large integrated industrial groups and local authorities.

Further information:

Oree: Circular economy, www.oree.org/3priorites/economie-circulaire.html

Ellen MacArthur Foundation: http://www.ellenmacarthurfoundation.org/fr/economie-circulaire/concept

ADEME: Circular economy, www.oree.org/3priorites/economie-circulaire.html

MEDDE: Circular economy, http://www.developpement-durable.gouv.fr/Economie-circulaire,33986.html

Institut de l'Economie Circulaire: www.institut-economie-circulaire.fr

European funds

Europe 2020 Strategy

The **European Structural and Investment Funds (ESIF)** target eleven thematic objectives (TOs) contributing to the goals of smart, sustainable and inclusive growth in the Europe 2020 Strategy, adopted in 2010. Of these objectives, four relate to ecological and energy transition: supporting the shift towards a low-carbon economy (TO4), promoting climate change adaptation (TO5), protecting the environment and promoting resource efficiency (TO6), and promoting sustainable transport (TO7).

The EU's multi-annual funding framework for 2014–2020 has allocated €960 billion, of which €27 billion is earmarked for France. It focuses on new regional development tools such as integrated territorial investment (ITI) and Community-Led Local Development (CLLD). In addition to grants, which remain the main means of allocating funds, it promotes greater use of financial instruments with the aim of optimising funding capacities through the leverage effect.

Prioritising energy transition within the cohesion policy

Within the ESIF, the **European Regional Development Fund (ERDF)** and the **European Social Fund (ESF)** are the main cohesion policy tools which aim to reduce socio-economic and environmental disparities between the European regions. Falling under national jurisdiction until 2013, regional councils took over a large part of the management of regional budgets from these funds, established on the basis of GDP per capita and subject to a Partnership Agreement with the European Commission.

The categorisation of the regions had an impact on the priority themes: the most developed French regions had to allocate at least 20% of total ERDF resources to TO4, shifting towards a low-carbon economy. For less developed regions, this requirement was lowered to 12%. In November 2015, EU Member States voted to allocate a quarter of the ESIF to this same objective, i.e. around €45 billion over the 2014–2020 period.

Other European regional assistance funds and programmes

Other sources of funding exist for projects led by regional authorities, directly managed by the European Commission, while technical assistance programmes provide support for their financial engineering.

■ Examples of European funding sources for territories

	Funds			Technical assistance		
	Horizon 2020	CIVITAS	LIFE	ELENA	EASME	Plateforme S3P
Beneficiaries	Local authorities	Local authorities, SMEs, universities, NGOs, transport operators	Public authorities, SMEs, NGOs	National, regional, local authorities	SMEs	National and regional authorities
Focus and type of project	Two programmes: - Secure, clean and efficient energies; - Smart, green, integrated transport systems.	Sustainable mobility, clean vehicles. Projects: workshops, assessment, feasibility study, discussion and training.	Mitigation, adaptation, biodiversity, governance. Projects : good pratices, information, technical assistance.	Energy efficiency in buildings and transport, renewable energies	Supports various european programmes: horizon 2020, Enterprise Europe Network, LIFE, Eco-Innovation	Promotes green energies: knowledge sharing, harmonization of national, regional, local activities

Source: Energy Cities, 2015

Juncker Plan

The Investment Plan for Europe (or the so-called 'Juncker Plan'), announced at the end of 2014, aims to raise investment to encourage growth and employment. It consists of:

- The creation of a **European Fund for Strategic Investments** (EFSI), a new fund entrusted to the **European Investment Bank** (EIB). With a €21 billion budget, it aims to raise up to €315 billion in investment in projects meeting EU objectives, combined with a significant level of risk;
- A portal listing the projects which add value to the European economy;
- An advice and investment platform (bringing together existing mechanisms such as fi-compass) to promote European projects;
- The creation of a regulatory environment which fosters investment: improving SME access to capital, encouraging long-term project funding, removing obstacles to the single market, etc.

Good practice : la Troisième révolution industrielle

The 2014–2020 operational programme for the Nord-Pas de Calais region allocates a significant amount of its €847 million budget to economic development and energy transition by using 33% of ERDF grants. To find out more : www.latroisiemerevolutionindustrielleennordpasdecalais.fr

■ Further information:

Commission Européenne : European Funds, ec.europa.eu/regional_policy/the-funds/regional

UE : www.europe-en-france.gouv.fr et www.partenariat20142020.fr

BEI : www.eib.org

Crowd-funding

Description and development

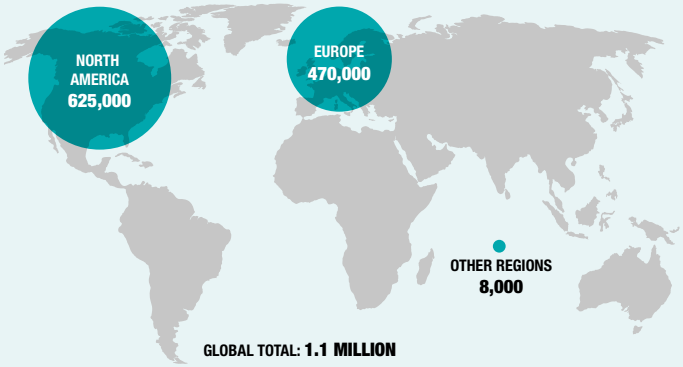
Crowd-funding is a mechanism calling on citizens to invest in certain types of projects. Crowd-funding, which first emerged in the artistic field, harnessing the emotional dimension of the relationship between an artist and his/her following, is now increasingly used to finance entrepreneurial and local projects, particularly in relation to energy and climate. It allows citizens to decide precisely how their money is used.

Two factors have boosted this new financing model since the 2000s:

- the increased scarcity of traditional financing sources, encouraging project coordinators to turn to alternative funding;
- and above all the internet which, for minimal cost, allows thousands of individuals to become involved in any size projects.

