

THE INDIGO CIVILIZATION

1- Goal

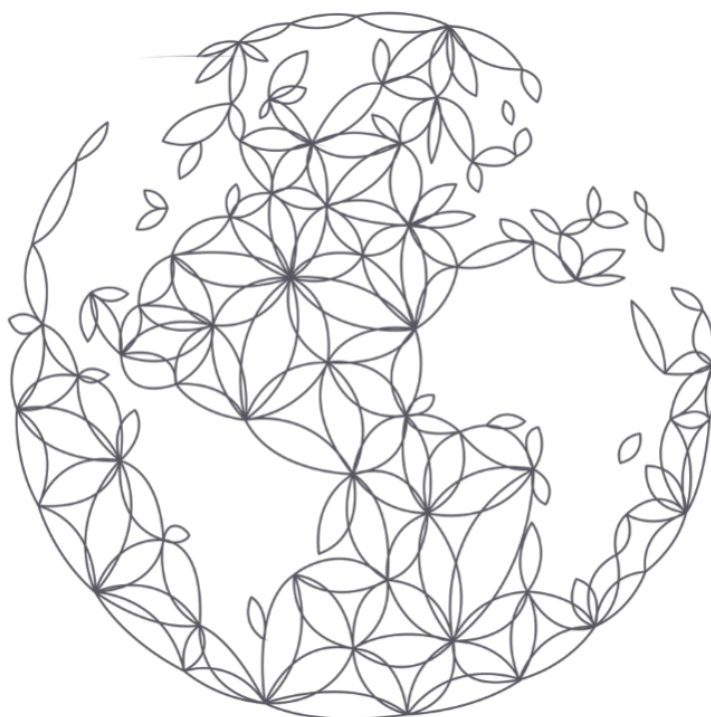
Reconciling the ecological and socio-economic challenges of tomorrow: virtuous growth.

2- Objectives

- a. Live, develop and flourish on, from and with the oceans.
- b. Anticipate inevitable natural and geo-societal changes.

3- Solution

- a. Design of floating, restorative & sustainable, multi-use & inhabited marine ecosystems.
- b. Creation of a multidisciplinary and international research cluster dedicated to the modeling and study prior to the design and experimentation of operational prototypes in French waters.



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Date: September 01, 2022

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INTRODUCTION

This white paper is intended for French and European public institutions, as well as companies, large groups or startups, private foundations, NGOs, scientists, economists, sociologists, in connection with maritime ecological or economic issues, or the Blue Economy.

At the UN Ocean Conference in Lisbon in June 2022, UN Secretary General António Guterres presented four recommendations to help us "save our ocean":

1. Investing in sustainable ocean economies.
2. Replicating Ocean Success.
3. Protecting people.
4. More science and innovation.

This white paper introduces a humanistic and realistic vision for France and its people, in harmony with goals 2, 7, 9, 11, 13, 14 and 17 of the UN [2030 Agenda](#)¹ : a transversal and global project that aims at the same time at **environmental restoration, sustainable economic growth and societal progress** in the long term. It advocates progress for people and companies, not regression.

This white paper entitled The Indigo Civilization suggest the founding of the Indigo OceanLab, an agile multidisciplinary cluster of innovation. This organization aims to bring together actors with proven and available expertise and innovations in fields as varied as marine energy, fish or algae aquaculture, marine engineering, habitat, or transport. The objectives of this transversal research project are:

- In the short term: modeling and testing of operational prototypes of shared and multi-purpose floating ecosystems on the French seas, profitable and sustainable.
- In the long term: the establishment of permanent communities within floating cities, ecologically virtuous and high value-creating.

This white paper addresses this concept in 3 chapters:

1. The report: France and the French within a VICA world and a threatened environment.
2. The objectives: a unifying ambition and a development lever.
3. The approach: moving towards the pragmatic and agile realization of a better world.



" We must set ourselves, as we did during the Paris agreements in 2015, ambitious goals for biodiversity and singularly for the oceans. " - *Emmanuel Macron on June 30, 2022*

¹ <https://www.coe.int/en/web/un-agenda-2030>

1- FRANCE AND THE FRENCH IN A VOLATILE AND UNCERTAIN WORLD

THE OBSERVATION

a. Environmental alert

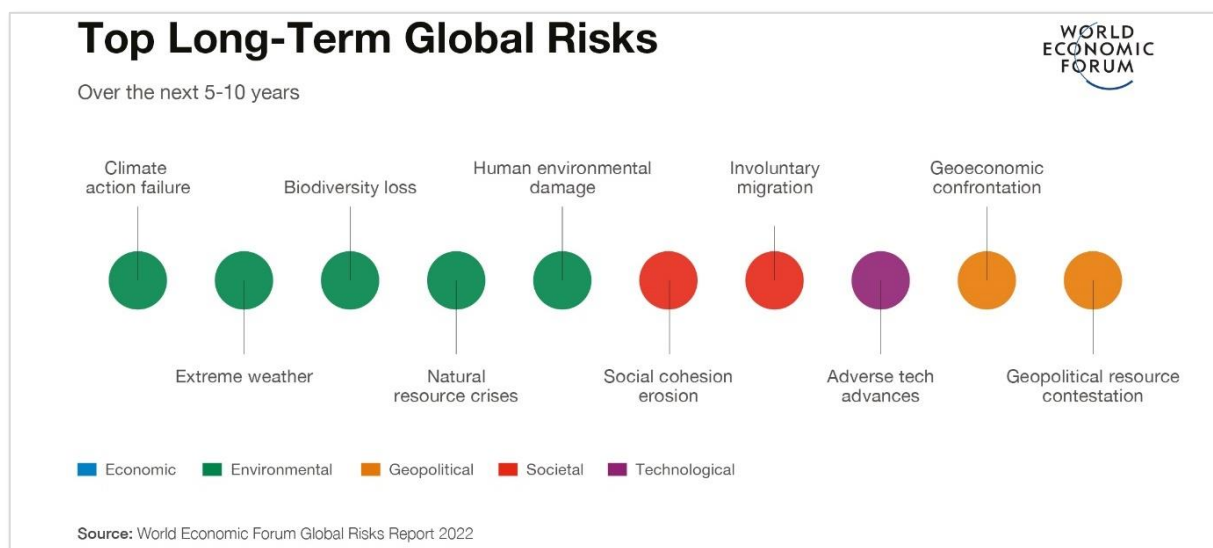
In 2050, 52% of humans will suffer from access to scarce water ([Growing Blue²](#)) and it will be necessary to allocate an additional **22 million km²³** of arable land to feed the population, the size of North America. According to the [International Energy Agency⁴](#), global energy consumption will increase by 68%, with a 35% increase in CO₂ emissions in the countries with the highest population growth.

The natural harmony of Nature, of which humans are a part, has been broken. Our environment suffers from an overexploitation of its resources reinforced by the proven and future consequences of overpopulation. The 2022 report of the [Intergovernmental Panel on Climate Change⁵](#) is perfectly eloquent on this subject.

Water is one of the most sensitive ecological and socio-economic parameters; it is as necessary as it is feared. Today, more than 2 billion people live in water-stressed countries and suffer from lack of access to safe drinking water and sanitation, according to the [World Meteorological Organization⁶](#). This could concern 5 billion people in 2050. Due to climate change, the number and duration of droughts have increased by 29% worldwide since 2000, according to the UN.

On the other hand, between 300 million and 1 billion people, depending on the scenarios envisaged, will see their terrestrial environment flooded by rising water levels aggravated by subsidence, the collapse of soils. In France, this will affect about 1.5 million people in 864 municipalities identified by the [French government⁷](#). Due to climate change, flooding has increased by 134% worldwide since 2000, according to the UN.

In summary, the recent [World Economic Forum⁸](#) study, conducted among 1,000 international experts and decision-makers, shows that environmental concerns constitute the major global risk for the world in the medium term, far ahead of economic considerations.



