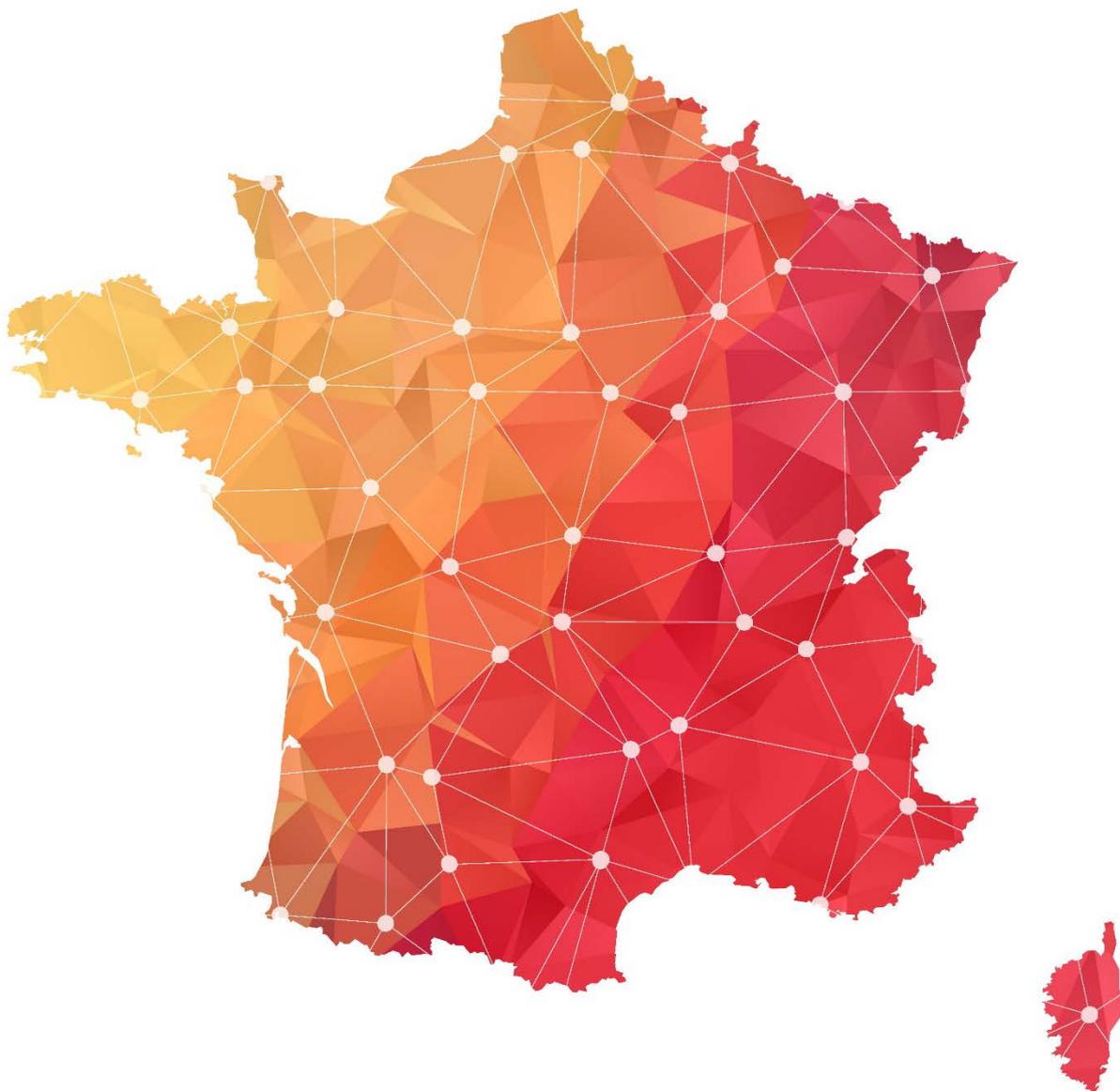


Country Study: France

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Contents

Introduction.....	3
Organisations	8
Processes	17
Content	22
France 2030 Recovery Plan	22
Good Practices.....	28
CIFRE: a successful scheme	28
References.....	30

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Introduction

France has had a tradition of active traditional industrial policy (aka "Colbertisme" or "dirigisme") until the early 1980s.

The main objective was to build large sovereign companies capable of internationalizing and competing around the globe e.g., on defence, energy including nuclear, aerospace, and agri-food. Picking the winners, playing with public procurement, and facilitating mergers to build powerful groups such as Airbus, CEA-Areva-Orano, CNES-Arianespace, Airbus, Total Energies, and Thalès. [As a side comment, it should be noted that the luxury and beauty business stands today as the leading sector for France on the stock markets (LVMH, Kering, Hermès, L'Oreal)].

DATAR contributed to the distribution of industrial investments over the territories (Telecoms in Brittany, Aeronautics in Toulouse, Microelectronics in Grenoble, Petrochemicals in Lyon, etc.). This territorial approach allowed the building of specialized clusters that mixed both private and public sectors. Investments in public research via Public Research Centres (CNRS, CEA, INRAE, INRIA, INSERM, IFREMER, CNES, etc.) in connexion with those clusters and universities strengthened the territorial specialization. These investments are also aimed at enhancing local universities in the process. (This laid the ground for the subsequent emergence of 10 IDEX, so-called "world-class" universities, and 10 sites specialized in technological transfer in one or several fields).

Public research centres apart from universities

Back in the 1930s, universities were considered incapable of managing their research properly. This led at the time to a decision, whose faulty consequences became clear in the long-term, to create large research centres that were separated from universities. Instead of fixing the matter in universities, new research entities were formed. This decision resulted in a divide between research (knowledge production) and teaching (knowledge transmission). The effects turned out to be counterproductive since tertiary education requires teaching at the front edge of new knowledge. Recognizing that the most efficient transfer of research results (new knowledge) to Industry flows through higher education, new policies subsequently introduced patches to the system. Those interventions aimed to encourage public researchers to teach in universities – not on a mandatory but voluntary basis. Joint laboratories (between research institutes and universities) were also created to link high-level research and teaching. These patches turned out to be useful but not sufficient to fully bridge the gap between the production and dissemination of new knowledge. (Moreover, in 1982, researchers in those large centres became State employees with permanent contracts. This contractual change ended up limiting the circulation of talent between public research, universities, and the private sector).

Basic science and industrial application

The belief in the economic and social benefits of science included hopes for spill overs from basic research and dual technologies, especially from the defence sector and nuclear research centres. Given the disappointingly limited spill overs, it became clear that transfers ("valorisation") from public research to Industry had to be actively promoted. This led to the creation of a national agency, ANVAR (literally national agency for valorization), in 1967. ANVAR was later (mid-1980's) decentralized in each Public research centre; hence developing a network of technology transfer agents (Curien's networks,

90's). Subsequently (2012), this network was reconfigured into 13 SATTs (sociétés d'accélération du transfert de technologie)- literally firms for the acceleration of tech transfers.

The French national system of innovation was and still is, characterized by a significant share of public R&D funding compared to R&D funded by the private sector. The total spending has been and still is below 3% of GDP. This seems to be a glass ceiling often aimed for but never reached.

During the '80s the traditional industrial policy came to a stop, in part under EU influence, in part due to liberal economic thinking (Prime Minister Raymond Barre mimicking the neoliberal doctrine of the time: "No subsidies for the lame ducks"). After a series of nationalizations of large companies and banks (1981-1983: the early Mitterrand's years), most were reprivatized; and have remained so until now.

From the 1990s, the economy switched to services to a large extent. Industry progressively fell to 10 to 12% of GDP.

While abandoning direct intervention in industrial business matters, the focus of public policy for Industry turned to the national industrial innovation policy (NIIP) and remained so.

Yet, in defence, nuclear and space, the French State continued to intervene beyond NIIP.

Interestingly enough, a public research centre, CEA (Nuclear research centre), proved capable of operating from basic science to industrial application. Amidst all those changes over time, CEA kept covering the full spectrum from fundamental research to technological development and even industrialization and production. CEA even owned the downstream industrial activities, named CEA-Industry, that later became Areva and then Orano; hence covering the full nuclear fuel cycle for the electricity public utilities - from uranium enrichment to reprocessing.

The dissemination of CEA research activities for other application fields is managed by CEATECH.

Broader questions arising out of the industrial innovation policymaking experience of France

1 – Targeting

Providing public support to Industrial development in advanced economies can no longer be done by picking and supporting the winner (a company) through public subsidies. It has become clear and widely accepted that such an approach distorts competition. Yet, the French experience tends to suggest that NIIP policies need to be targeted:

Horizontal measures (tax credit on research spending -CIR, or labour cost credit through reductions in social security contributions -CICE) in France proved altogether poorly efficient if anything.