Three main categories of financing platforms exist, depending on whether they rely on donations, loans or equity investments. More than a million projects were financed around the world in 2012, representing total inflows of $2.7bn. This figure is increasing sharply and exceeded $5bn in 2013. The number of projects financed in France has tripled from 10,000 in 2011 to more than 32,000 in 2013.

Number of projects financed by crowd-funding worldwide since 2012



Total in 2012 1.1 million projects were financed for a total amount of $2.7bn.

Source: based on Massolution – Crowdfunding Industry Report 2013 CF

Crowd-funding for the energy transition

There are several advantages to the crowd-funding of energy transition initiatives:

- It raises the profile of projects and helps increase public awareness.
- It provides a leverage effect for the financing of renewable energy and energy efficiency projects by helping to steer long-term savings towards these types of projects.
- If it is combined with participative governance of projects, it can offer a vehicle for the involvement and commitment of local residents, facilitating the social acceptance of development or infrastructure projects. Denmark in particular is attempting to harness this aspect and since 2008 has opened 20% of the share capital of wind-power projects to individuals living within a 4.5km radius.

In 2014, a regulatory framework was established for crowd-funding in France to allow all projects to take advantage of it and protect both savers and entrepreneurs from potential problems. In addition, the **Energy Transition for Green Growth Act** enables limited companies involved in renewable energies to receive funding from regional authorities and residents in their regions.

Good practice: community-financing of renewable energy projects

- **Crowd-funding platforms** such as Lumo and Crowd2win in France and Citizenergy at a European level are specifically dedicated to funding renewable energy projects. They act as an intermediary between the project and potential investors, with an average target of 20% financing through crowd-funding.
- **Community wind farm in Brittany:** inaugurated in 2014, the first community wind farm project in France generated €2.5m from crowd-funding, representing 20% of the project total. Information was provided to residents via «Tuperwatt» meetings explaining the project. To find out more: www.eoliencitoyen.fr/

Further information:

AMF, 2013: Crowd-funding guide for platforms and project coordinators

Financement Participatif France, 2014: 2014 survey of crowd-funding in France

MEDDE: Crowd-funding, www.developpement-durable.gouv.fr/Le-financement-participatif.html

UNDERSTAND

Eco-taxation

Definition

Eco-taxation aims to incorporate social and environmental costs into market prices. Based on the price signal given, the objective is to modify the behaviour of economic actors (companies, households and public authorities) by encouraging virtuous behaviour and penalising harmful actions. The **«polluter pays» principle** is an economic theory that aims to reduce the negative impacts on the environment by encouraging actors to favour the cheapest solutions, rather than imposing a single solution.

Environmental taxation may take the form of taxes or subsidies and relate to consumption of resources or various types of soil, water or air pollution, including GHG emissions.

Examples of taxes according to pollution sources

Sources of pollution	Object	Application country	Tax measure
Greenhouse gas emissions	Greenhouse gas emissions	Canada (State of Alberta)	CA$15 per tonne of CO_2eq. per year for emissions of six greenhouse gases (carbon dioxide (CO_2); methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs, perfluorinated hydrocarbons (PFCs), sulphur hexafluorides (SF_6)) on industrial sites responsible for more than 100,000 tCO_2eq. of emissions in 2003
Energy products	Fuels for transport and heating	France	Climate and energy tax on energy products according to their carbon dioxide content (€7 tCO_2 in 2014 for natural gas, heavy fuel and coal – €14.50 in 2015 and €22 in 2016)
	Electricity	United Kingdom	Climate Change Levy: £0.00524 per kWh of electricity consumed by companies
Motor vehicles	Taxes on heavy goods vehicles	Germany	From €0.14 to €0.29 per km for heavy goods vehicles taking national roads depending on the category of polluting emissions, the number of axles the vehicle has and the distance travelled.
Consumption of resources/ pollution	Nitrogen oxide emissions (NOx)	Sweden	40 SEK per kg from 1992 to 2008
	General tax on polluting activities	France	Due by companies whose activities or products are considered to be polluting: waste, oils and lubricants, detergents, solvents, mined materials, pesticides, chemicals, etc. Its amount and the rate applicable vary according to the category of activity and product.
	Land	France	Payment for low density
	Petroleum	Ireland	Tax of €0.15 on plastic bags in 2002

Source: I4CE, 2014.

Environmental taxation design principles

- The basis must be high enough to influence the behaviour of actors and come close to the actual cost of environmental **externality**.
- The tax must apply as closely as possible to those directly responsible for the pollution since they have access to the most effective levers.
- Eco-taxation may result in a double benefit, since as well as encouraging virtuous policies, its proceeds can be earmarked for investments in complementary measures to support transition.
- The main limitation of environmental taxes is their social acceptability. To address this, it is possible to apply the tax progressively and implement redistributive measures to counter the effects of the tax on the most vulnerable taxpayers. However the system must remain transparent in order to be effective and accepted.
- Long-term stability and transparency are important credibility factors to ensure structural changes.
- In a globalised economy, taxes can also have a negative effect on the competitiveness of a country's companies. International coordination and harmonisation are therefore important.
- The establishment of subsidies should avoid rebound effects – i.e. when reducing the cost of a virtuous product encourages more to be consumed – and windfall effects – *i.e.* when an actor who would have changed its practices in any case profits from the subsidy .

Good practice: Payment for low density

Since 2010, competent municipalities and local authority groupings can set a minimum density threshold in their Local Urban-planning Plan. The builders have to pay a tax for any new development or construction project which exceeds this threshold. This mechanism is designed to limit urban sprawl which usually has a negative impact on energy consumption and transport emissions. Some 40 French towns chose to test the system in 2013, including Bugarach, Morangis, Sète and Saint-Ouen. To find out more: www.cdcclimat.com/IMG//pdf/14-06-09_point_climat_no_36_vsd_.pdf

Further information:

CGDD, 2013: *La Fiscalité Environnementale en France: un État des Lieux (Environmental Taxation in France: an Overview)*

Eco-taxation Committee: *www.comite-fiscalite-ecologique.gouv.fr*

OECD, 2010: *Taxation, innovation and the environment, OECD publications.*

Tools for thermal renovation of private homes

Current state of the French housing stock and objectives

The housing sector represents 30% of final energy consumption.53% of homes had an average D or E energy label in 2012.

