# ANCRE Position Paper: « Carbon sink and negative emissions What roles for research to enhance their development in France?»


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Alliance Nationale de coordination de la Recherche pour l'Énergie

# ANCRE project presentation

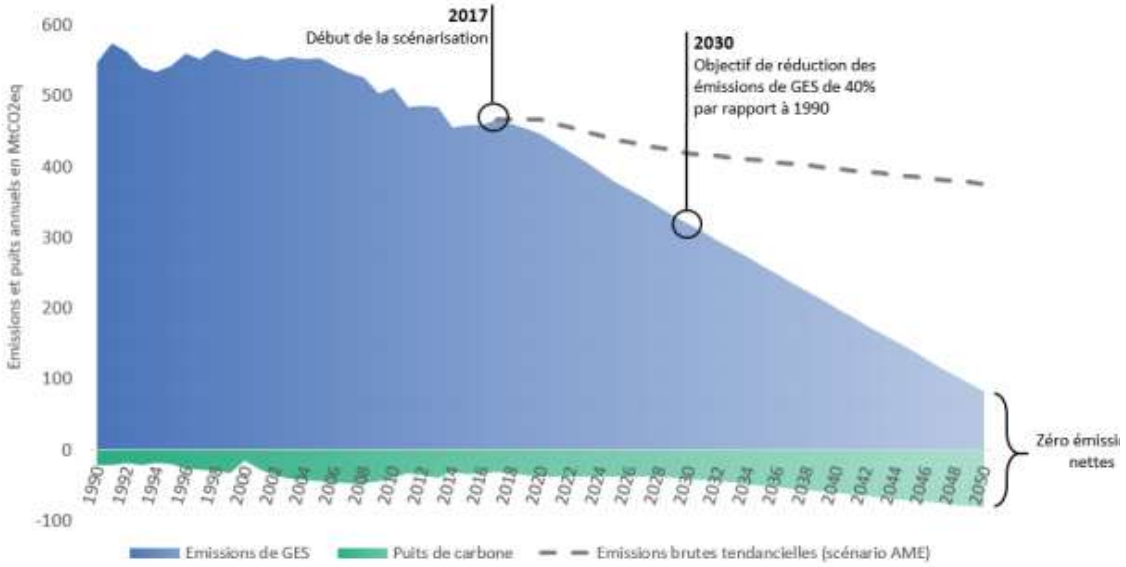
- **Collaborative 24 months research project (2020-2022) based on voluntary work, several key stages:**
  - **Workshop at mid-term (July 2021)**
  - **Position paper (October 2022)**
  - **3 presentations in congress (France, India, EUBCE/Italy) and 1 article in *"The Conversation" (FR)***

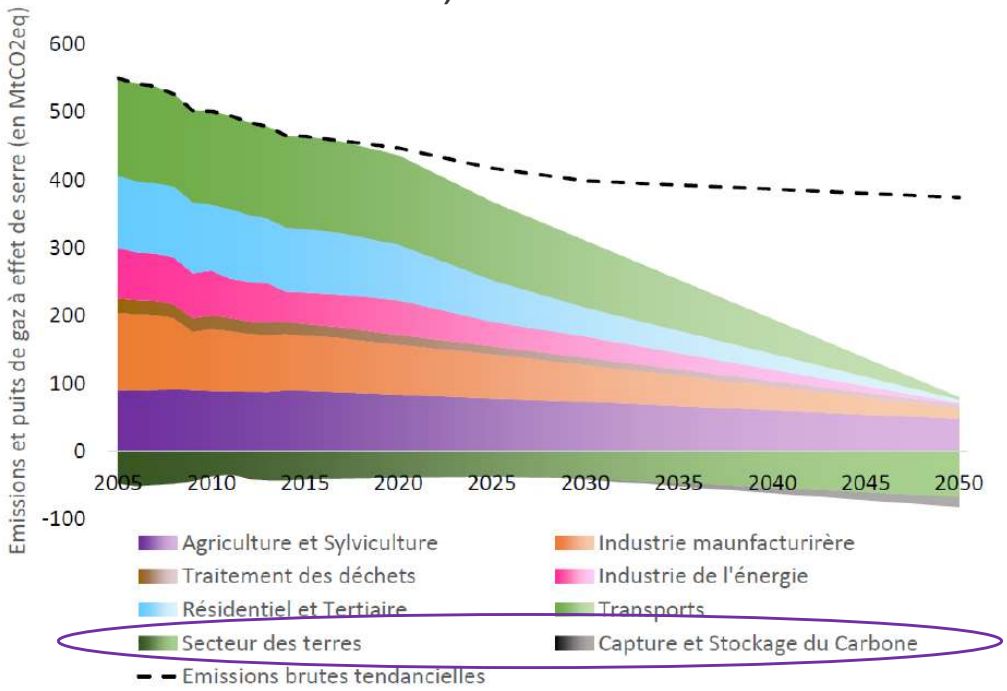
- **Main contributors in the working group**