In this sense, the experience of France suggests that targeting is important.

Targeting research teams of excellence (to allocate support while leaving them the key role of choosing the topics of research) has been used to a large extent in France (in the PIA scheme). The effectiveness of this policy is yet to be confirmed.

Yet, targeting can also be done vertically on key technologies for the future, on key sectors that are likely to be important or on building R&D capabilities to investigate new promising research venues (upstream) or speed up innovation (downstream). Issues of sovereignty have been raised on agri-food, energy, raw materials, and semiconductors. Those issues clearly suggest that targeting is important.

2 - EU - NIIP For Europe?

In the European context of the EU, there is a need and an opportunity for more coordination to avoid redundancies, and share costs and risks, sparing effort, time and energy.

The EU Commission initiatives such as Horizon Europe (2021-2027) are welcome. Yet, more is to be done on the specific theme of NIIP.

Although at Babbage this is a theme specific to the EU members, the theme of international cooperation may be worth looking at. In this context, management research proved wrong the idea that cooperation among competitors was necessarily bad, showing that coopetition (cooperation while otherwise competing) can be beneficial to the stakeholders.

3 -Lead times for shaping an ecosystem for start-ups

The experience of France suggests that it takes decades to build up an ecosystem that could make a start-up nation. A laissez-faire stance or a few liberal pro-business speeches by ministries will not cut it. Building such an ecosystem requires consistent and dedicated action which focuses on prioritized areas but covers a wide array of topics: promoting entrepreneurial dreams among students and the youth, encouraging former successful start-uppers to become business angels (this requires to have already several generations of former successful start-uppers - thus the lead time); facilitating recruitment and attraction of international talents (fast-track to grant visas and residency permits); stock option legislation; flat tax on capital gains; reducing red-tape; privileged access to government officials to help solve issues as they arise; attractive regulation for VC and investment funds (including for later stage); a secondary stock market for IPOs; connecting the start-up community to large corporations (opening commercial opportunities, piggyback to go international, alternate exit path beyond IPO) etc. This is not so much about public financial support: it is about some complex alchemy of cultural change and business atmosphere (Business image in public opinion, among bureaucrats, in the young generations with risk takers ready to venture and talents to join the ventures).

Public support for reindustrialization falls under "the visible hand" role of governments. However, a simplistic approach based on reshoring is a non-starter: what was sent offshore in search of low-cost labour is not likely to come back. Reindustrialization can stem from innovation and startups in new technologies. Yet, the cocktail to build a start-up nation is complex with plenty of interdependencies among the ecosystem ingredients. Moreover, it takes a continuous and consistent focus over time to shape an ecosystem for start-ups. This cannot be achieved during a typical political mandate.

4 - Capstone?

Is there something like a Capstone entity in a pro-industry public policy system of initiatives (instruments, measures, organizational entities)?

The creation of a public financial entity, in the form of a public bank (BPI France), seems to have changed the dynamics of the French tech/NIIP ecosystem. BPI brought patient capital to the French market. With up to 19% of total start-up financing, BPI became a significant player that has helped catalyze other investors for specific rounds of fundraising. In addition, BPI plays a role in protecting vulnerable start-

ups against eager acquirers coming to poach too early in the national pond. This protecting role is tricky because, while market mechanisms are being encouraged in France, predators from much bigger economies can in fact put the growth potential of the ecosystem at risk. When public resources (taxpayer money, time, effort, attention paid) have been invested, the vulnerability of the fruits generated may be a legitimate question to raise. After the brain drain of the '60s and '70s, the attractiveness of a US single market combined with the financial potential to scale up led many European start-uppers to cross the Atlantic; a "Business Drain" that occurred between the '80s and 2010s). The issue of acquisition/predation is both an opportunity for founders and VCs eager to exit and risk, given the vulnerability of the targets and their crucial role in spurring a thriving and resilient ecosystem.

5 - Deep-tech

The concept of "Deep tech" captures the potential of longer-term future industrial development stemming from basic research. The idea is that an array of technologies for the future could stem from fundamental research, requiring direct interactions between upstream research labs, typically in the public sector, and entrepreneurs interested in exploiting the potential of application of these longer-term research endeavours.

Should Deep tech open new sandboxes for a new generation of start-uppers, new organizational arrangements may emerge. Thus, new policies and new instruments may well be needed for such new settings. The value chain of innovation for Deep Tech is likely to significantly depart from the current start-up development paths. This remains to be explored.

6-Tech for Good

There is an increasing attraction in France (and most probably in other countries, including within the EU) among the new generation of start-uppers to go after "Tech with a purpose", typically for sustainability, environmentally friendly innovation, inclusiveness and/or reduction of inequalities.

This means that beyond the usual paradigm of business performance seen as profits for the firm's development, the founders and the shareholders, there is growing interest in bringing value to Society and the Planet - at least doing no harm.

This is a path that can reconcile business and public interest around public goods. This can lead to new narratives, re-legitimizing public intervention for industry and opening the ground for new policies and tools.

7 - Agility

The setting up of an organization (entities and process) for NIIP in France has benefitted from the creation of a small, reactive body (SGPI). This is a group of 30 senior officials operating as a channelling tool to translate policy priorities into funding distributed to those operators that are going to implement the corresponding programs. SGPI receives government priorities and funding, defines programmes or calls for tenders, and allocates funds received from the ministries to operators (of research and similar programs, some of which fall under the NIIP scope).

SGPI stands at the heart of NIIP in France today. SGPI could be seen as an administrative body channelling public funds and/or as an agency implementing public policies for Innovation through programs and funds allocated to a variety of operating bodies (public and private).

This body proved to move faster than the administrations of the ministries. Yet, SGPI had to call upon the deep knowledge that the ministries have of the operators. This means that the efficiency of the scheme requires cooperation.

A well-connected, small, agile, and reactive body may be useful when speed is important to keep moving despite many forms of inertia in the ecosystem. This new approach points to the roles and competencies that individual senior officials have mobilized to enact those changes.

8 - HR for NIIP policies

There are national traditions in the way senior officials are appointed to positions in the administration of Ministries.

The experience from France suggests that HR fit for the job are not necessarily those

- specialized in a specific scientific/technological field
- experienced in administrative processes.

Rather, policymakers and senior officials need to have good judgement, be open and willing to draw on the knowledge of ministerial experts regarding research specialities and/or innovation capabilities, and be ready to listen to all, including lobbyists, as long as they are driven by the general interest and the common good to draw their own conclusions.

A second key dimension of HR staffing for NIIP policies is continuity. NIIP requires dedication for several decades, not just within a political mandate. In that sense, most of the policies need to be trans-partisan so that consistency and continuity over time can build a workable and efficient path for the eco-system.

Organisations

The French public system for NIIP is fragmented with a wide array of organizations involved as well as processes in place to coordinate the players.

The focus here will be on two key public entities: 1) SGPI, the operating arm created to implement a significant recovery plan, called PIA (programme d'investissement d'avenir), launched after the 2008 great recession; and 2) BPI France, a public Investment bank set up to support the French National Industrial innovation policies.

First, we present an overview of the high-level **Innovation Council** that currently oversees the public policies on R&D, technology, and innovation in France. (As indicated by the red circles in the figure below, the heads of both SGPI and BPI seat on that council). Second, the content of the **PIA** programme that brought significant additional public financial resources into the system after the 2008 financial crisis is detailed. The presentation of PIA is needed to introduce **SGPI**, the organization responsible for implementing PIA. Finally, **BPI France** is presented as it plays a capstone role in the system.

In short, the innovation council oversees the whole public system of R&D and innovation. SGPI deploys the PIA programmes, channelling the money to operators. BPI France offers a full range of support and services for innovation and technological development. In that sense, SGPI and BPI have complementary roles in the system. Again, there are many other players in the French NIIP system but we focus here on SGPI and BPI France. (Note that among its many roles, BPI France plays the role of an operator for SGPI and thus receives funding from the PIA via SGPI). A **high-level innovation council** oversees public policies on innovation and research.



The council is co-chaired by the Minister of Economy and Finance (also in charge of Industry), and the Minister of Higher Education and research. The left part of the diagram below shows the ministers involved (Defence, Interior, Labor and Employment, Industry, Energy, and Digitalization). The centre part shows the senior public officers (general directors) in ministries or public entities (SGPI, DG Business, DG research and innovation), and operators (Research funding agency ANR, BPI France). The right part shows representatives of civil society (Corporations, SMEs, start-ups, Investors, think tanks).

