RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

_ ACTIVITY REPORT

NATIONAL ACADEMY OF TECHNOLOGIES OF FRANCE
/2022/

ACADÉMIE DES TECHNOLOGIES

SHARING A REASONED, CHOSEN PROGRESS

_EDITORIAL

It gives me great pleasure to present to you our academy's Activity Report for the year 2022. We wanted this report to be a reflection of what our academy is: diverse, committed and open.

Our academy boasts of 360 members, who come from varied backgrounds and paths - the world of industry, teaching and research, and are selected and elected by their peers. Our competence and independence are based on this diversity and on the collective and meticulously framed nature of our work. Finally, our gender diversity is increasing, with more than 40% women being elected over the last two years.

We are primarily committed to accomplishing our mission, which is to provide insight and support to public authorities and citizens on matters pertaining to technologies in the pursuit of the general interest, for their full understanding and adoption. Our motto is: "Sharing a reasoned, chosen progress". This commitment is reflected in the considerable work of our academicians, all of whom are volunteers, and who carry out all of our work and draft our documents. They are supported by a small permanent team, whose competence and dedication I greatly commend.

Our openness is manifested in our organisation, around 9 sections focused on the needs and challenges of our society, like climate change, the digital revolution, food and health challenges, all of which are explained in detail in Chapter 1. It leads us to publish almost all of our work, and to spread it far and wide to the various stakeholders. In 2022, we also undertook to translate our thematic plenary sessions into reports that are published on our website. We have also created a new cycle called "Les soirées de l'Académie des technologies (Evenings at the National Academy of Technologies of France)". It facilitates exchanges at a later hour with one or more academicians who share their knowledge and passion on the subject of their choice. For 2023, we have decided to go a step further and invite our partners to participate in these sessions.

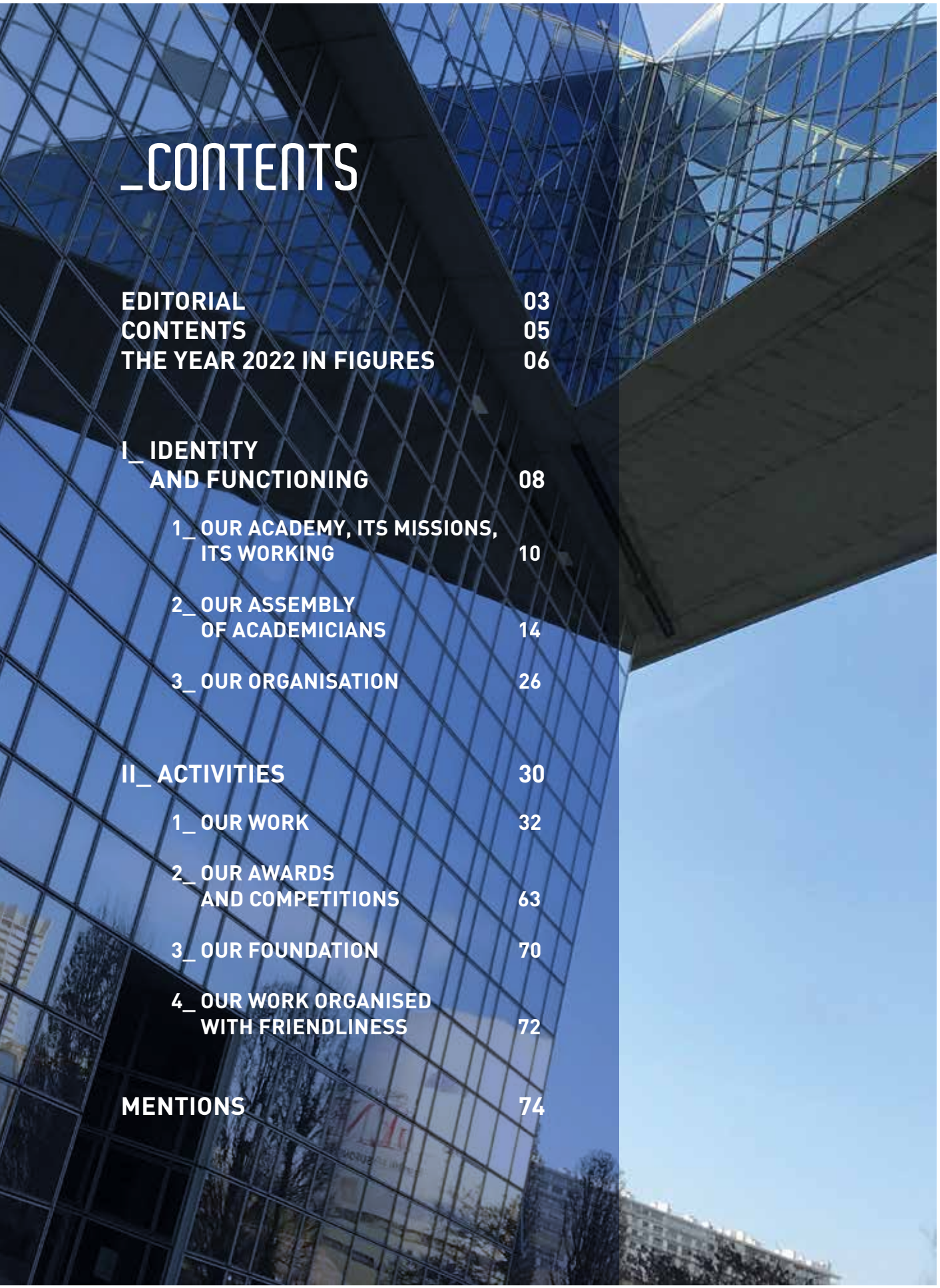
A priority is to increase the impact of our work with the Government and the Administration, in order to shed light on their policies supporting innovation, which, today, have considerable resources. A major step was taken in this direction when our Academy was asked, by the competent administrations, to provide long-term consulting support to the vast programme of France 2030 Plan. The initial significant contributions were made on small nuclear reactors, digital clouds, electronic components and photovoltaic panels. All of them seek, with total independence, to offer clear choices, based on a realistic assessment of the French situation of the sector, and practical avenues of technological and industrial development, within the reach of our country and our Europe. These opinions are intended to be made public after a period of examination by our sponsoring bodies. This new component of our mission will represent a significant portion of our future work.

