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ANR and the CCUS

ACT Workshop

4 & 5 september 2023

A very recent announcement by the French President

Emmanuel Macron

Macron launches 'ecological plan' to cut France's dependency on fossil fuels

50-point plan also aims to reduce greenhouse gas emissions by 55% and includes new offshore wind projects

Kim Willsher *in Paris*

Mon 25 Sep 2023 19.28 CEST

Emmanuel Macron: 'The priority that we have set is that by January 2027 we will have totally ended the use of coal for our electricity production.' Photograph: Christophe Ena/AP

Emmanuel Macron has unveiled a national "ecological plan" to reduce France's greenhouse gas emissions by 55% by 2030, compared to 1990 levels, and end the use of coal-fired power plants by 2027.

Speaking after a special ministerial council at the Elysée, the French president said an extra €10bn (£8.7bn) would be put towards the 50-point programme, which he described as "ecology à la Française".

The plan was aimed at addressing the climate crisis while ensuring that France remained competitive in agriculture and industry, said Macron.

It was essential, he said, that "France reduces our dependence on so-called fossil fuels, coal, petrol and gas, which we don't produce any more but on which we depend". The aim, he added, was to reduce this dependence from 60% to 40% by 2030.

L'annonce était attendue depuis plusieurs mois. Emmanuel Macron a enfin énoncé les contours de sa vision de l' *« écologie à la française »* ce lundi 25 septembre. En sortie du Conseil de planification écologique, il a expliqué qu'il s'agissait pour lui d'une « *écologie qui crée de la valeur économique* », d'une « *écologie compétitive* » qui favorise l'industrie verte, « *basée sur la science et sur les résultats objectifs* ». Il y voit aussi « *une écologie souveraine* » pour réduire la dépendance aux énergies fossiles. En

Le deuxième chantier concerne « *les technologies de rupture, en particulier l'hydrogène et capture et séquestration de carbone* ». Sur le sujet de la capture, du stockage et de l'utilisation du carbone, une consultation stratégique auprès des industriels est en cours jusqu'au 29 septembre. À l'issue, l'objectif sera de développer « *au moins un site en France* », a annoncé le chef de l'Etat.

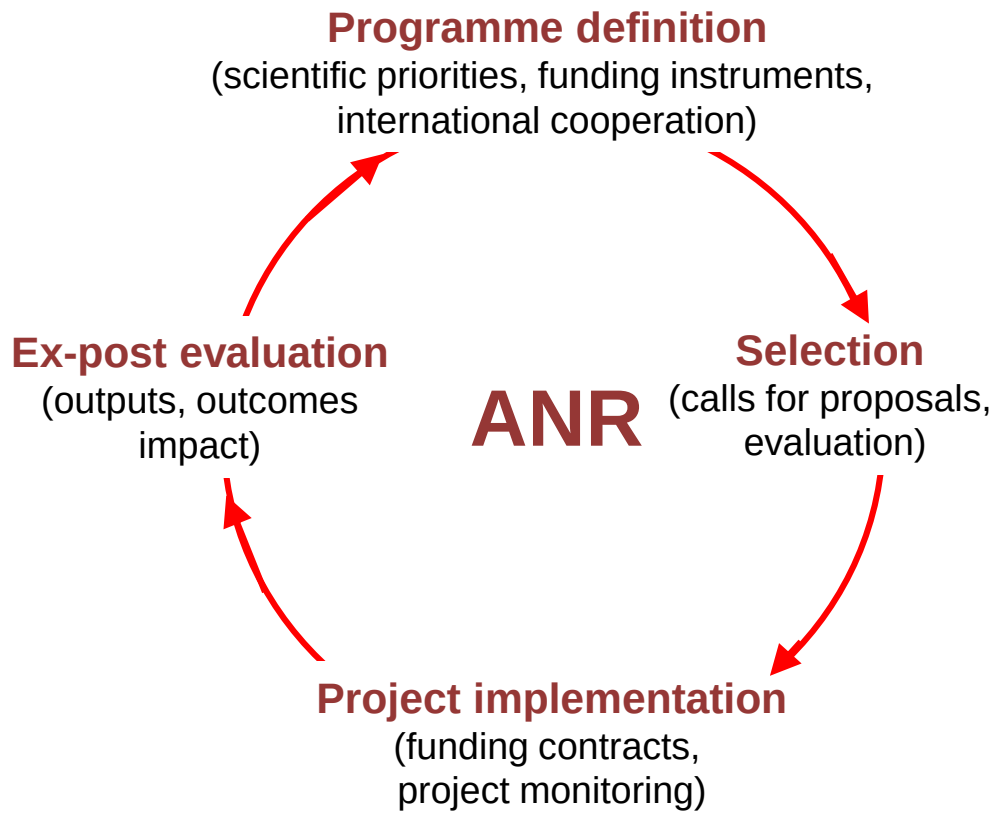
ANR: who we are?

