

ONE PRINCIPLE AND SEVEN GOALS FOR INNOVATION

**Commission
chaired by Anne Lauvergeon**

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OVERVIEW

The Innovation Commission, composed of 20 varied personalities, was set up by the President of the French Republic on 18th April 2013.

In an assignment letter, the Prime Minister asked the Commission to select a limited number of strong goals, relying on major innovations, to ensure prosperity and long term employment in France¹. The objective is to stimulate innovation in all types of companies around long-term priorities. To do so, the Commission is convinced that dispersion and constant switching must be avoided to succeed.

Although innovation can be favoured by a voluntarist action from public authorities over time, like Airbus, it also arises from individual initiatives and answers to societal demands. The role of the State and regional authorities is to ensure that a favourable environment exists.

The Commission started by focusing on the context in which France evolves before defining a work method presenting the strategic innovation choices. To do so, it auditioned people with various backgrounds, received very many contributions and examined policies developed in different countries from open sources and embassies' work.

The definition of these choices relies on strong, growing, societal expectations – environmental concern, a more “individualistic” vision of the consumer citizen, increased individual responsibility, etc. – but also taking into account a complex international context – emerging markets' economic potential, increased life expectancy, growing urbanisation, probable tensions for access to drinking water, energy and raw materials, growing effects of climatic change. The world's frame of reference evolves: progress combines with notions of usefulness, frugality and consumer goods. The need for security increases whether concerning people, goods or information, in parallel to a will for health and wellbeing at every age. The innovations of tomorrow must answer society's growing needs and arrive at the right time. Failing that, they won't meet their market and will remain on the shelves.

To take the leap from what's possible to reality, France disposes of strong assets, although world competition is on the rise. The Commission's international survey revealed that many States are setting up targeted investment strategies to reach leading positions in certain fields. Disposing of strengths in one field is no longer sufficient. One needs to be at the cutting edge of innovation, display assets of excellence, convince of one's quality at the right time and attract the best talents within a competitive international context.

But France also has handicaps, with its cultural ecosystem and organisation that do not encourage innovation, which need to be worked on. Taxation, regulatory constraints, sluggish economics or simply over-cautiousness do not make innovators' lives any easier. This is not news. France is afraid to dare and take risks. Currently, it is the antepenultimate country in terms of industrial economic production in Europe.

¹ The Commission's work took place under the aegis of the Minister for Industrial Renewal and the Minister Delegate with responsibility for Small and Medium-sized Enterprises, Innovation and the Digital Economy.

On these grounds, the Commission suggests seven Goals to the Government:

Goal #1: Energy Storage – cf. pages 19 – 21

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The development of renewable energy, for the most part intermittent, the optimisation of electricity generation and the development of portability require disruptive innovations in storage systems. It is a vital element of any successful energetic transition. France has genuine assets with large and small companies that are well positioned on this topic and quality public research.

Goal #2: Recycling of Metals – cf. pages 22 – 23

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The increased scarcity and price of metals, and environmental protection also will make recycling indispensable, particularly as concerns rare metals. France disposes of genuine assets in a favourable European context. Innovation and an adequate regulatory framework can give rise to the emergence of leaders in this field.

Goal #3: Development of Marine Resources: Metals and Seawater Desalination – cf. pages 24 – 27

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The development of metals found on the seabed and less energy-intensive seawater desalination will bring indispensable resources to a growing population. France disposes of one of the most important marine exclusive economic zones and extremely competent research companies and organisations.

Goal #4: Plant-based Proteins and Plant-based Chemistry – cf. pages 28 – 32

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New food products based on plant proteins need to be designed to meet the increasing world food demands which the animal husbandry sector alone cannot respond to. The combined strengths of its agriculture, food-processing industry and culinary innovation tradition should allow France to dispose of important export potential. Also, its agricultural wealth should enable the development of new materials.

Goal #5: Personalized Medicine – cf. pages 33 – 36

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The development of “omics” sciences (genomics, proteomics, etc.), the growing links between medical devices and therapies and the development of digital technology will make a more personalized medicine emerge, fostering greater collective and individual efficiency, with adapted treatments. France disposes of genuine assets in this field with its internationally renowned quality healthcare and research systems.

Goal #6: Silver Economy, Innovation in the Service of Longevity – cf. pages 37 – 41

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Within 15 years, 1.2 billion inhabitants will be over 60 years old in the world. In France, the elderly will represent the majority of consumers. Yet, they have specific needs. A new economy will grow, answering their loss of independence, amongst other things. The French elderly being rather technophile, the centralised healthcare system, the academic skills, the presence of high level innovative start-up companies in both integration and equipment domains are as many assets for the development of this sector in France.

Goal #7: Promoting Big Data – cf. pages 42 – 45

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The multiplication of data created by individuals, companies and public authorities will foster new uses and productivity gains. The availability of public data, through the State and its operators, will be the opportunity for new start-up companies to develop. Yet again, France

displays numerous assets. The French mathematics and statistics school is one of the best in the world. Several French companies are leaders in some sub-sectors.

The Commission selected these Goals on the basis of several criteria, namely their ability to generate growth, employment and exports. They are at the convergence of major markets driven by assured societal needs and distinctive French skills. They require disruptive innovations and are a sovereignty issue for the Commission to make France a sustainable prosperous economic power. Lastly, they take into consideration disruptive technological evolutions such as the digital revolution or the impact of new materials with advanced properties.

In this context, the Commission's practice complements the "New Industrial France" project setting up 34 priorities defining industrial sectors' growth areas on today's markets. The Commission wishes to trigger, within ten years, French industrial leaders on an international scale, in specific fields, focusing assets on key directions.

These goals can rely on European consortia favourably. Indeed, they fully comply with the different societal challenges identified by the European Commission.

Such strategic effort must be accompanied by considerable reforms of the context in which companies evolve.

Recognizing that innovation is essential to economic success, granting a favourable welcome to novelty, simplifying procedures, encouraging experimentation, lightening norms, devoting a significant part of public procurements to innovative proposals, being consistent in public policies, promoting risk-taking and its corollary, failure, in the education system, etc., are as many measures that the Commission recommends to install in an innovation principle, balancing the precautionary principle. This principle, promoted to the highest level of the State, can be a driving force for an ambitious policy for the future, resolutely committed to it and show entrepreneurs that the State supports their initiatives.

The Commission recommends a rapid and concrete implementation of its proposals.

Each Goal presents specificities to create employment and wealth in 2025. This is why the Commission suggests **leverage adapted to each case**: innovation challenges, public procurement, equity acquisitions but also normalisations, precise regulatory simplifications, adapted training, experimentations, etc.

The Commission recommends **launching seven innovation challenges within two months**, open to all types of companies, to encourage creativity around the seven Goals defined above. Quick and simple, the first stage, known as the start-up phase, will select projects that can make a difference internationally. They will be granted a subsidy making their maturation easier. Particular attention will be paid to identifying entrepreneurial and motivated personalities. A second phase will provide adapted public and private funding to each of the more promising projects. The Commission will remain mobilised on the set-up of these innovation challenges, in order to launch a generation of innovators, setting out to conquer these seven referential markets.

To define each Goal's leverage, the Commission intends to continue discussing with companies, trade unions, civil society, administrations and the government.

The Commission's objective is to finish these two subjects within four months.

Lastly, it recommends the organisation of regular moments of discussion, without creating a new structure, gathering entrepreneurs, civil society representatives, scientists, trade unions,

politicians and administrations. As the first brick of the operational set-up of the innovation principle, such exchanges will aim to build consensus enabling to suggest legislative, regulatory and administrative measures necessary to the spreading of the seven Goals on the long run, beyond political differences. This will also allow international monitoring on these topics. This “consensus factory” will work closely with the General Agency for Strategy and Prospective (CGSP in French) and the Economic, Social and Environmental Council.

INTRODUCTION

Set up by the President of the French Republic on 18th April this year, the Commission's objective is to define innovation goals leading to activities creating wealth and employment. Small or large companies, alone or in clusters, will drive and carry them out. The industrialisation of the results of their works must occur in France.

Innovation is indispensable for France to be part of the global race in ten years' time and maintain its standard of living and social model.

Innovating more and better is possible in France. The French are creative. They proved it in the past with the invention of pasteurization and more recently, the chip card or even the hand transplant.

To win the challenge of France creating employment and exporting more, **the Commission chose precise innovation goals**, carrying meaning and a sense of collective belonging. Choosing is necessary in a more and more open world, where each territory, each region focuses on its strong points to reach excellence. Only clearly displayed priorities will create sufficient positive impact and bring decisive competitive advantage to companies.

These goals require **a clear and stable policy over a long period of time**, from now on. The 21st Century's strategic State must rely on civil society and companies. It must mobilise all leverage: regulatory simplification, financial support, public procurement, experimentation, training, diplomatic presence, etc. It must rely on regions' dynamism and their proximity with the SME network. Its means must adapt to the different innovation situations.

Indeed, innovation has a multiform relationship with the public sphere. It can require strong mobilisation over time to reach widely spread products; in this case, the State and regional authorities can trigger impulsion and coordination for great projects, such as Airbus. But, often, innovation also appears in an unexpected way from the buzzing of ideas in dynamic ecosystems, which public authorities must simply encourage. What made the difference in South Korea or in the United States in the mass development of digital tablets was the mobilisation of numerous innovating entrepreneurs ready to set out in this technological and commercial bet. Lastly, and this is obvious, innovation also exists without public intervention. It can also arise from new values such as frugality whilst presenting potentially considerable impact. In India for instance, a refrigerator running without electricity that can keep milk for three days, was designed for under 40 euros².

Whatever the type of innovation considered, France has little time ahead of it. 2025 is near. Even more so for companies, whose **production capacity in 10 years' time must be planned now**.

² Navi Radjou, *L'innovation JUGAAD*, Diateino, 2013

1. 2025, A GLOBAL CONTEXT

Numerous studies³ have identified some of the great evolution trends of the world and society in 2025, without claiming to be exhaustive.

Emerging markets, such as China, India or Brazil will have a major position in the next ten years. Asia alone should represent 50% of the world's gross national product (GNP)⁴ within fifteen years. Africa is also growing – over 5% a year for several years⁵ – and should provide many opportunities. Unless major upheavals occur (epidemics, military conflicts, natural disasters, etc.), in 2025, emerging countries should be both investors through their sovereign wealth funds⁶, consumers with standards of living gradually converging with those of western countries⁷ and innovators with a growing population of engineers and creators notably⁸. The innovation context will be even more competitive.

The world will experience even more exchanges. This situation will bear consequences, like the fast spreading of epidemics whose sanitary, but also economic, impact may be considerable. The trend of concentrating mass productions in areas where work costs are low should continue for certain goods and increasingly affect activities of design, R&D or high tech production. New responses to mobile needs must also be found in a context of rarefied resources.

Digital technology will continue to revolutionise companies and our everyday lives, transforming our relation to reality and making technologies' democratisation easier. More and more interactive communication means will be possible. **New multifunctional materials** with advanced properties will also hold a key role in the development of all industrial sectors. More generally, **technology**, ranging from the nano scale to the macroscopic one, will continue to make rapid progress, notably in **biology**, which could play a spreading role comparable to digital technology. Such evolutions suggest more important networking between agents from different universes, both technological and non-technological (designers notably).

In parallel, **life expectancy** will continue to grow⁹, **urbanisation** to progress and **household sizes** to decrease. **Supplies tensions** with an increasing world population¹⁰ and urban congestions will be more sensitive. Resource/consumption balances will be more unstable around the access to water or raw materials, which should favour the development of circular economy and change companies' way of functioning. **Climatic change** will also have growing consequences.

³ Refer to appendix 5, p.57, Other Elements of Information.

⁴ OCDE, *Perspectives économiques*, 2013.

⁵ FMI, *Perspectives de l'économie mondiale*, April 2013.

⁶ Asian sovereign wealth funds represent over 2,000 billion dollars. Source: Sovereign Wealth Fund Institute.

⁷ From 2020 onwards, around 300 million new homes belonging to the middle and upper classes, i.e. homes disposing of over 25,000 dollars a year, will exist compared to 2010, essentially in China and Eastern Europe. Source: McKinsey, *Global Forces: how strategic trends affect your business*, p. 14.

⁸ According to Gereffi and Wadhwa (2006), the number of engineers trained in China was close to American figures in 2007. Source: Frédérique Sachwald, *La Chine puissance technologique émergente*, IFRI, 2007, p.15.

⁹ By then, the over 65 year olds will be 1 billion on the planet, twice more than today. Source: McKinsey, *Global Forces*, ibid, p.7.

¹⁰ According to the UN, world population should increase by 1.3 billion individuals by 2030, ranging from 7 to 8.3 billion.

Added to this are societal evolutions.¹¹

An increasing part of world population will aspire to individual wellbeing and develop new values (relation to space, perception of the human body, notions of privacy, etc.).

Environmental preoccupations will be more and more widespread and accompanied by concrete effects guided by the idea that it is everybody's duty to do something to be efficient. This concern and demand for the planet will have an increasing economic impact¹² with the rise of green economy, short supply chains and circular economy, frugal consumption, self-sufficiency and a will for long lasting goods. The consumer-employee-citizen will be even more attentive to company ethics.

As individuals are more and more critical and their desire to change is high, their feeling of distrust of institutions will lead to the wish for individual action with the idea that each person is responsible for his or her future. This trend will be obvious in fields such as healthcare where each person wants to be more and more involved. This **individual responsibility** will echo the increasing requirement for transparency: it is necessary to find out by oneself to make one's own choices. In terms of consumption, this will also lead to the demand of more and more personalized products and services, even the emergence of "mass customisation", with the consumer taking part in the design of his product or service.

The notion of usefulness will be a priority in consumption choices. "To consume better" rather than "consume more" is a trend that has been on the rise since the 2008 recession. This will have concrete consequences in the choice of products but also in purchasing modes. With the same spending power, the disintermediation and desire to make things last will develop with the renewal of a barter and exchange economy.

Another strong trend is the **notion of frugality** in consumption and production. Innovation can arise by designing better with less.

In parallel, an **increased need for security** should manifest itself, safety of people and goods but also, increasingly of services, information and systems with the rise in power of digital applications. Facing this technological abundance, more and more ethical questions shall be raised.

Major innovations carried by French companies must meet society's expectations.

