

THE ROLE OF THE STATE IN ENVIRONMENTAL SERVICES INNOVATIONS

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The public sector's power to encourage innovation is significant and frequently underestimated. Its support, which takes a variety of forms, is always useful. This article presents the testimony of a retired senior technical officer, Henri Boyé, Honorary General Engineer of the Corps of Bridges, Waters and Forests, formerly Director for Africa at EDF and Energy and Climate Coordinator for the CGEDD, today an international water and energy consultant who is very involved in state support for innovation in France as well as in Europe and Africa. He describes an example of state-supported innovation in renewable marine energy: the oscillating membrane tidal power generator from EEL Energy.

INTRODUCTION

The public sector's power to encourage innovation is frequently underestimated. The state plays an active role in stimulating growth based on innovation. Some countries do, however, produce more innovations than others. This article concentrates on the role the state can play to support innovation that is mission-focused and directed toward a specific goal, as well as the ways in which governance and policies can improve a country's capacity for innovation.

I have been interested in innovations throughout my career, and spent a considerable time supporting them, including during the time I worked as part of the French state system. I no longer work for the state, which allows me to express my more personal views, as requested by the Veolia Institute, on the role of the state in implementing innovations in environmental services.

In 1988, as a young engineer working for EDF, I was one of the founders of an association called TRANSINNOVA, which focused on transferring skills, technologies and innovations, and was lucky enough to take part in a mission to the USA, a country that was the world leader in innovation at the time. A standout example of that innovation is 3M, inventor of Post-its, small removable self-adhesive paper sheets that use a non-drying glue. This was not the product originally being researched, but is an example of serendipity, the result of a chance encounter between a commonplace situation and a seemingly unconnected concern that ultimately produced a useful creative combination that found a market all over the world.

In reality, the innovation process is far longer and far more difficult, and a lot more innovation projects fail than succeed. It takes time, money and resources as well as an entire ecosystem and the involvement of countless actors from the value chain – inventors, laboratories and universities, patent holders, startups, application developers, investors and financiers, manufacturers, services companies and subcontractors – to journey through the "valley of death" that is the development phase before finally arriving at the industrial phase.

Innovation corresponds to the introduction of new technologies, new uses or new methods, and modernization processes within a competitive system, and it often faces difficulties that center on resistance to change.

THE ROLE OF THE FRENCH STATE AND EUROPEAN UNION IN SUPPORTING INNOVATION

At the French and European levels, there is considerable aid for innovation as well as bodies that support it. There are generous incentives and financial assistance, with potential projects selected from a wide pool of candidates.

In France, sources of state innovation support include the ANR (national research agency), ADEME (the environment and energy management agency), IEED (institutes for excellence in decarbonized energy), state innovation challenges, FASEP (private sector assistance funds), BPI France (the public sector investment bank), SGPI (the general secretariat for future investment), CEA (alternative energies and atomic energy commission), IFP Énergies Nouvelles (French petroleum institute for new energies), CNRS (national center for scientific research), BRGM (geological and mineral research bureau), the major energy and environmental services groups (EDF, Engie, Total, Suez and Veolia) that all have their own in-house missions but also respond to calls for projects from the state, the European Union, SER (renewable energies syndicate), Coopération Européenne, OME (Mediterranean energy observatory), Plan Bleu Méditerranée, and so on...

For example, ANR, which administers the France 2030 program on behalf of the state, works on implementing the commitments of the future investment programs (PIA) created in 2010 to stimulate job creation, boost productivity, and ramp up the competitiveness of French businesses by channeling investment and innovation into priority growth-creating sectors.

Seed funds specialize in providing innovative businesses with capital and participate in the initial fund-raising process designed to finance the first costs involved in setting up a company, paying for research and development, feasibility studies and market research, or the cost of expert financial and legal advice. There are a great many seed funds, including the 600-million-euro national seed fund (FNA) created as part of the future investment program and managed by BPI France Investissement. **Regionally**, there are also semi-public seed funds, since regional authorities prefer to work with companies from their regions to support their local economies.

I should also mention the **role the state plays in setting standards and regulations**, which has a major impact in the development of innovative environmental solutions.

Afnor (the French standards agency) publishes guidelines on the management of innovation. This non-binding document describes the ideal trajectory for innovative businesses to follow.

There is an extensive **process of selection and support** to help innovations get off the ground and then over the long term, tailored to match their degree of maturity. Selection is an important and difficult process: where should help be targeted? Using which criteria? This is the difficulty of having

to make choices. At the European level, on seven separate occasions I myself was part of assessment, grading and selection groups looking at research projects submitted in response to an EU call for research and innovation solutions in the Mediterranean. The assessments were made by a team of experts from various countries and backgrounds and without any conflicts of interest.