Recent construction standards such as the 2012 thermal regulations have improved the energy performance of new constructions, although with an annual renewal rate of 1% a year, existing housing stock represents the main challenge.

It currently stands at 31 million housing units. A target of 500,000 thermal renovations a year from 2017 has been set by the French government, at least half of which will relate to homes occupied by low-income households. A range of tools are gradually being rolled out at each stage in the renovation programme to achieve this target.

Encouraging and supporting renovation, structuring sectors

The first step is to inform households and allow them to benefit from the advantages resulting from renovation work on their homes. Several tools are available to do this, in particular:

- **Regional thermal renovation platforms:** implemented by local authorities and ADEME as part of the energy renovation plan for housing, these platforms aim to provide information to individuals, encourage them to carry out renovation work and introduce them to structured and qualified sectors and a tailored range of financing.
- **Digital tools** to support and monitor initiatives (Passeport Rénovation Thermique, Carte Vitale du Logement, Carnet Numérique de Suivi, etc.).
- **Access to information**: the **Energy Transition for Green Growth Act** stipulates that consumption and production data and network information have to be made available to local stakeholders.

The challenge of fuel poverty

The renovation of homes is both an environmental and social challenge. This is because the least energy efficient buildings are often those occupied by households on the lowest incomes, who are therefore in a situation of fuel poverty. Based on the common but debatable assumption that 10% of income is allocated to energy expenses, 3.8 million households in a situation of fuel poverty were identified in France in 2014. This situation is affected by numerous factors, including income, but also the price of energy and housing conditions. The government support available can be broken down into two types: curative assistance, such as paying bills, and dedicated preventive assistance, involving thermal renovation of homes.

Financing renovation works

Tools for thermal renovation of buildings

	Financing grants for households	Specific grants for situations of fuel poverty
Private housing	• **Home improvement loans:** - ***Éco-Ptz***, a zero-interest loan to finance energy renovation projects. - ***the energy transition tax credit (CITE – Crédit d'Impôt Transition Energétique***) offering a 30% tax credit to carry out a renovation using a contractor with RGE (Reconnu Garant de l'Environnement) certification. - ***collective loans to co-ownership*** associations, granting of which needs to be streamlined and consolidated. • **Third-party financing** which involves submitting a renovation proposal financed by a third party.	• **Direct grants** such as the ANAH's «Habiter Mieux» programme, covering 35% to 50% of the cost of works, subject to income. • **Micro-loans** as a form of financing appropriate for households living in fuel poverty. Access is facilitated by the Energy Renovation Guarantee Fund. • **The Energy Renovation Guarantee Fund** to facilitate access to credit for low-income households
	• **Additional aid from local authorities des collectivités locales**	
Private tertiary	• Energy performance contracts: allowing contractual definition of restrictive energy efficiency improvement targets when carrying out works. • Corporate or real-estate loans.	
Social housing	• Home improvement loans	
Public tertiary	• Public procurement tools. • Energy performance contract, long-term public lease (bail emphytéotique administratif). • Partnership contract. • Use of white certificates to finance renovation work.	
All types of buildings	• Valorization of the white certificates	

Source: I4CE, 2015.

Further information:

CGDD, 2015: La Revue du CGDD, *La Rénovation Thermique des Logements: Quels Enjeux, Quelles Solutions?* (Thermal Renovation of Homes: What Challenges, What Solutions?)

ADEME: Housing renovation, www.ademe.fr/collectivites-secteur-public/integrer-lenvironnement-domaines-dintervention/renovation-lhabitat

ANAH: «Habiter Mieux» programme, www.anah.fr/habitermieux.html

ADEME, 2015: 2015 grants for thermal renovation of existing homes

White certificates

Presentation and functioning of the scheme

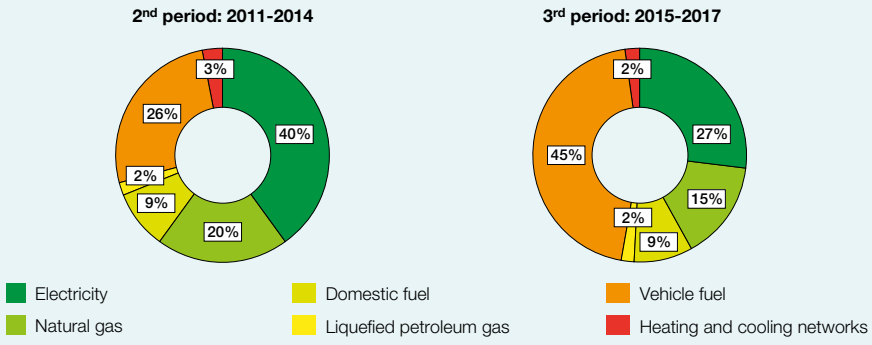
White certificates (certificats d'économie d'énergie) are an instrument for controlling energy demand created in 2005 by the **POPE law** to encourage energy suppliers to promote energy efficiency among their customers.

- Energy-saving obligations are imposed for three-year periods on suppliers of electricity, gas, LPG, home heating oil, heating and cooling and, since 2011, vehicle fuel suppliers.
- At the end of each period, the suppliers must be in a position to return sufficient white certificates to meet their energy saving obligation or pay a penalty of two euro cents per kWh missing.
- White certificates are allocated throughout the period by the French Energy Ministry (**MEDDE**) directly to suppliers or other eligible organisations (local authorities, ANAH, social housing providers and public-private joint ventures offering third-party financing services) that carry out energy savings projects. These projects may relate to the residential sector, tertiary buildings, transport or the industrial and agricultural sectors.