¹¹ Trends, of consumers notably, correspond to answers to fundamental needs (food, accommodation, medication, etc.). They are very slow and do not vary much unlike fashion.

The analyses presented here are from the BETC Worldwide study of July 2012, available on <http://www.dgcis.gouv.fr/politique-et-enjeux/innovation-2030>

¹² As an example, the market of low emission technologies should represent 1,200 billion dollars in 2030 according to McKinsey Global Institute, *Disruptive Technologies: Advances that will transform life, business and the global economy*, 2013.

2. FRANCE'S STRENGTHS AND WEAKNESSES

To win the battle of 2025, **France must act immediately**. Indeed, although France is the 5th world power today in terms of **GNP**, it is only 18th in terms of wealth per inhabitant¹³. It represents around 3% of world exports in value, with a downward trend¹⁴. In terms of innovation, the European Innovation Scoreboard¹⁵ categorises it as 11th.

Our great international competitors have already set up official or unofficial, targeted investment strategies¹⁶. China, South Korea but also the United Kingdom or Germany have precise goals in the matter. The idea of a strategist State is well present for our competitors.

Having strengths in a field is no longer enough. One must be at the cutting edge of innovation, convince of quality, put products and services on the market at the right time and attract the best talents in a competitive international context.

In this global context, France disposes of numerous genuine assets.

It can rely on internationally renowned **areas of excellence** such as the aeronautic and aerospace industries, the luxury, pharmacy, water and waste management, cultural, nuclear, touristic industries, etc. This concentration of knowhow is a major asset which must be further improved.

France's **productive make-up** is important with powerful groups and dynamic innovative SMEs. According to Bpifrance, in 2012, investments in R&D and innovation were on the rise despite the crisis¹⁷. France has numerous skills in cross-cutting technologies (complex software and systems, materials, micro and nanotechnologies, etc.).

French **public research**, awarded by six Nobel prizes and three Fields medals since 2005, is also of great quality, particularly in the early stages. Applied mathematics is a recognised field of excellence.

France's population is **highly educated**. French engineers are sought after for their ability to adapt, their generalised training and productivity. Another asset is employees' loyalty to their company, whatever their level of training.

Another strength is France's **youth**. It has the 2nd highest birth rate in Europe. In 2030, its population will be higher than Germany's, with a constant migratory policy. Such youth will bring new behaviours forth, related to deep-rooted societal trends. Historically, France is also a country of immigration. The land of civil rights, with its rich cultural mix, can find a second demographic lung.

Through its history, France also has the ability to develop privileged commercial relationships with high growth zones such as many French-speaking African countries and experiment the deployment of frugal innovations.

¹³ Respectively 2012 and 2010 figures (IMF source). The World Bank categorises France 25th in terms of per capita income.

¹⁴ Foreign trade results, Nicole Bricq, Minister for Foreign Trade, Bercy, 7 February 2013

¹⁵ http://ec.europa.eu/enterprise/policie/innovation/facts-fugures-analysis/innovation-scoreboard/index_en.htm.

¹⁶ These analyses rely on the consulting of different economic services of embassies, led with the support of the Foreign Affairs Ministry (cf. Appendix 5). A summary of the main elements is available on <http://www.dgcis.gouv.fr/politique-et-enjeux/innovation-2030>.

¹⁷ Bpifrance, *Rapport PME 2012- 2013*.

Lastly, France's environment is favourable to several extents. Rule of law in a peaceful continent, founding member of the European Union, its healthcare system and infrastructures (transport, water, energy, telecommunications, etc.) are renowned for their high quality. Also, metropolitan France has a temperate climate with few major natural risks. Its shorelines also constitute genuine potential.

However, innovating is a difficult path to follow today.

Taxation, regulatory constraints, sluggish economics or simply over-cautiousness do not make innovators' lives any easier. This is not news. France is afraid to dare and take risks. Currently, it is the antepenultimate country in terms of industrial economic production in Europe¹⁸.

France does not value the entrepreneur enough. Although the French word conquered the world, it has not convinced at home. Economic speech is difficult.

Although the role of public research is crucial, particularly to prepare for the more radical innovations, the studies of the Organisation for Economic Co-operation and Development (OECD) reveal that French research focuses too much on the high end of the innovation chain. Cooperation between the public and private sectors is not intense enough. Also, it occurs in a landscape marked by a multiplicity of aid devices, partnership research or technology transfer structures. There is no global clarity. Despite rather important public funding of companies' R&D, the private sector's share of French R&D expenses remains below the average of OECD countries. **Research and corporate worlds still work in silos too much**, each composing with its own priorities.

Our education system does not encourage risk-taking and stigmatises failure. It makes meetings between future technicians, traders or designers difficult. There is a pressing need to de-compartmentalise more and teach our youth the beauty of working together on the same project with different cultures and trainings. Added to this is youngsters' loss of interest for technical jobs, although they are recruiting. The quality of our higher education system is also put into question in various international comparisons.¹⁹

Investment capital also appears insufficiently developed in France compared to the needs expressed. In 2012, 6.1 billion euros benefited 1,548 companies in France²⁰, whereas in the United Kingdom, 14 billion euros were invested in 1,000 companies²¹. This situation is worsened by the limited funding capacity of public authorities in the long term.

Like in most European countries, the **French domestic market** is not large enough to pay off important investments but large enough to delay passing to export. Moreover, our markets are often mature (maintenance or incremental evolution markets) and present modest domestic growth. Companies must imperatively "play global" to grow faster and have a chance of becoming leaders. Although the French adopt new technology easily, paradoxically, they trust science and technology less than others, which corresponds to a growing refusal of risk, and even a certain reluctance towards change and preparing the future.

¹⁸ Eurostat data: comparison of industrial added value (other than construction) and total GNP.

¹⁹ As an example, France ranks 29th out of 65 in the PISA 2009 study in terms of mathematics and 35th in sciences 'Source OECD, Pisa 2009 database, table I.3.1., statlink : <http://dx.doi.org/10.1787/888932366921>).

²⁰ Source: French association of investors in growth.

²¹ Source: British Private Equity and Venture Capital Association.

Lastly, **France has created other handicaps**. Its taxation is penalising for whoever wishes to undertake business. Complex and changing rules surround the entire economic life and stifle innovation.

Given this reality, it is time to react.

3. CREATING A FAVOURABLE ENVIRONMENT FOR INNOVATION

It is important to undertake considerable reforms of the context in which companies evolve.

In this respect, the Commission pays tribute to the work of the Commission chaired by Jean-Luc Beylat and Pierre Tambourin²² concerning the improvement of the innovator's environment.

In-depth reforms in terms of mass education of entrepreneurship and innovation need to be considered. The innovations of 2025 will be the fruit of individuals who are in training today. So, it is necessary, whilst promoting courses' internationalisation, to fight the lingering perception that "life is elsewhere". Our education system must teach and encourage risk-taking and its corollary, failure. Experimentation, boldness, creation, project spirit must be encouraged. Training on innovative design methods needs to be developed, notably throughout professional life. Training courses must be organised to enable future engineers, salespersons and designers to mix. Design, for example, plays a crucial role in the development of innovative systems and the acceptance of technologies. Cultural and education evolutions are necessary for companies of various sizes and sectors to appeal to industrial design more. The Commission does not wish to make precise recommendations on this very broad topic, on which other works have focused. However, it is convinced that our education system itself must be innovative to reveal talents, trust them and boost confidence.

Concerning the State and local authorities, regions in particular, **their different intervention tools need to align, consistently, on the same strategy**: to win the battle for growth and exports. These tools are plentiful and can be as many assets for the growth of our companies if they are coordinated by a stable and renowned pilot, beyond political changes. Public authorities' general commitment, taking economic operators into account, is necessary on the long run.

²² Jean-Luc Beylat, Pierre Tambourin, *L'innovation, un enjeu majeur pour la France, Dynamiser la croissance des entreprises innovantes*, 2013.

It concerns all public initiative fields. Thus, as an example, the State creates standards; it determines tax policies and controls certain prices; it defines the migratory policy; disposes of a vast diplomatic network that it can mobilise²³. The State and regional authorities master public procurement and support. Regions know their SME network well. This leverage exists both on a national and local level. Regions can contribute to the specialisation of certain areas and attract talents and funding, like Grenoble did for micro and nanotechnologies or Toulouse with aeronautics. International recognition of such places, symbols of innovation and concentrating projects, would convey the image of a dynamic France positively.²⁴

A new way of conceiving standards also needs to be established to avoid over-complicating company life. It is important to carry on amplifying the simplification process without, in parallel, creating new norms presenting more constraints for companies. Norms must be proportionate to the various stakes, including economic ones. An impact assessment must precede any new regulation, legislative but also infra-legislative. “Company protection” must come alongside consumer, environment, publics at risk etc., protection. This is becoming a necessity to develop new economic activities in France.

The Commission advises adopting an innovation principle.

Innovation allows man to evolve continuously. It will be decisive to overcome upcoming challenges in an exacerbated competitive international context.

Yet, undertaking business in a new field, in which the absence of risks has not yet been established, sometimes leads to societal resistance and legal responsibility making it impossible to carry out the innovation in practise.

The Commission is convinced that we must re-learn to dare, accept risks and thus failures. Starting businesses, innovation, innovative SMEs, experimentation, boldness, innovative purchases²⁵, etc. must be stimulated and encouraged by all means. To do so, the Commission suggests acknowledging the existence of an **innovation principle**, at the highest level, balancing the precautionary principle, yin and yang of societies’ progress.

The State must show that it supports entrepreneurs’ initiatives and the development of a bold France, committed to the future and change. Our economy and thus our social system arise from our companies’ strength. This suggests the awareness-raising of public authorities but also of the civil society and media.

The innovation principle also comes out as the acceptance of risk in decisions to reach weighted choices but also as regular assessment that can limit potential negative consequences and amplify the set-up of innovations as initial risks fade. The Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST in French) could assess whether this principle was taken into account in public policies or not and compare French risk management with that of foreign countries.

²³ It could set up global agreements with international groups, favouring their development in France, or their subcontractors’, notably as a counterpart of the active support of the diplomatic network, like other countries have already organised.

²⁴ In this respect, the point of an initiative like the European capital of innovation, iCapital award, must be underlined.

²⁵ The Commission agrees with the recommendations of the “Practical Guide for innovation public procurement” published in April 2013 and recommends the implementations of its suggestions, via the creation of a social network.

The State and regional authorities must have an open attitude towards innovative proposals to favour this principle and lead to the emergence of original initiatives. The more systematic undertaking of responsible, targeted experimentations, decisions relying on collective expertise founded on the best international knowledge, pursuing studies in case of potential risks and looking for alternatives need to be encouraged.

It is also important to discuss the consequences related to innovation. There is no such thing as zero risk, whatever the activity. Our fellow citizens must know, apprehend and understand this risk to live with it. Aspiring to transparency must prevail. The Commission thus asks for the **opening of regular public debates**, allowing constructive discussions between technologists, innovators, scientists and citizens.

Lastly, it recommends defining **a pilot to monitor the stability of public authorities and companies' commitment over time, beyond political changes**. To meet this continuity need, it suggests organising regular discussions, without creating a new structure, gathering entrepreneurs, trade unions, civil society representatives, scientists, politicians, etc. As the first brick of the operational set-up of the innovation principle, such exchanges will aim to build consensuses and suggest legislative, regulatory and administrative measures necessary to the spreading of the innovation principle and the Goals presented by the Commission. This will also allow rallying all public policy tools and carrying out international monitoring of these topics. This “consensus factory” will work closely with the General Agency for Strategy and Prospective and the Economic, Social and Environmental Council.

4. MAKING CHOICES

The Commission suggests our country rallies on goals with strong economic impacts to come out of dispersion and “constant switching”.

Making choices is necessary in a more and more open world, where each territory, each region focuses on its strong points to reach excellence. Only clearly displayed priorities will create sufficient driving force and bring decisive competitive advantage to companies in a limited budgetary context.

To do so, the Commission identified and analysed the main technological and industrial issues to which our society will be confronted by 2025, based on varied auditions and numerous written contributions (cf. Appendix 5). It listened to prospective specialists, innovative company founders, scientists, union representatives, presidents of entities operating in fields the Commission is interested in, ministers, etc²⁶. It opened up to young students and/or entrepreneurs, those who will build the France of tomorrow.

²⁶ Most of these auditions are available online, <http://www.dgcis.gouv.fr/politique-et-enjeux/innovation-2030>

The Commission's work is pioneering. It is not a question of compiling a scientific roadmap, or building a programme of infrastructures. Nor is it a question of listing great generic themes but rather of stimulating innovation in companies.

All the elements gathered underline the fact that innovative systems go beyond the technological innovation field and concern activities traditionally qualified as industrial and services just as much. Digital technology durably irrigates all innovation fields, with a very fast evolution. Also, new materials play a crucial role in industrial development. The distinction between industry and services is finer and finer and the Commission has decided to discard it. The State, regional authorities, organisations themselves also need to change, making the most of societal and technical evolutions, in order to be more efficient.

The Commission relied on several criteria to choose.

- 1- Their innovations Goals have the ability to **generate growth, employment and exports in France**. This is a major criterion.
- 2- They must answer **deep-rooted societal evolutions** to be accepted and find a market.
- 3- They correspond to **sovereignty** stakes, in the sense that the Commission views them as essential to make France a sustainable, prosperous economic power.
- 4- They belong to fields in which France has **genuine assets**: high-profile scientific and technical skills, an entrepreneurial fabric able to get mobilised, composed of pioneering SMEs and large companies, the presence of a potentially consolidating company, important resources, etc.
- 5- **Major innovations, technological or not, are necessary** to meet these Goals allowing a paradigm shift to gain new markets durably.
- 6- Lastly, the State is even more legitimate in defining a strategy in terms of innovation when the field concerns the **action of public authorities** and can make it more efficient.

The Commission is convinced that the innovations answering society's expectations the most efficiently will result from **cross-cutting disciplines** and will constitute innovative systems combining several technological and non-technological solutions in the same product and/or service²⁷. The hybridisation between technological and services innovations, the convergence of societal trends and different sectors coming together are often success factors for new products and services.

Based on these criteria, the Goals selected by the Commission do not answer all of French economy's needs. It puts into practice what it encourages: taking the risk to choose.