A FRENCH INNOVATION INITIATIVE: IEEDS (DECARBONIZED-ENERGY EXCELLENCE INSTITUTES)

The goal of the IEED future investments program is to nurture the emergence in France of five to ten IEEDs within technology innovation campuses that have a global reach. After several rounds of calls for projects, each of the selected IEEDs receives funding to allow it to make investments and support its activities over the medium term. These institutes are structured as innovation hubs and include educational establishments, public and private applied research laboratories, prototyping, and at-scale demonstration capabilities via strategic public-private partnerships for research, training and innovation. They run research programs that leverage technology platforms for experimental developments focused on market-led needs, ensuring knowledge transfer to businesses via pre-established partnerships as well as positive socio-economic spin-offs of the results obtained.

Examples of IEEDs for high potential future-facing energy and climate sectors include geothermal, energy efficiency in buildings, tools for controlling and attenuating energy use, observation methods, adaptation strategies, marine energies, hydrogen

and fuel cells, solar energy, green chemistry and industrial biotechnologies, energy storage and smart networks, and CO₂ storage and capture:

- **FEM (France Energies Marines)**, in the field of renewable marine energy (offshore wind, wave energy and oceanic thermal energy); based in Brest.
- **Supergrid**, in the field of electricity transmission networks (development of systems for transmission of large quantities of electricity over long distances); based in Villeurbanne.
- **IFMAS** (French agro-sourced materials institute) in the field of green chemistry (such as biomass recovery, starch macromolecules in particular); based in Villeneuve d'Ascq.
- **Green Stars**, in the field of biofuels and CO₂ recovery (innovative processes for harvesting and biorefining microalgae); main site in Mèze.
- **IPVF** (Ile-de-France photovoltaic institute), in the field of new-generation solar photovoltaics (thin-layer technologies); based on the Paris Saclay campus.
- **VeDeCom** (low-carbon intelligent transportation systems) in the field of ground transportation and eco-mobility; based at Satory.
- **Geodenergies** (geotechnologies for decarbonizing energies)

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in the field of underground technologies (geothermal, CO₂ and energy storage); main site in Orléans.

- Other projects are also funded in the fields of energy efficiency and solar energy.

The state provides more than just funding, it also helps **support the projects**. From 2007 to 2015, I worked at CGEDD (now IGEDD – general inspectorate for sustainability and the environment) in the Sciences and Techniques department (now TECI - energy, construction and innovation transition), where I was Energy and Climate Coordinator specializing in renewable energies, photovoltaic and wind power, energy storage, energy efficiency, smart grids, waste and the circular economy, with particular expertise in renewable marine energy.

My role gave me a ring-side seat since many innovative project owners were sent to see me, sometimes the inventors of a one-in-a-million concept. This was how in 2011 I came to meet the people behind **EEL Energy**, a highly original and innovative project for an oscillating flexible membrane harnessing tidal energy without a turbine or fan.

INTERNATIONAL INNOVATION IN AFRICA AND ELSEWHERE

I have described the landscape of French state support for innovation. But what of innovation elsewhere in the world, especially in regions such as Africa where it is badly needed for ecological transformation? In these regions, Europe may bring technical and financial support as well as expertise in innovation selection and administration processes. Together with locally-relevant knowledge and expertise, such support can help African countries fulfill their ecological transformation and sustainable development potential through accelerating innovation. According to an analysis of the number of worldwide patents that is regularly updated by the **World Intellectual Property Organization (WIPO)**, innovation is primarily centered on the most developed countries and those from the global north, with the exception of China, which has overtaken the USA. Many actors, particularly the countries of Asia, are home to growing numbers of activities centered on scientific research and invention, a field previously monopolized almost completely by a handful of rich countries. In 2021,

EEL ENERGY, A 100% BIOMIMETIC OSCILLATING ELECTRIC EEL MEMBRANE, HARVESTS ENERGY FROM TIDAL CURRENTS BY MIMICKING HOW FISH MOVE

EEL Energy provides a disruptive tidal power technology that instead of employing a turbine, uses the current to move a flexible membrane that undulates underwater in a manner similar to a whale tail – an undulation that can propel certain species of fish to speeds up to 110 kph!

EEL Energy was set up in 2011 and the first small-scale tests were conducted in a tub on Rue des Ecoles in Paris, then in Boulogne at a tank belonging to IFREMER (French institute for exploitation of the seas). EEL Energy was presented at COP21 and received backing from BPI (French public investment bank). The project is financed by the European Union with the European Fund for Regional Development (ERDF). Then followed testing in the bay at Brest, a lengthy process that managed to overcome a number of obstacles. In 2022, the startup scaled up successfully with a 30-kW generator delivering 50% greater efficiency than conventional tidal power turbines. As I write, in 2023, EEL Energy has installed its first pre-commercial unit, a 30-50 kW machine,

on a section of the Rhône between the Cité Internationale district of Lyon and the town of Caluire, as part of a partnership with Voies Navigables de France (the inland waterway authority) for what will be the country's first tidal power farm. The teams are now working on a 250-kW river generator and a 750-kW tidal marine unit.