A public research project funding agency

- created in 2005
- under the French Ministry of research and higher education (MESR)

5 missions:

- to **fund and promote** the development of **basic and applied research, technological innovation, technology transfer and public-private partnerships**
- to **implement** the Action Plan approved by the French Ministry of Research
- to **manage** major government **investment programmes** in the fields of higher education and research
- to **strengthen** scientific cooperation across Europe and worldwide
- to **analyse** trends in research supply and assess the impact of the funding it allocates (added 2014)



A wide remit

⇒ **all fields** of science and **all types** of research funded (basic research, applied research, experimental development up to TRL 5)

⇒ **Public or private funding recipients**: universities, research organisations, foundations, commercial companies...

⇒ **Various funding instruments** described in a yearly Work Programme https://anr.fr/en/the-2023-work-programme/

For **more information**: 👉 Annual activity report

https://anr.fr/en/anrs-role-in-research/the-agency/documents/

https://anr.fr/fileadmin/documents/2022/ANR_annual-report-2021.pdf

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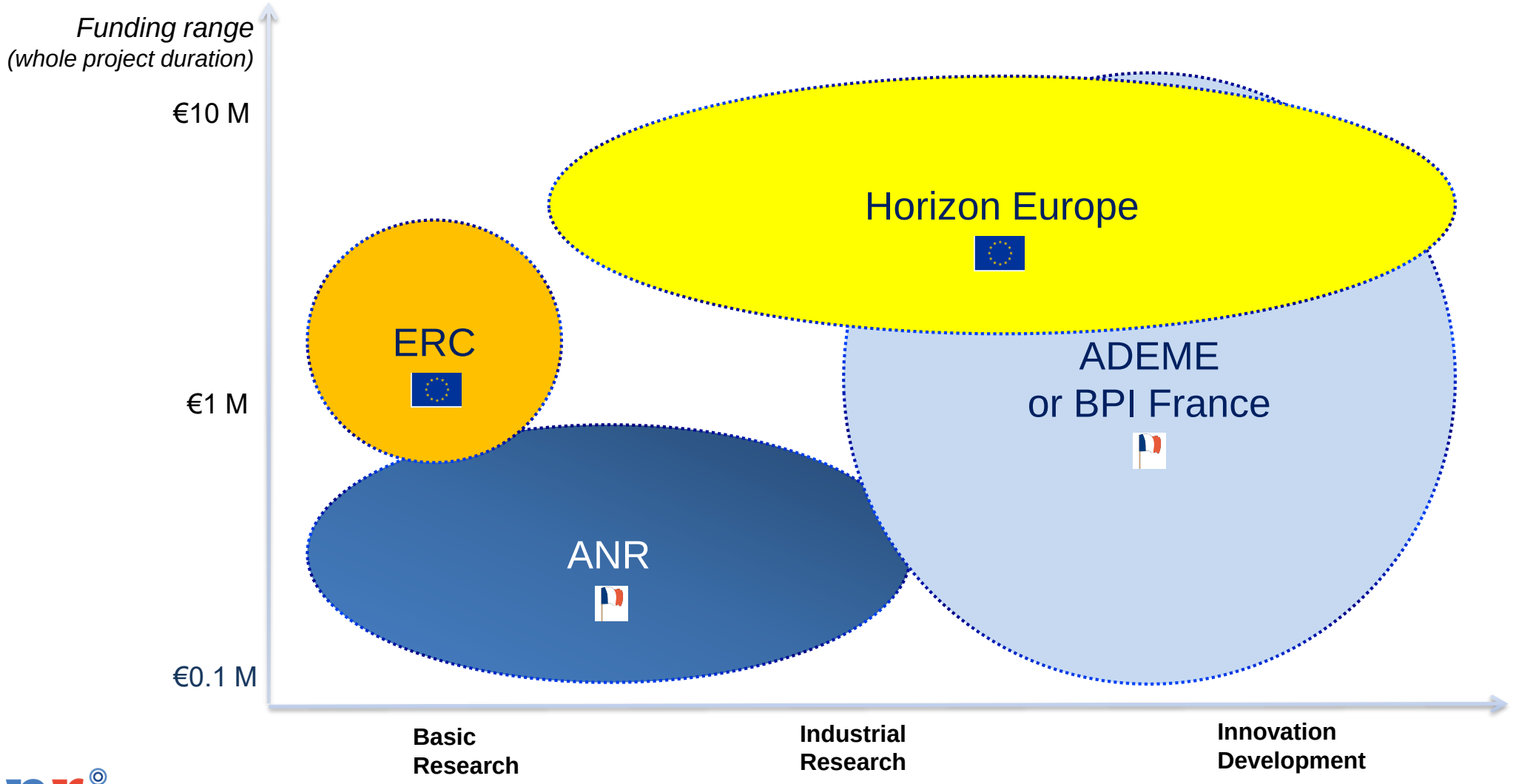
ANR in the national (and EU) RDI funding landscape