  - **Other ad-hoc contributions: ADEME, Air Liquide, Karibati, INERIS, Cirad, B4C,….**

# Background: the climate targets (FR)

**National Low Carbon Strategy of 21 April 2020: Emission trajectory of GHG sinks on the national territory of the SNBC scenario** (with state incitation: SNBC-AMS)

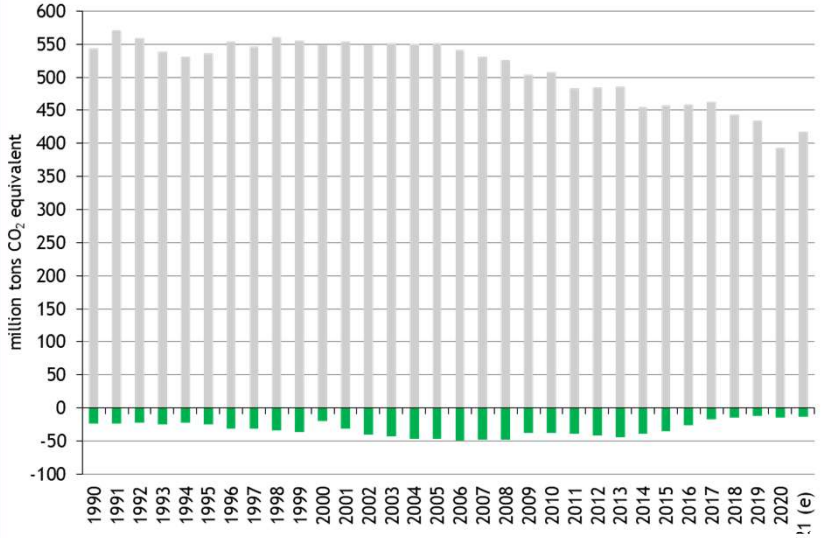



**By 2050, by mobilising to the maximum the potential of each available lever to reduce greenhouse gas emissions, without however making any technological bets, a certain level of emissions appears to be incompressible (~85 Mt $CO_2$eq/year). To achieve carbon neutrality, these emissions must be offset by "carbon sink" solutions**

# Background: LULUCF carbon sink in France

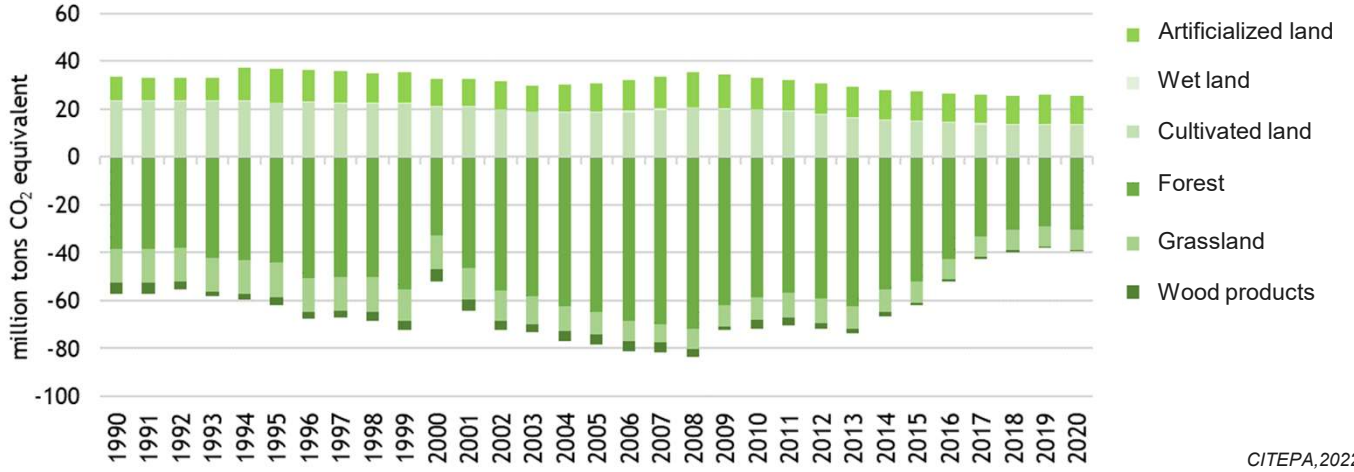
Evolution of CO2e emissions into the air since 1990 in France