² www.growingblue.com

³ <https://vu.fr/TjZS>

⁴ <https://www.iea.org/>

⁵ <https://www.ipcc.ch/report/ar6/wg3/>

⁶ <https://public.wmo.int/fr/medias/communiqués-de-presse/un-rapport-met-en-garde-contre-la-crise-de-leau-qui-se-profile>

⁷ <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000045726134>

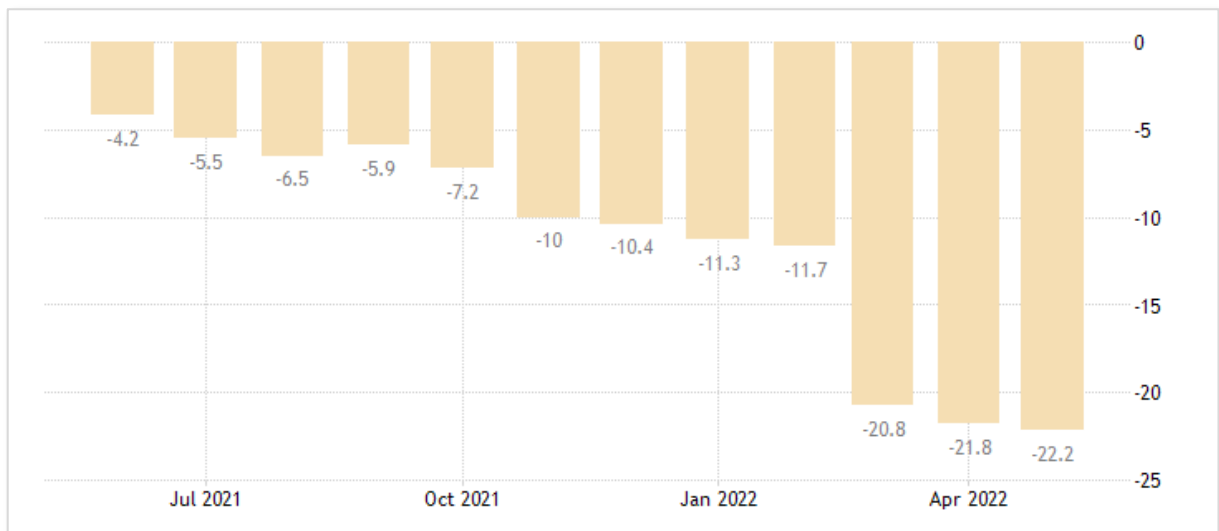
⁸ https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2022.pdf



b. Moderate growth prospects and uncertain geopolitical context

The international geopolitical context is ambiguous. In the short term, economic forecasts are gloomy with a global slowdown in growth, particularly in France (+1.4% in 2023 vs. 3.6% worldwide according to the [International Monetary Fund](https://www.imf.org/fr/Home)⁹).

The hereafter consumer confidence indicator in the European Union decreased by 0.4 points from the previous month to -22.2 in May of 2022, the lowest since April 2020 – i.e. the start of Covid 19 pandemics ([Trading Economics](https://tradingeconomics.com/european-union/consumer-confidence)¹⁰).



Source: Trading Economics / European Commission

In the longer term, no one knows how to predict the world's economic future because it has become so volatile. The past two years have reminded us that nothing can be taken for granted and that one day's reality is not the same as the next: Sino-American tensions, Russian-European tensions, a pandemic, and war at the gates of Europe. These few events have shaken up the established order in France and Europe: supply of raw materials, explosion of energy costs, inflation, possible decline in GDP in 2023, decline in household purchasing power, rise of populism, democratic split, growth of inequalities and loss of meaning.

Such a context implies some questions:

- How to create new virtuous growth levers with scalability and in harmony with Nature?
- How to initiate a new profitable, virtuous, and humanistic capitalism?
- What will be the autonomy and independence of France in the coming decades?
- How can we ensure France's place of choice on the international stage of the future?
- How to boost the economy and encourage more investment?

⁹ <https://www.imf.org/fr/Home>

¹⁰ <https://tradingeconomics.com/european-union/consumer-confidence>

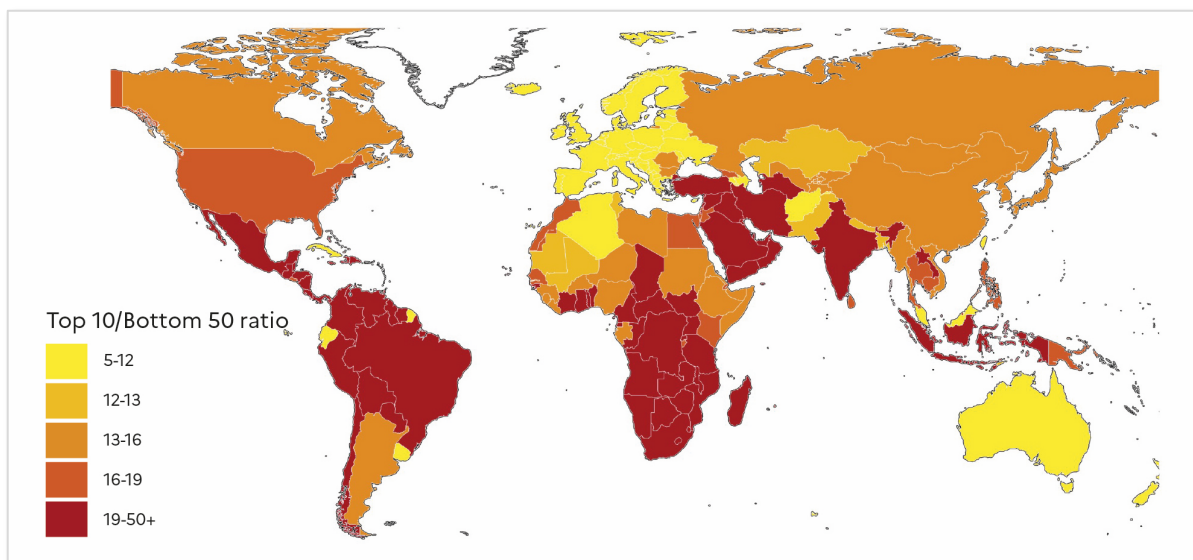
c. Population growth and migration

According to the [UN](https://www.un.org)¹¹, the world population will grow by 26% by 2050. The IPCC report published in 2022 also indicates that regardless of the rate of greenhouse gas emissions, by 2050 nearly one billion people could be living in [coastal areas at risk](https://coastal.climatecentral.org)¹², while rising sea levels would increase the impact of storms and sea surges. Sea levels could rise by an average of 50 to 110 cm by 2100. The value of infrastructure and other assets in these areas prone to extreme flooding is estimated at \$10 trillion in a moderate emissions scenario. However, the Greenland and West Antarctic ice sheets contain enough frozen water to raise the oceans by 13 meters...

The [World Bank](https://openknowledge.worldbank.org/handle/10986/36248)¹³ also warns that climate change could force some 216 million people in the developing world to migrate by 2050 due to the direct consequences of climate change (water stress, reduced agricultural yields, food shortages, floods, heat waves, droughts, cyclones, etc.) but also due to the conflicts that will result. By 2050, sub-Saharan Africa could have up to 86 million climate migrants; East Asia and the Pacific, 49 million; South Asia, 40 million; North Africa, 19 million; Latin America, 17 million; and Eastern Europe and Central Asia, 5 million.

These migration estimates do not consider possible international geopolitical crises. With more than 5 million exiles, the Ukrainian conflict ranks just behind the civil war in Syria, which has generated more than 6.8 million refugees, according to the UN.

Finally, the choice of migration destinations is influenced by the social stability and protection of the host countries. Western Europe, relatively egalitarian and to date peaceful and stable, is likely to become a preferred destination.



Income gap between the top 10% and the bottom 50% (World Inequality Lab)

¹¹ <https://www.un.org>

¹² <https://coastal.climatecentral.org>

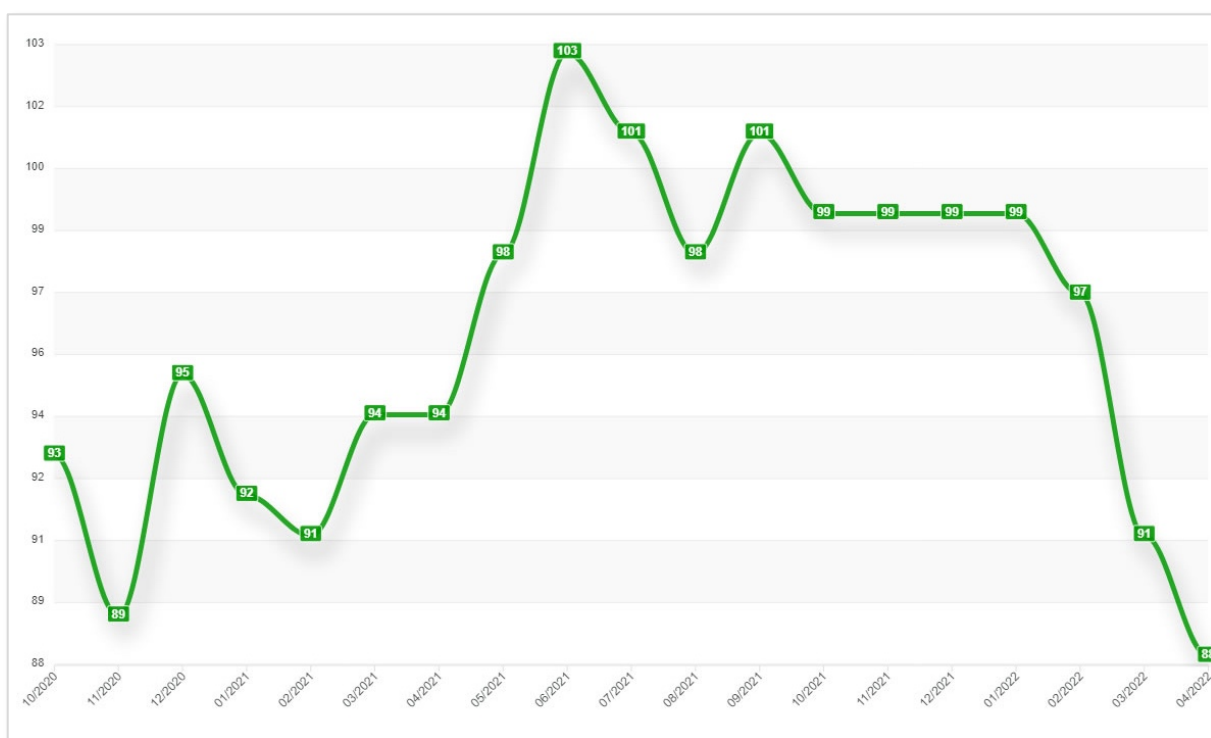
¹³ <https://openknowledge.worldbank.org/handle/10986/36248>

d. French societal crisis

The political climate illustrated by the 2022 elections demonstrates a societal fracture in France. The French have generally lost confidence in the ability of institutions and their government to improve their lives and solve the world's problems.