²⁷ Autolib for instance associates technological and non-technological innovations on the charging modes, a new sales concept, insurance and parking payment.

The Commission has defined seven innovation Goals which must lead to employment in France and export abilities.

For these Goals to materialise, the Commission has set up, for each one of them, **action proposals adapted to each case**: innovation challenges, public procurement, equity acquisitions but also normalisations, precise regulatory simplifications, adapted trainings, experimentations, etc.

1. Goal n°1: Energy Storage – details pages 19 to 21

The development of renewable energy, for the most part intermittent, the optimisation of electricity generation and the development of portability require disruptive innovations in storage systems. It is a vital element of any successful energetic transition. France has genuine assets with large and small companies well positioned on this topic and quality public research.

2. Goal n°2: Recycling of Metals – details pages 22 to 23

The increased scarcity and price of metals, and environmental protection also, will make recycling indispensable, particularly as concerns rare metals. France disposes of genuine assets in a favourable European context. Innovation and an adequate regulatory framework can enable the emergence of leaders in this field.

3. Goal n°3: Development of Marine Resources: Metals and Seawater Desalination – details pages 24 to 27

The development of metals found on the seabed and less energy-intensive seawater desalination will bring indispensable resources to a growing population. France disposes of one of the most important marine resource exclusive zones and extremely competent companies and research organisations.

4. Goal n°4: Plant-based Proteins and Plant-based Chemistry – details pages 28 to 32

New food products based on plant proteins need to be designed to meet the increasing world food demands which the animal-husbandry sector alone cannot respond to. The combined strengths of its agriculture, food-processing industry and culinary innovation tradition should allow France to dispose of an important export potential. Also, its agricultural wealth can enable the development of new materials.

5. Goal n°5: Personalized Medicine – details pages 33 to 36

The development of “omics” sciences (genomics, proteomics, etc.), the growing links between medical devices and therapies and the development of digital technology will make a more personalized medicine emerge, fostering greater collective and individual efficiency, with adapted treatments. France disposes of genuine assets in this field with its internationally renowned quality healthcare and research systems.

6. Goal n°6: Silver Economy, Innovation in the Service of Longevity – details pages 37 to 41

Within 15 years, 1.2 billion inhabitants will be over 60 years old in the world. In France, the elderly will represent the majority of consumers. Yet, they have specific needs. A new economy will grow, answering their loss of independence, amongst other things. The French elderly being rather technophile, the centralised healthcare system, the academic skills, the presence of high level innovative start-up companies in both integration and equipment domains are as many assets for the development of this sector in France.

7. Goal n°7: Promoting Big Data - details pages 42 to 45

The multiplication of data created by individuals, companies and public authorities will foster new uses and productivity gains. The availability of public data, through the State and its operators, will be the opportunity for new start-up companies to develop. Yet again, France displays numerous assets. The French mathematics and statistics school is one of the best in the world. Several companies are leaders in some sub-sectors. The security of data and communications online also represents fertile ground for many companies.

5. PRINCIPLES FOR AN INNOVATIVE IMPLEMENTATION

To materialise, these seven Goals require a clear, long-term, stable policy. Their realisation also implies immediate collective commitment. 2025 needs to be planned today, particularly as concerns innovation.

Projects and personalities able to answer the seven Goals must be identified quickly.

First of all, the Commission suggests the fast launch, in December 2013 of **seven innovation challenges** in order to create the conditions for ideas to buzz. We need to create emulation around each of the seven Goals and mobilise creativity.

The calls for proposals emanating from these challenges will be open to all: small and large, French and foreign companies wishing to set up shop in France. The Commission's priority is to identify motivated entrepreneurs, and then accompany them in their project's development.

The process will be rapid and simple (cf. Appendix 4). A short application (ten pages maximum) will be addressed to Bpifrance within the framework of the Investments for the Future. The application will be examined by experts and an audition will take place in the following weeks. Financial support can be provided within four months.

This support procedure will remain flexible in its functioning, acknowledging projects' different maturities and providing adapted support. Risk taking will be key. There will be failures, but also long lasting mobilisation of public authorities around the more promising projects. These challenges aim to be a driving force among larger innovation support organisations (Invest for the Future Programmes, etc.). At the end of the start-up phase, public support will be granted, correlated to private funding.

The Commission also recommends **using all forms of public support over time** in ways adapted to each project and each phase of their development. In this respect, it encourages pragmatism according to projects and ambitions. Since each Goal is specific, it offers distinct leverage.

Lastly, the Commission would like the State, if necessary and when the time comes, to become a shareholder of the companies, in a sovereignty logic but also of involvement in results and risk-taking.

The Commission will remain mobilised on the key stages of innovation challenges' implementation:

- The Commission suggests validating the organisation methods of the innovation challenges and strategic follow-up.
- It can take part in the first choices of innovation projects, with the experts, in spring 2014, starting up its approach within the framework of piloting bodies.
- It suggests sponsoring each of the first projects. Each selected project will thus be able to benefit from, if it wishes to, a referent to discuss with during the start-up phase both on its project's development aspects and administrative matters. It also suggests organising the conditions highlighting these first projects with investors.
- It can take part in the creation of a pool of experts that will choose future projects. The Commission would like these experts to be of various profiles, reflecting the range of experiences it gathers. Other than representatives of administrations, investors, social science specialists, designers, industrials, scientists, etc., are necessary for a bold selection of received projects.

Leverage corresponding to each Goal must be specified.

To polish the implementation of these Goals, the Commission will **continue to exchange with companies, trade unions, civil society, administration and the Government**. To meet these seven Goals, collective mobilisation is necessary.

Goal by Goal meetings will be organised, until the end of 2013, to polish the leverage brought forward by the Commission. Each of these meetings will be driven by members of the Commission.

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The Commission hopes its proposals will inspire the State's actions and be the beginning of a strategy of innovative and targeted investments. To win the 2025 battle, it is important to start collective mobilisation now. Many companies anticipate their development and innovation cycle ten years ahead. Products and services of tomorrow are in the research and development projects of today.

SEVEN GOALS FOR FRANCE

In the course of its work, the Commission defined seven Goals which are detailed hereunder. Each Goal is accompanied by proposals of leverage adapted to each case.

Goal 1: Energy Storage

Energy storage, better development of intermittent energy and improvement of tomorrow's mobility.

Today, electricity production emits around 13 billion tons of CO₂ in the atmosphere a year in the world and transport emits 7 billion. The climate change induced by these emissions and the progressive reduction of fossil fuel supplies, that are less and less accessible, lead States and companies to look for new electricity generation and transport solutions. Thus, the European Union set the target of 20% of electricity to be from renewable sources in 2020, notably intermittent.

In parallel, vehicles' heat engines are to be gradually substituted by hybrid, electric engines, running on batteries or fuel cells. The aim is to replace half of the fleet around 2025²⁸. The number of mobile electronic objects will be multiplied by a factor between 10 and 30 over the next 10 years²⁹.

Energy storage devices are necessary to meet the increasing needs but also for the regulation of electric networks to face the growing demands, daily and seasonal, heat storage for domestic, urban or industrial ends, electric regulation of isolated areas... Companies and individuals in developing countries are often handicapped by power cuts between 2 and 70 hours a month: energy storage can be an alternative to buying generators.

Defining and implementing energy storage solutions has become a crucial aspect to stabilise electric networks and meet the new uses of electricity in a context of intermittent energy production growth. McKinsey estimates the market to be of 100 to 600 billion dollars a year³⁰, including 20 billion a year for stationary storage according to Boston Consulting Group³¹. This is a response to network operator's concrete need from 2020 onwards, a need it is important to anticipate due to the considerable time it takes for storage infrastructures to be operational.

²⁸ McKinsey, *Disruptive Technologies*, ibid. p.100 and following.

²⁹ McKinsey, ibid.

³⁰ Hypothesis of more than half of electric, hybrid or fuel cell vehicles.

³¹ Boston Consulting Group, *Revisiting Energy Storage There Is a Business Case*, February 2011

Numerous technological and industrial bottle-necks remain to lower costs and increase the performance of these systems. Current energy storage technologies are either mechanical (pumped storage hydroelectricity, compressed air storage, flywheel...), or electrochemical and electrostatic, or heat and thermochemical (sensible or latent heat), or chemical (hydrogen, methanation...). They provide solutions with variable production capacities and response times. Numerous innovative energy storage systems should provide less costly and more efficient solutions than today's and adapted to the multiple needs mentioned above.

The development of smart grids is a wonderful opportunity for storage systems with varied characteristics, whilst enabling optimal use of numerous types of storage, and thus reducing the need of capacities. It complies with one of the societal challenges pinpointed by the European Commission.

France's position in the energy storage field is **very competitive**. Indeed, it is in the top 10 with companies such as Alstom Hydro, Alstom Grid, Sevil, Alcen, Saft, Air Liquide, Areva, Saipem, Legrand, Bic, Axane, Saint-Gobain, GDF Suez, etc. EDF has been using pumped storage plants (STEP in French) for a long time. Alstom has 25% of the world's turbomachinery market. SAFT or Batscap, on electrochemical technologies, realise their production and part of their research in France. Several SMEs (such as McPhy or Levisys) develop innovative products: flywheels, electrode materials recycling, solid hydrogen storage, etc.

French public research also gathers all the required skills with the CEA (French Alternative Energies and Atomic Energy Agency), IFPEN (French Institute of Petroleum and New Energies), BRGM ((French Geological Survey) (notably for the storage in subterraneous cavities, aquifer heat or gas), the CNRS (French National Centre for Scientific Research), the Laplace Laboratory (Toulouse), etc.

The Avenia, DERBI, S2E2, Tenerrdis and Capénergies competitiveness clusters, and the IEED (Institute of Excellence in Decarbonated Energies), the Store-ex laboratory of excellence (electrochemical energy storage), STEEVE platform (electrochemical energy storage for electric vehicles) are as many examples of French agents' cooperation.

Several obstacles to develop energy storage remain, first linked to technological bottlenecks enabling low cost storage.

Energy storage systems are still too expensive to be genuinely competitive. It has been estimated that the cost of energy delivered by a Lithium-ion cell could lower from a factor 3 to 4 by 2025. To be attractive, electrical network energy storage must be less costly than electricity produced by thermal power plants used occasionally, that can also compensate an offer/demand unbalance³².

In parallel, the specificity of metropolitan France's network makes mass storage solutions less urgent than in other countries (Japan, United States). By lack of awareness-raising of storage issues, there is a risk of seeing this subject arise too late when our main competitors will have already set up solutions.

Lastly, like for any innovation, there are risks that need to be mastered (battery fires, STEP rupture due to natural risks, hydrogen explosions...).

³² According to the Electric Power Research Institute (EPRI) 2010, STEP and compressed air storage can store several gigawatts hour (GWh) for costs by kWh respectively between 250 and 430 \$ on the one hand and 60 and 125 \$ on the other.

Leverage proposals

1. Open an innovation challenge linked to local experimentations.

It is essential to promote **high level R&D programmes** to define **energy storage** systems and **prototypes** (batteries, stationary storage, etc.). Non-interconnected zones (ZNI in French) are very interesting experimentation fields. The State's support must be complementary to R&D calls for proposals, notably within the framework of the "Invest for the Future" Programme.

2. Clarify cost conditions of access to storage installation networks.

R&D's financial support does not seem sufficient for the deployment of energy storage solutions. It is also important to **clarify cost conditions of access to the network of storage installations**. Today, in France, only the producer is allowed to sell energy from storage and the services associated to storage are not recoverable.

More generally, there is great uncertainty in France about the role of producers, network operators and consumers in terms of electricity storage: is a storage installation a means of production, or network equipment like a transformer? Is it an additional device installed by the consumer like a generator? In accordance with article 6 of 7th December 2010 law concerning the new organisation of the electricity market (NOME), each electricity supplier must prove that he has sufficient means to cover his clients' peak consumption, increased by a reserve margin. It seems necessary to harmonise regulations on a European scale.

Two economic and regulatory ways appear: 1) to impose electricity storage obligations to intermittent energy producers; 2) to set up an economic model, giving profitability to storage devices, with probable new industrial agents.

In any event, the regulatory setting must be clear, stable and incentive for economic agents to position themselves on this market.

3. Develop public procurement.

Public procurement could also focus on thermal or energy storage devices in new areas, or public buildings. Within the framework of the shareholding State policy, public authorities could also ask public energy companies to present an innovation policy and animation of its SME ecosystem and give an account of it regularly at their board of directors.

4. Adapt regulations.

Several regulatory constraints need to evolve. As an example, obligations to purchase and associated prices, although beneficial to the structuration of the renewable energy production branch, must be reviewed to make room for storage without penalising production. For mass storage systems requiring the use of the public field, the principle of the call for bids for the renewal of concessions also puts a brake on investments, by not giving investors a long term guarantee. Finally, to make the integration of storage systems in buildings easier, a regulatory frame must be set up, providing guidelines to the industrials for their products' design.

Goal 2: Recycling of Metals

Recycling rare metals, a response to the scarcity of raw materials in keeping with the environment.

Recycling waste falls in line with two ambitions: to limit the environmental impact of pollution due to waste and facilitate access to resources that have become rare, and increasingly expensive to use.

Among the different dimensions of recycling, rare materials represent a particularly important stake, considering their market value and strategic character in terms of resources. Titanium, cobalt, vanadium, molybdenum, tantalum, tungsten, gold, silver, platinum, palladium, rare earth elements, etc, can be found in our everyday electronic objects. In June 2010, Europe published a report, “Critical Raw Materials for the EU”, which was concerned about the coming shortages of 14 elements qualified as “critical”: antimony, beryllium, cobalt, fluorine, gallium, germanium, graphite, indium, magnesium, niobium, platinumoids (six materials including platinum and palladium), rare earths (17 elements), tantalum and tungsten. Only 1% of metals used in high tech products are recycled. As a comparison, for nonferrous metals, end of life products’ salvage is of 20%.

Even if new deposits will be discovered and substitutes to rare metals sometimes found, the reserves of these metals remain limited whereas their consumption is growing. The price of rare metals should increase on the long run. In this context, waste represents a deposit of rare metals, whose volume increases, at approximately the same rhythm as consumption. Furthermore, exploiting these rare metal resources has the advantage of limiting soil pollution by them. Lastly, this resource is available on French land.