*CITEPA,2022*

- Since 2005, net decline of negative emissions from land use, land use change and forestry
- Last 10 years, reduction of emissions and mostly absorption in wood products and in forest (due to slowed growth and increase in mortality induced by more frequent drought, disease, fire, and storm)

Evolution and distribution of CO2e emissions and absorptions from the LULUCF sector in France




*CITEPA,2022*

# Background

- **Main issues to be raised:**

  - ✓ **What sink solutions are available to achieve the 2050 target? Which environments? Which practices? Which technologies?**

  - ✓ **How can the dynamics of existing natural sinks be preserved or even reversed?**

  - ✓ **What can we expect from the new solutions? Can we precisely assess their potential? What are associated challenges?**

  - ✓ **What role can research play? what are the priority actions to be developed?**

# The 6 families of carbon sink solutions of the ANCRE project

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## Natural capture and/or sequestration solutions

**S1. Photosynthesis in agricultural and and forestry**

**S2. Photosynthesis in urban environments**

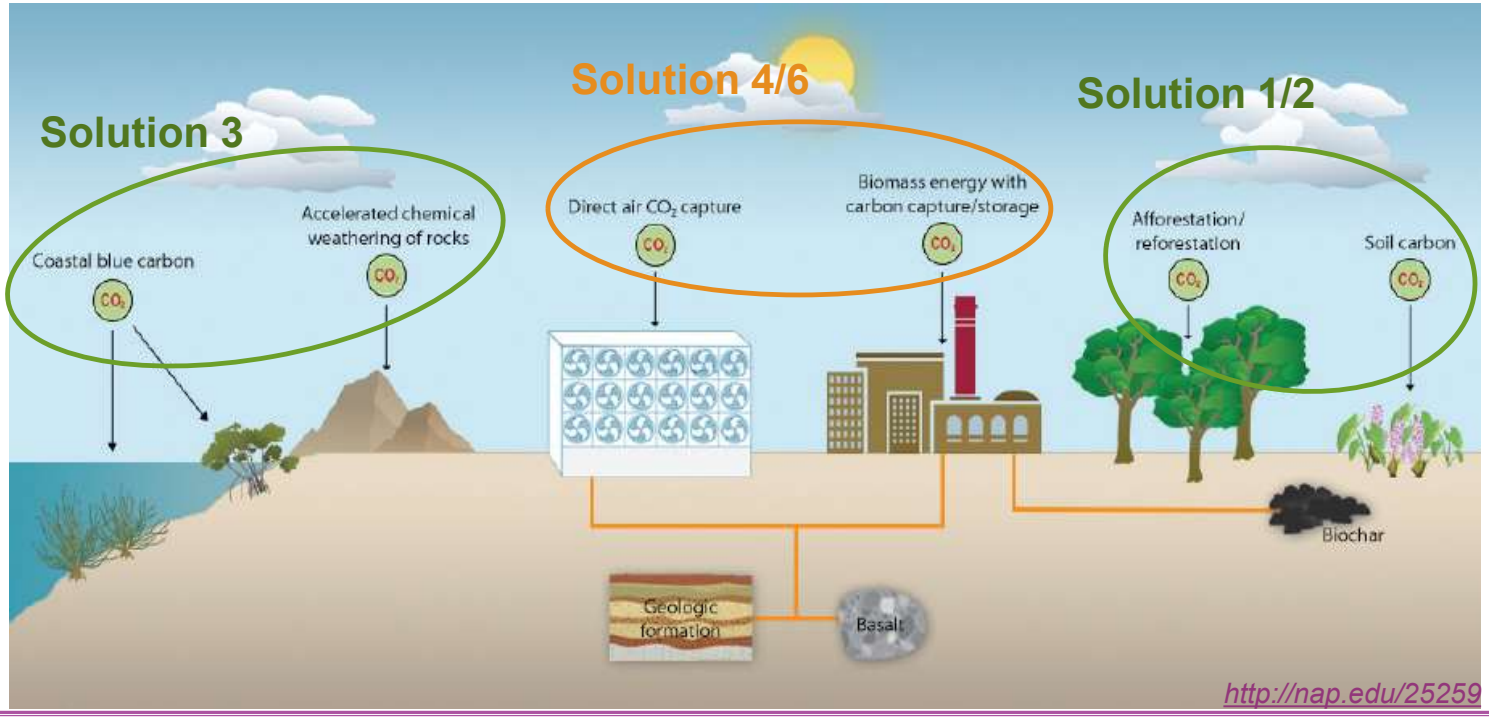
**S3. Aquatic environments and alteration of rocks**