The volatile international context and two years of pandemic have profoundly undermined citizens' morale, growth, and prospects. Distrust and even mistrust have led to a rise in populism and individualism. This is even more worrying since nearly one out of two young French citizens between the ages of 18 and 30 has a negative overall state of mind. 26% of them are worried about the future ([Crédoc](#)¹⁴ - 2022) and do not see any bright prospects for their future. Worse, 73% of the French do not trust governments to improve the world and solve their problems.

According to a study by the [OECD](#)¹⁵, the confidence of the French in their government in 2020 was only 41%, far behind some of its continental neighbors: Switzerland (84.6%), Germany (65%), Scandinavia (from 67.1 to 82.9%) or Portugal (61.5%). The record abstention rate of the French presidential and legislative elections of 2022 does not augur a better confidence.



Economic indicator - evolution of French confidence (INSEE)

¹⁴ <https://www.credoc.fr/>

¹⁵ <https://data.oecd.org/gga/trust-in-government.htm>



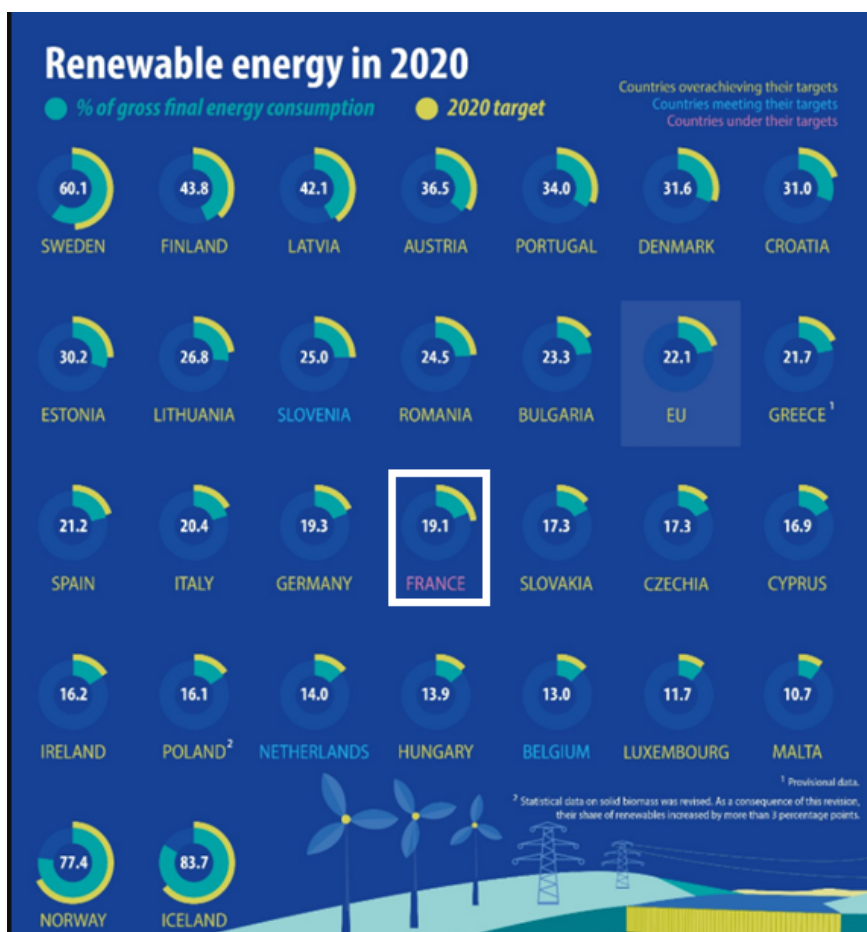
e. France, late in its energy transition

The French energy mix is more than 60% carbon-based, according to [EDF Renewables](https://www.edf-renouvelables.com/en/)¹⁶. To date, 40% of the final energy consumed in France is of fossil origin, derived from oil. France is one of the only countries in the Union that has not met its objectives in terms of reducing greenhouse gases and transitioning to RE (Renewable Energies). In 2020, only 19% of the energy consumed is of renewable origin. All European Union member states have reached their 2020 target for RE in their energy mix, except France...

The French offshore wind power only starts in 2022 with the opening of the Saint Nazaire wind farm to reach 80 wind turbines, against more than 2,300 in the United Kingdom and 1,700 in Germany in 2020. The 2028 target is in the order of only a few hundred offshore wind turbines in French waters. To achieve carbon neutrality, France aims to have 40 to 50 offshore wind farms available by 2050. They should produce 22 GW, or 44% of the capacity of the nuclear sector, according to [RTE](https://www.rte-france.com)¹⁷. Potentially, such offshore infrastructures could be skilfully complemented by other usage targets, or even pooled.

Solar photovoltaic energy had an installed capacity of just over 13 GW in 2021, while the target for 2023 is 20 GW and the target for the end of 2028 is 35 to 44 GW.

Agrofuels represent only 10% of renewable energy in France to date. However, third generation agrofuels using microalgae represent an undeniable future opportunity, with an expected yield 20 to 30 times higher than terrestrial oilseeds.



Source: European Commission – Eurostat

¹⁶ <https://www.edf-renouvelables.com/en/>

¹⁷ <https://www.rte-france.com>

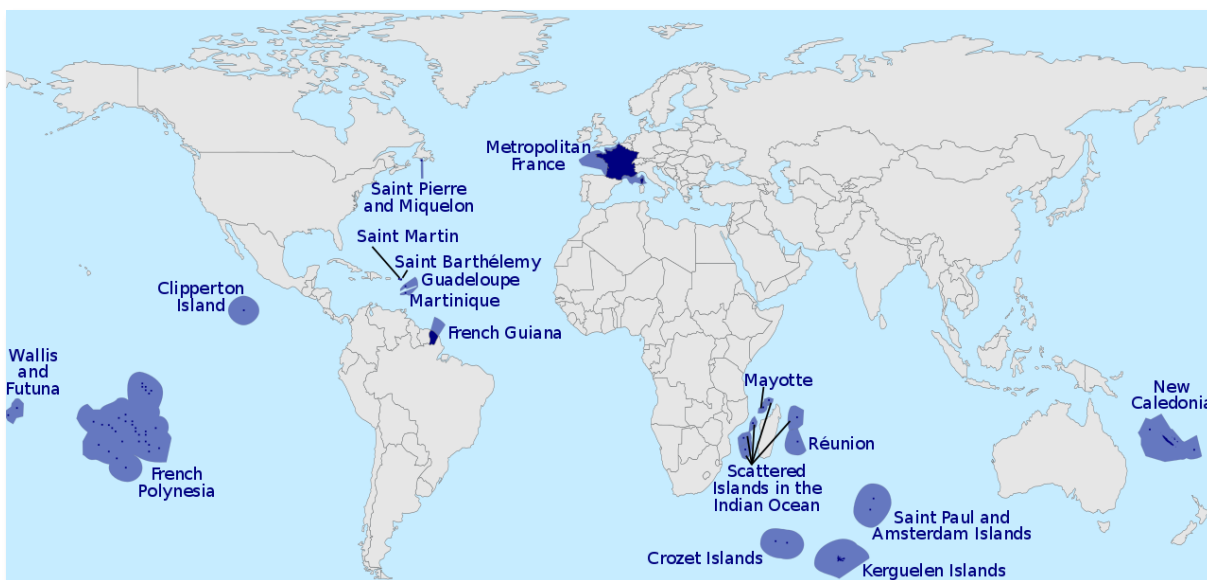


f. France's master asset in the world: its maritime heritage

France benefits from an exceptional asset. Its maritime empire on 3 oceans is an exceptional heritage. Indeed, the country has the second largest maritime domain in the world with nearly 11 million km², behind the USA (12.2) and ahead of Australia (9). France is even ranked first in the world in terms of submarine areas.