France has genuine potential. In Europe, the Germans are the waste processing champions. A company like Umicore in Belgium has important metals recycling capacity on a European scale. However, France disposes of real potential with global agents such as Véolia or Suez (SITA) and metallurgic and mining groups like Eramet or Areva.

The context is favourable to this industry’s development. In accordance with articles 3 and 4 of directive 2008/98/CE of the European Parliament and Council of 19th November 2008 relative to waste, France set up a plan to bring the rate of raw materials and organic recycling of household and related waste down to 45% in 2015. On 27th June 2010, France defined a plan for actions to secure its supply in rare materials, integrating a recycling aspect. The Horizon 2020 programme is also a strong opportunity for this goal that belongs to one of the six societal challenges identified for efficient resource and raw materials’ use. The European directive mentioned earlier can contribute to the birth of European consortia.

Technological barriers need to be raised. Several recycling processes exist (aqueous technology, electroslag refining processes, liquid metal extraction, pyrolysis oven...) but none are developed commercially. Indeed, several technological difficulties arise: low quantities of rare materials in electronics, separation of alloy rare materials, high costs, low yields, high evolution of waste deposits. Only Japan is truly active on rare metals recycling and manages to salvage 500g of gold per ton of treated electronic components.

Lastly, the entire recycling chain must be organised: products' eco-design, automatic waste sorting, extraction and separation processes and the taxation pertaining to it.

Leverage proposals

1. Make recycling part of materials' lifecycle and give it a positive image.

Rare materials' recycling needs to be anticipated as early as possible in products' lifecycle to make their extraction easier, in an eco-design logic. This evolution will make the image of recycling and this industry easier to promote.

2. Favour the deployment of regulations facilitating transformation rather than incineration/storage/dumping.
3. Launch an innovation challenge.

An innovation challenge could create emulation around this goal, with the idea of developing **R&D works but also prototypes** of rare materials recycling processes, to make processes more efficient and less costly. The support of the State must be complementary to R&D calls for projects, notably within the framework of the "Invest for the Future" Programme.

4. Promote exemplary public action.

The State's administrations and operators are important consumers of electronic devices. Well organised to ensure relevant sorting at an early stage, they can be eco-design prescribers. The State, setting an example, could also support companies who recycle the rare materials they have, notably via public procurements, imposing technical specifications on the rates of recycled materials.

5. Adapt taxation.

The *taxe générale sur les activités polluantes* (TGAP) (pollutant activities tax), installed by the 1999 finance act, relies on the "polluter pays" principle: damages caused to the environment by certain activities are not taken into account by market costs properly and can be subjected to specific taxation. Ecotaxes on electronic products, rich in rare metals, could be increased and paid via the ADEME (French environment and energy management agency) to recycling companies as grants for modernisation and innovation actions.

6. Develop diploma training courses in garbology.

Goal 3: Development of Marine Resources: Metals and Seawater Desalination

The sea's resources are considerable: oceans are estimated to contain 90% of hydrocarbons and 84% of rare metals. Offshore activities are spreading progressively. Today, marine wealth development has concentrated on hydrocarbons (30% of the production is offshore), wind turbine energy, fishing and aquaculture. Tomorrow, man will use marine turbine energy, ocean thermal energy, some ore; he will find resources to make drugs and produce drinking water from seawater.

Marine economy (including transport) represents an annual world turnover of 1,500 billion dollars, making it the second economic sector after agribusiness. Growth is estimated at 8% a year.

Developing submarine metals.

The development of marine mineral resources is in its early days (not including hydrocarbons). The known reserves of certain minerals that are critical for industry (zinc, tin, lead, copper, indium, gallium, germanium, platinoids, etc.) may have run out within 10 to 30 years if current consumption rates continue. China, for example, went from a consumption of 0.66 kg of zinc a year per inhabitant in 1996 to 3kg in 2010. The seabed certainly abounds in mineral resources superior to land resources; but currently only the surface deposits of the seabed are the subject of real attention; these are³³:

1) Hydrothermal sulphides, found between 800 and 4,000 metres deep. They contain copper, zinc and generally silver and gold, sometimes other metals. Exploring the 150 known sites and their potential use are at the heart of all stakes, due to their abundance of metals, their massive character and their depth which is not as important as the nodules'. The Nautilus project in Papua-New Guinea's exclusive economic zone (EEZ), which Technip ensures the engineering of, will teach us a lot;

2) Crusts, mostly made up of iron oxides and manganese, offer stronger economic potential when they are enriched in cobalt and platinum, and even rare earths. They are all located in the Pacific and notably in the French Polynesia EEZ. Their exploitation should not occur before 2030, due to the technological difficulties and insufficient assessment of relatively flat areas, the only ones favourable for collecting;

3) Polymetallic nodules contain iron, manganese, copper, nickel and cobalt. The Clarion-Clipperton zone in the North Pacific has been subjected to numerous mining permits. Despite very important R&D effort devoted to this subject since the 1980s, their exploitability still has not been demonstrated economically. France was granted two mining permits in the North Pacific.

France disposes of assured assets to seize market opportunities. Generally, marine exploitation requires highly advanced technology which France possesses, notably via its offshore oil experience. Technip is a world technological leader via the Nautilus project, whose pilot is a junior Australian company. More generally the skills of the DCNS (French naval defence company), the French oil services sector, IFREMER (French Research Institute for Exploitation of the Sea), BRGM and IFPEN or even the CNRS can be mobilised, like those of AREVA and ERAMET.

³³ *Les ressources minérales marines profondes*, Ifremer, 2011 ; and *Les ressources minérales marines* by Yves Fouquet, Annales des mines, April 2013

Lastly, France disposes of an 11 million km² exclusive economic zone (EEZ), the second largest maritime territory in the world. The Wallis and Futuna programme allows a first exploration of the French eponymous EEZ, through a public-private partnership associating Ifremer, Technip and Eramet.

However, to meet this Goal, seabed knowledge must be extended in order to identify the most promising ore zones. Technological stakes are also genuine: water pressure response, corrosion, necessity of remote controls, etc. Also, the potential exploitation must take into account the very rich animal biodiversity in the targeted sites with constraining regulations needing to be anticipated in this field. The International Seabed Authority (ISA or AIFM in French) has already set up regulations for international zones on nodules and sulphides. A text on crusts is expected.

Lastly, the increased development of seabed ore is identified as one of the strategic goals of the European innovation partnership for raw materials. The terms of this strategy will probably be used in the calls for projects of the European Commission's Horizon 2020 programme. Other than the French assets, identifying European partners is indispensable, notably to mobilise the necessary, important funding.

Leverage proposals

1. Develop innovative technologies for the exploration, use and treatment of minerals.

An innovation challenge should enable to develop efficient technologies in terms of local exploration, resource assessment and respect of the biodiversity, environmental survey, use and treatment of minerals based on public-private partnerships.

These R&D works should lead to the realisation of an industrial pilot for metal extraction from ocean ore, different from those used on land. The potential of part of the French EEZ could be used to develop an in site pilot demonstrating the different submarine exploitation techniques (definition of specific equipment, automation, remote controls, etc.).

A French participation in the Horizon 2020 Seabed Mining project also seems important.

2. Take an inventory of geological and biological resources available on the seabed.

A research programme needs to be elaborated and led, in particular in the French exclusive economic zone (EEZ), in order to compile an inventory of geological and biological seabed resources and their capacity of being used. These works will rely on innovative exploration technologies (cf. supra).

This programme must be led associating public research and private operators. The first step should be to undertake a detailed analysis of already gathered samples.

An in-depth study of the ability of very specific seabed organisms to support the use of their biotope's geological resources needs to be undertaken.

3. Reinforce French presence in the International Seabed Authority.

Seawater desalination at a competitive cost.

Population growth and the convergence of lifestyles between developing and western countries will lead to increased pressure on natural resources, such as water. Access capacity to quality drinking water will become more and more critical.

This is already the case in some specific geographical areas. The World Bank estimates that 40% of the world's population suffers from water shortage. The OECD estimates that between 2005 and 2030, the world population lacking water will range from 2.9 billion people to 3.9 billion people: 47% of humanity will be under water stress³⁴. Water will become a key resource and one of the major factors of supportable world growth.

Today, desalinated water volumes are around 70 million cubic metres per day, produced by 17,000 desalination plants in 120 countries. The sector's growth rate was of 10% over the last decade. In the next 10 years, this figure should double. More than half of the world's desalination capacity is in the Middle East.

Two technologies are essentially implemented³⁵: reverse osmosis (60% of plants) and distillation. In both cases, progress is necessary to lower energy consumption by 30 to 50% (seawater compression, water heating, etc.) and to develop or eliminate salt or concentrated brine. Disruptive innovations must occur to make desalination an economically competitive tool, notably by developing new technologies (biomimetic or nanostructured membranes, direct osmosis, pre-treatment, etc.). Several countries in the Mediterranean area, the Gulf, Asia, like China or India, California or even Australia have undertaken to take up this challenge.

France is well positioned in this area. Although it doesn't have important desalination facilities on its land, it has a strong export capacity. The two world water leaders are French, Véolia and Suez Environnement, and master desalination technologies. The International Energy branch of GDF Suez also holds a leaders' position in the Integrated Water & Power Projects. Other than that, a fabric of SMEs works on this topic. The Polynium SME for instance, is positioned on membrane design. Public R&D is also of high quality, notably at the Institut européen des membranes (Montpellier) (European Membrane Institute), the CEA, the group for research on thermal chargers.

However, difficulties remain. The offer is too "turnkey" orientated and not positioned enough on equipment. Other economic models could be invented. Competition is high, particularly in Asia, when markets are essentially export-orientated. The main markets are located in the Middle East in the short term.

Salt discharge, lowered energetic consumption, require important R&D works. Another issue concerns membranes that aren't sealed totally. Sensors must be defined to identify and measure emerging pollutants.

Also, behavioural changes and resulting demand changes can have considerable consequences in terms of environmental quality requirements.

³⁴ OCDE, *Environment Outlook for 2030*, 2008.

³⁵ DGCIS, *Technologies clés 2015*, DGCIS, March 2011.

Leverage proposals

1. Support innovation through R&D.

An innovation challenge must be launched to encourage new ideas to reduce desalination energetic costs and develop the use of concentrated brine or limit the effects of its discharge on the environment.

These projects must associate public and private research agents. The public authorities' financial support must go up to the prototype.

2. Set up a demonstrator of low cost seawater desalination in France.

3. Rely on economic diplomacy to support our national champions' export effort.

The main markets in terms of seawater desalination are in exports for French companies. Local and national public authorities must present a consistent strategy to facilitate these new technologies' export and our national champions' positioning.

Goal 4: Plant-based Proteins and Plant-based Chemistry

New food products, developing plant protein consumption.

According to the UN's estimations, the world's food consumption should double over the next twenty years, with under-nourishment already affecting 2 billion people today. The increase of the world's population associated to the evolution of food diets in developing countries, notably in Asia, making them closer to European habits, raises a genuine sustainability problem: to produce 2kg of chicken flesh, the animal needs to consume 3.2kg of plant proteins and for 1kg of beef flesh, 8kg of plant proteins.

The UN also holds that the world's agricultural production would need, to meet demand, and with constant technologies, to increase of 70% by 2050 to feed the 9 billion inhabitants. Very important increase of agricultural production is a necessity when its growth slows down.

In parallel, particularly in western societies, it will be important to meet the needs of "better" consumption, "frugal" consumption and environmentally-friendly production.

This is the challenge: to produce more and better in respect with the planet in an increasingly constraining context (less input, less water, less land). The necessary reinforcement of livestock farming and the meat transformation industry will not suffice to face the world's protein demand. Consequently, it is important to make products, such as soya, lentils, algae, attractive to the consumer today³⁶.

³⁶ One should anticipate that food evolutions and in particular the acceptance of plant proteins will differ according to geographical areas, and cultural constraints.

In this context, the Commission would like French industrial leaders to get mobilised **to develop new, attractive food products, based on plant proteins**, able to make food behaviours evolve and provide a sustainable human and animal food solution, employment in France and export capacity. It is also possible to consider new food for livestock farming.

France has genuine assets to develop this additional recourse to the plant protein branch. With a **strong favourable climate and powerful agriculture**, France is well positioned to meet this goal. It has a variety of raw materials on its lands and important transformation potential. The agrifood industry represents 3% of French GNP with world leading companies. 670 billion euros of farm and food products are exchanged throughout the world. France has the 5th best world turnover for export in 2012, with over 42 billion euros. Furthermore, France is **internationally renowned for its know-how in terms of quality gastronomy**. French agribusiness is also **one of the safest in the world**, despite recent scandals. Finally, France disposes of quality public research with a great number of competent organisations (Inra, (French national institute for agricultural research) Cirad, (French agricultural research organization working for development in the South and the French overseas regions), Irstea (National Research Institute of Science and Technology for Environment and Agriculture), Ifremer, Inserm (French National Institute of Health and Medical Research), universities, etc.) and a network of technical institutes sharing knowledge with companies. It is the country that will know how to make its eating habits evolve, more than any other.

However, **several difficulties need to be solved** for this Goal to reach its potential.

The agrifood industry sector is very fragmented with 98% of companies with fewer than 250 employees. The means devoted to R&D and innovation are very limited whereas research fields are considerable (green biotechnologies notably). The challenge relies on an ability to get organised collectively to encourage disruptive innovations. In terms of world export, France has considerably pulled out since 2004 when it rivalled the United States until the early 2000s. Today, it is behind the Netherlands, Germany and Brazil and is followed closely by China. Although French companies dispose of structural advantages, reaching critical size seems to be what's missing today to be able to invest, innovate and export.

From the consumer's point of view, in developed countries, and in France in particular, transformed products are distrusted, far removed from the "natural" aspiration that is part of our society's well-established trends. A feeling of anxiety can also appear facing the multitude of information on the subject. Beyond that, the development of plant proteins suggests a strong change in consumers' behaviour, which will probably occur in countries where food needs are more urgent and cultural barriers less considerable. This constraint may seem more limited in the case of animal feed which is another vector for plant protein-based diet development.

Moreover, youngsters are not attracted to the agrifood sector, which experiences recruitment difficulties, including for technology transfer and innovation jobs.