After the 2008 great recession, a major bipartisan recovery programme called **PIA** (100 bn€, of which 35 bn€ for R&D and innovation) was launched under N. Sarkozy's presidency. Two former Prime Ministers (Rocard, centre left, and Juppé, centre right) chose to give priority to funding research. President Sarkozy had decided to create a new public entity to deploy this PIA initiative. He intended to circumnavigate what he perceived as the ministerial bureaucracy in France. This new entity was initially called Commissariat général à l'investissement (CGI) and later became **SGPI**.

Focus on PIA – Programme d'investissement d'avenir – Investment plan for the future

PIA Principles and Organization

The origin of the PIA stems from the Juppe-Rocard mission that was ordered by President Sarkozy in 2009, in the aftermath of the 2008 financial crisis. This mission was to establish proposals to revive innovation, investments, and industrialization in France, sustain growth, create employment and reboot France's competitiveness.

It identified 7 strategic streams (see Table 1) to organize and prioritize actions. As a direct consequence, President Sarkozy decided to launch a national investment plan of 35bn€ around 5 initiatives. To organize the allocation of funds, a specifically dedicated structure was created with the CGI (later renamed SGPI).

Dedicated financial autonomy

From the beginning, PIA plans were based on a dedicated financial organization that was specifically separated from the annual budget allocation process. In France, public budgets for any type of ministerial action, be it in the fields of Research and Higher Education, Industry, Trade or Sustainable development, must be agreed upon every year through a parliamentary validation as a bill called Loi de Finance. Budgets that have not been spent within the period cannot be carried over to the next period and must be reapproved by the next annual Loi de Finance. In this context, the PIA funding scheme was designed to circumnavigate the standard annual budgetary process and its constraints.

The advisors of the Juppe-Rocard Mission argued that the standard annual budget process could not apply to the funding of a large investment program in innovation, research and industry, as the monitoring of the financing should be spread over several years.

Therefore, a specific process was built to ensure that the funds of the first PIA (and the forthcoming PIAs) could be managed throughout the years **without** going through parliament's annual review under the Loi de Finance.

Along this line, several principles were defined:

- *Funds are allocated on a pluriannual basis*
- *Funds can be spent across the timeline without the annuity principle (annual vote by the parliament)*
- *Funds are transferred directly to the operators and cannot be subject to cuts as part of reduction measures (for instance if a saving plan is decided for an operator, it cannot apply to the PIA funding)*
- *In the case of Higher Education, funds are transferred to a deposit account, and financial incomes generated by the endowment secure additional financial flows*

Dedicated governance

The monitoring of the allocation of funds and control of use was delegated to the SGPI (initially the CGI), working directly under the supervision of the Prime Minister. One of the key tasks of the SGPI in this budgetary process is to ensure that funding shall not be used in replacement of previously agreed actions and to guarantee that the PIA is an **addition** to the already defined investment plans in the various ministries. In other words, PIA comes on top of the normal annual funding allocated to operators by ministries.

The governance of the PIA by the SGPI includes the following rules:

- The SGPI reports directly to the Prime Minister. This positioning offers higher efficiency in the monitoring of transverse or inter-ministerial decisions. In the case of large investments by the PIA, actions are coordinated between various fields which are covered by different autonomous entities.
- The SGPI defines the agenda, and since 2017 it is also in charge of defining the major themes supported by the investment policy. The initial philosophy of the SGPI governance was to delegate the choice of programs to independent committees; since 2017, SGPI under the prime Minister is more involved in the definition of the policy content.
- SGPI coordinates the actions between the various operators (research bodies, etc.).
- And finally, SGPI evaluates the effects of the investments and their impact. A 2019 report indicated that this evaluation process should be reinforced and that a lack of consistency in the evaluation methods remains.

In a period of budgetary constraints, after the 2008 crisis, the PIA process proved to be useful as it released the pressure on government budgets, in particular in light of the EU budget rules that limit public spending and public deficit.

PIA actions and outcomes

Funding opportunities of the PIA 1 were aligned with the recommendations of the Juppe-Rocard Mission report as shown in Table 1.

Most of the PIA 1 funding was directed towards Higher Education, as shown in the following table, with 11bn€ aimed at increasing the critical mass of French universities by promoting Excellence campuses and developing the Saclay pole in the Paris Metropolitan area.

Evaluating the efficiency of the PIA is difficult because multiple indicators are necessary to cover the variety of projects across multiple operators. In terms of territorial spread, it appears that PIA flows have been concentrated in major cities and urban centres.

Table 1: The destination of funding across the 5 streams of the PIA 1 (in bn€)¹

Juppe Rocard Mission		PIA 1 (2010)		Application
Support Higher Education, Research and Innovation	16	Higher Education	11	Excellence Campuses
Increase the development in biosciences	2	Research in Health and BioTech	7,9	Labex Research dissemination
Sustain Small Business	2	Industry and Small Businesses	6,5	Small business growth
Develop the Mobility of the future	3			
Develop low-carbon energy	3,5	Sustainable development	5,1	Low carbon Nuclear
Smart Cities	4,5			
Digital Innovation	4	Digital	4,5	Innovation in content

Later on, PIA 2 to 4 followed PIA 1 as shown in figure 1, with additional streams added to those already in PIA 1.

Figure 1: PIA across time



PIA today: a programme that coexists with various institutional actors

In 2022, PIA is part of a fragmented institutional model, with various actors each in charge of specific aspects of the funding and monitoring of innovation. In addition to the successes of some of the projects run by the PIA, other initiatives have emerged recently in the area of innovation policy, such as the revival of the Commissariat Général au Plan, and the plan France 2030 (see chapter IV).

Initiatives	SGPI/PIA	Commissariat Général au Plan	Bpifrance	Equity firms
Purpose	Long-term, disruptive innovation	Develop and improve industries, infrastructure	the partner for firms' growth	Invest in startups developing future solutions
Financial Resources	PIA funds	No specific funding Co-funding with local/regional	Caisse des dépôts et consignations (CDC)	Private Equity

¹ Evaluation du premier volet du PIA 2019

² Adapted from « Evaluation du premier volet du PIA 2019 »

Method	Projects, Jury, Selection	Top-down plan	Central operator for PIA actions Loans to small businesses Direct investment in innovative firms Incubators	Company evaluation
Reporting to	Prime Minister	Prime Minister	Owned at 50% by the state and 50% by the CDC	Private Shareholders

While the monitoring of PIA has been maintained at the highest level, i.e. the SGPI working directly under the Prime Minister, to ensure consistency in the allocation process, note that operations are delegated to operators.

SGPI oversees the deployment of PIA and delegates to operators. BPI France is one of them.

The role of these operators is then key to orchestrating the release of funds and the control of projects (selection, follow-up...).

However, these operators are also decision centres for other investment projects in innovation, either on their own or in cooperation with private partners as co-investors. Thus, they carry dual innovation processes. For instance, BPI France is involved in many major innovation projects, either as a lender or co-lender with other investors or as a direct investor.

This dual ecosystem is claimed to bring the benefit of helping operators gain visibility and expertise in being associated with long-term projects. This contributes to improving their capabilities when discussing with private co-investors on other projects. The operator is situated at the centre of the innovation ecosystem. The result is a flourishing ecosystem in favour of the development of startups and growing unicorns. For instance, BPI France reports having 11 unicorns in their portfolio of investment in innovative companies.

On the other hand, one could consider that this spread of responsibilities does not help when it comes to focusing massive investments on a specific heavy topic, in particular in new and disruptive technologies (such as hydrogen or IA). One could argue that large technological disruptive innovations should be conducted at a higher level to gain critical mass, i.e., at the EU commission level, in coordination with European partners.

In short, **SGPI** “secretariat general au programme d’investissement”, literally General Secretariat for the investment programme, was created as a new organization to operate the PIA(s).

When SGPI was created (as CGI), the governance of SGPI was led by business leaders, a strong signal was sent about the objectives of the PIA initiative.

Conversely, SGPI staff obviously need to understand the political rationale and intents behind the priorities put to them, as well as the conditions of implementation in the operating bodies.

All in all, SGPI can be seen as an administrative body channelling public funds and/or as an agency implementing public policies for Innovation through programs and funds allocated to a variety of operating bodies (public and private).

SGPI stands at the heart of NIIP in France today. When the most recent plan for Industry called “France 2030” was announced (fall 2021) with total credits of 34bn€ (plus 20bn€ from PIA4), SGPI had to realign its activities to adjust to the new plan. (Yet, France 2030 is not presented as PIA 5).