Our planet is 71% covered by seas and oceans. The world ocean regulates more than 80% of the Earth's climate and generates 50% of our oxygen. Water represents 96% of the biospheric volume.

Particularly threatened by global warming, acidification and pollution of the oceans, these immense and various maritime spaces, or Exclusive Economic Zones (EEZ) represent a tremendous potential of progress for France and humanity: water, food, energy, natural resources, lifestyle, employment, technological innovations, etc. The seas and oceans are thus the assets of the future, well beyond the 4.5 million jobs and €65 billion in value currently generated.



A maritime empire for an exceptional wealth



2- A NOBLE AND UNIFYING AMBITION FOR FRANCE, THE INDIGO CIVILIZATION

THE OBJECTIVES

- a. The Indigo Civilization: a realistic and virtuous avant-garde project on the ecological, economic, and societal levels

The Indigo Civilization aims to facilitate the establishment of virtuous and value-producing communities on shared floating infrastructures with multiple ecological and economic purposes, close to the coast or offshore. This holistic concept is revolutionary and aims at both a negative carbon footprint and a positive socio-economic balance. The Indigo Civilization also draws on the work of partners such as [Blue21](https://www.blue21.nl)¹⁸, a Dutch company that pioneered research and design of floating projects, or [The Seasteading Institute](https://www.seasteading.org)¹⁹, an American non-profit organization created in 2008.

This apolitical ambition follows the various positive feasibility and viability studies funded by the European Union's Horizon program: [Tropos](https://cordis.europa.eu/project/id/288192/fr)²⁰, [United](https://www.h2020united.eu)²¹ et [Space@Sea](https://spaceatsea-project.eu/)²².

Key objectives:

- Testing new flexible models of civilization, habitat and virtuous commerce.
- Stimulate innovation and the emergence of new levers for growth and employment.
- Restoring the subtle balance of Nature, more than protecting the environment.
- Develop new energy and food resources in an ecological manner.
- Responding to demographic and social issues for better societal cohesion.
- Alleviate environmental and demographic pressure on land and at the coast.
- Helping to welcome refugees: value producers and new pioneers.



Oceanix floating city in Busan - South Korea: construction to start in 2023

¹⁸ <https://www.blue21.nl>

¹⁹ <https://www.seasteading.org>

²⁰ <https://cordis.europa.eu/project/id/288192/fr>

²¹ <https://www.h2020united.eu>

²² <https://spaceatsea-project.eu/>

b. Generating prosperity and economic growth: a positive economic record

The concept of Indigo Civilization advocates the creation of new economic models through the development of underwater aquaculture, plant, and animal in the open sea. The relevant creation of platforms or self-sufficient floating artificial islands allows the development of a rich biodiversity, like a natural reef. These oceanic farms, such as [Open Blue](https://openblue.com)²³, become the opportunity to develop a dynamic and healthy open sea aquaculture such as underwater fish farming. The annual potential for offshore farming is estimated by [Nature Ecology & Evolution](https://www.nature.com)²⁴ to be around 15 billion tons of fish and shellfish, theoretically more than 100 times the world's seafood consumption. Less than 0.015% of ocean space would be sufficient to produce an amount of fish equivalent to that caught in one year.



Source: Global Seafood Alliance

Seaweed has exceptional benefits. Rich in vitamins, minerals, proteins and trace elements, this biomass is a real opportunity to relieve intensive agriculture and soils, and to feed the population as well as farm animals. According to [NOAA](https://www.noaa.gov)²⁵, algae cultivation is one of the simplest solutions for our food future. Rich in lipids, microalgae also have cosmetic virtues but especially energy. They are indeed the raw material of biogas and a new generation biofuel. Despite the immense surface area of its maritime empire, France accounts for only 0.2% of the world's algae production.

Overall, Marine Renewable Energies (MRE) are at this stage relatively undeveloped: biogas/fuel, wind, solar, TME, tidal, wave. However, the economic and ecological potential is undeniable in the medium term. The [World Energy Council](https://www.worldenergy.org)²⁶ estimates that the theoretical energy potential of marine renewable energies is two million TWh per year. This estimate does not consider the great additional potential of 3rd generation biofuels from algae. At present, only a little over 100,000 TWh/year would be technically or economically exploitable. However, global electricity consumption in 2018 was just over 23,000 TWh. To date, MREs account for no more than 0.05% of global renewable energy production.

²³ <https://openblue.com>

²⁴ <https://www.nature.com>

²⁵ <https://www.noaa.gov/>

²⁶ <https://www.worldenergy.org>

Another virtuous but little-known MRE is OTEC (Ocean Thermal Energy). Under some latitudes, this cutting-edge technology, which complements tidal, wave, solar and wind energy, produces electricity from the thermal differences between surface and deep waters. The global potential for the production of thermal energy from the seas could reach 10,000 TWh/year according to a study by the [International Energy Agency](#)²⁷ dedicated to marine energy, or 44% of the world's electricity consumption.

Producing hydrogen by electrolysis with seawater and from renewable energies also has the advantages of not exploiting a resource necessary for the life of land populations, and of ensuring at least an alternative energy autonomy for floating islands, their equipment and boats (first production unit in France - [Lhyfe](#)²⁸). This production also has the virtue of producing fresh water. According to the IEA, hydrogen is a clean energy of the future.



Source: Horizon 2020 United

The Indigo Civilization allows new forms of employment and powerful levers of growth through the development of technological or aquaculture innovations, the development of biodiversity, the clean and sustainable collect of organic or mineral submarine resources and the emergence of new ecosystems and business models: innovating and prospering while protecting the natural capital available. The recent discovery of an ecological cement, negative in CO₂ and pollutants, made from algae is a concrete example: this avant-garde biomimetic material aims in the long term to replace concrete, the third largest industrial pollutant in the world ([US Environmental Protection Agency](#)²⁹).

According to the OECD, the Blue Economy could **grow twice as fast as the global economy** over the next ten years and could account for **5% of global GDP** by the end of the decade.

²⁷ <https://www.iea.org/>

²⁸ <https://fr.lhyfe.com/nos-unites-de-production/usine-lhyfe-offshore/>

²⁹ <https://www.epa.gov/>

c. Restoring Nature's subtle balance: climate inversion and negative carbon balance

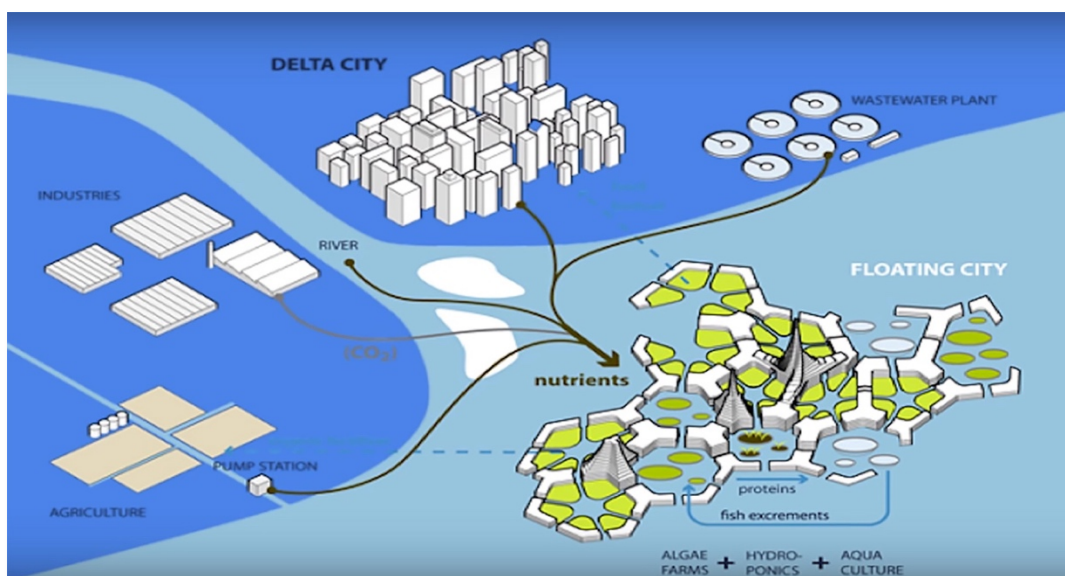
The concept of Indigo Civilization envisages economic growth but at the service of Nature, of which Humanity is a part. The reversal of climate change and ecological restoration must imperatively be economically and socially profitable for humans. This imperative objective must not be synonymous with constraints and regression. Let's keep our previous few examples.

Algae represent only 11% of the biomass on Earth but produce about half of the available oxygen. They are proving to be a technically and economically viable solution for capturing and treating CO₂. A floating aquaculture ecosystem also allows the nutrients produced by cities and land-based farms (wastewater, excrement) to be used to feed seaweed fields and their biodiversity. The photosynthesis linked to the production of these algae reduces the level of CO₂ in the environment and marine acidification, and produces oxygen: microalgae absorb five times more CO₂ than forests ([Sea6 Energy](https://www.sea6energy.com/)³⁰, [GreenWave](https://www.greenwave.org/)³¹, [Algolesko](https://www.algolesko.com)³² in France). According to the [Center of Climate and Energy Solutions](https://www.c2es.org)³³, the value of global algae production is estimated at \$320 billion.