Leverage proposals

1. Encourage innovation with an innovation challenge.

Agrifood companies do not innovate sufficiently and disruptive innovation is rare. Launching an innovation challenge has been suggested to encourage ambitious projects for the nutrition of tomorrow, like the Eco-Trophelia competition. **R&D and prototypes** of new products must be developed. Synthetic biology and marine resources (algae, aquaculture) progress will be taken into account. The expected projects will be consortia projects preferentially. The State's support must be complementary to very significant R&D calls for projects, notably within the framework of the Invest for the Future Programme.

Also, answering the difficulties to accept new food products, these **R&D projects will integrate design and marketing specialists as soon as possible.**

2. Develop public purchase to enhance innovation acceptance.

Culinary education encourages the acceptance of new food products and new means of consumption. National and local public authorities are important prescribers in terms of food purchasing through administrative restaurants and school canteens. Turning the Semaine du Gout (Fresh flavours week) into the week for food and culinary innovation could also contribute to this.

3. Experiment new animal feeding methods based on plant proteins.

4. Adapt and simplify regulations.

Several aspects of agrifood regulations could already be simplified (ICPE - inspectorate of classified installations - etc.). Additionally, administrative authorisations to start a production unit should be notified quicker.

In terms of disruptive innovation, it is important to allow scientists and industrials to dare and innovate. A first principle could be to regulate more on proven risks, particularly in terms of animal feeding. An authority could allow case by case experimentations within a controlled framework. A right to experiment needs to be acknowledged if we want to see the French agrifood industry strengthen and become an economic asset.

5. Open a public debate about the nutrition of tomorrow.

Food-related innovations are subjected to suspicion. However, innovation is a necessity. The importance of “producing more” and “producing better”, which is in accordance with environmental demands, need to be presented to citizens in a serene scientific framework, allowing them to grasp this theme. The potential in terms of economy and employment is unknown today, as is intensive farming's ability to operate in an environmentally-friendly way.

Plant-based chemistry, for new materials

In a context of hydrocarbon dependency, with a 69 billion euro energy bill in 2012 and probable tensions on resources in the next decades, white or industrial biotechnologies are a positive solution that could reduce our energy dependency and find sustainable raw materials. **The challenge is to partially get rid of fossil fuels without creating strong tensions on food use.**

Indeed, white biotechnologies aim to transform materials through biological agents (fermentative or enzymatic processes). Means exist to position France on new molecules' development, impossible or very difficult to produce from fossil raw materials, and put them on the market. Thus they will have very high added value. They will enable to set up efficient processes with a favourable environmental impact by reducing energy and material consumption, using lower functioning temperatures, eliminating dangerous products or reducing pollutant and waste discharge. They may encourage better social acceptance of the chemical industry through this reduced environmental impact and human health impact. The world market experiences constant progress and is estimated at 300 billion euros in 2015³⁷. In France, plant chemistry could create 35 to 45,000 jobs and make 1.5 billion euros of export turnover. Plant chemistry also offers vast applicative market perspectives such as healthcare, eco-industries, energy, biopolymers, etc., from different biomass sources³⁸. Synthetic biology could give rise to new biomass sources.

Facing this evolution, France has **significant assets**. It has quality scientific research with applied organisations (ARD, Toulouse White Biotechnology for instance) and laboratories involved on more fundamental subjects such as synthetic biology, which can design and build new biological systems and mechanisms. Several industrials have invested in the subject (Roquette, Téréos, Proteus, Metabolic Explorer, Deinove, Global Bioénergie, Fermentalg, Sofiprotéol, Solvay, etc.) including 4 groups among the 50 great world agents. On top of these industrial assets, France also has strong agro-industries.

However, **several obstacles** to this development remain.

Plant chemistry's reality is complex and multidimensional. It depends on the type of biomass used – according to the different plant materials used, to their yield per hectare, their availability -, the manufacturing processes and technologies and the accepted level of complexity in input (raw materials) and in output (mono or multi products).

The sector remains compartmentalised. Its development will depend on its ability to integrate the technologies at stake in an industrial ecosystem optimised to use bio-resources in their entirety and rationalise costs. Generally, chemical industries and materials are closely connected in the material's transformation chain and their prospects down the line. They depend on the French industrialisation degree.

³⁷ PIPAME Study, *Mutations économiques dans le domaine de la chimie*, February 2010.

³⁸ Using cereals and sugar is far more mature than wood, straw or algae.

There is genuine competition. World scale groups like Cargill, Dow, DuPont, Ajinomoto, DSM are present on this subject. Other countries bring important public support like Brazil, the United States and to a lesser extent China and Germany³⁹. International alliances, European ones in particular, will be welcome to combine skills, R&D, supplies and distribution networks.

The resource availability problem and the question of competition between land uses must also be raised.

Leverage proposals

1. Launch an innovation challenge leading to prototypes.

The objective is to invent new processes that can produce chemical products currently of fossil origins, at competitive costs, from the necessary R&D to the optimisation up to the demonstration stage. The innovation challenge will be complementary to existing R&D calls for projects, notably the “plant chemistry” AMI (Call for Expressions of Interest) of the Invest for the Future Programme.

2. Introduce demanding norms to push demand.

Common standards on the European scale will favour the emergence of a market of a sufficient size.

3. Maintain competitive energy price for industrials.

The price of energy is an important component of these processes’ costs.

4. Ensure a regulatory environment comparable to those of foreign countries, and stable over time.

5. Relax the European regulatory framework on public support to fund industrial units.

Prototypes are indispensable to reach industrialisation and processes always need to be improved, to optimise the functioning of reactors.

6. Improve the image the general public and students have of the “chemistry and materials” branch.

The chemical industry is viewed as a risky and pollutant sector. Students are not attracted to process engineering or materials science jobs. The trade and public authorities can rely on the sustainable character of plant chemistry, to promote its image. Leading public debates will contribute to the public’s adhesion to industrialisation projects in France.

³⁹ McKinsey, *ibid.*, p. 22

Goal 5: Personalized Medicine

The healthcare system in the broad sense represented 11% of GNP and 2,500,000 direct jobs in 2005⁴⁰. It has contributed positively to the French trade balance since 1981, through drugs notably, and has a knock-on impact on the entire society, bringing security and better collective health. The Académies des Technologies (National Academy of Technologies of France) estimates that this sector will represent 15 to 20% of our national wealth in 2030. This forecast is based on both ongoing scientific evolutions that will revolutionise the way of considering care, the ageing of the population, leading to the necessity of help and particular follow-up, and the increase of new chronic pathologies' prevalence.

This situation means our healthcare system must be redesigned in the near future. Indeed, the mass needs that will appear, when western healthcare systems' costs are already high, will lead to a new conception of innovation, linking technological novelties and frugality.

Treatment and care in 2025 will be very different from what is known. It has already been acknowledged that medicine will personalize its diagnosis according to each individual's own characteristics, notably his or her genome. Drug or surgery interventions will be adapted to the specificities of each patient, thus reducing the cost of care on the scale of a society. The individual and his own characteristics will, more than ever, be at the heart of tomorrow's medicine with a strong reduction of risks associated to treatment. The relationship with doctors will evolve; a certain number of acts will be performed by the patient himself. For instance, mobile imaging at home will be a reality making a patient's continuous follow-up from a distance possible. A considerable amount of surgical interventions will be avoided and will be programmed when unavoidable. A patient's therapeutic compliance will also be better controlled. All of these evolutions may be behind a reduction of healthcare costs and public health gain.

The fields of application of this new way of treatment are vast: chronic diseases, neurodegenerative and sensory ailments, cardiovascular illnesses, cancer, diabetes, respiratory diseases, transmissible diseases, independence and dependence issues etc. The first developed products will probably be at the origins of norms and standards.

This evolution relates to three main factors: the development of "omics" sciences, with genomics at increasingly low costs⁴¹, narrower links between drug therapies and medical devices and the integration of digital technology's potential in medicine.

This ongoing revolution will foster wealth in terms of long-lasting employment⁴² and exports. On a world scale, McKinsey estimates the economic impact of the evolution of genomics on health to be between 500 billion and 1,200 billion dollars per year in 2025. Around 80% of this figure would arise from the ability to make life longer through the easier detection of diseases and therapies' personalization. As for medical technologies, they represented a world market of 206 billion euros in 2010, Europe being the main prospect (95 billion €) in front of the USA (68.5 billion €) and Asia (24.5 billion €)⁴³. France is the 4th world market behind the USA, Germany and Japan.

⁴⁰ Source: « La place de la santé dans l'économie française » by MM. Charles Pilarski (Insee) and Alexandre Bourgeois (DREES), 2008.

⁴¹ McKinsey, *Disruptive Technologies*, op. cit, chapter 7 « Next-generation genomics », p. 86 and following, 2013. In 2003, the first human genome sequencing cost near 3M\$ and took 13 years within the framework of an international scientific collaboration. Today, it would cost around 1,000\$.

⁴² As an example, the Sorin Group's employees increase by over 10% a year for several years in France.

⁴³ Source: Eucomed, *The Medical Technology Industry in Europe*, 25 May 2011, p.18.

It is also a sovereignty subject in terms of public health. But currently, over 70% of the French medical technologies market is imported from Europe (with Switzerland and Germany in the lead) and the United States⁴⁴. Conversely, France's trade balance is positive as regards implants, a growing field.

Lastly, this revolution is strongly integrative of other technological evolutions. Several technologies such as the ICT (Big Data, robotics, etc.) and nanotechnologies (nanocomponents, etc.) now impact medical technologies more and more, thus leading to their mutation: distance communication with medical staff, home care, improvement of a patient's post-implant follow-up, etc. It also answers the questions raised by silver economy.

This is why the Commission is convinced of the importance of a strong goal in terms of **personalized medicine relying on the one hand on “omics” sciences, synthetic biology, high resolution imaging (tissue, and even cellular level) and Big Data, and on the other hand favouring targeted therapeutic interventions whether pharmaceutical or interventional by imaging.**

Facing this challenge, **France has genuine assets.**

The quality of its healthcare system is renowned worldwide. France also disposes of excellent efficient research, which produced between 4.4 and 5.2% of world publications in 2010, according to disciplines (microbiology, immunology, cancer research...), and 4.2% of American pharmacy patents. There are narrow and efficient links between scientists, doctors and engineers. The hospital system and clinical research are recognised for their competence.

More specifically, regarding “omics” sciences (new generation genomics, transcriptomics, cellular metabolism analysis, etc.) and imaging, the excellence of the French mathematics school will be of reliable support for the promotion of data gathered. World renowned organisations, such as the Pasteur Institute, also possess the first biobanks necessary to the formalisation of personalized medicine. In terms of targeted therapeutic intervention, France can rely on an academic abundance around the ESPCI (Industrial Physics and Chemistry Higher Educational Institution), the Institut d'optique, the Ecole Polytechnique, the medical faculties, etc.

France's industrial presence on these topics needs no further introduction. France has the world leaders in orthoses, implants, etc., which explains why the trade balance as regards implants is already positive. It also disposes of a very dynamic fabric of start-up companies. Carmat, Supersonic Imaging, Pixium Vision are examples of them.

Personalized medicine can rely on the power of public healthcare cover and the role of the mutual insurance system. The latter in particular will be able to facilitate the experimentation of new devices.

Experimentation possibilities, on a local level, are facilitated by the efficiency and involvement of regional authorities. Opportunities also exist on a European scale where healthcare has been identified as a societal challenge.

⁴⁴ Sorin Group estimation.

However, **several difficulties need to be solved.**

The first one is that genomics, a new discipline with many things to discover, already disposes of influential players. It also implies high risk to reach a new stage and disruptive innovations.

The industrial fabric that is able to answer this personalized medicine goal is highly fragmented. 94% of French medical technology companies are SMEs⁴⁵. The emergence of leaders supporting the development of start-up companies constitutes a real challenge for companies to gain critical size and come out of niche markets. Poor coordination between different research teams is one of this sector's weaknesses today.

Other more societal difficulties need to be overcome. The generalisation of genome sequencing and avatar creation raise numerous questions, both ethical and of security. The Supreme Court of the United States decided on 13th June 2013 that "natural" human DNA could not be patented. Another question relates to the ownership and use of the gathered data. Our fellow citizens have genuine fear of losing control of the human being. This calls for debates and answers.

Conversely, such fears reinforce the weight of the precautionary principle on the development of this sector. This is particularly present in France. Furthermore, one notices a certain cautiousness to reimburse innovative solutions of telemedicine or telediagnosis. The involvement of the national social security system is necessary to build an economic system around these technological revolutions. To the initial limited additional costs, substantial savings and an improvement of treatment will succeed. This over-cautiousness does not help large companies get involved and leads the start-up companies to bear the risks.

Several regulatory constraints also have a negative impact on personalized medicine's development. Furthermore, the State being involved with healthcare industrials to underline its strategic character and define investment priorities with them is necessary.

Leverage proposals

1. Reaffirm the strategic character of healthcare industries.

The constitution of a political relay facing healthcare industrials' challenges appears necessary to facilitate the development of companies and their ability to export. It is important to think of healthcare as an industry and not only as a cost centre.

2. Launch an innovation challenge.

It is a question of organising an innovation challenge with targeted initiatives to solve precise problems, articulated with existing R&D calls for projects, notably those of the Programme d'investissements d'avenir ("Invest for the Future" Programme).

⁴⁵ Pôle interministériel des prospectives et des mutations économiques (PIPAME), (French Inter-ministerial Centre for Forecasting and Anticipating Economic Change) *Dispositifs médicaux : diagnostic et potentialités de la filière française dans la concurrence internationale*, 2011.

3. Create a personalized medicine virtual institute, coordinating different local initiatives.

A great diversity of local initiatives around start-up companies and doctors exists today. These constitute founding bricks towards the deployment of personalized medicine. The strength of these initiatives is their spontaneity and their energy. However, on a national scale, flexible coordination could be set up, and even an incentive to make small medical instrumentation and imaging companies group to reach sufficient critical size.

First, it is important to help the sector get organised and create a medical technology pole. This virtual institute could support local initiatives, facilitate their maturation, coordinate them, ensure their recognition and facilitate experience sharing.

4. Facilitate innovative experimentation with regulations.

A first simple act consists in carrying out article L 165-1-1 allowing to experiment new treatments. This regulatory evolution should have been applicable for several years now.