ANR’s international actions

1/ National funding schemes geared towards international objectives (like climate change mitigation)

2/ Transnational policy fora & policy-oriented actions (Science Europe, Coalition S, Global research council, Belmont Forum…)

3/ Transnational funding networks dedicated to jointly fund research projects, bilateral or multileral (ERANET Cofund like *ACT*, now European Partnerships like ***CETPartnership*** or *Driving Urban Europe*): 30 to 35 transnational calls launched per year

ANR and the energy domain

Action through the Generic Call for Proposals: 2 research areas dedicated to energy transition:

- Theme ***Basic Energy Science***:
  - Support mainly fundamental research (TRL 1-2) oriented toward energy transition issues
  - *The "basic energy science" theme seeks to support **upstream research**, to **explore new ideas and methods and to study breakthrough concepts**. With **long-term application perspectives**, in particular beyond a 15-year horizon, the aim of this theme is to mobilise and transpose fundamental knowledge, methods and tools from the disciplines of matter, engineering and digital sciences to the field of energy, and to encourage research projects bringing together skills from a wide range of scientific communities, some of which do not necessarily focus on energy at present.*

- Theme ***Sustainable, clean, safe and efficient energy***:
  - Support mainly research on **technology development at TRL 3 to 5**
  - Open to any technology
  - *The objective of this scientific theme is to accelerate research aimed at improving energy technologies (in a **medium-term perspective**) on the one hand, and, on the other hand, to support research projects involving **social sciences and humanities**.*