Herbivorous fish raised in the open sea, in innovative underwater farms ([Aquapods](https://www.innovasea.com/open-ocean-aquaculture/)³⁴) or by aquaponics, can be from a lower trophic level, requiring up to 100 times less energy than a tuna at the top of the food chain.

The Ocean Thermal Energy Conversion (OTEC) is an opportunity to cool not only the ocean but also the atmosphere thanks to the cold waters coming up from the deep (4°C). The [upwelling phenomenon](https://oceanservice.noaa.gov/facts/upwelling.html)³⁵ provides a collateral benefit since it generates an upward flow of nutrients accumulated at the bottom of the sea for millions of years, which contribute to promote photosynthesis and the growth of biodiversity created at the surface.

The reasoned concept of Indigo Civilization aims to reverse climate change and restore the natural balance. Floating ecosystems not only aim at self-sufficiency, but also contribute to relieve and complement the exploitation of terrestrial resources: energy, fresh water, food.



Example of a virtuous ecological chain (Blue21)

³⁰ <https://www.sea6energy.com/>

³¹ <https://www.greenwave.org/>

³² <https://www.algolesko.com>

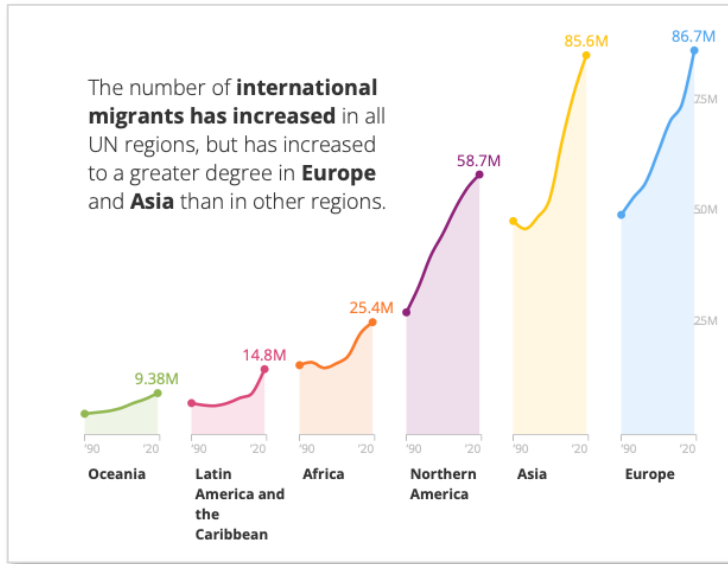
³³ <https://www.c2es.org>

³⁴ <https://www.innovasea.com/open-ocean-aquaculture/>

³⁵ <https://oceanservice.noaa.gov/facts/upwelling.html>

d. France, land of welcome and prosperity

In 1793, France, the country of the Enlightenment, was the first state to integrate the principle of the right of asylum into its Constitution. Being welcomed when persecuted became a human right. This principle is also included in the 1948 UN Universal Declaration of Human Rights and the 1951 Geneva Convention relating to the Status of Refugees.



Source: UN World Migration Report 2022

The concept of Indigo Civilization aims at humanitarian progress: millions of people will be forced to leave their homes due to conflicts, rising waters, or lack of water. These risks are unevenly and unfairly shared across the globe.

The principle of a virtuous floating city thus allows the reception, protection, education and integration of climate refugees, and the chosen rise of a generation of new pioneers. These French or foreign aquapreneurs will create value and work for the good of France and its people. The Indigo Civilization allows to manage a migration not only benevolent and faithful to the values of the Nation, but also innovative and creating socio-economic value.

"Europe will always provide shelter to those in need of international protection. "

Ursula von der Leyen, President of the European Commission

e. Social renaissance and societal progress

In the long term, and as a collateral benefit, the concept of Indigo Civilization envisages a double social and societal gain. Federative and transgenerational, it is a real opportunity for the Nation.

France will have approximately 70 million inhabitants in 2050, one in three of whom will be over 60 years old ([INSEE](https://www.insee.fr/en/accueil)³⁶). The average ageing of the population coupled with a relatively low fertility rate (1.83), resulting from a lack of confidence in the future and a tense economic situation, implies some serious concerns: imbalance of the social system by distribution (active vs. inactive), explosion of public and health expenses, probable increase of inequalities, or weak economic dynamism.

- A **social progress**: the concept of Indigo Civilization is a source of virtuous growth that generates in the long term new commercial opportunities, new jobs, a new nourishing and ecological economy, new territories of life, a great potential for disruptive innovations, and prospects for personal fulfillment within a space where everything is done.
- A **societal harmony**: the ambitious and innovative vision of a virtuous and progressive maritime civilization becomes a national pride, the cement of a national cohesion. Developing autonomous ecosystems that create resources and value on the oceans allows France to shine on the international scene, to lead the way and to attract international talent within sectors of excellence and future.

83% of the French are convinced that we should stick together and face problems together ([Kantar](https://www.kantar.com/en)³⁷, 2019). In fact, the French are right: at the end of the 1970s, Switzerland mobilized to save a watch industry in decline. Today, Switzerland accounts for 1.1% of the volume but 53% of the value of the global watch market. Its know-how is second to none. Why not consider such a passion for a project with a unifying future, and for which France has exceptional assets?



³⁶ <https://www.insee.fr/en/accueil>

³⁷ <https://www.kantar.com/en>

f. The opportunity to test new, more agile organizations or governance

It is interesting to note the correlation between a country's economic freedom and its prosperity. Countries ranked as the most economically free in the world by the [Economic Freedom Index](#)³⁸ in 2022 often appear at the top of the GDP per capita rankings: Singapore, Switzerland, Ireland, Taiwan, the Netherlands, Scandinavian countries, Australia, or Iceland.

New challenges require new organizations. Creating and developing incremental communities and economies on the seas and oceans requires innovative solutions and processes that demand agility. This liberated organization model has proven itself in the most successful companies such as Apple, Tesla, or SpaceX, and has allowed them to adapt quickly to human constraints in a volatile, uncertain, complex, and ambiguous world.

The transversal concept of Indigo Civilization is thus an opportunity to test and adapt new territorial, cultural, economic, agricultural, and industrial, social, and demographic models aiming at progress for both Nature and the prosperity of France and its people. **A great agility envisages liberated modes of governance, without being independent and uncontrolled.**

The IPCC report published in February 2022 (Ch.6: pp 80-81) presents Rotterdam as a case where the institutional environment is very supportive of eco-innovation. The municipal government is working directly with the private sector to improve flood protection by developing a marketing strategy around the "floating city" concept. The market for "floating homes" has developed, with benefits for the local real estate and construction industries, as well as for knowledge-exporting companies that provide consulting expertise, delta technologies, and architectural designs. Nevertheless, these new trends raise new governance challenges to ensure adaptation."



Rotterdam – Floating Pavilion

³⁸ <https://www.heritage.org/index/>

3- TOGETHER TOWARDS THE REALIZATION OF A VIRTUOUS CIVILIZATION THE APPROACH

a. Let's not procrastinate: all technical solutions already exist to get started

All the technologies and aquaculture or energy engineering are already available or emerging to start developing the Indigo Civilization, already underway.

To accommodate and house its activities, solutions also exist. For example, the first oil platforms raised above the swell and waves were created at the beginning of the 20th century. Resistant to storms and hurricanes, they have become surprisingly rich islands of biodiversity, such as artificial reefs or augmented ecosystems ([Scientific Reports](#)³⁹, 2018).

More recently, the [Space@Sea](#)⁴⁰ project, funded by the European Union's Horizon Program, has demonstrated the technical and economic feasibility of safe and modular multi-use floating structures according to a documented roadmap. [Blue21](#)⁴¹, a global leader in floating projects with a positive impact and partner of the Indigo Civilization project, offers the world's largest open-source knowledge base on floating solutions. Besides, two [World Conferences on Floating Solutions](#)⁴² were organized in 2019 and 2020, and brought together industry, policymakers, entrepreneurs, and researchers around the future of structures for offshore waters in the context of sustainable development. Viable solutions already exist.



Artificial reef, naturally created under a disused platform

³⁹ <https://www.nature.com/srep/>

⁴⁰ <https://spaceatsea-project.eu/news/54-floating-island-development-and-deployment-roadmap>

⁴¹ <https://www.blue21.nl/about/knowledge-base/>

⁴² https://books.google.be/books/about/WCFS2020.html?id=6iVgzgEACAAJ&redir_esc=y

The concept of living on water is not new: Venice (7th century) or Koh Panyee in Thailand (18th century), or the artificial island of G. Rosa off Rimini (20th century).