The suppliers can purchase white certificates from other eligible actors. All white certificates allocated and traded are recorded in a national register at www.emmy.fr.

To simplify procedures, a number of actions have been defined in standardised information sheets. Other specific projects are studied on a case by case basis.

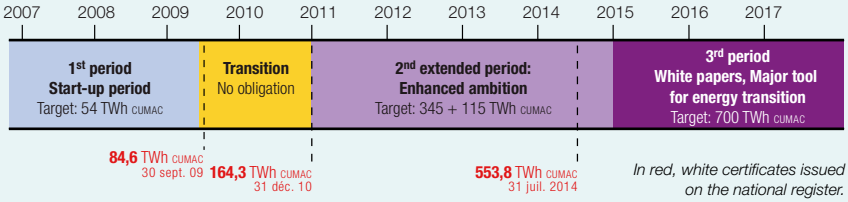
Breakdown of the energy savings target between energy sources



Sources: DGEC, May 2014.

An evolving system

The various phases of the system since 2007: objectives and achievements



Source: ADEME, 2014.

White certificates issued during the second period represented €24bn of investments in energy savings, avoiding some 28 Mt of GHG emissions, or 5.2% of the construction sector's emissions.

The target for the current period is 700 TWh Cumac (cumulated and discounted). The procedure for obtaining white certificates was simplified at the launch of the third period on 1st January 2015. It is now declaratory with subsequent verification.

The Energy Transition for Green Growth Act broadens the scope of beneficiaries of white certificates and supporting programmes. Local public third-party funding companies, regional authorities and their groupings as well as social landlords' associations are now eligible.

Moreover, the Energy Transition for Green Growth Act is establishing a new volume of energy efficiency obligations specifically focused on households experiencing fuel poverty. The French government has set the objective of 150 TWhc for 2016–2017.

Further information:

MEDDE: White certificates, www.developpement-durable.gouv.fr/-Certificats-d-economies-d-energie,188-.html

ADEME: White certificates, www.ademe.fr/expertises/changement-climatique-energie/passer-a-laction/comment-valoriser-economies-denergie-cee

Association Technique Énergie Environnement (ATEE): www.atee.fr/c2e

Carbon offsetting

Principle of an offset project

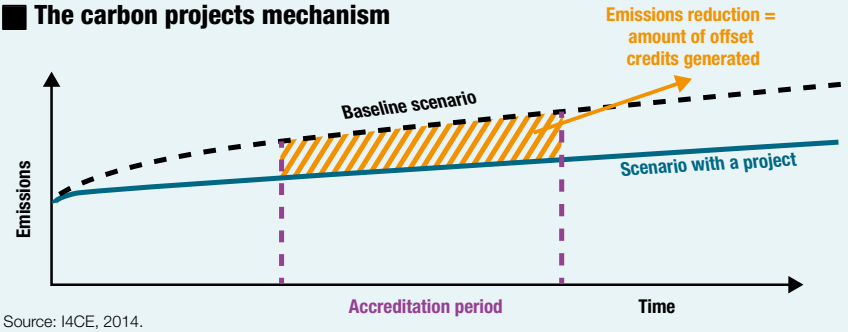
Carbon offset projects generate carbon credits equivalent to the emissions avoided by the projects, which can be traded on quota exchange markets (see figure). Various gases are targeted by the various systems, although they are always converted into tonnes of CO_2 (said CO_2 equivalent).

Demand for these credits can be divided into two categories:

• **«Compliance» demand** resulting from a regulatory obligation. This is because carbon pricing systems (Kyoto Protocol intergovernmental cap-and-trade system, **EU ETS**, etc.) allow participants to return credits purchased from other actors instead of quotas or a tax payment. The regulatory then defines quality criteria, to ensure that carbon credits generated by these projects are accepted.

• **«Voluntary» demand** from entities, often local authorities or companies, which are not subject to regulatory constraints with regard to **GHG** emissions, but have set themselves a carbon-reduction or neutrality target. If they do not achieve this target through their own internal reductions, they buy credits to make up the difference. Since they are not covered by any regulatory framework, these entities use «Kyoto credits» generated by **JI** or **CDM** projects, or credits from projects certified by voluntary labels such as the Gold Standard or Verified Carbon Standard.

The carbon projects mechanism



Source: I4CE, 2014.

Five quality criteria of an offset project

Offset projects must fulfil five main quality criteria to be certified and marketable:

1. **Additionality:** the project coordinator must demonstrate that the project would not have been implemented without carbon credits. It must also be proved that the project goes beyond regulatory obligations.
2. **Monitoring:** emissions or sequestration must be subject to a quantitative monitoring plan throughout the accounting period. Certified methodologies set out the project's emissions calculation methods and a reference scenario. The difference between the two corresponds to the quantity of carbon credits generated.
3. **Verification:** credits are only obtained once the emission reductions have been achieved and verified by an independent and accredited third party.
4. **Permanence:** most labels have established insurance mechanisms to guarantee the replacement of credits in the event that an offset project proves inadequate (*e.g.* carbon sequestered in the ground or in a forest is not stored indefinitely).
5. **Avoidance of double counting:** a project can only issue carbon credits in the framework of a single programme or reduction incentive and a carbon credit can only be sold once.

Offsetting by local authorities

Some local authorities, including Eastleigh, Toronto, San Francisco, Perth, British Columbia and the Ile-de-France region, have chosen to measure, internally reduce and offset all or part of their GHG emissions. They have a range of motives (visibility, innovation, desire to support a region and/or a sector by buying credits from them) and take various forms (purchasing of credits directly or via an association or fund consolidating private capital).