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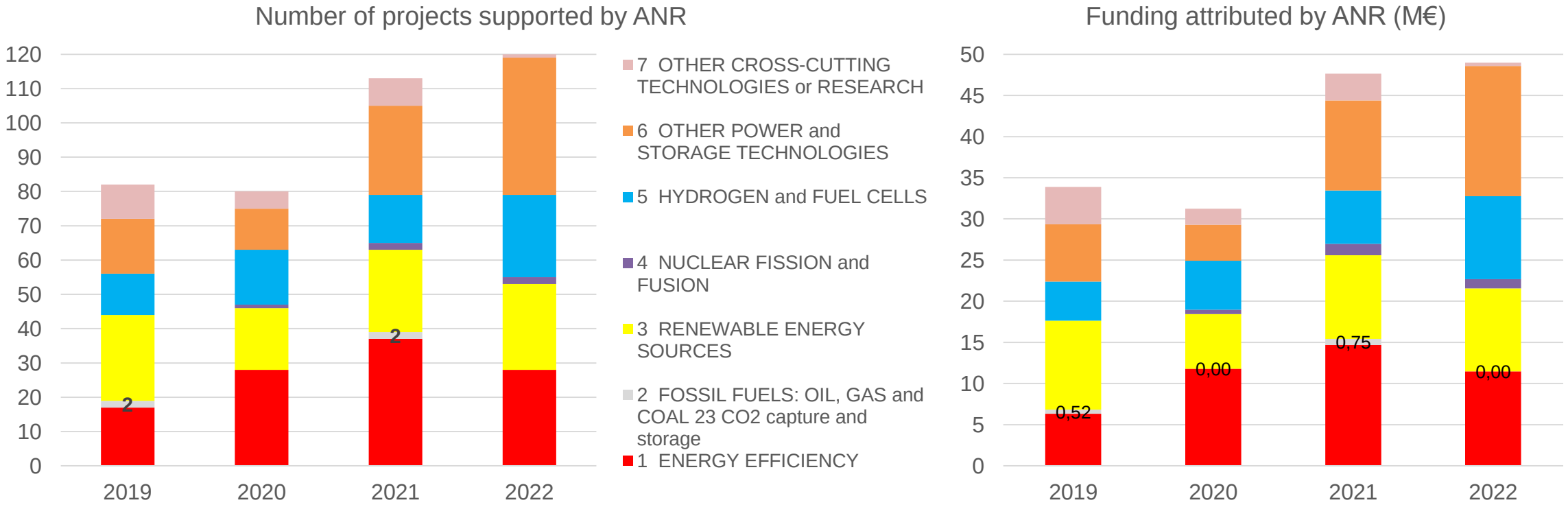
ANR and the energy domain

Today, about 110 to 120 projects selected and funded (per year), supported through various actions (mainly the generic call for proposals but also through European and international cooperation schemes), for a funding budget of about 45 to 50 millions euros.

Covering the different energy areas (statistics presented based on the International Energy Agency R&D classification). Very few projects on CCS (and on nuclear energy).

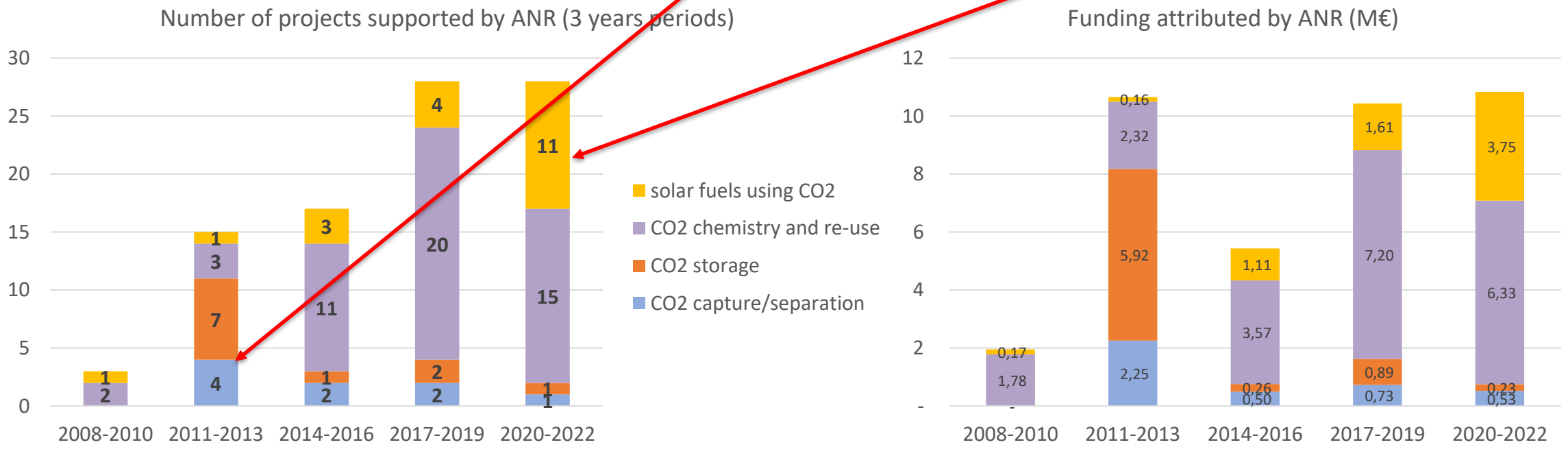


ANR and the CCUS

Far fewer CCS projects have been funded in recent years than 10 years ago.