In parallel, like for the other Goals, it is important to give regulations a dynamic of vigilance, but not blocking. If genuine ethical subjects exist and if, of course, innovation represents a risk, notably for the patient, the innovation must not be muzzled, but supervised. This is why a right to supervised experimentation must be carried out.

Decisions regarding healthcare are very slow today. Organisations are numerous (national social security, ANSM (French National Agency for Medicines and Health Products Safety), etc.) and the responsibilities of each one hard to identify.

To favour the development of this Goal, a process recognising personalized medicine disruptive innovations could be considered, like what the FDA considers. A pre-approval frame could be set up; more frequent and anticipated discussions between healthcare industrials and public deciders could be considered.

5. Mobilise the healthcare system financers and in particular the French Mutuality.

6. Establish European norms and standards favourable to “European” personalized medicine.

Other than the simplification of the French authorisation of drugs and therapies administrative environments, it is important to develop common standards on a European scale allowing the deployment of technologies linked to personalized medicine on a market of a sufficient critical size.

7. Give financial support to innovative start-up companies and SMEs by public procurement.

There is a fabric of start-up companies in France today which finds, with more or less ease, answers to their initial financial needs. The most important difficulties in terms of finances appear at the 3rd round and thus concern needs in development capital. Although strictly speaking, public authorities find this challenge difficult to address, they could however fortify young French companies’ first referencing through public procurement.

8. Organise the conditions of regular public debate.

Goal 6: Silver Economy, Innovation in the Service of Longevity

In 2025, globally, population should be healthier and live longer than today. Although infectious diseases will remain predominant in developing countries, in emerging countries the adoption of standards of living similar to those in developed countries (smoking, high fat diets, obesity and lack of exercise) will lead to the generalisation of certain diseases that are not directly transmissible.

Also, in 2030, one French person out of two will be over 50 years old; 30% of the population will be over 60 and 12.3% over 75 according to Insee (French National Institute of statistical and economic information) figures. But, according to a May 2010 study, “Les Seniors, une cible délaissée” (Seniors, a neglected target) of the Centre de recherches pour l’étude et l’observation des conditions de vie (CREDOC) (Research Centre for the Study and Monitoring of Living Standards), the elderly will ensure the majority of expenses (54%) on different markets from 2015 onwards including 64% of healthcare, 56% of insurances, 57% of leisure and 58% of household equipment expenses.

This situation questions current solidarity funding models but also opens numerous goods and services markets to meet the elderly’s specific demands whether they are active, losing their independence or dependent.

On average, the elderly have a more favourable financial situation than the rest of society. Those over 60 dispose on average of income that’s 30% higher than the rest of the population. Their income was multiplied by seven in 20 years. In France they withhold 60% of household wealth and 75% of stock portfolios. Lastly, they represent 54% of household expenses. Yet, between 1990 and 2020, the number of under 50 year olds will have increased by 1% in the European Union while the number of over 50 year olds will have increased by over 75%. The silver economy market could increase of 0.81 GNP points around 2040, reaching 2.4% of GNP.

The elderly have specific needs, which are not well covered by mass consumption goods, and high aspirations for differing projects (organisation involvement, sports, travels, household equipment), quality of life demands, lifestyle and prevention of ageing. 30% of internet users are over 50 years old today and 27% are online shoppers. The over 50 year olds have a real appetite for new technologies. The economic revolution started by the seniors concerns all companies.

This part of the market will be subjected to high growth in the years to come partly through consumption goods, but also in terms of prevention, prolonging of independence and home care⁴⁶. It’s on this second section that this Goal is positioned, even if the boundary between both categories is sensitive.

⁴⁶ According to the *New waves of growth* study written by Accenture, silver economy could bring 46 billion pounds to the United Kingdom by 2020, a 2.5% GNP increase over this period and an additional 1.3 million jobs.

In 2040, the over 60 year olds will be part of the 4 million people who are over 80. Currently prescribers and family helpers, half of them will be weakened and dependent but better informed and properly equipped: today's active seniors, having seen their parents grow old, will have anticipated their own dependency and organised their personalized home care. The other half will constitute a new, valid and dynamic population at a very advanced age expecting great consumer products and services offers that are innovative and adapted to their needs.

By encouraging the younger seniors to anticipate their ageing, public policies would improve prevention which delays the loss of autonomy, encourage individual equipment decisions (notably at home) at a stage where the individuals are still financially independent. This would allow a more positive discourse on ageing and avoid stigmatisation. As an example, social and intergenerational links can be strengthened thanks to ITC making communication between seniors and their relatives easier within the framework of private and sociocultural activities. In another framework, professional service robotics can offer distance interventions and examinations, assistance to the person lacking autonomy in his or her rehabilitation and/or personal life, etc. Also, domo-medicine, via continuous and direct follow-up of vital parameters, the set-up of tests at home, will strongly improve prevention and regular medication-taking. Bio-markers proper to each great pathology and behaviour and environment sensors will be able to identify risk situations or those announcing a pathology.

This implies the development of an industry around personalized health data, access to it and treatment to help diagnosis, preventive care, personalized therapies (cf. Goal 5) even the development of a new form of public health policy. Promoting such data with Big Data agents should facilitate the development of relevant applications for users. It is also a question of a technological offer to build with the development of sensors, actuators, care-providing robots, systems integrating these various objects, etc.

France can meet these new needs of home care customisation via domotics, e-health, a new relationship between general practice and hospital medicines, etc.

It has a technophile aged population that can try out an important number of solutions. The centralised healthcare system (social security, insurances) can quickly become an important deployment strength. Academic skills are present and talents recognised. A few innovative start-up companies exist like Aldebaran in humanoid robotics or Robosoft offering a passive tele-presence robot. There are also high level practitioners, integrators and equipment suppliers (EADS, Thalès or EDF) that can provide integrated solutions. An industrial leader like Legrand is a major group today on a world scale in the domotics domain and especially remote assistance. Several insurers and great retirement home groups are also currently positioning themselves on the silver economy theme.

Robotics is well established in France with over 200 companies in the Midi-Pyrénées, Rhône-Alpes and Ile-de-France regions and a "Cap Robotique" (Robotics plan) community. The robotics market is expected to double between 2012 and 2015.

Genuine opportunities can also emerge on the European scale where the theme of “Health, demographic change and wellbeing” was identified as a priority by the European Commission and where several European agents are complementary of French companies.

Several constraints must not be eclipsed.

Several solutions, whether technological or not, targeted on people who are gradually losing their autonomy, exist today and struggle to reach their objective due to the users’ rejection. The latter view them as stigmatisation and refuse to use them. A positive discourse on the prevention of dependency and help of home care is necessary to enable the acceptance of technological solutions and visibility of potential markets to encourage investments.

Also, the fact of relating these technologies solely to dependency situations makes the financial equation extremely difficult. These are supported by the national solidarity system and families of the dependant person when he or she must be subjected to a more important number of treatments. Anticipating the equipment in the senior’s environment could spread out costs at moments in life when the person can afford such expenses. It would also avoid the national social security system being handicapped by such costs and thus not being able to fund large-scale experiments and implementation.

International competition is genuine. Companies such as Philips or Siemens are well positioned in terms of medical devices. However, they tend to introduce the hospital at home rather than consider a new way of living with a dependency. There is room for French companies who rethink product acceptance, design and personal life while being dependent rather than care. Between 1,500 and 2,000 companies in the world focus on service robotics as their activity. The main rivals are located in eastern and south eastern Asia (Osaka) with the development of “humanoid nursing robots” in Japan for example. The United States design exoskeletons that can provide mobility to disabled people.

In France, the industrial and service branch around silver economy subjects is not formed. There is no great structuring leader yet and many SMEs have critical size problems. Our companies face several challenges including that of going from an experimentation stage – there are numerous e-health micro projects for example – to a real industrial stage. Technology transfer between academics and industrials needs to be reinforced. Aware of these difficulties, public agents (regional authorities, economic development agencies, higher education and research establishments, etc.) support the creation of Living Labs orientated towards the design and assessment of solutions for seniors⁴⁷.

The development of continuous follow-up of vital parameters, for example, imposes the development of individual-based databases in terms of health. This medical data management associated to care technologies must occur in complete safety (cf. Goal 7, Promoting Big Data).

Lastly, with the development of personal service robotics, a new law field will open up to establish responsibility rules associated to using these new machines.

⁴⁷ Such as, for example: Autonom’Lab (Limousin), LUSAGE (Hôpital Broca – Ile-de-France), Humanité (Université Catholique de Lille, Nord), Active Ageing (Champagne Ardennes) and soon I2ML (Languedoc Roussillon).

Leverage proposals

1. Go from experimentation to industrialisation of healthcare solutions for seniors via innovative public procurement.

Currently, due to their lack of visibility, these markets remain particularly risky. The offer in robotics, e-health and domotics could widely be supported by public authorities via public and para-public procurements, since these agents are currently important prescribers. This initial referencing could bring security to SMEs concerned by these markets but also visibility that would facilitate their products' acceptance. It is important to mobilise the financiers of the social protection system.

2. Organise an innovation challenge to support disruptive R&D.

Disruptive innovation as regards robotics and domo-medicine is long and costly. It presents a genuine risk. So, we suggest launching an innovation challenge to encourage ambitious R&D projects leading to prototypes. The expected projects will be consortia projects essentially, regrouping agents being one of this field's needs. The State support must be complementary to R&D calls for projects, notably within the framework of the Programme d'Investissements d'Avenir ("Invest for the Future" Programme).

Also, answering the difficulties to accept these new products and bearing in mind customer consideration, these **R&D projects will integrate design and marketing specialists as soon as possible**.

3. Elaborate marketing adapted to this new target.

The marketing approach of silver economy markets is complex. In western societies, the image of ageing reflects social withdrawal, conservatism and physical and mental degradation. It is difficult to build a positive discourse. Seniors also develop paradoxical behaviour: they refuse to be stigmatised, but claim to have specific aspirations and needs.

This is why marketing effort needs to be particularly developed. It could rely on a label of solutions fostering quality and security warranties for customers.

Similarly, to modernise the image of silver economy, **making constituted living labs visible and networking** around the integration of assistance technologies on home-dependency prevention could be realised in the short term. This would accelerate the spreading of technologies integrated to the home by taking the opposite view of importing the hospital at home, which is often what our older fellow citizens fear. These living labs could assess, medically, economically, and in use, these solutions and their acceptance by real users. The "LLSA forum" initiative, covering the wider field of health and autonomy, prefigures such networking.

4. Build European normalisation favourable to companies' development.

Robotics is booming, but regulations are not yet defined. This also applies to medical-social technological systems, despite the recent involvement of specialised international organisations (IHE, Continua Alliance).

Globally, normalisation works concern industrial robotics more than service robotics, the administrative workflow from the home caring activity rather than care processes themselves. Norms proposals and active lobbying could favour European companies on this growth market.

5. Create a simple tax framework favouring fast amortisation of robotics and solutions adapted to ageing.

France could inspire itself from the policy led in Japan with its Abenomics⁴⁸ revival programme that enabled the fiscal facilitation of investments' amortising in the robotics field. Such a device could concern personalized service robotics in particular.

⁴⁸ Japan developed the Abenomics revival plan that supports investment in terms of humanoid robotics.

Goal 7: Promoting Big Data

After over two decades of very important productivity gains in companies, information technologies have, since the early 2000s, essentially benefitted consumers, with the mass adoption of the Internet, social networks and e-commerce. These new uses gave rise to giants such as Google, Yahoo, Facebook or Amazon, to name only the greatest, and led them to gather more and more considerable quantities of data (search engines, targeted advertising, data usage, etc.). Existing technologies, like relational databases, turned out to be unable to deal with such quantities of data, so these companies had to develop their own technologies to store and treat these data. This is Big Data.

Also, new usages have appeared related to the development of smartphone applications, especially in transports and mobility. This evolution highlights the emergency, for the digital sector, to dispose of general interest data developers, like the statistics that public authorities have. This is what is called Open Data. Other types of data, detained by private or parapublic players are also essential to the development of new uses like electric meter consumption data or information about bike car parks in Vélib type systems. This is not open data though.

The use of these big data, which companies and public authorities dispose of, fosters new applications and huge **competitiveness gains** in fields as varied as health (health insurance system's management, genomics, epidemiology, etc.) the environment, agriculture, banking/insurances, culture, tourism, online advertising, marketing, research, education, economic or demographic studies, customer relationships... Emerging projects such as "smart cities" or "smart grids" will generate a lot of information which will need to be managed in real time.

The ability of companies, individuals and smart objects (robots, man-machine interfaces, connected smart objects, sensors,...) to use these huge quantities of information in a relevant way is an even more important challenge when this data from sectors far removed from a company can be of utmost importance to it (for example, detecting the propagation of an epidemic in real time via search engine queries). These new methods of data treatment will also enable the increase of automation, reacting faster but also better knowing one's customers.

Using these data is an undeniable economic challenge of the years to come. McKinsey estimates that in 2025, big data will represent 5,000 billion dollars a year. Applications will be multiple and concern all industrial fields. The French added value of this branch is estimated at 4.8 billion euros in 2010 with around 7% growth a year, but with a far higher impact on all economic sectors, and notably by progressive “merchandisation” of databases (Massive Open Online Courses, for example).

Such technological change meets deep-rooted societal trends. The consumer citizen wants to have access to more and more information to decide by himself. He also requires more and more personalized information, adapted to his own case. The extracted information must be personalized to answer a precise need: treat your own illnesses in terms of your own genomes and living habits, learn according to your profiles and ambitions, define your personal risk profiles, etc. Such offers must also scrupulously respect individuals’ private life. The challenge is not only technological but also legal and regulatory to combine corporate competitiveness and innovation capacity with respect for privacy.

Other than the previously mentioned companies’ competitiveness challenges, this sector also has **sovereignty challenges** on national security data (cyber security) on the one hand and the use of big data potential in the administration on the other. It is also a question of giving small companies an efficient international access, to enable an expansion as quick as might be effected in the United States, and, to develop French supply on a global scale.

Facing the economic challenges that big data promotion represents, the Commission is convinced that France needs to master this challenge by 2025. Different time scales exist. Part of the evolutions will be incremental and cannot be considered here. Ruptures with R&D effort on a longer time scale can be considered in parallel.

To do so, France can rely on several strong points.