Further information:

Bellassen, V and Leguet, B. 2009, *Comprendre la Compensation Carbone (Understanding Carbon Offsetting). Pearson*

Ecosystem Marketplace, 2014: *State of the Voluntary Carbon Markets*

CDC Climat, 2011: *Climate Report no. 29, Voluntary Carbon Offsetting by Local Authorities: Practices and Lessons*

Carbon compatibility tools

Challenges of measuring and monitoring GHG emissions

Quantifying **GHG** emissions, identifying their sources and monitoring changes is necessary for the implementation of any climate change mitigation policy. Various GHG measurement tools have been developed according to specific scales of analysis or needs. These approaches also favour the appropriation of climate issues by local actors.

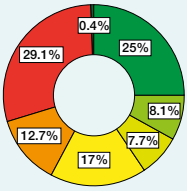
Assessments and inventories

GHG audits are carried out at various levels and stages in order to:

- Conduct an initial audit, identify action levers and coordinate actions;
- Respond to a regulatory obligation: in France, intercommunalities with more than 20,000 inhabitants have to conduct a regulatory GHG assessment of their portfolio and competencies;
- Promote progress achieved and report to internal stakeholders or external partners, *e.g.* in the context of international commitments such as the Covenant of Mayors. The audits must be detailed and transparent. Various guides and methodologies exist to assist with measuring and reporting results, *e.g. The methodological guide to conducting regulatory GHG emission assessments for local authorities* published by **MEDDE**, the regional Bilan Carbone® (carbon assessment) and the **GPC Protocol**. Taking into account indirect emissions remains a challenge for these methodologies, which are continuing to evolve.

Example of the initial GHG audit by Greater Lyon by scope

Total CO_2 emissions: 7.6 million tonnes



- Industries subject to CO_2 quotas
- Industries not subject to quotas
- Heating network
- Residential
- Tertiary
- Transport
- Agriculture

5%

Bilan Carbone® for Greater Lyon's portfolio and services
- Public order
- Buildings
- Waste management
- Water services
- Agents' travel

20%

Emissions under the influence of current community public policies
- New housing in urban development zone
- Social housing
- Public transport
- District heating
- Urban planning

75%

All other emissions
- Companies: industrial facilities, transport of goods, etc.
- Municipalities
- Inhabitants: private housing, transport, consumption

Sources: Bilan Carbone® for Greater Lyon and register of CO2 emissions (Air Rhône-Alpes), 2009.

Technical and normative choices

Accounting of GHG emissions may vary significantly according to the methodological parameters resulting from technical as well as normative choices made according to the scale and final use of the assessment, *i.e.* voluntary or regulatory, internal use (to plan mitigation policies and/or serve as progress indicators) or external use (comparison or reporting). The main parameters include:

- **Scope:** three main GHG emissions scopes (ISO 14064) can apply to a project, an entity or a region:
  - Scope 1: direct emissions,
  - Scope 2: indirect emissions, i.e. produced in a different location and linked to production of electricity, steam, heat or cooling,
  - Scope 3: all other indirect emissions, upstream and downstream (particularly linked to the consumption of goods and services).
- **Gases taken into account:** often the six gases mentioned in the Kyoto Protocol: CO_2, N_2O, CH_4, SF_6 , HFC and PFC.
- **Sectors included:** often those in the **IPCC** standard framework.
- **Attribution of responsibility:** based on production (allocation of emissions at the site of their production) or consumption (allocation of emissions at the point of consumption).
- **Calculation methodology:** the most commonly used is the emission factors methodology (estimated according to standard values that have been either modelled or measured).

Sectoral carbon tools

One of the current challenges is to design tools to assess the actual impact of mitigation policies in order to facilitate the integration of climate change into sectoral policies such as development or transport. Various complementary tools, with varying levels of precision, can be used depending on the objectives pursued. A choice must be made between cost and precision, since the more precise an assessment, the more time and resources it takes, while a high level of precision is not always necessary.

Further information:

MEDDE: Method for establishing GHG emissions assessment www.developpement-durable.gouv.fr/Methode-d-etablissement-des-bilans,24300

ADEME: Greenhouse gases resources centre, bilans-ges.ademe.fr

Association Bilan Carbone: www.associationbilancarbone.fr

CITEPA: www.citepa.org/fr/

GPC Protocol: www.ghgprotocol.org/city-accounting

Green bonds

Definitions and functioning

Bonds are negotiable securities issued by an economic actor, giving the purchaser a claim over the issuer. Some are called «green bonds» since they are issued specifically to finance investments with an environmental benefit, *e.g.* mitigation or adaptation to climate change. Green bonds are generally subject to a monitoring and verification system to prove that the money raised has been used to finance the stated actions, thereby increasing the number of potential investors.

Increasing use of the bond market by local authorities

To make their bond issues profitable and justify transaction costs, local authorities must be large enough and have sufficient needs, generally from €100m to €150m, although bonds for lower amounts have been issued. Large regional authorities are the only ones which meet these conditions. Others may consider amalgamating, through local funding agencies.
French local authorities diversify their financing sources by using this method. Other local authorities in Europe are more familiar with it, raising amounts up to 80 times higher in Germany for example. The greater use of obligations in Germany can be explained partly by the federal structure of the State.

Change in the volume of bond issues by European local authorities (in €)

	2011	2012	2013	2014	2015 (3e trimestre)
France	748	2 315	1 933	1 719	2 227
Allemagne	57 742	53 156	51 943	56 064	48 344

Source : Crédit Agricole CIB, 2015

The total amount of bond issues by local authorities in France varies widely, ranging from €10m to €600m. Most regional authority issuers are Regions or Departments, the City of Paris being the only agglomeration to have issued bonds to date.

Financial and extra-financial assessment of the issuer

Even the valuation of green bonds depends on the issuer's rating.

Regional authorities appeal to investors since they benefit from regular income and issue bonds with long-term maturity. Investors still need to know the risk profile of their investments, however. Local authorities must therefore undergo in-depth analysis of their position by a rating agency such as Standard & Poor's or Fitch.

The financial rating may be accompanied by an extra-financial rating to attract those interested in **socially responsible investment (SRI)**, thereby generating competition when negotiating the interest rate.