Koh Panyee - Thailand



Rosa Island, 1968 - Italy

More recently, aquatic architects have specialized in the design and construction of floating habitable structures, which are **less invasive, less expensive, more flexible and modular** than artificial infrastructures made by land reclamation, or even dikes.

The specialized architectural firm [Waterstudio](https://www.waterstudio.nl)⁴³ headed by Koen Olthuis has built entire floating neighborhoods in Amsterdam and Rotterdam in the Netherlands, a country that is highly threatened by rising water levels. Waterstudio is also the architect of many other projects, including the first floating theater in Europe in Lyon.



Waterbuurt district in Amsterdam - 13.000 inhabitants

⁴³ <https://www.waterstudio.nl>

The Goldsmith firm has created the world's first self-sufficient, circular, floating dairy farm in Rotterdam, where 80% of the city's area is below sea level. Other complementary farms are planned.



Other architectural firms are working on offshore modular concepts, such as [Arktide](https://arktide.org)⁴⁴ or [Ocean Builders](https://oceanbuilders.com)⁴⁵.



SeaPod & EcoPod concept of Ocean Builders in Panama (credit: Grant Romundt)

⁴⁴ <https://arktide.org>
⁴⁵ <https://oceanbuilders.com>



b. An international rising awareness of the relevance of sustainable floating cities and multi-use ecosystems

In addition to the [Tropos](#)⁴⁶, [United](#)⁴⁷ and [Space@Sea](#)⁴⁸ research projects, funded by the European Commission, future large-scale project of sustainable floating cities have been officially endorsed:

- In March 2021, the Maldives made official the start of construction of a [floating city](#)⁴⁹ in the center of an atoll not far from Male. This country made up of 2,000 islands, whose highest point is 10 meters high, is threatened by the rise in water levels in the 21st century. Delivery: 2027.



- The future [floating city Oceanix of Busan](#)⁵⁰ in South Korea, supported by the UN and presented at the World Economic Forum in May 2022, will be built in 2023 and will accommodate 12,000 people on modular, mobile and self-sufficient platforms. Delivery: 2025.



Future floating island of Busan in South Korea (approved during the [second UN Roundtable](#)⁵¹ - November 2021)

⁴⁶ <https://cordis.europa.eu/project/id/288192/fr>

⁴⁷ <https://www.h2020united.eu>

⁴⁸ <https://spaceatsea-project.eu>

⁴⁹ <https://maldivesfloatingcity.com/>

⁵⁰ <https://www.weforum.org/videos/floating-city-to-be-built-in-south-korea>

⁵¹ https://unhabitat.org/sites/default/files/2022/04/1_-_second_un_round_table_floating_cities.pdf

- Saudi Arabia has also launched the construction of the eco-responsible floating city [Oxagon](#)⁵² on the Red Sea, intended to be an exemplary research center and a cutting-edge logistics platform. Oxagon will be the largest floating structure in the world: 48 km², with an expected population of 90,000 people in 2030. Start of construction: end of 2022.



Another example of this rising interest as stressed by Rutger de Graaf – van Dinther from Blue21 is the [IPCC report Climate Change 2022](#)⁵³: Impacts, Adaptation and Vulnerability. Published on the 27th of February 2022, it proves how urgent and crucial it is for humanity to change course and adapt and transform our society in face of the global climate crisis.

Cities are mentioned in the report as hotspots of climate impacts but also as places containing key opportunities to address climate change and adapt to the impacts. The IPCC report also contains **several references to floating urban development as adaptation or anticipation opportunities.**

- In [Chapter 13](#): Europe (page 18). Elevated and floating houses are mentioned as part of a 'hybrid strategy' which also includes flood protection and contributes to innovative urban development.
- In the [Cross Chapter paper 2](#): Cities and Settlements by the Sea (page 13). The report mentions that floating structures are so far, only applied in calm and protected water but that advancing seawards to more challenging conditions may become possible.

⁵² <https://www.neom.com/en-us/regions/oxagon>

⁵³ <https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/>

c. To create in France a “Silicon Valley” dedicated to oceans - Indigo OceanLab

Designing and developing self-sufficient floating communities and ecosystems that create value for land-based populations is an ambition that requires energy, coordination and resources that can quickly become prohibitive before any project is even launched.

This is why a Lean Start up approach, rational, sequenced, concrete but derisory, is recommended. This entrepreneurial and dynamic methodology allows not only to refine models and prototypes through learning, but also to consider economies of scale in larger deployments.

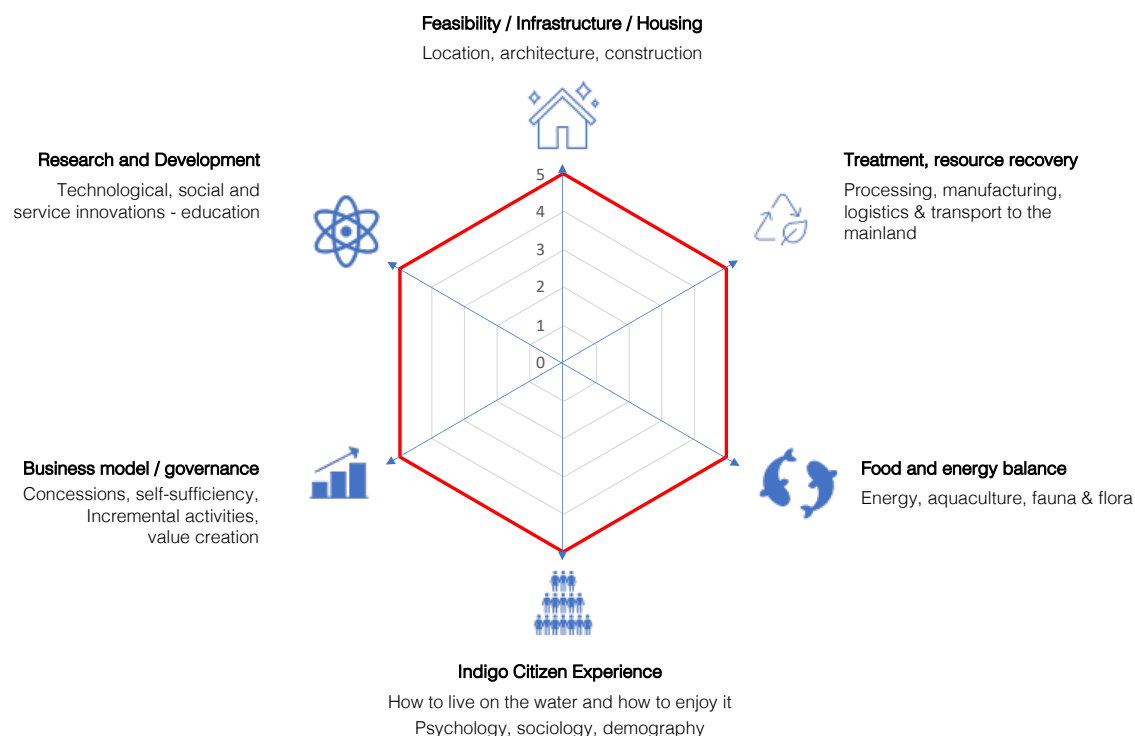
The Indigo Civilization project is divided into **3 complementary and intertwined phases over 10 years**.

- Phase 1: modeling and functional design of complementary prototypes of floating, restorative and sustainable, multi-use and inhabited marine ecosystems.
- Phase 2: in situ prototyping, operational experimentation, and corrective measures.
- Phase 3: declinations and international deployment on a larger scale.



A long-term vision (Blue21)

- **Phase 1, from 2023: modelling and design of complementary prototypes of floating, restorative and sustainable, multi-purpose and inhabited marine ecosystems.**
 - In the short term, I recommend the creation of a cross-cutting research and innovation cluster dedicated to the design and study of three categories of operational prototypes, detailed below: the **Indigo OceanLab**.
 - The Indigo OceanLab's research and innovation vocation supports a long-term operational project, deployed via a 10-year action plan. This agile entity focuses on the development of incremental communities, economic and ecological activities, through floating, virtuous and self-sustaining structures. How to live on, from and with the seas and oceans?
 - The Indigo OceanLab brings together independent multidisciplinary experts, volunteers, and representatives of the French diversity of today and tomorrow, to imagine, analyze and design 3 theoretical viable and value creating models, hereafter described, in accordance with 3 imperative and complementary pillars: ecological positive balance and restoration, socio-economic progress.



- On the other hand, Indigo OceanLab organizes international calls for projects, invites, coordinates and federates actors as different as national or international scientific institutions (such as [IFREMER](https://wwz.ifremer.fr)⁵⁴ or the GdR OMER of the [CNRS](https://miti.cnrs.fr/initiatives-transver/ocean/)⁵⁵), PhD schools (such as Arts & Métiers), independent socio-economic or scientific consultants (such as WaterStudio or Blue21) in order to prepare the operational implementation of the prototypes according to an agenda, objectives and a budget. An indicative list of potential contributors is available in Appendix.