Focus on BPI, the Banque Publique d’Investissement (SA) / Public Investment Bank

BPI France

Another new body **BPI France** (Public Bank for Innovation) emerged in 2013 and has been playing a key role, broader than, and complementary to **SGPI**.

BPI France is a public financial institution that positions itself as a “trusted partner for entrepreneurs” and offers a continuum of solutions adapted to every key step in a business’ growth. BPI France's goal is to favour the growth of the French economy by supporting micro-businesses, SMEs and mid-caps, as well as those large caps that are considered important for France’s vital interest in terms of the national economy, the territories or employment. BPI France offers solutions for business growth such as business creation, financing, guarantees, or equity investment.

BPI France provides firms with public support that can trigger additional funding by private investors, thus catalyzing raising money to fund innovative projects and development.

With the absorption of ANVAR, BPI France has de facto become the French agency for innovation, delivering large-scale programs to innovative entrepreneurs, as well as financing 25 SME accelerator programs. As a result, BPI France embraces several roles (including being one of the operators for the PIA fund).

The focus on BPI France below stems from BPI France presentation documents.

Finances

Shareholders: 50% French state, 50% Caisse des Dépôts et Consignations (CDC)

Assets: 76,7bn€

Mission & Timelines:

“Serving the Future”

BPIFrance results from the successive mergers of multiple entities and agencies over the years. The remit of its mandate has expanded accordingly.

1967 creation of ANVAR, the national agency for research and development. Its role was to channel research results produced by public laboratories and universities towards the French industry.

1980 Creation of the Crédit d'Équipement of SMEs (CEPME), the main investment and financing institution for SMEs.

1982 Introduction of Sofaris, a loan guarantee programme created to guarantee some of the risks taken by banks and other lending institutions.

1984 with the CDC, Creation of Avenir Entreprises, the equity activity of CEPME

1996 CEPME and Sofaris are merged to create the Bank for development of SMEs (BDPME)

2005 Creation of OSEO ANVAR by merging BDPME (1996) and ANVAR (see 1967). Its mission is to promote and finance innovation in the French industry and particularly for SMEs. OSEO ANVAR was renamed OSEO Innovation in 2007.

2008 Creation of the Strategic Investment Fund (FSI)

2013 Bpifrance is launched from the merging of OSEO, CDC Entreprises and FSI.

2014 BPIFrance Investissement is created as a subsidiary of BPI when CDC Enterprises, FSI and FSI regions regroup

2015 Launch of three accelerators for start-ups, mid-caps, and large caps which marks the beginning of BPIFrance's activity as a coach for entrepreneurs

2017 Bpifrance becomes the French export credit agency with the integration of Coface Garantie Publique.

2018 Bpifrance's activity continues to grow as it becomes the French sovereign fund with the integration of CDC International Capital.

2020 BPI Entreprises 1: fund-of-fund launched to allow a private individual to invest in private equity in France.

Main Activities

Bank for entrepreneurs: Bpifrance helps stimulate the growth of French businesses by offering loans, providing guarantees, and awarding buyer credit and supplier credit to encourage business abroad. It finances over 80 000 companies, providing over 6000 investment loans and 50000 short-term loans in 2018 with a total production of 19bn€. Bpifrance is also the innovation agency for entrepreneurs with 1,3bn€ of innovation soft loans distributed to 6000 companies every year.

Private equity: BPIFrance is the French Sovereign Fund. It invests in start-ups, SMEs and mid-caps through direct investment and a fund of fund activity. In 2018, this activity represented 2bn€ with a portfolio of over 1000 direct investments and 400 partnering funds. It is considered the European leader in its fund-of-funds activity.

In 2020, Bpifrance launched a private equity fund-of-funds: BPI Entreprises 1 collects private money from private individuals to invest.

Export credit agency: BPIFrance Assurance Export is the French Export Credit Agency. In keeping with its mission to boost French exports, Bpifrance offers export insurance solutions for French companies and banks with a direct guarantee of the French State. It supports small and large French companies, as well as French or foreign banks willing to finance French export transactions, by securing the export

transactions against potential risks at every stage of the contract, from negotiation to its complete payment (credit insurance, investment insurance, exchange risk insurance, bonds and working capital). This export finance activity follows the commitment of the international coalition "Export Finance For Future (E3F)" which aims to align export finance with climate change objectives.

Coach for entrepreneurs: BPIFrance helps accelerate the growth of companies through accelerator programs, consulting services for executives and training for CEOs, events that encourage networking between entrepreneurs, and international learning expeditions to help businesses discover markets abroad. It has accelerated 600 companies, organized over 1200 consulting missions and around 100 networking events for CEOs.

The Consulting Division of BPIFrance provides consulting aimed at supporting small and mid-size enterprises in their growth, productivity, and sustained performance. Bpifrance covers 50% of the cost of the assignment for companies it funds or in which it holds equity.

The accelerators, such as BPIFrance Le hub, are categorized by company size: start-up, SME, Intermediate-Size ISE, and an international accelerator focused on boosting the export growth of companies that already have a strong international presence. Interestingly, a new type of accelerator was introduced in the late 2010s to create acceleration programmes that meet the specific needs of the industrial sector. For example, sectoral concerns over consolidation, the push towards Industry 4.0, CSR, or circular economy challenges. The Sector Accelerator provides support for 12 to 24 months to companies selected for their growth potential and relies on customized consulting to identify growth priorities and to guide the company in its strategic thinking by identifying obstacles.

International Expeditions are organized (20 per year) so that groups of 10-15 French entrepreneurs, with high growth potential from specific sectors, can discover ecosystems abroad, meet local investors, identify business opportunities with potential buyers and accelerate their development.

BPIFrance University offers free e-learning modules for business leaders covering topics such as finance, strategy/innovation, international expansion, and digital transformation. Its university also offers workshops on soft skills (pitches, media training, leadership) and customized training such as two-day seminars in partnership with business schools - London School of Economics (LSE) on digital and marketing topics, Technical University Munich (TUM) on Industry 4.0 and digital topics, and with Bocconi University in Milan on International expansion.

EuroQuity is an online matching platform created in 2008 that helps companies meet investors and partners. This platform aims at promoting the companies' visibility, helping investors access a deal flow qualified by the market, and encouraging joint investments. Companies are certified and assigned to 20 different communities around specific interests and themes; they can then build up an "EQ score" reflecting their engagement on the platform and increasing their centrality.

International cooperation: BPIFrance is committed to supporting European entrepreneurship and innovation policies and to cooperating with its counterparts across Europe and internationally, to create mutual value for the benefit of companies. For non-French companies, the actions undertaken by Bpifrance include international tech partnerships, buyer credit and supplier credit. Through its Brussels office, Bpifrance also partakes in the European public debate and dialogue with European institutions

and counterparts: as a partner of the European Investment Bank, BPI France is a shareholder of the European Investment Fund (supporting InvestEU), as well as a partner of the Regional Authorities deploying EU Structural Funds and facilitating access to Horizon Europe for French SMEs.

International Collaborative Innovation programmes are designed to encourage and fund innovative collaborations between French and international companies. The aim is to allow companies to unlock the final stages of developing an innovative solution before going to market. With its partners, Bpifrance offers a joint financing framework whereby Bpifrance funds the French company, and the foreign company is funded by the Bpifrance's counterpart in their country. In France, eligible companies with less than 2000 employees can receive one of the following forms of funding:

- Innovation Development Assistance: a repayable loan which can cover up to 65% of eligible costs, capped at €3m
- Deeptech Development Assistance: combining a grant (max of 50% assistance) and a repayable loan, which can cover up to 45% of eligible costs, capped at €2m
- A grant under the Eurostars programme, which can cover up to 40% of eligible costs, capped at €3m

French Sovereign Fund: BPIFrance is the French Sovereign Wealth Fund (SWF) with over €36bn assets under management. As such it manages a large and diverse portfolio of direct participation in startups, small, medium, and large-sized companies, as well as participation in venture capital and private equity funds (250 investment professionals managing 850+ direct participation and 400+ participation in funds). Following the merger with CDC International Capital (2018), BPIFrance has started partnering with other SWFs and long-term investors for joint investments in France (or in certain cases abroad). BPIFrance is a founding member of the Institutional Investors Roundtable (IIR), an association of SWFs and pension funds. It is also a member of the International Forum of SWFs (IFSWF) and the 20-20 Investment Association.