Good practice: the green bond issue by the Region Ile-de-France

The Ile-de-France Conseil Régional (regional council) issued socially-responsible bonds in March 2012, particularly targeting projects with an environmental scope. This raised €350m, at an interest rate of 3.625%, for energy projects, low-energy social housing and actions devoted to biodiversity and the social and welfare sector. To comply with the requirements for green bonds, the Region undertakes to carry out annual reporting on projects.

A second issue for €600m was also successfully completed in April 2014.

Projects financed must all comply with 11 criteria, relating in particular to the fight against climate change and energy transition. To find out more: www.iledefrance.fr/ile-france-emprunte-responsable

Further information:

Climate Bond Initiative: www.climatebonds.net/
Ile-de-France: http://www.iledefrance.fr/conseil-regional/budget-2015
Agence France Locale: www.agence-france-locale.fr/

EcoDistrict, EcoCity

Concept

The idea behind the European EcoDistricts is the development of resident-led planning initiatives to create a new way of living in sustainable districts.

The EcoDistrict approach

Launched in France following the Grenelle Environment Forum, the EcoDistrict programme became reality with the Ministry for Housing's first project tender in 2009. Although no model has been imposed, an EcoDistrict must respect the principles of sustainable development:

- Consultation with all stakeholders during project development;
- Improvement in daily life through a healthy and safe living environment;
- Development of an economic fabric and artisanal businesses, promoting new local industries to stimulate the regional economy;
- Responsible management of energy and resources, and adaptation to climate change.

Support mechanisms are offered by the Ministry for Housing. In 2012, a certification scheme was created to identify examples of good practices – 39 operations have since been certified.

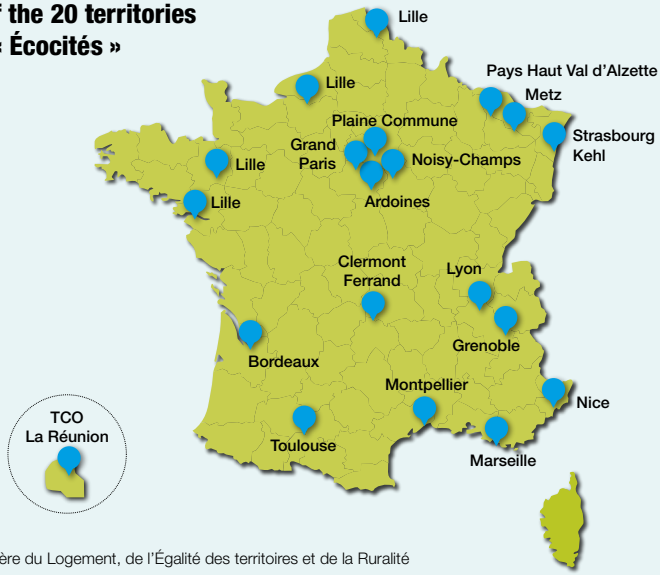
The EcoCity approach

The EcoCity programme, which was launched in 2009 at the same time as the EcoDistrict programme, aims to support the growth and attractiveness of cities, make them more environmentally friendly and reduce their energy consumption and occupation of semi-urban space, while meeting the expectations of their current and future inhabitants. The French government has certified 20 major urban regions, including Greater Paris, to drive urban ecological transition forward.

'Cities of Tomorrow', a fund of the Investments for the Future Programme, was created in March 2010. With a €670 million budget, this fund aims to finance urban innovation in the EcoCity regions from 2011 to 2017 by supporting innovative, reproducible and exportable projects in five areas: 1. Urban design and the environment; 2. Construction and use; 3. Energies and networks; 4. Mobility; 5. Innovative urban services.

The EcoCity operations on French territory

■ **Map of the 20 territories labelled « Écocités »**



Source : Ministère du Logement, de l'Égalité des territoires et de la Ruralité

Good practice : the Bayonne EcoDistrict

The Séqué EcoDistrict of Bayonne, France, is located on a former wooded campsite near a lake. This environment is very favourable to new architectural approaches, such as the inclusion of trees in housing plans. Bayonne has supported the project in two particular ways:

- The production of comfortable, low-cost and energy efficient housing combining quality of life and controlled construction costs;
- The inclusion of future residents in the project development process, which has given rise to experiments: a guide to composting, management of shared areas, a welcome guide for new residents, feedback for contracting authorities, etc.

■ **Further information :**

Ministry for Housing, Territorial Equality and Rurality :
www.territoires.gouv.fr/ville-durable

Caisse des Dépôts : www.caissedesdepots.fr/activite/domaines-daction/investissements-davenir/ville-de-demain-1000-meur.html

SHEET 37

AGIR

Sustainable public procurement

Sustainable public procurement is an important lever for public action to promote sustainable development. Representing 10% of French GDP, public procurement is regulated by the French Public Procurement Code, which, since 2006, has made it compulsory to take sustainable development into account when defining needs. In addition, a national action plan for sustainable public procurement sets out the objectives and strategies for 2015–2020.

■ Areas and initiatives in the national action plan for sustainable public procurement:

Areas	Initiatives
I. Mobilising decision-makers	1. Recalling obligations or tools and ensuring they are implemented.
	2. Encouraging decision-makers to rethink their organization's procurement process
	3. Highlighting success stories and advantages to encourage further development of sustainable procurement
II. Supporting purchasers	4. Studying the legal and technical conditions of certain new or complex subjects
	5. Raising awareness about sustainable development and sustainable public procurement
	6. Developing public purchaser training in sustainable public procurement
	7. Developing and sustaining public purchaser networks that enable the expansion of good practices in sustainable public procurement.
	8. Improving the platform and national website dedicated to sustainable public procurement
	9. Making tools available to public purchasers
III. Reporting on progress	10. Leading the way with a view to continuous improvement over several years
	11. Involving stakeholders

Source: PNAAPD 2015-2020

A practice which is not yet widespread

In 2012, only 5.4% of contracts over €90,000 before tax included an environmental clause. A few authorities have tried but have encountered methodological or legal difficulties.