- probably a sign of maturity of most technologies, that, today, have reached TRLs > 4.

An profusion of research on CO2 chemistry and re-use supported for more than 10 years, with many avenues explored (including using solar energy, *e.g.* solar fuels, in strong emergence). Most of these projects target fine chemicals and high value-added applications (and therefore, not suitable for large scale CO2 valorization).



ANR and the PEPR SPLEEN

SPLEEN: a large programme dedicated to support upstream research, at low TRLs (between 1 and 4), to support innovation for industry decarbonization with a budget of 70 millions euros (over 7 years).

Launched in the framework of the national Acceleration Strategy Industry Decarbonisation

(see https://www.entreprises.gouv.fr/files/files/secteurs-d-activite/industrie/decarbonation/presentation-de-la-strategie-d-acceleration-decarbonation-de-l-industrie.pdf)

The programme's aim is to provide decisive added value in the innovation chain through upstream responses to industry's major scientific challenges in this area. It will work on the development of innovative decarbonisation solutions for this.

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Support innovation to develoP new Largely carbon-frEe industrial procEsses

6.5 years **70 M€**

Scientific Pilots

cnrs ifp Energies nouvelles

Governance

- **Steering Committee** *supported by three advisory bodies*
  - Panel of Experts
  - Club Industry
  - Club Europe
- **Operational Committee** *supported by*
  - Projects Leader and co-leader

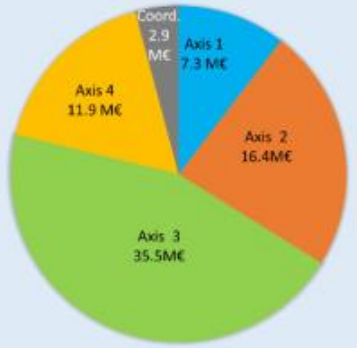
Four research axes

1/ New prediction and monitoring tools

2/ Integration of low carbon energies and efficiency

3/ Processes decarbonisation and intensification

4/ CO_2 storage and valorisation



Three modalities

- **10 targeted projects**
  - > *to be launched S1[1] 2022*
- **5 Calls for proposals**
  - > *to be launched S2 2022 and S4 2023*
- **7 Calls for expressions of interest**
  - > *to be launched S2 2022 and S4 2023*

ANR and the PEPR SPLEEN

Axis 3 – Processes decarbonisation and intensification	
▪ Intrinsic decarbonisation of industrial processes	*ECOCHEM*– Eco-friendly and intensified chemical reactions Breakthrough multifunctional processes Decarbonise the iron and steel and the cement industries
▪ CO_2 capture	*IMOSYCCA*– Intensified Modular Systems for friendly CO_2 capture *CATALPA*– CO_2 capture at low or decarbonised energy penalty *OXY3C*– Carbon capture by eco-efficient oxycombustion processes Modular process: a key challenge for CCUS processes mass adoption for small emitters Process up-scaling: a key challenge for CCUS processes mass adoption
▪ Coupling CO_2 capture and conversion processes	New concerted CO_2 capture/valorisation process

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ANR and the PEPR SPLEEN

Axis 4 – CO_2 storage and valorisation	
▪ CO_2 valorisation for industry decarbonisation	*PowerCO_2*– Propelling CO_2 conversion to e-fuels, solar-fuels and e-chemicals beyond the state-of-the-art Materials, polymers and carbonates from CO_2
▪ Enabling long-term CO_2 storage	*SESAME*– Socio-technical trajectory for on-shore geological storage of CO_2 in France Long-term monitoring and quantification for onshore CO_2 storage

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New business activities originating from ANR projects?