Demand for green electricity is exploding and marine energies, which are far more predictable than other intermittent renewables, will make a significant contribution to tomorrow's energy mix.

The company has already been approached by countries in Africa and the Americas for rural electrification projects, and from major European power companies for the development of offshore tidal power farms.

There is a critical need for constant and increased state support so that EEL Energy can become a world leader in its field.



In the IFREMER tank, and the bay at Brest.



Photo of the barge on the Rhône in Lyon.

China lodged 1.59 million patent applications, more than twice as many as the USA (WIPO, 2022). This geographical breakdown of innovations may seem paradoxical: production of scientific knowledge and innovations is increasingly globalized and interconnected on the planetary scale, yet intensively concentrated in a handful of hubs.

As a specialized agency of the United Nations, WIPO contributes to meeting the UN's Sustainable Development Goals by supplying tangible services to member states, enabling them to use the intellectual property system to stimulate the innovations, competitiveness and creativity they need to meet these goals. It is only thanks to human ingenuity that it will be possible to design new solutions to eradicate poverty, boost agricultural productivity and ensure food security, combat diseases, improve education, protect the environment, accelerate the transition to a low carbon-emission economy, increase productivity, and stimulate business competitiveness.

The role the state plays in setting standards and regulations has a major impact in the development of innovative environmental solutions

RESEARCH, INNOVATION AND SUSTAINABILITY IN AFRICA

Sub-Saharan Africa is very badly under-represented in this worldwide race for patents. Africa will be home to a quarter of the world's population by 2050, but currently boasts only 2.4% of the world's scientists, fewer than 1% of all patent applications and fewer than 4% of all scientific publications (CNRS, 2021).

The fast-growing population of Sub-Saharan Africa is very young. Deforestation and the climate emergency represent a threat to the region, despite considerable potential for renewable, hydroelectric and solar energies, which remains underexploited. The ongoing slow pace of electrification is one of the causes limiting development and innovation.

For countries in the Organisation of African, Caribbean and Pacific States (OACPS), the **ACP Innovation Fund**, financed by the EU, is a key component in their research and innovation (R&I) programs. Following a European call for proposals published in October 2019, the ACP fund is financing 12 consortiums to provide support to R&I actors in OACP states. The support provided is both technical and financial, via capacity-building, assistance from peers, mentoring, networking, swapping experiences, and lobbying policymakers. The 12 projects are all located in a different geographical region and cover different fields – green agriculture, access to digital culture, climate challenges, health – while also reflecting local conditions and synergies and promoting local and indigenous wisdom and its use in furthering knowledge within inclusive innovation ecosystems. They are also linked to efforts designed to create a critical mass of qualified people with skillsets suited to the needs of the labor market.

One of the 12 projects is **PDTIE (project to roll out environmental technologies and innovations for sustainable development and reducing poverty)** that runs in DR Congo and Cameroon. It aims to lay the groundwork for the future by working to support the strengthening and improvement of applied R&I capacities by training targeted scientists, technicians and

engineers, providing these actors with the necessary material and financial resources, and supporting scientific and technical innovations that favor sustainable development and are suited to local contexts, needs and knowledge.

The outstanding natural wealth of this region of central Africa, thanks mainly to the network of waterways within the Congo River basin, offers considerable possibilities for environmental innovations in the field of renewable energies. This great untapped potential must also be seen in the context of extremely low electrification rates in both countries. According to 2019 data from the International Energy Agency, the electrification rate in Cameroon was 69%, compared to just 19% in DR Congo, making this one of the least

electrified countries anywhere in the world. The delay in delivering electrification is one of the factors limiting research and innovation.

In terms of emerging digital technologies for energy and the environment, Africa is developing very rapidly, using ICT for telephones and mobile payment apps, and for small decentralized solar-powered electricity networks including storage, with connected metering and remote pay-as-you-go systems for users to ensure the projects' financial viability.

CONCLUSION

Appropriate initial and ongoing support from public authorities and the state for energy and environmental innovations is indispensable to the achievement of progress and sustainable development. This support is available in France in many forms and is relatively well resourced.

There is a special focus on green technologies, technological incubators, collaborations with international partners, and non-profits that are active in researching and innovating to protect the environment.

Several important questions must be considered. Why do certain innovations succeed? Conversely, why in many cases do they fail, missing their window of opportunity?

If an innovation project is to succeed in tackling the challenges of today and tomorrow, it requires perseverance on the part of the actors involved, significant long-term financial backing (over 10 years in the case of EEL Energy's tidal generators), immersion in a stimulating ecosystem, connections to the market, properly taken opportunities, and maintaining a long-term competitive edge over rivals.

Specifically, it has to pass through the so-called valley of death, a critical moment in any business' innovation strategy, a phase that sees many startups fail as they scale up, a moment when investment is harder to attract, the risks are higher, and investors can lose faith that the project will succeed or become sufficiently profitable. It is during this critical moment that support from the state and the public authorities is absolutely critical if worthwhile projects are to succeed.