In short, BPIFrance progressively absorbed most of the public / para-public players that emerged over the years to deal with financing, risk and export for growing and innovating firms in the country. It has since become an important operator for the resource allocation of PIA funding, under the devolution from SGPI. BPI France plays the role of both a source of trigger funding to attract private investors and some sort of a capstone institution in the French NIIP landscape.

Processes

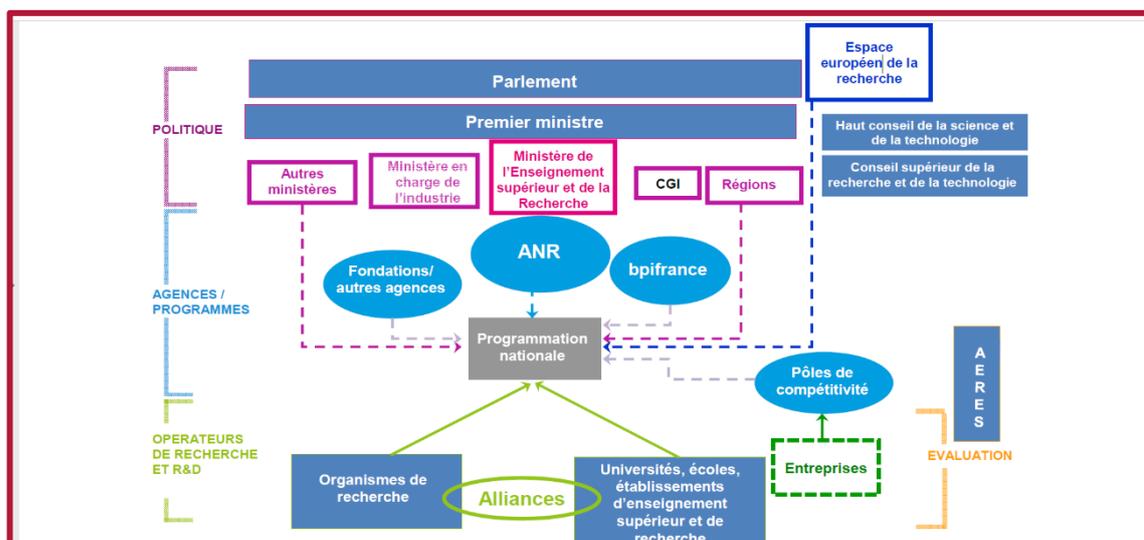
Framework: part of the legacy of the 1960s, under Ch. De Gaulle's presidency remains. This era conveyed a strongly dedicated, and candid belief in science and research to generate technology, economic development and social progress. This was an era of the significant continued growth of public funding for research. The funding was somehow hacked by basic research in the name of Science and the belief in spill overs. Yet, the classical divide between basic research and Industry was soon identified as an obstacle for NIIP. This obstacle still exists today to a lesser, though still significant, extent.

One after the other, many instruments were cumulatively implemented to bridge that gap. While these instruments collectively led to some successes, the divide remains. (ANVAR, conventions CIFRE,

decentralization of ANVAR, Curien's network of transfers agents, Satts - incentive schemes for public research to create start-ups- Carnot institutes, Pôles de compétitivité, etc.).

Among these, “Pôles de compétitivité” (or innovation clusters) inverted the rationale of technology transfer. Instead of pushing a flow of knowledge and technologies downstream, i.e., from public research to Industry for application, the new rationale from 2008 onwards became to channel some R&D funding via a set of sectoral or thematic "hubs", sometimes at a regional level. In these hubs, stakeholders set up priorities in the resource allocation process. The representatives of the stakeholders have come primarily from public research centres, universities, businesses (large Firms and SMEs), plus local governments when the hub contributes to regional development. In this setting, the key point is that the power in those hubs has been given to business leaders. The decisions for funding allocation are co-constructed but the final say de facto ends up on the business side. The funding is of the order of 500M€ per year. [This comes on top of the fixed cost of public research – labour, premises, basic equipment, all covered by the usual ministerial channels – and on top of PIA]. This scheme makes it possible to orientate the research agenda of part of the public research, via a set of calls for tender selected under the significant business influence. In a way, this counterbalances the dominance of fundamental research and basic science that prevails in the French system of public R&D.

The French national system of Research and innovation and some of the coordinating processes:



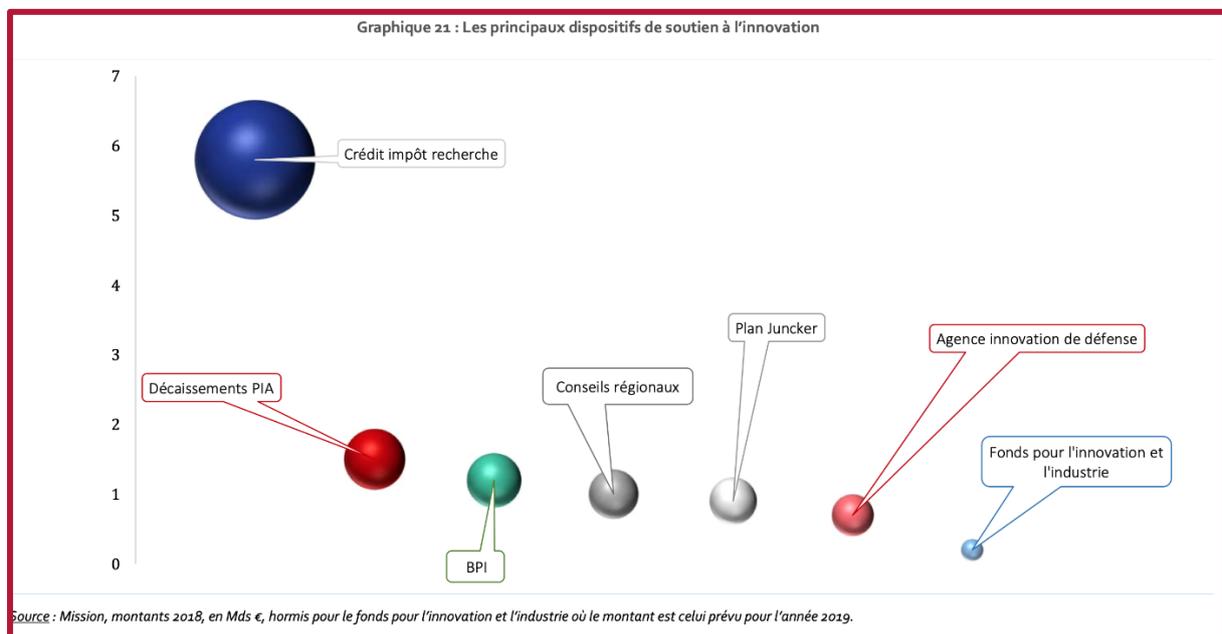
Note: CGI (commissariat general à l'investissement) became SGPI (see strand 1).

Until the early 2000s, the French system of public R&D was not accustomed to funding agencies. Most of the funding was negotiated by the technostucture of each public research centre with their ministries. As a result, researchers had the comfort of working on their topic of interest without having to bid on calls for tender (except for the EU commission Framework programs). This was culturally embedded in the research community. However, the **ANR** (national research Agency) was created in 2005 as a tool to orientate public research thanks to research programs set up via calls for tender. This meant both cultural and organizational changes that took several years to be fully accepted in the setting. This is now the case.

In 1983, the new belief in NIIP as the main path for industrial policy led to focusing the support to the business on a tax relief scheme in relation to R&D spending by firms. **CIR**, “crédit d’impôt recherche”, literally tax credit for research, became a major policy instrument that survived the successive political changes after each main election.

Initially, the amount of tax relief was 25% of the increase of total R&D spending in the year for a firm, with a ceiling of about 50 k€ per firm at that time. In 2000, this goes up to 50% of the yearly increase in R&D spending. In 2004, a 10% tax cut on the yearly volume of R&D expenditure is added on top. In 2006, the tax relief on the increase in R&D spending is abandoned as the CIR becomes a straightforward tax credit for the firm, based on the volume of yearly R&D expenditure in the limits of 16m€ per firm. The yearly government spending for CIR goes up to 1,5 bn€. In 2008, the ceiling is abandoned, and the tax relief is 30% of R&D spending below 100M€ and 5% beyond 100M€. In 2013, a CII (I for innovation) is introduced for SMEs: a tax cut of 20% of amounts spent to develop prototypes or new products. The cost of CIR was 6,3bn€ in 2021. For 2008 to 2021 an evaluation of the total cost of CIR leads to 72bn€.