Tools are available for local authorities:

- The ecoproduct passport (**ADEME**) which guides public purchasers to procure sustainable products and services;
- The national public procurement and sustainable development inter-network. Led by the Ministry for Ecology, it enables regional experiences to be shared and encourages the development of joint action;
- As part of a response to a call for tender, eco-comparators enabling an assessment and comparison of the environmental impact of the technical solutions being proposed.

Good practice : school canteens in Strasburg

Since 2009, the City of Strasburg has integrated requirements affecting school canteens into its Climate Plan, with a contractual reduction of 3% per year in the carbon footprint. In particular, requirements include the use of seasonal products, local products, and 20% to 40% of organic products to favour local supply chains. Not only are these actions beneficial to children's health, they also minimise environmental impact while moving towards a new regional food governance model. This approach led to Strasbourg win the first national prize for sustainablepublic procurement in 2009.

■ **Further information:**

Ministry for Ecology (MEDDE): inter-network www.developpement-durable.gouv.fr/L-inter-reseaux-Commande-publique,40861.html

ADEME: Report, CO2 and public markets www.developpement-durable.gouv.fr/CO2-circuits-courts.html

Eco-comparator SEVE : www.seve-tp.com

Appendices

Abbreviations and acronyms

CITE: Energy Transition Tax Credit (Crédit Impôt Développement Durable) – *see sheet no. 31.*

COP: Conference of the Parties (here, signatories to the UNFCCC) – *see sheet no. 13*

DRIAS (portal): Provides access to regionalised climate scenarios – *see sheet no. 5.*

EnR: Renewable energies (Énergies renouvelables)

EFSI: European Fund for Strategic Investments - *see sheet no.28*

ERDF, ESF: European Regional Development Fund and European Social Fund – these are the main three European structural funds – *see sheet no. 28.*

ESIF: European Structural and Investment Funds - *see sheet no.28*

EU ETS: European Union Emissions Trading Scheme – *see sheet no. 19.*

GHG: Greenhouse gas, found in the atmosphere, either natural or anthropogenic which absorb and radiate infrared rays

GPC Protocol: Greenhouse Gas Protocol – *see sheet no. 34*

UHI : Urban Heat Island – *see sheet no. 9.*

SRI: Socially Responsible Investment – *see sheet no. 35.*

Mt CO_2 eq.: million tonnes CO_2 equivalent, CO_2 equivalence is a method of measuring greenhouse gases, taking account of the warming potential of each gas relative to that of carbon dioxide.

Mtep: millions of tonnes equivalent of petroleum, a unit for measuring energy

CDM: Clean Development Mechanism – *see sheet no. 17.*

JI: Joint Implementation – *see sheet no. 17.*

MRV: Monitoring, Reporting and Evaluation of greenhouse gas emissions

PC(A)ET: Regional climate, (air) and energy plans (Plan Climat (Air) Énergie Territorial) – *see sheet no. 24.*

CEP 2020 and 2030: European climate and energy package 2020 and 2030 – *see sheet no. 18.*

PNACC: National climate change adaptation plan (Plan National d'Adaptation au Changement Climatique), 2011-2015 – *see sheet no. 26.*

NEEAP: National Energy Efficiency Action Plan – *see sheet no. 20.*

POPE (law): Law no. 2005-781 of 13 July 2005 setting out the direction of French energy policy – *see sheet no. 21.*

SRCAE: Regional climate, air and energy plan (Schéma Régional du Climat de l'Air et de l'Energie) – *see sheet no. 24.*

TEE: Energy and ecology transition (Transition Énergétique et Écologique)

TICPE: Domestic consumption tax on energy products (Taxe Intérieure de Consommation sur les Produits Énergétiques)

Organisations and institutions

EEA: European Environment Agency *www.eea.europa.eu*

EIB: European Investment Bank *www.eib.org*

EBRD: European Bank for Reconstruction and Development *www.ebrd.com*

CEREMA: Centre for risk, environment, mobility and regional development studies (Centre d'Études et d'expertise sur les Risques, l'Environnement, la Mobilité et l'Aménagement) *www.cerema.fr*

CGDD: General Sustainable Development Commissariat (Commissariat Général au Développement Durable), attached to the French Ministry for Ecology, Sustainable Development and Energy

CGEDD : General Council for Environment and Sustainable Development (Conseil Général de l'Environnement et du Développement Durable)

CITEPA: Interprofessional technical centre for studies on air pollution (Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique) *www.citepa.org*

UNEP: United Nations Environment Programme *www.unep.org*

UNFCCC: United Nations Framework Convention on Climate Change *www.unfccc.int*

CERFACS: European Center for Research and Advanced Training in Scientific Computation

www.cerfacs.fr

CNRM-GAME: National metereological research centre (Centre National de Recherches Météorologiques) *www.cnrm.meteo.fr*

IPCC: Intergovernmental Panel on Climate Change *www.ipcc.ch*

ICLEI, C40, R20, UCLG, R20: *www.iclei.org www.c40.org/cities www.uclg.org/fr www.regions20.org* main international networks of local authorities

IPSL: Institut Pierre Simon Laplace *www.ipsl.fr*

MEDDE: Ministry for Ecology, Sustainable Development and Energy (Ministère de l'Écologie, du Développement durable et de l'Énergie) *www.developpement-durable.gouv.fr*

OECD: Organisation for Economic Cooperation and Development *www.oecd.org*

WMO: World Meteorological Organization *www.wmo.int*

I4CE - Institute for Climate Economics: *www.i4ce.org*

Météo France: *www.meteofrance.com*

ONERC: National Observatory of the Effects of Climate Change (Observatoire National des Effets du Changement Climatique), attached to the French Ministry for Ecology, Sustainable Development and Energy *www.onerc.gouv.fr*

ADEME: Environment and Energy Control Agency (Agence de l'Environnement et de la Maîtrise de l'Energie) *www.ademe.fr*

AFD: French Development Agency (Agence Française de Développement) *www.afd.fr*

Appendices

Glossary

«Solutions agenda»: range of concrete initiatives and mitigation and adaptation solutions to climate change implemented by various civil society organisations (companies, NGOs, public institutions, local authorities, etc.) and presented as high-potential actions in international negotiations on climate.