## Technological capture and/or sequestration solutions

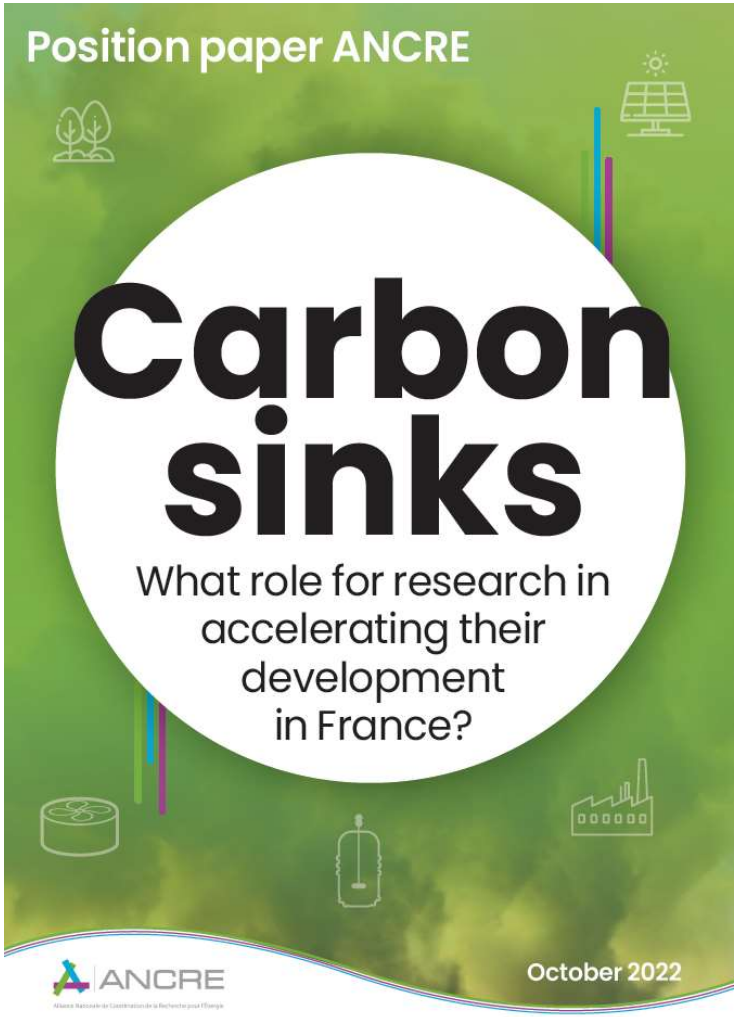
**S4. Atm $CO_2$ capture and geological sequestration (DACCS+BECCS)**

**S5/5bis. Atm $CO_2$ capture and usage and storage in materials**

**S6. Re-use and cycle closure of industrial $CO_2$ towards long-term storage (CCUS)**



# ANCRE Position paper and fact sheets




- **Available at:**

**https://www.allianceenergie.fr/etudes-et-rapports/**

**Report comprising:**

- **7 carbon sink solution Fact Sheets** (3 pages each)
  - **State of knowledge**
  - **Issues**
  - **Challenge and barriers**
  - **Recommendations for research and support**