Recent studies show that 58% of the CIR benefits manufacturing companies. Also, among other objectives, CIR is used as an incentive to attract FDIs. Between 2007 and 2016, the R&D spending by the private sector rose from 1.27% to 1.43% of GDP, suggesting that CIR did its job – at least to some extent. Yet, the diagram below shows the important relative weight of CIR in the annual direct public support to innovation in businesses. As a result, while CIR is clearly a public tool well-received by Industry, there are also critics from economists who find it not efficient. The CIR is periodically debated but remains alive.



Since the mid-'80s, France has developed policies to promote entrepreneurship. Incubators, fab-labs, and venture capital have all been encouraged. Paradoxically, the initial result of this new priority was both impressive and disappointing. On the one hand, several generations of young start-uppers emerged. On the other hand, the most successful start-ups tended to move to the US, due to easier market accessibility (integrated, one language, more money to fund scaling up). Yet, overall, the French business setting was culturally transformed. Along the way, four decades of entrepreneurial activities pervaded public policymakers as well. More recently, President Macron presented his vision of France as

a start-up nation and kept praising French tech during his international travels. In 2017, at the beginning of his first mandate, there were only 3 Unicorns in the country. Five years later, there are 26 Unicorns (Startups reaching a valuation above 1b\$).

In a way, NIIP in France has been searching (and still is) for a reasonable framework to think, design and implement industrial policy. In the 80s, the NIIP was built on the legacy of the 60s, in the form of a strong belief in Science and research to feed technological progress as a way to serve prosperity and well-being in society. This is also when the interventionist stance of industrial policy was abandoned, leaving industrial business choices to market forces. The new framing was focused on creating the conditions for firms to innovate and allocate resources according to their market perception of needs and business opportunities. Within such a frame, public funding allocated to support research (CIR, see above) was typically horizontal. So was the CICE, a tax credit on labour costs (reduction in social security contributions) – see chapter V, page 17.

Then, after 2008, came the PIA (See the focus on PIA pp 3 to 6 above) with a specific approach as far as targeting is concerned. While not targeting technologies or sectors, in the realm of public research, the selection process aimed at identifying teams of excellence which would receive focused support. As an illustration, the PIA1 oriented 9.2bn€ to IDEX and LABEX (universities or laboratories selected on criteria of excellence in a specific domain or area). In turn, those teams of excellence were assumed capable of properly selecting the relevant topics for their research. The targeting was left to them.

Yet, around 2010-2015, including at the EU level in preparing for Europe 2020 (the EU research Framework program), a noticeable inflexion occurred; if not a shift. The NIIP of France started leaning toward more vertical (sectoral and topical) orientations. This orientation materialized in openly searching for key domains for the future: e.g., SGPI was explicitly looking for advice on sectors and topics of interest to prioritize, calling upon consulting firms to do so, etc. This change in policy thinking may have been the result of market failures on two grand challenges: climate change and sovereignty. This change did not mean a full revert to the interventionist industrial policy of the past. In the renewed thinking, there is no "pick the winner" (typically one leading firm by sector that would be supported). Yet, there is an intent to direct public resources towards clearly identified topical or sectoral priorities, then leaving to players in the arena (public research, business, start-ups, venture capitalists and financial markets) the role of allocating their resources according to their strategies.

In other words, the new French NIIP now tries to avoid a horizontal policy that spread resources across the entire economy (like watering the desert). Instead, the new French NIIP concentrates on pre-identified areas of priority (technologies or sectors for the future) while leaving to firms the role of identifying business opportunities and designing *ad hoc* innovative business models in those areas. The most recent plan for Industry (France 2030) is typically structured around sectoral priorities and boundary objects to materialize the objectives, thus helping political communication of the package (see plan France 2030 in strand 3 below on contents). The only important exception to this is the CIR (tax credit), an instrument that is horizontal and remains significant.

It means that a new version of NIIP recently emerged: supporting innovation (more than research per se, although still funding R&D) and promoting entrepreneurship, addressing the financing tools of innovation (BPI), identifying national sectoral or topical priorities (cleaner planes with Hydrogen fuel,

small modular nuclear reactors, etc.), while still calling upon private firms and market mechanisms to exploit business opportunities.

As an illustration of this shift, the PIA4 has allocated 1,8 bn euro credits to a Battery plan aiming at contributing to creating champions and sovereignty in this area, as well as 0,9bn euros for developing decarbonated hydrogen solutions.

All in all, a pro-business policy has been adopted over the year to generate good, well-paid and sustainable jobs. Innovation and entrepreneurship have been major keywords to create jobs, aiming at a higher range of added value in international competition. As far as manufacturing and Industry are concerned, from around the mid-'80s, the focus shifted to industrial innovation. That meant supporting both public and private R&D (CIR), reorganizing the tools and processes to orientate a more significant share of the programs in line with industrial needs (poles de compétitivité, ANR), while letting basic research investigate new topics as freely as ever. In parallel entrepreneurship was promoted, leading to the start-up nation claim, with recent successes (Unicorns).

The Framework is based on (1) a belief in Innovation, “thus” R&D, and (2) Entrepreneurship.

The processes are managed through:

- SGPI as the pilot for targeted allocation of a range of R&D funding, in coordination with Ministries who provide the money and operators who conduct the research, plus CIR to spur private R&D.

Some central operators who lead the implementation. These operators are CDC (Caisse des dépôts and consignation), BPIFrance, ANR (Agence Nationale pour la Recherche), ADEME (Agence pour la transition écologique), CEA (Commissariat à l'énergie atomique) and CNES (Centre d'études spatiales). Even though these agencies are autonomous, ANR mainly covers research coordinated by the Ministry of research and tertiary education, ADEME falls under the coordination of the Ministry of ecological transition, while CEA and CNES remain relatively autonomous.

BPIFrance, the public bank for innovation, has a somehow different approach as its financing schemes contribute to helping start-ups (and established firms, including SMEs) in finding investors through a sequence of rounds of fundraising, thus keeping the start-ups in France and Europe. There is still a missing link in the system, namely the lack of funds capable of investing over 100 M€ on the scale-up of a successful start-up. Below 100 M€, funding can be found. Above, it is difficult. (Note that IPOs are often seen as the last option due to the constraints attached to being listed on the stock market).

Content

A useful illustration of the content of an initiative is provided by the plan launched in October 2021.

France 2030 Recovery Plan

The French Industrial and Innovation Plan: “France 2030”

The French President, E. Macron, officially announced the "France 2030" plan on 12 October 2021. France 2030 is essentially a public investment plan of €34 billion to which added €20 billion already engaged with a previous plan (the fourth wave of the Plan of Investments for the Future, “PIA4”). These €54 (34+20) billion investments aim at fostering technological innovation and industrial development.

This does not mean however that France 2030 is like some sort of a PIA5. However, France 2030 follows, and to some extent pursues the same objectives as the previous plan "France Relance". This previous plan was launched in September 2020, for the 2021-2022 period, in coordination with, and co-financed³ by the European Union (EU). "France relance" was the coordinated EU response to the covid crisis to foster a recovery in country members after the pandemic. Beyond common aims (capabilities development, reindustrialization, digital transformation, and environmental transition) the main difference between the contents of "France relance" and "France 2030" is that France Relance involved macroeconomic goals (social measures, taxes and subventions changes) whereas France 2030 only aims at investing in (radical) innovation and technological development. In that sense, France 2030 is closer in its philosophy to the previous Plan of Investments for the Future (Plan d'Investissements d'Avenir, PIA). Yet, again, France 2030 comes on top of PIA 4 and is not PIA 5.

The following sections present France 2030: the content of the policy initiative, the structures involved, and the process followed in its development and implementation.

France 2030: contents

The France 2030 industrial and innovation policy is organized around three generic thematic strands which are then translated into 10 objectives. At a meta-level, technological, strategic and political thinking is driving these objectives:

- the digital transition (impacts everything),
- the environmental transition (badly needed)
 - (radical) innovation (key in the economic competition as reindustrializing is a major objective for France)

The plan contains 10 objectives that are technology and/or industry specific. The idea is to build strong capabilities and competitive positions around specific techno-industrial choices that are mainly related to the existing specialization and strengths of the country. Sandbox

The three thematic and 10 objectives are the following:

Produce Better

³ https://www.economie.gouv.fr/files/2021-09/DP_PLF_2022.pdf

- i. Develop an offer of small modular (nuclear) reactors (1 000 M€)
- ii. Become the leader in green hydrogen and renewable energies (2 300 M€)
- iii. Make our industry free of greenhouse gas emissions (5 000 M€)
- iv. Produce 2M electric or hybrid vehicles in France (2 600 M€)
- v. Produce the first plane flying with low greenhouse gas emissions (1 200 M€)

Live Better

- vi. Develop a healthy, sustainable, and traceable agriculture /agri-food (1 500 M€)
- vii. Produce biopharmaceuticals (2 300 M€) and create new medical devices (650 M€)
- viii. Develop the cultural industry (movies, videogames) with new studios, virtual reality (VR) technologies, and capability development (600 M€)

Understand Better

- ix. Develop a reusable launch vehicle for space exploration and new space actors (1 550 M€)
- x. Invest in deep submarine exploration (300 M€)

To make these ten objectives reachable and ensure the success of the plan, five conditions were identified as prerequisites: secure supply of materials, secure strategic component and equipment supply, master strategic technologies, develop capabilities, and support startups.