⁵⁴ <https://wwz.ifremer.fr>

⁵⁵ <https://miti.cnrs.fr/initiatives-transver/ocean/>

- **3 categories of multi-use and inhabited prototypes** are defined in geographical areas with complementary resources and potential. The waters of Brittany, the Mediterranean, French Guiana and Polynesia are thus considered a priori suitable for such experimentation. French waters are a precious and rare asset. They are all the more relevant to experimentation as they present very varied conditions: temperature, marine weather, flows and currents, depths, geographical location, underwater resources, commercial potential, migratory attractiveness, proximity of coastal or island infrastructures.
- Each category has a priority objective but must meet the **three imperative pillars**: positive ecological balance, economic growth, and societal progress.
 - Energy (wave, solar, wind, ETM, green hydrogen, other resources...)
 - Food (aquaculture, aquaponics, hydroponics, water, by-products...)
 - Habitat (live-in workers, research & innovation, migrations, tourism...)
- The Indigo OceanLab **multidisciplinary research and innovation cluster** aims to bring together experts in the following fields
 - Environmental engineering and sustainable development
 - Oceanology, biomimicry, environmental management
 - Maritime spatial definition and planning
 - Aquatecture, design and engineering
 - Design & marine engineering
 - Materials & Technology
 - Floating and underwater infrastructure
 - Mesology, psychology
 - Habitat, quality and way of life
 - Health & safety
 - Ecotourism
 - Economics
 - Affordable solutions & viable economic models
 - Blue economy & circular economy
 - Governance, risks and social impact
 - Policy & governance: legislation & regulation
 - Social impact & responsibilities, awareness & acceptance
 - Food
 - Aquaculture (fish farming, hydroponics/ aquaponics, trace elements)
 - Algaculture (algae, seaweed)
 - Water / nutrient recycling, desalination by reverse osmosis
 - Marine renewable energies
 - Biogas/fuel
 - Wind
 - Solar
 - OTEC, osmotic
 - Wave, tidal
 - Hydrogen
 - Management and sustainable recovery of island waste
 - Transport and logistics

- Phase 2, from 2026: MVP, prototyping, small-scale testing, and corrections
 - The French EEZs are the host for the prototypes, financed by a **public-private consortium** to make the operational implementation concrete according to a defined agenda, objectives, governance, and budget.
 - The floating prototypes are located in the most appropriate waters according to the defined specifications and objectives. Pragmatically, they may be grafted onto an existing coastal or offshore community, as the core of a future larger ecosystem. Concerned by the rising waters, the Isle of Sein, for example, wishes to be [energy self-sufficient](#)⁵⁶ and could eventually become a laboratory for renewable energies, subject to an inclusive and participatory governance.



Credits: Philippe Plisson, Island of Sein

- As a consultative entity focused on research and innovation, the Indigo OceanLab's objectives are to explore, test and amend with agility concrete, holistic and varied solutions to meet the challenges of tomorrow: ecological, demographic, economic and social. This agile methodology allows us to learn by iteration, to dare innovative ways without taking real risks and without rushing the ecosystems concerned.
- Depending on the analysis of the results of the operational prototypes, the observation of progress or mistakes made, or the analysis of risks, Indigo OceanLab adjusts and directs its research and recommendations towards the most virtuous model according to the defined objectives: efficiencies and economies of scale.

⁵⁶ http://www.idsenergies.fr/idse_home/the_project/100_eneable_energy

- Phase 3, from 2030-33: deployment of proven models on a larger scale
 - The State may create **mixed economy companies** or transfers **temporary territorial concessions** (works/services) in the medium term. The Indigo OceanLab cluster may pursue its R&D activities to improve and fine tune the Indigo Civilization concept. Botswana, for example, has succeeded in combining economic and ecological development through the establishment and rigorous monitoring of private concessions. This country has become a virtuous economic model for its population, its fauna and flora thanks to a bold and intelligent management of its exceptional resources, both underground and on land.
 - In the longer term, this organization makes it possible to validate reliable and efficient complete solutions that are deployed on a larger scale and shared throughout the world via structures such as the UN Environment and Habitat. This humanistic vision of France's role is a guarantee of growth and influence on the international scene.



Source: 3D simulation of the world's first floating city at Busan, South Korea (CNN / Oceanix)

d. **An international mutualized R&D platform:**
experiential learning or learning by doing

Some solutions are more efficient when combined with others. It is a systemic approach that has been widely proven in Nature. Each activity is interdependent on the others: **biodiversity and ecodiversity create a virtuous circular ecosystem.**

Let's take an example of an ecosystem whose initial objective is energy, located a few kilometers from the coast. It is now possible to produce hydrogen at sea by electrolysis from salt water, while producing fresh water and oxygen. The energy required for this low-carbon process is provided by renewable energy sources: wind, solar, wave, marine thermal, and even nuclear. The recovered hydrogen is then purified and compressed in containers that are stored. Some of this energy feeds the floating ecosystem; the rest is destined for the land.

Not far from this energetic nucleus, a multidisciplinary aquafarm is being developed which ensures the cultivation of algae and microalgae, the breeding of fish at low trophic level in the sea, and the harvesting of mineral salts and trace elements abundant in the sea. These activities are complemented by hydroponic / aquaponic culture.

The local transformation of these resources will feed the ecosystem and supply the land with food, cosmetics, medical products, and produce limestone that will serve as the basis for a new revolutionary ecological cement. These "blue factories" with a negative carbon footprint will employ people who will live within the ecosystem for reasons of productivity (costs/time) but also well-being.

A logistics platform and a port are created. The ecosystem optimizes its functioning and develops like a village, then a clean, modern, rich, and connected city. Families are founded, a school is born, then a clinic, a police / coast guard / fire department office, shops, sports, and entertainment facilities... Scientists and engineers are joined by a whole society, progressively transgenerational, with multidisciplinary professionals contributing to serving France and making the world a better place. This society, synonymous with progress, attracts talents, professionals, and new oceanic entrepreneurs. Its governance evolves according to the constraints of its environment.

The Indigo OceanLab aims to strengthen this multidisciplinary approach to create restorative ecosystems that are not only self-sustaining but also create value, both economically and socially.

- e. **A shared and profitable model for all future interdependent parties:**
Indigo pioneers, companies, the French state and all the living on Earth.

« The totality is more than the sum of the parts »
Aristote, or the systemic approach

In the long term, The Indigo Civilization aims for a virtuous, inclusive, and sustainable model that advocates progress and growth in harmony with Nature. It thus aims to provide many humanist and economic benefits to all the parties concerned.

FRENCH INDIGO CITIZENS

- Life adventure, pioneering spirit
- Self-improvement dynamics
- Work / life balance
- Living environment (vs. land density)
- Rare potential for career development
- Co-development of a new virtuous model

COMPANIES AND INVESTORS

- Agile and dynamic ecosystem:
the "Silicon Valley" of the seas and oceans
- Technological and service innovations
- Economies of scale with a profitability target of 5%.
- Systemic integration of activities: food, energy, housing, processing, trade, logistics, etc.
- Profitable investment beyond prototypes: exporting reliable, viable and profitable solutions to the world

FRENCH STATE AND LOCAL AUTHORITIES

- Growth of the maritime economy
- Creation of a new field of excellence
- Direct revenues from French floating cities
- Revenues from industry players
- Positive energy and food balance
- Positive ecological balance
- France, leader in the economy of tomorrow

HUMANITY AND OTHER COUNTRIES

- Faster anticipation of future crises
- Access to reliable solutions:
 - Ecological restoration
 - Migration management
 - Response to rising water levels
 - Energy and food resources

CONCLUSION

The concept of Indigo Civilization is an apolitical, bold, optimistic, and humanistic vision for the future: to live and develop on and under the seas to protect, flourish and enrich all living beings on the planet in a sustainable and harmonious manner. In line with Europe's Horizon 2030 program, this long-term project is the illustration of a noble ambition for France and its people in the long term, beyond political, social, ideological, or generational divides.

Ambition, greatness, innovation, and audacity have shaped the history and heritage of our brilliant culture. Charlemagne, Louis XIV, Napoleon, and General De Gaulle are just a few of the illustrious examples that have made France shine internationally. Although imperfect, these leaders developed a remarkable vision of their country and realized their brilliant ambition, still recognized worldwide.

According to a report published in 2022 by the [European Investment Bank](https://www.eib.org/en/index.htm)⁵⁷, 56% of Europeans believe that climate policies are a source of economic growth but 66% believe that climate change will still be a serious problem in 2050.

In 7 years, the USA and JF Kennedy succeeded in walking on the Moon and to enthuse the whole world. Jules Verne had anticipated these 104 years earlier. I dare to believe that this enlightened humanist was just as right when he wrote "Twenty thousand leagues under the sea".