The French education system trains general engineers with a very good mastery of maths and statistics, necessary to algorithms that can treat huge amounts of heterogeneous information. The French school of mathematics and statistics is internationally recognized as one of the best in the world and our students are sought after. French public research also presents a high level of excellence in this regard.

France hosts several international level companies, especially in the Internet of Things field (Withings, Sigfox, Parrot, ...), that are as good as any competitors, or companies like Critéo, one of the world leaders in the targeted advertising field, of a very significant size already. Several large groups are leaders of sub-fields (Dassault Systèmes, Gemalto, Ingenico, Morphosytèmes,...). A dynamic ecosystem of start-up companies exists in France around this subject. Competitiveness clusters of the ITC field, fostering public private co-operations, such as Systematic, Cap Digital, Images & réseaux or secured communicating solutions, are a focus point of this ecosystem.

The young innovative company statute is particularly relevant in this field.

France has a pioneering tradition, with the CNIL (French data privacy commission), in personal data management. With balanced regulations, our country could become the land of usage innovations in the big data field.

Lastly, a large amount of data is available on a national scale and only asks to be used, the French state being structured around a centralised organisation.

Big data promotion in France faces several difficulties.

It is important to invent innovative solutions (in-memory databases, new treatment architectures, real time analysis, automatic learning methods, new data modelling models, etc.) and economic models around this data. The question of access to funding for the growth of companies in the sector is fundamental.

Facing this big data, debates abound. It is important to ensure both data **security** and **accessibility, privacy protection** and **freedom of use**. Thus, the treatment and use of digital information must not harm privacy and personal freedom. Other than files containing personal data and that in France are controlled and moderated by the CNIL, everyone leaves digital traces with which we can gather information about him or her: Internet searches, online orders, etc. Recent affairs, like the American NSA's PRISM cyber surveillance system, reveal the fragile frontier that exists between respect of privacy and the necessity to dispose of advanced technology (cybersecurity) to fight against terrorism, paedophilia etc. Personalisation of services, like the appearance of targeted advertising banners on the internet present added value both for the internet user and the seller, but relies on data collected on pages viewed by the user. The aggregation and/or anonymity of data are crucial. In most cases, it is not necessary to obtain nominative information. Beyond this, the question of data ownership must be raised.

Although internationally accepted regulations appear to be necessary to proscribe the surveillance of individuals beyond any legal framework, these must not become an *a priori* ban of technologies in France, which would stop French companies from experimenting and promoting new uses.

Leverage proposals

1. **Open public data, made anonymous, to favour the creation of start-up companies and create ecosystems in France via the development of certain uses for commercial ends.**

This measure, already adopted in Great Britain notably under the terms "open data" is free for the State and can allow companies to know markets better. All sectors and infrastructures are concerned: healthcare, energy, transport...

2. **Change the scale of French companies by launching big data stocks development challenges.**

France, through its centralised tradition, disposes of very important data stocks (INSEE, administrative data, social security, etc.). It is a question of launching development programmes by licences of five "stocks" of big data whose analysis can bring added value to all our society: **employment agencies, social security, national education and higher education and support to touristic promotion**. Other development challenges like smart management of energy can also be considered by public authorities related to the economic world.

By its massive character, using big data is an essential objective for companies taking part and constitutes a valuable reference. Also, the development of public data will reinforce public action efficiency through the “smart” use of the huge stock of data that the administration disposes of and new analysis possibilities may be found.

Occasionally, the State can also intervene by supporting the development of big data start-ups, often capital intensive in early stages.

It is also important to promote start-up companies that create and accumulate their own data. These companies will have a decisive competitive advantage and capture an essential part of its market value.

3. Create the right to experiment.

The duration of the traditional approach (regulation and control administration) is not adapted to the cycle of new usages that develop through technologies. A right to experiment must be recognised, and monitored by a “data observatory”.

It is important to not legislate on this theme in a generic way. Data usage is sector-specific and needs a case by case approach. This method could be progressively widened on the European scale so as to, when possible, build common, European-scale regulations.

The Commission thinks it is possible, via a sector-specific approach and by usage type, to define relevant legislation and regulations. It is important to take the time to observe the development of new usages before legislating. The example of the trust relationship between banks and users proves that it is possible to have a win-win approach in the personal data management field, but certain systems like user profiling for advertising should be managed in a specific way.

Similarly, it is indispensable to impose an economic impact study before any legislation on this subject is written, in order to preserve the balance wanted between innovation, competitiveness and respect of privacy.

4. Create a technological resource centre.

A dedicated “technological resource centre” could contribute to considerably lowering the barrier to entry that the very complicated technologies of big data represent and thus reduce the time to market of start-up companies, maximising their chances of becoming world leaders.

It would be a question of providing innovative agents with software tools, statistic or mathematic methods, big data sets or massively distributed calculation infrastructures, allowing the very rapid set-up of new uses founded on big data technologies. This technological resource centre would be open to everyone (start-ups and large groups) and everyone could contribute to it.

5. Reinforce Big Data SMEs’ export ability.

The French market is too limited to ensure long-term growth to Big Data’s young companies. Passing to export must occur quite rapidly. To do so,

- Large groups could be incited to assist SMEs in their international deployment;
- Public authorities could target their interventions in this particular sector and provide the information needed about existing tools (VIE - international voluntary programmes -, Coface, etc.).

APPENDICES

APPENDIX 1: LETTER OF ASSIGNMENT TO THE COMMISSION

The Prime Minister

Paris, 18th April 2013

Madam,

In this constantly changing world marked by increased technological and economic competition and the appearance of new needs, many countries are getting organised to dispose of companies able to meet the challenges of the societies of tomorrow, stimulating innovation today in areas defined as priorities.

Renewing with the anticipation approach which enabled the rise of our industrial champions, the Government launched, during the Council of Ministers on 30th January this year, an ambitious, renovated industrial policy articulated around three axes:

- Support to existing industrial branches, by setting up partnership agreements within the Conseil National de l'Industrie (national council for industry);
- Consolidation of emerging industrial branches, so that France will dispose of, within ten years, skills and reference companies in fields such as energy and environmental change, the digital sector, healthcare, nutrition or safety, whose importance is always on the rise;
- Reinforcement of our companies' industrial advance, encouraging and supporting innovation projects answering our society's essential needs of 2030.

In order to give body to this third axis, I would like to entrust you with the chair of a commission of qualified people, the "Innovation 2030" Commission.

Taking into account global competition landscapes, sustainable development imperatives and our lifestyle changes, this commission must identify and analyse, working with the General Agency for Strategy and Prospective, the main technological and industrial stakes, which our society will be confronted to, and select sectors and technologies in which France must acquire top level knowhow to maintain its competitiveness. Naturally, you will privilege activities creating the most value and employment on our territory.

In order to stimulate our companies' creativity as regards these industrial challenges, whose mastery represents a genuine economic long-term challenge, I have decided to implement, at the beginning of the year, a disruptive innovation programme, through the investments for the future, endowed of 150 million €, that should trigger the most promising projects and accompany them during all development phases. Such funding aims to be largely completed by private funds.

Before the end of July, you will send me proposals of such industrial challenges which you find to be of priority for our country's future; calls for proposals will then be

launched by the General Agency for Investment, in order to make those who take up the challenges emerge. Each project shall be accompanied up to its industrialisation.

You will also formulate recommendations concerning the set-up of long-term accompaniment strategies, mobilising all public tools, in order to reach the various projects' objectives. Lastly, you will ensure the follow-up of these recommendations and will regularly give me feedback on their progress.

The "Innovation 2030" commission's works will be led under the aegis of the Minister for Industrial Renewal and the Minister Delegate with responsibility for Small and Medium-sized Enterprises, Innovation and the Digital Economy, and in close collaboration with the Minister for Higher Education and Research. In addition to the other ministries concerned, you will associate with the General Agency for Strategy and Prospective's director, the General Agency for Investment's director and the general director of the Public Investments Bank. The ministry of Industrial Renewal will provide you with a State Engineer of the Mines to assist you in your works. You can rely on the services of the competent administrations, which I asked to help you to fulfil your assignment.

Yours sincerely,

Jean-Marc AYRAULT

APPENDIX 2: COMMISSION MEMBERS

Chair

Anne LAUVERGEON

Members

Philippe AGHION

Jacques BIOT

François BOURDONCLE

Philippe BOUYOUX

Jean-Louis CAFFIER

Alain DEMAROLLE

Nicolas DUFOURCQ

Mercedes ERRA

Mathias FINK

Claudie HAIGNERE

Jean-Claude LEHMANN

Didier LOMBARD

Thierry MANDON

Jean PISANI-FERRY

Pierre PRIEUX

Alain ROUSSET

José Alain SAHEL

Michel SERRES

Henri VERDIER

Reporters

Aurélie FAITOT

Benoît LEGAIT

APPENDIX 3: THE COMMISSION'S SELECTION APPROACH

The Commission collected many agents' opinions.

It auditioned prospective specialists, innovative company founders, scientists, union representatives, presidents of entities operating in fields interesting the Commission, ministers, etc. It opened to young students and/or entrepreneurs, those who will build the France of tomorrow.

These auditions, a great number of which have been made public, concerned the vision of 2025, markets, France's strengths and weaknesses. They allowed the Commission to perceive ongoing trends on which the innovation of tomorrow must rely to meet the market but also identify and analyse the main technological and industrial challenges to which our society will be confronted in 10 years' time. Throughout this work, the transversal challenge of the digital revolution and materials was raised. Also, the Commission is convinced that the innovations that will answer society's expectations the most efficiently will result from cross-cutting disciplines and will overcome the traditional distinction between products and services.

The Commission then selected seven Goals based on societal and economic criteria. This process can be illustrated through the following matrixes.

TABLE 1: ANSWERS TO SOCIETAL EXPECTATIONS

	Environmental Concern	Longevity	Urbanisation	Supplies	Usefulness, Better Living, Simplicity	Individual Responsibility	Frugality	Need for Security
Energy Storage	X		X	X	X	X	X	X
Recycling of Metals	X		X	X		X	X	X
Development of Marine Resources	X			X				X
Plant-based Proteins and Plant-based Chemistry	X	X		X	X	X	X	X
Personalized Medicine		X			X	X	X	X
Silver Economy	X	X	X		X	X	X	X
Promoting Big Data			X	X	X	X		X

TABLE 2: IMPACT OF GOALS FOR FRANCE

Selection Criteria	Ability to Generate Growth, Exports and/or Employment.	Response to Societal Change⁴⁹	Sovereignty Challenge	France's Scientific and Technical Assets⁵⁰	France's Industrial Assets	Major Innovation Potential	Public Action Leverage
Energy Storage							
Recycling of Metals							
Development of Marine Resources: Raw Materials and Seawater Desalination							
Plant-based Proteins and Plant-based Chemistry							
Personalized Medicine							
Silver Economy							
Promoting Big Data							

The intensity of colour is proportionate to the answer to each criterion.

⁴⁹ This criterion is a weighting of the results of Table 1 (above).

⁵⁰ This criterion was set up from French agents' patents and publications on connected fields.

APPENDIX 4: FIRST FINANCIAL SUPPORT TO THE SEVEN GOALS: IMPLEMENTATION PRINCIPLES

Via the Investments for the Future, the Government has decided the implementation of an initial 150 million euros support for projects meeting the Goals within the framework of a “disruptive innovation” action.

150 million euros are both a lot and not much. This envelop is a first stage that must trigger the launch of first projects⁵¹. This programme must have a lever effect resulting in the multiplication of private funding and other forms of subsequent public support, including non-financial. An innovation policy targeted on growth sectors requires significantly more important budgetary means over time. A strong signal would be to announce an increase in financial support to these Goals via other State financial support.

Projects’ support must occur over time, making out two stages: the start-up phase where a broad call for proposals must trigger a buzz of ideas (i) and the risk reduction and development phases that must select the more promising projects and accompany their evolution (ii). The public authorities’ intervention will not be the same in these two stages. All projects do not have to follow this linear path.

For a triggering effect to exist, the Commission suggests a specific timeline and using the first 150 million euros envelop in the following way.

The start-up phase.

- 1. Seven calls for proposals are launched before the end of 2013 to target several dozen projects per Goal.**

Similar calls for proposals will be set up regularly.

These calls for proposals are open to companies, large and small, French and foreign, wanting to set up shop in France. The process will be rapid and easy. Entrepreneurs must describe their major innovation project in ten pages maximum. They will explain to what extent their project fosters innovations that can make them stand out favourably internationally whilst presenting its credibility. There will be no other additional criteria beyond the response to the Goal. Formalism will be as light as possible.

- 2. Selecting applicants beyond projects.**

No funding will be granted without auditioning projects’ applicants. This will allow the identification of entrepreneurial and motivated personalities.

The Commission will be mobilised on the organisation of the selection process.

⁵¹ In particular, several Investments for the Future R&D calls for proposals enabled us to support projects on themes of the different goals chosen by the Commission.

3. Rapid selection and agreement of projects at the first trimester of 2014.

The selection of start-up projects will be decided by the General Agency for Investment, after a proposal from the steering committee associating the Commission. Each project will be the subject of an agreement between the company and Bpifrance. The State commits to taking a financing decision and agrees with the applicant within one month after the call for proposals closes. Subsidies granted throughout this first phase will be lump sums.

Risk reduction and development phases

4. A thorough selection of projects ready to go from start-up to development.

After the start-up phase, the selected projects but also others that will enter this phase directly won't all be able to enter the risk reduction and development phases. It is important to filter these projects coherently, whilst being bold and ambitious. Individual follow-up and meeting the project applicants are unavoidable to approve this passing to the second phase.

5. A flexible and pragmatic use of all funding methods.

During the risk reduction phase (approximately 12 to 24 months), grants with financial returns on results or repayable advances will probably be the most appropriate.

During the development phase, the duration of which varies according to projects, it is important for the State to act as a shareholder, through equity acquisitions or capital injections. The State will then be fully associated to the capitalistic risk-taking founding the entrepreneurial approach, and profits that may arise from it. To do so, complementary financing to the first envelop must be found.

6. Public and private parity funding.

After the start-up phase, private co-funding is an important principle for the Commission: except certain cases, no public funding should be granted without equivalent private funding.