On top of being allocated by sectors, the funding also points to boundary objects. This contributes to political communication towards the general public. Yet it helps envision concrete targets, e.g., small modular nuclear reactors, green hydrogen (Energy & decarbonation, 8bn€); electric and hybrid vehicles, low emission aircraft (Transportation: 4bn€); or sustainable and traceable healthy food (agri-food: 2bn€); or 20 bio-drugs for cancer or chronic diseases (Bio-pharma: 3bn€). Boundary objects may facilitate public acceptance of the plan. (Typically, a project of a new plane or even more so a new spaceship is likely to capture more attention than a program of energy saving in Industry).

The content of this investment policy builds upon a rather optimistic view of the capabilities of France to face the challenges. Some argue that certain objectives are technologically very challenging, if not too ambitious, and most probably not reachable by 2030 (e.g., the low-emission plane).

Some other objectives seem less difficult technologically speaking and build on resources and capabilities that seem more at hand in France (e.g., agriculture/agri-food). However, other dimensions of the French and European policies such as the *Common Agricultural Policy* or health and environmental standards in international trade agreements may not be fully aligned with the development of sustainable agriculture and high-quality food.

In addition, despite these planned significant investments in new technologies and products, the question of the protection of nascent industries should be raised. The support provided by the policy implemented through France 2030 may help develop and industrialize new technologies. Yet, no specific strategy is included in the plan to support new ventures (against lower prices for example) in the scale-up and subsequent incremental improvement phases when long-lasting competitive advantages are to be built. This is a typical issue for a medium size developed economy facing larger competitors. This relates to the theme of keeping start-ups at home. The brain drain of the previous '60s and '70s left the floor open to a free market eager to acquire the most promising start-ups; leading to a "business drain" in the 80s, 90s and early 2000s.

1. Governance of “France 2030”

The development and implementation of France 2030 involve six main organizational layers of advisory, implementation and control:

- i. A forum of experts and players from the ecosystem (National System of Innovation): research, innovation, industrial sectors, regions... Their role is to provide insights to build the strategic vision and take field needs and opportunities into account.
- ii. A strategic committee reporting to the French Presidency (Elysée Palace) and involving experts to follow and revise the strategy along with its execution.
- iii. Sectoral Steering committees, involving ministers and experts, are responsible for the strategy implementation and the evaluation of results by sector (energy, digital, life-long education)
- iv. The France 2030 committee, chaired by the prime minister, is responsible for monitoring the implementation and evaluation of the plan.
- v. SGPI, (*Secrétariat Général Pour l'Investissement*) is responsible for implementing the plan.

This structure is similar to the one created in 2010 to implement PIA (as discussed in Chapter II, pp. 4 to 8).

2. Specificities of France 2030 as a scheme

The official narrative is that the content of the plan was built based on a broad series of work sessions with actors from the national system of innovation – including the youth whose future stands at the heart of the matter. The plan also resulted from discussions with EU partners, Germany in particular. It seems though that if requests were sent to such a variety of players, the plan was thought of, designed and structured by the ministry of Economy and Finance with a final say by l'Elysée (the President's team). Regarding the funding, one principle is that the money must be raised from financial markets and, similarly to PIA, ring-fenced to make sure it is clearly used for the plan and not for other investments or operational expenses. Other general implementation principles are to make the processes simple, to trust actors on the field, including emerging actors as a priority, and to accept risk - adopting a “fail fast, learn fast” stance.

More specifically, the implementation operates in the following way. Public structures, typically SGPI (see above), release calls for expressions of interest or calls for projects in line with the strategic orientation of France 2030. Examples of calls aim at "support[ing] research and innovation in the battery value chain" or to "support[ing] a major reduction in national dependence on supplies of critical metals for strategic industrial sectors". These calls are drafted by ministries or SGPI and selected experts. Companies, public organizations (such as universities or public research organizations), or consortiums can bid on project proposals. Classically, selection committees choose which proposals will be allocated funds.

France 2030, as a plan, was discussed and voted on in the Parliament in 45minutes! President Macron having at that time a solid majority, the democratic process to discuss the plan, was kept to a minimum. Ex post, it looks like ex-ante concertation was seen as permission to skip a subsequent real debate in parliament. Yet, the president's speech when he presented the plan on October 12, 2021, was quite remarkable in articulating the context, the overall objectives and the resources allocated. The implementation of the plan calls upon the entities in place (SGPI, BPI, etc.). In a way, although France 2030 is not presented as PIA 5, it is worth noting how similar France 2030 and PIA initiatives are.

As far as assessing the relevance and impact of the plan, there are no visible results yet. More time is needed to say.

In short, France has a tradition of industrial policy to improve the performance of the industrial sector and to support its social and territorial cohesion. The French government had and still has a strategic role. The development of a nuclear and aeronautical industry typically results from the past French industrial policy.

The latest plan is called "France 2030". It was launched in October 2021. The funding is allocated by sectors and boundary objects. The budget is 34 bn€ for 5 years, coming on top of PIA4 (20 bn€).

V-French initiatives for NIIP: successes, failures and so so's

The French public policies for Industry have a track record made up of a series of failures, sometimes costly, and a few successes.

Looking back, the "dirigiste" years (the '60s) have generated a wealth of large groups. Some of them are competing today globally and stand among the leaders of their respective sectors. In that sense, this policy, the old way, proved to have had a positive and long-lasting impact – obviously at some cost but with significant returns. Nonetheless, there also were expensive failures such as "Plan Calcul" in IT or Concord in aeronautics, although Concord led to Airbus – a remarkable success.

In many ways, the years of such publicly supported (and to some extent planned) industrial development are gone.

Since the early '80s, a new policy (essentially NIIP) has been developed through a succession of tools, initiatives, programmes and plans with, say, mixed results. Indeed, despite such policies, the main result has been a hollowing out of the manufacturing industry through offshoring or loss of competitiveness that led to the closing down of businesses and plants. Yet, not all French NIIP-related policies failed. Here is a brief overall qualitative assessment of those initiatives stemming from assessment reports and interviews. The section below is far from being intended as a final say on the matter but essentially aims at pointing out those few initiatives that most probably brought something useful to the country.

Major policy initiatives for innovation & industry since

- *Fall 2021: France 2030 recovery plan (see above): 34bn€+ 20bn€ from PIA 4*
- *2017-onwards: Start-up nation: institutional rearrangements (e.g., BPI), VC, regulatory & cultural change*
- *2013-2017 CICE: tax relief/credit on employment social costs: up to 20bn€/year)*
- *2010 - onwards: PIA -Investissement d'avenir 57bn€ to date: public research funding*
- *2004- onwards: Pôles de compétitivité 0,5bn€/y : clusters funding business driven research in public labs*
- *1983-onwards: Credit Impot recherche (CIR): a tax credit for businesses*
- *1983-onwards: Cifre: funding PhD candidates' salary to conduct their doctoral research within a firm*

CICE: not really a success despite its cost- though with spillovers

Note that the CICE was not a NIIP initiative. CICE was set up following a recommendation by Louis Gallois (former CEO of Airbus and long-time Industry defender) who argued that French industrial companies were not in a position to invest in new equipment and innovate, essentially because the cost of labour was too high in France, leading to low profitability and thus lack of self-financing. Thus, he suggested an expensive tax relief (in fact a reduction of social cost on salaries between the minimum wage and 2.5 minimum wage. This missed the target on two counts. First, this was a horizontal measure that benefitted all firms, not just the manufacturing companies. Second, the workers in industrial and manufacturing were to a large extent paid more than the upper limit retained to keep the cost of the CICE affordable. In other words, the scheme was intended to help industrial competitiveness but turned out to simply give back part of the tax paid to private firms employing low-cost labour. In addition, assessment studies conducted on the impact of CICE showed no relocation of manufacturing. It appeared that most industrial firms used the savings on labour coming from CICE to spend on new product development and marketing. All in all, for a policy initiative that represented a burden of up to 20bn€/y on the national public budget, CICE cannot be presented as a success.