- **7 transversal recommendations**

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# ANCRE Position paper and fact sheets

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## Example worksheet 1

Worksheet 1

### Carbon storage in biomass and agricultural and forest soils

### State of play

The natural mechanism of photosynthesis allows the sequestration of atmospheric $CO_2$ in the form of organic matter, in almost equal parts, between agricultural and forest biomass and soils. French terrestrial ecosystems already constitute a very significant carbon sink that EFESE estimates in Metropolitan France at nearly 20% of 2015 French emissions, i.e. approximately 90 Mt $CO_2$ eq/year [EFESE, 2019]. The vast majority of these sinks are in forest environments (more than 60 Mt in 2018 in mainland France according to ADEME, 2021). In the French Overseas Territories and in Guyana in particular, it is considered that these forests have reached their maximum carbon storage capacity and therefore their sink seems to have stopped (according to ADEME Guyane, 2016).

With regard to metropolitan soils in particular, the study conducted by INRAE in 2019 indicates that forest soils account for 38% of the total carbon stock, permanent grasslands 22% and field crops 26.5%. It is the latter which have the highest additional storage potential in the litter because of their current low carbon content and the size of their surfaces. On the already hand, for forest soils and permanent grasslands, which have a high carbon content, the challenge is to maintain their stock and preserve their surface area. The report highlights concrete actions to maintain and develop carbon storage in soils and the type of practices to achieve this, assuming no change in land use. The practices are potentially diverse (agroforestry, intermediate crops, hedges, extension of temporary grasslands, return of co-products to the soil, etc.) and they are accompanied by co-benefits in terms of water quality and biodiversity. However, all these practices must be considered in a given geographical and temporal context (soil conditions, stocks of origin, costs in line with existing crop rotation and existing opportunities). Through this study, a maximum additional storage potential of 30 Mt of $CO_2$ eq/year has been estimated for agriculture. However, there are many major risks to these carbon sinks due to, among other things, the reduction in forest area as a result of fires, pest attacks, drought and reductions in area through changes in land use. More work is therefore needed to improve understanding of the long-term effects of these practices and the effects of climate change on storage and sequestration.

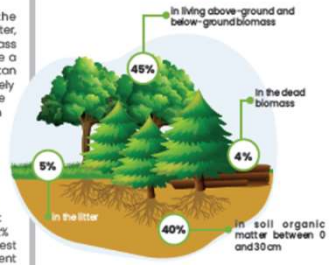


Figure 1 - Carbon storage in the forest (ADEME, 2021)

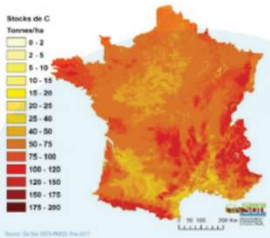


**Figure 2** - Mapping carbon stocks in metropolitan soils (INRAE, 2019)



### Challenges

At EU level, among the measures to accompany the latest proposed target of at least a 55% reduction in GHG emissions by 2030 are actions to preserve and expand the capacity of natural carbon sinks in each Member State, with binding targets from 2026. By 2035, the Union should strive to achieve climate neutrality in land use, forestry and agriculture [...] (Green Pact for Europe of 14 July 2021).

In addition, in its National Low Carbon Strategy (SNBC, 2020), France attributes an important role to natural carbon sinks for achieving carbon neutrality in 2050, which should be doubled to reach approximately 65 Mt CO eq2 /year in 2050, of which a growing share is in long-lived wood products (20 Mt, see sheet 5bis) as well as in agricultural areas (11 Mt). This scenario is accompanied by a number of measures such as increasing carbon storage in agricultural soils through changes in practices; the development of active and sustainable forest management, allowing both the adaptation of the forest to climate change and the preservation of carbone stocks in the forest ecosystem; the development of afforestation adapted to climate change and the reduction of land clearing.