The concept of Indigo Civilization offers a solution to face the realities of the World and Humanity. The investment required is at least as justified as the escape of the elites to Space or of Mr. Everyone to virtuality, the Metaverse. 1 is better than 0. There is no reason to wait for progress and to realize a complex but noble ambition: to live and flourish on the seas and oceans in progress and harmony. Success lies in failure and learning. No one can criticize such a progressive, naturalist and humanist approach as long as it is explained with pedagogy, including at the local level.



⁵⁷ <https://www.eib.org/en/index.htm>

ABOUT FRÉDÉRIC PONS AND HIS ROLE

A French humanist and visionary who grew up on the Mediterranean coast, Frédéric wishes to contribute to a more harmonious and beautiful world. The combination of progress, harmony and aesthetics is his leitmotiv. During his professional career of almost 25 years in marketing, he has developed and launched innovative projects for major international brands such as TotalEnergies, Fujifilm, TAG Heuer or Red Bull Racing.

From now on, Frédéric wishes to devote his time and energy to raising awareness and developing a realistic, unifying, and ambitious project that aims to improve our way of life, to make France shine in the world and to restore the subtle balance of Nature. Author of The Indigo Civilization and ambassador of the famous Seasteading Institute and in love with his country, he wishes to contribute to the concretization of a virtuous oceanic civilization, and of models that are both ecological and socio-economic, profitable, and viable.

With his orchestration skills, his pragmatic vision, his strategic marketing skills, and his pedagogical leadership, Frédéric wishes to create and co-facilitate the Indigo OceanLab with the help of the State and French and international multidisciplinary experts, with integrity, without dogma.

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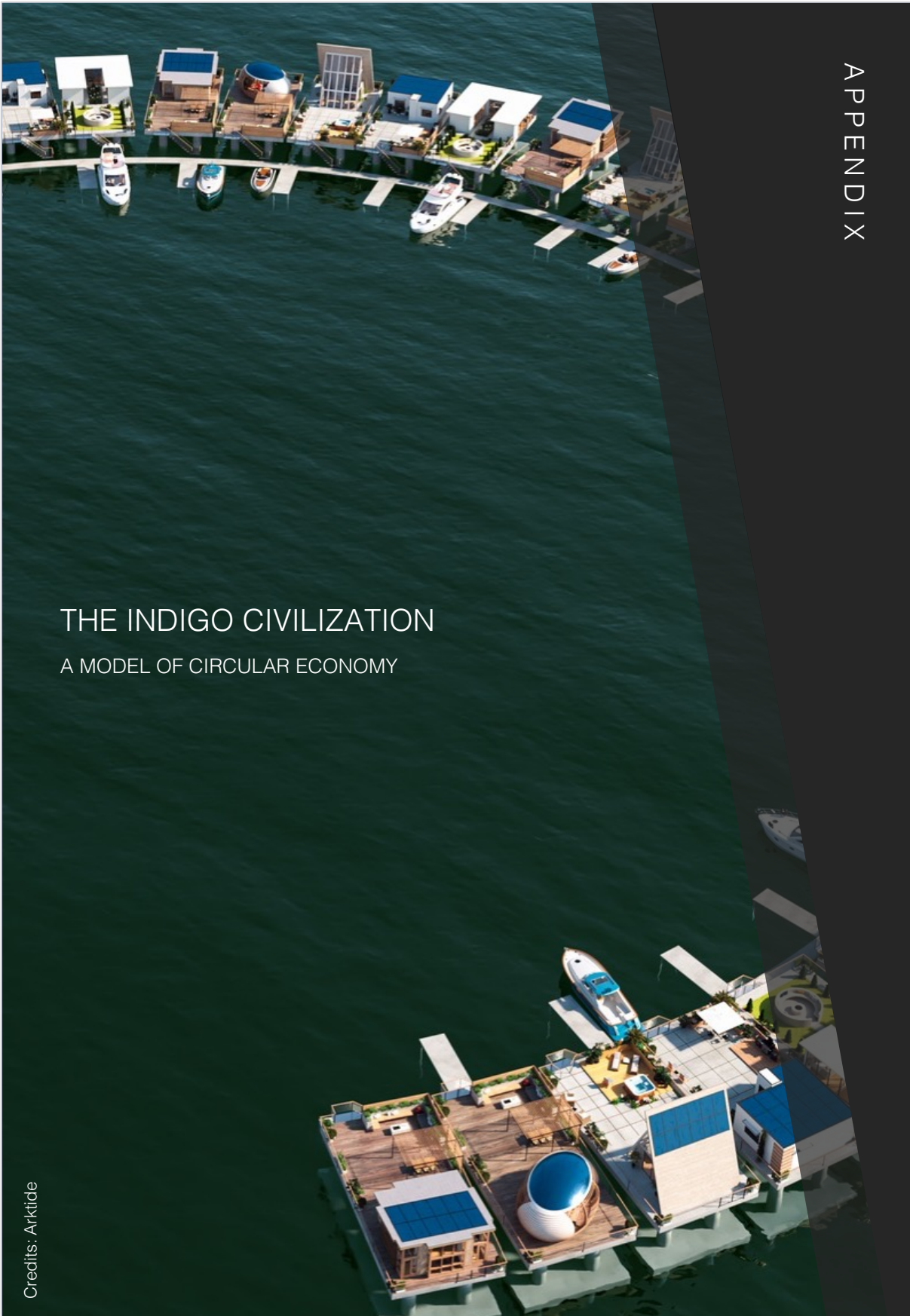
www.seasteading.org

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+ Freshwater division

+ R&D division
Sciences & innovation

+ Logistics Division
Port & transport

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Close to the coast at first
Close to functional satellites

+ Aquaculture division
Fish farming, aquaponics, algae

+ Treatment & recovery division
Resources & manufacturing

+ Clean energies division
OTEC, wind, solar, hydrogen, wave

INDICATIVE AND NON-EXHAUSTIVE LIST OF POTENTIAL CONTRIBUTORS

Multidisciplinary international teams composed of experts from the ocean, the blue economy and floating solutions.

- Seachers of IFREMER
- Marine research group of CNRS (OMER)
- Dr. Ir. Rutger de Graaf-van Dinther, Co-founder of Blue21
- PE. Soon Heng Lim, President SFSS, Society of Floating Solutions (Singapore)
- Ir. Maarten Flikkema, Space@Sea Coordinator and Consultant at FBS
- David Kirkwood, M.Arch., Architect PII ARB/RIBA
- Prof. Mr. Maarten Claringbould, Emeritus Professor of Maritime Law at Leiden
- Dr. Ir. Dries Hegger, Assistant Professor at Utrecht University
- Fen-Yu (Vicky) Lin, M.Sc., Researcher and Project Coordinator at Blue21
- Dr. Ir. Floris Boogaard, Professor at Hanze University of Groningen and CEO at INDYMO
- Dr. Ir. Jan van Kessel, Senior Engineer Floating City Development at Blue21 and Chairman of Offshore Technology at the Royal Institute for Engineers in the Netherlands (KIVI)
- Robert Newman, M.Arch., Co-founder at Floatopolis and Architect at Foster + Partners
- Dr inż. arch. Łukasz Piątek, Faculty of Architecture, Warsaw University of Technology
- Prof. Chien Ming Wang, School of Civil Engineering, The University of Queensland
- Ir. Karina Czapiewska, Cofounder of DeltaSync and Blue21
- Dr. Alona Armstrong, Senior Lecturer in Energy & Environmental Sciences and Deputy Director of Energy Lancaster at Lancaster University
- Barbara Dal Bo Zanon, Arch., Architect and Researcher at Blue21
- Ir. Olaf Waals, Manager Offshore at Maritime, Research Institute Netherlands
- Jeroen van Dijk, Watermanagement, Hogeschool Rotterdam
- Rui Lima, M.Sc., Researcher and Engineer at INDYMO and Researcher at MARE
- Ir. Pieter Ham, Cofounder of Finch Floating Homes and Ph.D. candidate at Faculty of Civil Engineering and Geosciences at Technical University of Delft
- Maarten Flikkema, Space@Sea Coordinator and Consultant at FBS
- Koen Olthuis, Founder of Waterstudio.NL
- Paul Holthus, CEO of World Ocean Council
- Nathalie Scheidegger, Project Leader Sustainable Blue Economy, Netherlands
- Marijn Rabaut, Independent expert - Marine and Renewables - Blue Cluster Int Marine Policy Manager, Brussels
- Zhi Yung TAY, Ph.D, Associate Professor at Singapore Institute of Technology
- Antidia CITORES, European Commission, Surf Rider Foundation and Ocean & Climate Platform
- Sabrina Speich, Professor of Ocean, Atmosphere and Climate Sciences at ENS, France
- Nikos Papandroulakis, Researcher at IA - HCMR
- Christine Valentin, General Manager WOC Europe
- Corinne Dubois, Founder of Ys Energies Marines Developpement
- Vincent Doumeizel, Senior Advisor United Nations Global Compact / Director Food Programme Lloyd's Register Foundation
- Hélène Leriche, Director of the Marine Biodiversity and Economy Program - Associate Professor AgroParisTech...