7. Mobilise public procurement.

All public leverage must be mobilised in favour of goals for the foregoing projects to have better chances of success. Among them, public procurement is a powerful securing tool of the first markets of innovative companies. This is why the Commission requires:

- the systematic study of relevance and feasibility of public markets by the State and its operators but also regional authorities for the different Goals. The public procurement mediator may be mobilised in this respect. Particular attention will be paid to the articulation with R&D funding on a legal but also operating point of view, vigilance on good temporality is necessary;
- launching public procurement as soon as possible and relevant to accompany the creation of a market on the themes of the different Goals.

APPENDIX 5: PEOPLE AUDITIONED, CONTRIBUTIONS RECEIVED AND MAIN REFLEXION SOURCES

People Auditioned

- Mr. Philippe AGHION, economist, member of the Commission
- Mr. Olivier APPERT, CEO of French Institute of Petroleum (IFP)
- Mr. André Michel BALLESTER, CEO of Sorin Group
- Mr. Jean-Louis BEFFA, patron and chairman of the board of Saint-Gobain
- Mr. Jean-Luc BELLINGARD, CEO of Biomérieux
- Mr. Pierre BELLON, chairman and founder of Sodexo
- Mr. Philippe BERNA, President of the Comité Richelieu (French association of innovative SMEs), and Mr. Christophe LECANTE, vice-president and Mr. Thomas SERVALL, entrepreneur and member of the Comité Richelieu
- Mr. Xavier BEULIN, President of Sofiprotéol and Mr. Jean-Philippe PUIG, General Director, Mr. Michel BOUCLY, deputy managing director, Mr. Jean-François ROUS, Director of innovation and Mr. Stéphane YRLES, director of public affairs and institutional relations
- Mr. Jean-Lou BLACHIER, public procurement mediator
- Mr. Philippe BOUYOUX, Deputy General Commissioner for investment projects, Juppé-Rocard Commission reporter, Commission member
- Mr. Jean-Louis CAFFIER, journalist, Commission member
- Mr. Frédéric CUVILLIER, Junior Minister for Transport and the Maritime Economy
- Mr. François DARCHIS, Air Liquide Senior Vice-President and member of the executive committee and Mr. Pierre Etienne FRANC, Vice President, advanced business and technologies, and Mr. Thierry SUEUR, Vice-President, European & International Affairs
- M. Marc DAUNIS, Alpes-Maritimes Senator, secretary of the Senate
- Mrs Isabelle DELANNOY, DoGreen Manager
- Mrs Michèle DELAUNAY, Minister for the Elderly and Dependent Care
- Mrs Agnès DENIS, (conseil&recherche) manager and Mr. Bertrand DALLE, associate Director and Mr. François BOTTELLIER-DEPOIS, consultant
- Mr. Nicolas DUFOURCQ, General Director of Bpifrance, Commission member and Mrs Laure REINHART, Director of partnerships and innovative ecosystems of Bpifrance
- Mrs Mercedes ERRAS, Founder of BETC, executive President of Havas Worldwide and Commission member
- Mrs Geneviève FIORASO, Minister for Higher Education and Research
- Mr. Thierry GAUDIN, President of Prospective 2100
- Mr. François GERIN, Vice-General Director of Siemens France
- Mr. Alain GIFFARD, National Secretary in charge of economics and industry sectors, CFE-CGC
- Mr. Marc GIGET, prospective specialist, founder of the European Institute for strategies and innovation
- Mr. Pierre LAFFITTE, Honorary Senator of Alpes-Maritimes
- Mrs Marie-Cécile LEBAS, Public Affairs Director, Syngenta
- Mr. Jean-Pierre LETARTRE, Director of the Pôle France 2020, MEDEF, and Mr. Alain DAMAIS, Deputy Managing Director in charge of economic and international affairs, MEDEF
- Mr. Bruno MAISONNIER, CEO of Aldebaran
- Mr. Gérard MESTRALLET, CEO of GDF Suez, and Mr. Marc FLORETTE, member of the executive committee and research and innovation director and Mr. Edouard SAUVAGE, member of the executive committee and director of strategy
- Mr. Arnaud MONTEBOURG, Minister for Industrial Renewal

- Mr. Matthieu PELISSIE DU RAUSAS, Director of McKinsey & Company, and Karim TADJEDDINE, partner
- Mr. Pascal PAVAGEAU, Confederal Secretary Force Ouvrière for the economic sector
- Mrs Fleur PELLERIN, Minister Delegate with responsibility for Small and Medium Enterprises, Innovation, and the Digital Economy
- Mr. Patrick PIERRON, CFDT union National Secretary in charge of industrial policies
- Mr. Jean PISANI-FERRY, Commissioner General for Strategy and Prospective, Commission member
- Mr. Navi RADJOU, Executive Director of the Centre for India & Global Business at Judge Business School, University of Cambridge
- Mr. Joël DE ROSNAY, prospective specialist, advisor of the president of Universcience
- Mr. Gérard ROUCAIROL, President of the National Academy of Technologies of France and Mr. Jean-Claude RAOUL, member of the Academy of Technologies
- Mr. Jean-Baptiste RUDELLE, CEO of Critéo
- Mr. Serge SARLAT, President of the Urban Morphology Institute
- Mr. Pierre TAMBOURIN, President of the Genopole, cowriter of the report « L'innovation, un enjeu majeur pour la France » (Innovation, a major challenge for France)
- Mr. François THIBOUST, Director of Public affairs, Bayer CropScience
- Mr. Daniel RAOUL, Senator and President of the economic affairs commission, and Mr. Raymond VALL, Senator and President of the commission for sustainable development, infrastructures, equipment and urban planning, and their colleagues Jean-François MAYET, Benoît HURE, André VAIRETTO, Gérard BAILLY, Michel MAGRAS, Bruno SIDO, Charles REVET, Rémy POINTEREAU, Roland COURTEAU, Hervé MAUREY, Marcel DENEUX, Alain CHATILLON, Bernadette BOURZAI, Odette HERVIAUX, Michel TESTON, Jean-Jacques MIRASSOU, Yannick VAUGRENARD, Jean-Jacques FILLEUL, Robert NAVARRO, Didier GUILLAUME and Ronan DANTEC
- A group of students and young entrepreneurs including Thibaut COLLETTE, Pauline ROZENBERG, Cécile OZANAM, Benjamin ASKENAZI, Manola VYARAVANH, Julien HOBEIKA, Rémy ROUSSEAUX, Ayrton GIAVEDONI, Florian COLAS, Thomas HELD and Grégoire HENRION

A great number of these auditions were recorded and made public on <http://www.dgcis.gouv.fr/politique-et-enjeux/innovation-2030>

Received Written Contributions

The Commission appealed to and received written contributions from companies, research, administration or civil society organisations, based on lists of questions or given spontaneously.

• Companies

- Mr. Jean-Claude ANDREINI, Vice-president of COSEI
- Mrs Elisabeth BARGES, Public Policy Manager Innovation at Google
- Mr. Philippe BERNA, President of the Comité Richelieu
- Mr. Jean-Luc BEYLAT, President of the Systematic Paris-Region cluster and president of Alcatel-Lucent Bell Labs France
- Mr. Patrick BOISSIER, CEO of DCNS
- Mr. Yves GABRIEL, CEO of Bouygues Construction
- Mr. Philippe BREGIER, President and CEO of Airbus
- Mr. Pierre CALLEJA, founder and CEO of Fermentalg
- Mr. Eric CARREEL, President and founder of Sculpteo
- Mr. Ivan CAUSSE, engineer

- Mr. Philippe DEMIGNE, General Director of Bertin
- Mr. Jean-Paul DERIAN, senior VP/research, innovation and performance, Suez environnement
- Mr. Manuel DIAZ, founder of Emakina
- Mr. Antoine FREROT, CEO of Véolia
- Hitachi Group, from Mr. JL Archambault, Lysios
- Mr. Olivier HOMOLLE, President of BASF France
- Mr. Xavier HUILLARD, CEO of Vinci
- Mr. Olivier LAFFITTE, project manager, Séréo
- Mr. Jean-Gabriel LEVON, CEO of Ynsect
- Mr. Bertin NAHUM, MEDTECH association
- Mr. Jean-Claude NOACK, President of Optitec competitiveness cluster and Mrs Katia MIROCHNITCHENKO, General Director
- Mr. Thierry MISSIONIER, Aquimer competitiveness cluster Director
- Mr. Hervé MULTON, Director of strategy, research and technology, Thales
- Mrs Catherine ORPHELIN, public affairs and communications direction, Roche SAS
- Mr. Thierry PENET, Business Development Manager, Laster Technologies
- Mr. Guillaume PEPY, CEO of SNCF
- Mr. Edouard ROQUETTE, President of board of directors of Roquette Frères
- Mr. Adrien SCHMIDT, entrepreneur, President of « Silicon Sentier »

• Scientific Agents

- Mr. Olivier APPERT, CEO of IFP Energies nouvelles
- Mr. Michel AVIGNON, CNES
- Mr. Jean-Michel BILLAUT, President of the Broadband 78 organisation
- Mr. François HOULLIER, CEO of INRA
- Mr. Thomas DUBOUCHET, Nanothinking
- Mr. A HATCHUEL, Coordinator of the Chair “Design Theory and Methods for Innovation” at Mines ParisTech
- Mrs Hélène JACQUOT- GUIMBAL, Director of IFSSTAR
- Mr. Christian JOACHIM (CNRS), Mr. N. SILLON (CEA-TEC), Mr. Xavier BAILIN (CEA-Leti)
- Mr. Franck MOLINA, Director of Sysdiag and president of European Diagnostic Cluster Alliance (EDCA)
- Mr. Maurice ROULOT, consultant engineer
- Mr. Alain SYROTA, CEO of INSERM

• Administrations

- Mr. Jean-Paul ALBERTINI, General Commissioner for sustainable development
- Mr. ALLAIN, Director General for policies on agriculture, agrifood and territories
- Mr. Emmanuel BERTHIER, Interministerial Delegate for territorial planning and regional attractiveness
- Mrs Michèle DELAUNAY, Minister for the Elderly and Dependent Care
- Mr. Pascal FAURE, General Director for competitiveness, industry and services
- Mr. Emmanuel DESCLEVES, Vice-admiral
- Mr. Roger GENET, Director General for research and innovation
- Mr. Patrick GANDIL, Director General for civil aviation
- Mr. Jean-Marc MICHEL, Director General of Planning, Housing and Nature
- Mr. Luc ROUSSEAU, Vice-president of the High council for economy, industry, energy and technology
- Mrs Laure REINHART, Deputy General Manager Innovation, Bpifrance
- Mr. Justin VAISSE, Director of the Policy Planning staff of the French Ministry of Foreign Affairs.

• Civil Society

- Mr. Patrick PIERRON, CFDT union National Secretary in charge of industrial policies
- Mrs Anne-Sophie NOVEL, journalist and blogger (www.demoinsenmieux.com)

International Benchmark Elements

The Commission would like to thank the ministry of foreign affairs who addressed a position paper on the role of French technological innovations in France's international influence and mobilised the resources of the ADIT and embassies' economic services in order to bring international comparison elements in terms of the investment choices of our main world competitors.

The positions of the following countries were appealed to: the United States, the United Kingdom, Germany, Sweden, Finland, Denmark, China, Japan, Korea, Singapore, Hong Kong, India, Norway, Brazil. Information was also gathered from the European Union's Horizon 2020.

An overview of these elements is presented on the website: <http://www.dgcis.gouv.fr/politique-et-enjeux/innovation-2030>.

Other Elements of Information

- Commissariat général à la stratégie et la prospective (General Agency for Strategy and Prospective), *Internet 2030*, 2013
- David WILLETTTS, Policy Exchange, *Eight Great Technologies*, 2013
- McKinsey Global Institute, *Disruptive Technologies: Advances that will transform life, business, and the global economy*, 2013
- Ministère de l'enseignement supérieur et de la recherche (Ministry of higher education and research), *France Europe 2020, un agenda stratégique pour la recherche, le transfert et l'innovation*, 2013
- Ministère de l'enseignement supérieur et de la recherche (Ministry of higher education and research), *État de l'enseignement supérieur et de la recherche*, février 2013
- Navi RADJOU, Jaideep PRABHU, Simone AHUJA, *L'innovation JUGAAD, Diateino*, 2013
- Jean-Luc BEYLAT, Pierre TAMBOURIN, *L'innovation, un enjeu majeur pour la France, Dynamiser la croissance des entreprises innovantes*, 2013
- M. Eric CARREEL and M. Clément MOREAU, *L'impression 3D en France : qui fait quoi et où en impression 3D en France ?*
- Union des industries chimiques (UIC) (Chemical Industry Association), *Chimie Innovation 2030*, 28 juin 2013
- IFSSTAR, CSTB, CERIB, Syndicat français de l'industrie cimentière (French Cement Industry Union), *Vers des produits et des matériaux de construction technologiques pour les bâtiments et les infrastructures de la ville de demain*
- IFSSTAR, IDRRIM, *La route de cinquième génération*
- OCDE, *Perspectives économiques*, 2013
- BETC and Havas Worldwide, *Etude sur les tendances sociétales*, juillet 2012
- Geneviève FIORASO, *Les enjeux de la biologie synthétique, rapport de l'OPECST*, février 2012
- DATAR, *Territoires 2040, Des systèmes spatiaux en prospective*, in *Revue d'études et de prospective* n°4, 2011
- Association des centraliens, *8 priorités pour dynamiser l'innovation en France*, Armand Colin, 2011
- Centre d'analyse stratégique, *France 2030 : 5 scénarios de croissance*, avril 2011
- Direction générale de la compétitivité, de l'industrie et des services, *Technologies clés 2015*, mars 2011
- Roland Berger Strategy Consultants, *Global Future Trends*, 2011
- McKinsey, *Global Forces: how strategic trends affect your business*,
- Alain JUPPE and Michel ROCARD, *Investir pour l'avenir, priorités stratégiques d'investissement et emprunt national*, novembre 2009
- OPECST, *Rapport sur le principe de précaution : bilan de son application quatre ans après sa constitutionnalisation*, 2009

- European Commission, *The World in 2025*, 2009
- Conseil d'analyse stratégique (Centre for Strategic Analysis), under Eric Besson's direction, *France 2025*, April 2008
- Frédéric BIZARD, *Refonder le modèle social français*, (Recasting the French social model)