Marc Robert

Professor at Université de Paris and Head of the Laboratory of Molecular Electrochemistry (CNRS)

Key takeaways

- French start-up, Carboneo, is seeking to transform atmospheric CO_2 into oxygen and carbon monoxide (CO) - a very useful molecule for the chemical industry.
- To do so, Carboneo wants to capture CO_2 from industrial sites (cement/steel factories or the chemical industry) the emissions from which, in France, were calculated at 133 million tons in 2019.
- The technology developed by Carboneo has several advantages: it does not contain any rare metals whilst operating at ambient temperature and pressure.
- The proof-of-concept was published in the journal Science in 2019 and the challenge now is to increase scale

Based on results obtained through several research projects supported by ANR.

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/ Funded projects and Impact / Search for a funded project / Funded projects

DS0204 -

From CO2 to fuels : electrons, protons and earth-abundant metal complexes for new, highly active catalytic systems – EClock

Reducing CO2 to fuels with electricity and abundant metals

New business activities originating from ANR projects?

Des inventeurs futurs Prix Nobel ?

Au départ, son dada, c'est le gaz carbonique (CO_2), grand coupable du réchauffement climatique. Mais comment régler le problème ? En sortant d'une Cop, ces conférences internationales de lutte contre le dérèglement climatique, les gouvernants ont l'idée de réunir les meilleurs chercheurs de la planète pour plancher sur le sujet. « En 2018, je suis sollicité pour un workshop mondial. On a été enfermé dans un hôtel à Houston, au Texas, pendant cinq jours », confie le chimiste Julien Leclaire (48 ans). « Conclusion : s'il n'y a pas de levier économique, on n'y arrivera pas ». Or, capter du CO_2 pour capter du CO_2 intéresse très vaguement les États, et encore moins les investisseurs. « J'ai alors regardé quelles propriétés, seul le CO_2 pouvait avoir et quels services lui seul pouvait rendre à la société. » L'ancien élève de l'école normale supérieure (ENS) de Lyon, docteur en chimie et professeur à l'université Claude-Bernard Lyon 1 s'y attelle avec un « camarade féru de chimie industrielle », Frédéric Fotiadu, directeur de l'Insa Lyon, et avec Claude de Bellefon, directeur scientifique de l'école supérieure chimie physique électronique de Lyon (CPE).

Les trois chercheurs mettent au point un procédé révolutionnaire permettant de recycler à l'infini le nickel, le cobalt, le manganèse ou encore le lithium, grâce aux fumées du CO_2. Moins de carbone dans l'atmosphère et moins de métaux à extraire du sous-sol, le jackpot pour la planète ! Au point qu'on se demande si le Prix Nobel de chimie n'est pas à la portée d souhaitaien

Brevets et start-up

Plusieurs brevets sont déposés par le trio, avant de fonder, en décembre 2020, avec Arnaud Villiers d'Arbouet, un ingénieur bardé d'un MBA, la start-up Mecaware (Metal and Carbon Waste Recycling). Le prototype est à Villeurbanne et le hall pilote de 1 000 m² à

à leur activité professionnelle en mettant leur énergie et leurs neurones au service des générations futures », selon les mots du Pr Leclaire.

(Agence nationale de la recherche, université Lyon 1, Région Auvergne Rhône-Alpes) mettent d'abord la main au porte-monnaie à hauteur d'un million d'euros. Grâce à « un modèle économique non seulement viable mais également environnementalement vertueux », estime le Pr Leclaire, les investisseurs et soutiens dont l'Ademe, sont partants pour financer la phase pré-industrielle en accordant, sur les douze derniers mois, des fonds à hauteur de 42 mil-

Initial project supported by ANR through a Young Investigator Grant (JCJC) funded in 2012.

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JCJC SIMI 7 - JCJC - SIMI 7 - Chimie moléculaire, organique, de coordination, catalyse et chimie biologique

Multi-component Assembled Architectures incorporating CO2 for Selective Capture of Rare Earth – MA2RCO2SCARE

Promoting CO2 for the selective separation of precious metals included in waste material of high technology devices

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Thank for your attention