Energy performance contract: contract concluded with an energy efficiency services company designed to legally ensure a certain level of improvement to buildings' energy efficiency compared with a reference scenario through an investment in works, supplies or services. (MEDDE)

Eco-design: way of designing a range of environmentally-friendly products (goods or services). (ADEME)

Efficient design of functions: economic models favouring usage over possession by selling services linked to products rather than products themselves. (ADEME)

Energy efficiency: capacity to produce as much or more energy and/or reduce energy consumption for the same service provided.

Energy Transition for Green Growth Act: adopted in August 2015, this bill provides a common framework for action and sets up short- and long-term objectives for the energy transition.

Externality: costs or benefits created by an economic activity supported by or benefiting others and not accounted for.

Factor 4: objective of quartering greenhouse gas emissions by 2050, in order to restrict global warming to a temperature rise of 2°C (according to the IPCC). This corresponds to a reduction in French emissions of around 3% a year. This target was enshrined in the French law of 12 July 2005 fixing the direction of energy policy. (ADEME)

Adaptation Fund: fund created by the Kyoto Protocol and operational since 2010, with the objective of financing adaptation projects in developing countries which are Parties to the Kyoto Protocol.

Green Climate Fund: one of the main tools to finance mitigation and adaptation projects in developing countries. It was proposed and adopted at the Conferences of the Parties in Cancun and Durban (2010-2011).

Grenelle environmental pact: consultation and debating process initiated in 2007 aiming to define French environment and sustainable development policy. It culminated in the passing of two laws in 2009 and 2010 – a law setting the framework for implementation of the proposed measures and a law defining the national commitment to the environment.

Horizon 2020: the European Union's main research and innovation programme, allocated a budget of €80bn over the period 2014-2020. It follows on from the 7th research framework programme and the programme for competitiveness and innovation.

Energy intensity: the ratio between consumption and an economic variable (GDP, added value at constant prices), measuring energy efficiency from an economic perspective. It is above all an indicator of energy productivity gains. (ADEME)

LIFE: European financial instrument supporting projects relating to the environment, nature conservation and the fight against climate change.

Maladaption: change in natural or human systems exposed to climate change which unintentionally increase vulnerability instead of reducing it (ONERC).

Jouzel project: established by Jean Jouzel in 2010, by ministerial order, to define and submit reference scenarios for the future climate in France for use by those working on adaptation to climate change. The scenarios are updated on multiannual basis. (Météo France)

New financial instruments (NFI): financing mechanisms distinct from subsidies, such as venture capital, guarantees or loans, involving European funds (particularly structural or investment funds).

2°C target: target of limiting global warming to 2°C by 2100 officially pursued in international negotiations since 2009 and generally considered (since the IPCC's 4th report) as an adequate threshold to avoid dangerous climate change.

Loss and damage: human and financial cost of climate change experienced despite efforts to mitigate greenhouse gas emissions. A mechanism was established by the UNFCCC in 2013 to tackle this.

Durban Platform: working group set up at the 17th UNFCCC Conference of the Parties (COP17) in Durban in 2011 to develop a new universal regime to tackle climate change, due to come into force in 2020.

Polluter pays principle: principle defined by the OECD in 1972 stipulating that «the polluter should bear the expenses of carrying out the measures decided by public authorities to ensure that the environment is in an acceptable state. In other words, the cost of these measures should be reflected in the cost of goods and services which cause pollution in production and/or consumption.»

Stern Review: report commissions by the UK government in 2006 from a committee chaired by the economist Nicholas Stern, comparing for the first time in monetary terms the costs of mitigation of climate change and the costs of inaction against climate change.

REDD+: Reducing Emissions from Deforestation and Forest Degradation, a mechanism launched in 2008 and coordinated by the UN, to reduce GHG emissions linked to deforestation in developing countries. It relies on market mechanisms.

RCP scenarios: Representative Concentration Pathways – a set of four climate scenarios developed ahead of the IPCC's 5th Assessment Report defining representative profiles of changes in greenhouse gas concentrations in the atmosphere. «These scenarios correspond to efforts of varying magnitudes to reduce GHG emissions at a global level. For each of these four representative profiles, climatologists deduce the climate conditions and associated impacts of climate change. In parallel, sociologists and economists are working on scenarios presenting various characteristics of socio-economic development and various adaptation and mitigation strategies.» (ONERC)

Scopes: scopes of greenhouse gas emissions included in the emissions assessment of a project, an entity or a region (direct or indirect emissions which may or may not take account emissions linked to imports and exports). Defined in standard ISO 14064.

Energy savings: reduction in energy needs due to a change in habits and practices.

Europe 2020 Strategy: the European Union's 10-year growth strategy. Adopted in 2010, this takes over from the Lisbon Strategy. (EC)

Climate-resilient pathways: development pathways combining mitigation and adaptation policies to achieve sustainable development objectives, avoiding dangerous disruption to the climate system. (IPCC)

More detailed glossaries:

Glossary (in French) compiled by the national PCET observatory, ADEME, www.pcet-ademe.fr/ressources/glossaire

The Repères collection published by MEDDE, particularly «Highlights: Key Figures on Climate France and Worldwide - 2016 Edition», November 2015

This report, released in the year of the Paris Climate 2015 summit (COP21), reviews concepts vital for understanding and acting to address climate change at a regional level. Based on the experience of French territories it presents 37 factsheets aimed at local players, providing concise and informative access to the most up-to-date knowledge. It also offers feedback on the impacts of climate change, climate policies at a global, European and French level, and economic tools supporting climate change mitigation and adaptation.

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