France must therefore now acquire the means to consolidate existing data and knowledge in order to specify the real potential of these carbon sinks and to improve the monitoring of land use and the understanding of carbon dynamics within ecosystems. It also appears necessary to construct quantified scenarios of the evolution of these sinks under the impact of climate change. Locks

### Barriers

**LACK OF DATA**
on the current evolution of carbon stocks and fluxes in ecosystems and the interactions between carbon, nitrogen and water,

**LACK OF PROJECTION**
on the dynamics of these developments under the impact of climate change,

**LITTLE BACKGROUND**
on the effects of changes in agricultural practices on long-term carbon storage,

**LACK OF SCENARIOS**
on projections under the impact of climate change,

**NEED FOR TRACEABILITY**
competition between agricultural and forestry land uses and artificial development (land reclamation vs.urbanisation),

**LACK OF STUDIES AND INDICATORS**
on assessing the environmental impacts of biomass harvesting,

**LACK OF KNOWLEDGE**
and regulations on the agronomic use of bioenergy co-products (digestates, biochar, etc.),

**COMPARTMENTALISATION OF SECTORS**
agri-food and energy, lack of systemic vision,

**LACK OF PUBLIC POLICY**
in the long term and lack of coherence between agricultural, food and energy policies,



### Actions

#### Research recommendations

**Behaviour of media and products:**

- **Propose technological solutions** for in-situ biogeochemical analyse (biosensors, miniaturised geochemical and geophysical sensors, smart samplers).
- **Maintain databases** and samples of French soils, including the diversity of the macrofauna and microflora of the soil.
- **Build databases** on material transfer processes and establish behaviour laws to assess the consequences of these transfers (quantify the closing of C, N, P cycles).
- **Analyse the sensitivity** of ecosystems to the export of small wood and the return of ash to the soil (Sensitivity indicators for major mineral elements and overall combination - Field diagnostics).
- **Develop multi-criteria approaches** to the duality of biomass removal addressed on all elements: physical, chemical and biological, develop multiscale predictive models of the evolution of sustainability indicators.
- **Understanding the relation between the structure** of biochars and digestates from methanisation and their properties when returned to the soil.
- **Develop scenarios** for sustainable biomass harvesting at the levels of territories under climate change impact.

**Identification of practices**

- **In terms of silvicultural** practices, develop biophysical and economic approaches to identify practices for sustainable forest management (conversion of coppice to high forest, reasoning out soil preparation, avoiding clear-cutting with soil degradation, not harvesting the whole tree), and transfer these stocking practices to professionals.
- **Develop strategies for optimising climate** change mitigation in the choice of stand rotation length at the scale of territories, propose new stands with species resistant to biotic and abiotic stresses (rather than considering only one economic criterion).
- **Conducting trials on forest** (and agroforestry) plots to intensify biomass growth and soil carbon storage, carrying out complete balances of the biogeochemical cycle of the plots over a long period of time and then integrating the entire (multiproduct) wood value chain.
- **In terms of agricultural practices:** broaden the species of intermediate crops and refine the practices of insertion in rotations; deepen the trials of spreading digestates and biochars, characterise the carbon that can be stored and feed the soil/microorganism/plant models.
- **Couple pyrolysis** and methanisation for the agronomic quality of the digestate and favour its return to the soil.

### Implementing recommendations

- Need to centralise, record and appraise FAIR data from experiments with new practices and environmental behaviour,
- Deploy or maintain the national infrastructure for long-term monitoring of C, N, P cycles.
- Deploy projects that can benefit from a low-carbon label with generation of carbon sinks in agricultural and forestry environments.
- Identify the full range of ecosystem services from new practices.
- Strengthen public agricultural and forestry policies at national and territorial levels that promote sustainable agricultural and forestry practices to increase carbon storage.
- Identify and reforest degraded land.
- Enable the resilience and adaptation of forest stands to the effects of climate change so as to ensure the preservation of their different ecological functions in order to carry out mitigation action.

# General recommendations

- Develop observatories of carbon flux in natural environments
- Develop framework and practices for carbon storage in anthropised environments (ex: net zero artificialisation)
- Improve knowledge of national geological reservoirs
- Supporting national demonstration projects for negative emission technologies
- Develop geographic information expert system for the deployment of $CO_2$ mineralization (ex: contact between alkaline waste (e.g. bottom ash, ashes and $CO_2$)
- Improvement and harmonisation of environmental assessment methods of negative emission solutions and Multicriteria analysis
- Governance and support measures harmonised at national and European level

# « Carbon sink and negative emissions
# What roles for research to enhance their development in France?»


## Thank you for your attention


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