SME

The start-up nation: an ongoing success

In contrast, entrepreneurial activities in France took off through start-ups. This has led to some remarkable results after 2017. With 27 unicorns as of 2022 (ahead of president Macron's objective set in 2020 of 25 unicorns by 2025), something has happened in the country. For sure a unicorn has not reached 1b\$ sales. It reached a valuation of 1b\$. Valuations and turnover are not the same things. Yet, this result of 27 unicorns by 2022 when there were only 3 in 2017, means that something noticeable has indeed happened and come from nowhere. It takes decades to create an ecosystem for start-uppers, with an appropriate legal and regulatory context in place; red-tape drove down to a minimum; successful start-uppers who stayed in the country and became business angels to help and coach the new generations; Funds ready to invest at various stages of firms' development, successful entrepreneurs who became visible enough for the young generation to follow their path.

Achieving such an ecosystem is not straightforward. Many policy measures may lead to such a fertile context for start-uppers. Ministries in the French government make sure to be reachable by the 120 most promising start-ups identified every year. The idea is to provide help when they need it. This includes the president who spares no effort on the matter. The president votes with his feet travelling around the world to speak at tech conferences about French tech year after year. This also includes 53 correspondents in incubators and communities of start-uppers to facilitate their life when need be. This also includes "greater visibility through access to official French delegation overseas and help in connecting with public sector opportunities". Fast-track visas for non-EU recruits by the start-ups have been organized to grant residency for four years. This applies to founders and investors as well. The stock-options rules have been modified to help start-ups recruit talents without necessarily paying the highest salaries while filling the gap with stock options. BPIFrance has been called upon to serve the start-up community, providing funding at several stages of development, thus facilitating the rounds of fundraising with investors. "BPI has invested 20bn€ across sectors". As a result, BPIFrance estimates that they "contribute 18 to 19% of start-up financing in France, directly or indirectly through contribution to investment funds and other schemes. And BPI takes only 4 to 5% return on investment, compared to the 10% or more typical for regular investors". "While 50% state-owned, it is staffed by private sector experts".

The recipe for this Start-up Nation initiative is complex, but the overall cost is not necessarily high in terms of out-of-pocket spending, apart from the funding and backing of BPI. The rest is a matter of sincere commitment, dedication and cultural transformation by showing that it is possible to do things differently.

Cifre: a clear success as an instrument

This is about funding PhD candidates working on their doctoral research within firms. This is a small but very symbolic scheme welcomed by both the firms and the public labs – and the PhD candidates as well.

The cost of the scheme is rather small (about 60M€/y). Yet, the impact to bridge the gap between public research and firms, primarily in the fields of engineering, technology, and IT is quite significant. Paradoxically, this impact is not strongly visible because the Cifre scheme is distributed over 4000 specific contracts, with no or little communication. Nevertheless, it is a solid instrument that steadily pays off over the years.

If one envisions the prospects of Deep Tech (that is those technologies rooted deep in fundamental science), then one could imagine that the Cifre scheme could be a remarkable vehicle to set up collaborations between basic science in public research and Firms interested in, and capable of working in deep tech.

CIR (see above): "so-so": limited effect: a sacred cow for the business sector

As a tax credit (based on R&D spending), CIR intends to push private R&D spending up. To a certain extent, the scheme produced some of that. However, the amount of the yearly cost for the budget is high (about 6bn€/y) with not much in return. Politically, it would be difficult to cut it. Hence government officials will comment softly in private *"Well, it is probably relevant for SMEs much less for large Firms. Yet, firms are more taxed in France than in other EU countries. In a way, CIR is a way to compensate for the high tax by giving some money back"*.

In short, the objectives of the portfolio of instruments listed above were to decrease the cost of labour (CICE) and develop research and innovation in industries by improving links between public research and the private sector (CIFRE, poles de compétitivité, ...) while decreasing the cost of research for firms (CIR). Interestingly, the most impactful policy probably was the ongoing set of actions to promote entrepreneurial activities in the country.

Good Practices

CIFRE: a successful scheme

The CIFRE programme mainly covers manufacturing and industrial firms. It plays a specific role in linking academic research to private innovation in France. It thus addresses the divide between public research and Industry.

This programme is representative of the National schemes for Industrial Innovation set-up in the country.

A « Convention industrielle de formation par la recherche (CIFRE) » is a PhD funding programme that helps companies recruit doctoral students. The CIFRE programme is part of the R&D support whose overall objective is to increase the R&D effort of beneficiary companies. In addition, the CIFRE programme aims to contribute to the employment of PhDs by companies and more generally to promote collaboration between companies and public labs.

With the CIFRE programme, the French State offers financial support to any socio-economic entity (most often a private firm) established on the French territory that recruits a doctoral student to carry out a research project that will be part of / constitute the subject of the PhD thesis. The funding runs for three years. The doctoral candidate is entirely devoted to the research project, sharing time and effort between the employer and the academic lab. The research topic is negotiated among the three partners (the PhD candidate, the lab – typically the PhD supervisor – and the firm). Legally the PhD candidate is employed by a firm that can pay a salary beyond the Cifre public funding. As a result, the lab often views the PhD candidate as an additional researcher in the lab, as part of a collaboration with an external firm. In many cases, once the PhD is obtained, the firm offers to retain the new doctor. In that sense, the Cifre scheme also contributes to facilitating the hiring of PhDs in the Industry.

There are therefore four beneficiaries of this agreement: firstly the company that receives support from the State, secondly the research lab that welcomes a doctoral student properly funded, thirdly the doctoral student who receives a three-year subsidy for the PhD project and benefits from a dual academic and professional environment and training, and fourthly the economy that build up R&D capabilities in the private sector in close relations to public research. The State, therefore, subsidizes qualified jobs within these companies. In return for this research support received, these undertake to train, coach and pay the doctoral student and many times to hire the doctor upon completion of the PhD degree.

Description of the CIFRE programme

This programme was launched in 1981 when the divide between public research and Industry was identified as an issue.

The CIFRE programme was therefore born to create and strengthen links between public laboratories and private companies through doctoral students. Although there is no limit on the company's sector of activity, and the field of disciplines of Cifre doctoral students' theses, the research carried out by

these doctoral students is mainly in the scientific and technical field - i.e., in the physical sciences, engineering sciences and natural sciences - and contributes to the industry.

When a Convention CIFRE is awarded, the company receives a state grant of 14,000 euros per year and per CIFRE contract (amount in 2018). Each CIFRE convention is valid for 36 months (the recommended standard duration of a PhD in France) from the date of granting the support. These grants are paid quarterly during these 36 months and are not subject to VAT. Each year, the company is required to send a detailed annual report on the progress of the thesis work to the Agence Nationale Recherche et Technologie (ANRT: French national agency in charge of operating the CIFRE programme). The continuation of the CIFRE grant is conditional upon receipt of this report and its consistency with the initial CIFRE project.

The CIFRE grant is awarded on top of Crédit Impôts Recherche, Research Tax Credit, and CIR – see *infra*). As a result, the scheme is financially attractive for the company involved.

For example, a CIFRE doctoral student paid 23,484 euros per year (the minimum salary) generates 10,595 euros per year in CIR in addition to the 14,000 euros direct grant from the ANRT. For a salary of 23,484 euros, the overall cost of the employee's salary for the firm is 32,878 euros. Thanks to the Cifre grant and the CIR, the final cost of the PhD student is 8,283 euros per year. This is therefore a significant labour cost subsidy for companies enrolling PhD candidates via a Cifre and benefitting from CIR.

In the first years, there were less than 1,000 new CIFRE contracts each year. Since 2015, there more than 1,500 convention CIFRE allocated each year. The current stock of ongoing contracts is about 4000. Considering only the CIFRE grants (and excluding the additional possible deductions for CIR), the total amount of the CIFRE grant in 2018 exceeded 60 million euros for more than 600 companies.

Analysis of the impact of the CIFRE programme

Big companies are more likely to use the CIFRE programme, especially in the manufacturing sector. More than 80% of the conventions CIFRE lead to a publication in a scientific journal. More than 20% have a patent as an outcome. The main contribution is generally a prototype, new products or processes in the company. This programme has a strong value for developing innovation in the industrial field.

In short, the CIFRE programme is a modest but efficient scheme that kept growing over time. It is accompanied by positive effects on the professional life of PhDs. The Cifre scheme is most often used by companies that are growing.

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