Another important project in 2022, an undertaking for which we have been preparing for several years, was to host the world convention of academies of engineering and technologies, on the subject of breakthrough technologies for healthcare.

Finally, a common theme of the past year was the preparation and holding of our annual seminar on the subject of sufficiency. It will lead to a publication in 2023, expressing the conviction that technology alone will not be able to address all of humanity's challenges: our behaviour and consumption patterns will also have to change to satisfy the "right need" to make the best use of our planet's limited resources, thereby allowing for the sustainable pursuit of human development at its most fundamental level.

Denis RANQUE
President
of the National Academy
of Technologies
of France

The National Academy of Technologies of France is located on the "Le Ponant" site at 19 rue Leblanc in the 15th district of Paris.



_CONTENTS

_THE YEAR 2022 IN FIGURES

32 sessions and conferences

15 session reports

1 newly created cycle of sessions

1 annual seminar

174 people met: guests, participants, speakers, interviewees

6 women among

14 new elected members

Emilie du Châtelet, woman of letters, mathematician, physicist (1706 - 1749)

41 projects

12 awarded prizes

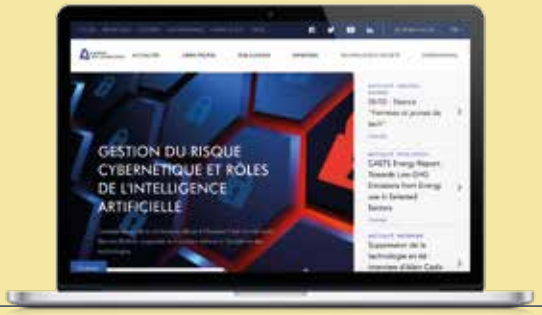
20 new "Women in Tech" portraits

_AN EVER-INCREASING VISIBILITY

1 international conference organised

11 publications: reports, opinions, responses to consultation

Our
NEW WEBSITE



Our new
GRAPHIC CHARTER

Our presence on
SOCIAL NETWORKS

262 posts,
3,159 subscribers
of which **1,377** are new subscribers

263 posts,
1,639 followers
of which **112** are new followers

More than **400 press** releases and **9** articles have communicated information about our activities.

I_ IDENTITY AND FUNCTIONING

1_ OUR ACADEMY, ITS MISSIONS, ITS WORKING

The National Academy of Technologies of France (NATF) was founded in 2000 to support the growing role of technology in everyday life and in all the dimensions of society. This approach was taken by a large number of countries around the world.

Technology is now **at the heart of the challenges that are facing our societies** in the form of issues like green transition, energy, health, employment, digital technology, demography, education, food, etc. It also raises questions, particularly pertaining to the risks it entails, be it in the field of public health, environmental degradation, data security, addiction to social networks, job replacement, inequalities of access, etc. Moreover, it is bringing about a large number of new regulations in all these fields (different European strategies are developed as regards data, cybersecurity or even artificial intelligence). Even though citizen debate is essential, it is sometimes disrupted or prevented by a mistrust of technology and, in recent years, by the explosion of "*fake news*".

The role of our Academy is to contribute to making technologies, and all their impacts, a subject of debate that is as informed and factual as possible, and thus to better equip decision-makers and citizens.

There are four fundamental ideas that govern our action:

- progress
- sense of general interest
- listening
- anticipation

Sharing a reasoned, chosen progress.

Our motto expresses the conviction that **technology must contribute to the public good.**

The Academy's missions are to reflect, debate, conduct dialogue, formulate proposals and issue recommendations on matters relating to technologies and their impact on society, for a **sustainable technological development for mankind**.

The Academy relies on its academicians, who are experts in their respective fields, both French and foreigners, coming from varied backgrounds: researchers from the academic and industrial spheres, engineers, economists, sociologists, architects, doctors, etc. This **assembly** reflects the diversity of technologies and knowledge facilitating the comprehension of the associated challenges and impacts.

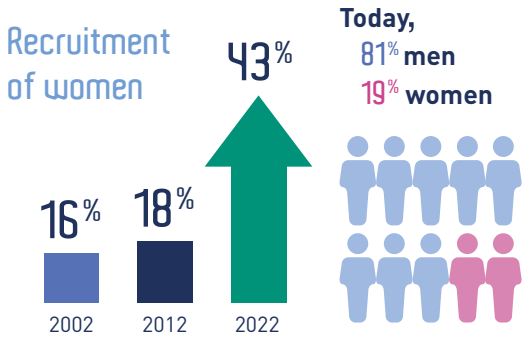
_ AN ORGANISATION COMBINING A THEMATIC APPROACH AND COLLECTIVE WORK

The Academy analyses the opportunities and risks associated with new technologies. It carries out **expert assessment, forward planning and coordination.** Its approach seeks to predict the transformations and their consequences, and then identify priority actions. **It supports information, training and education** pertaining to technology, especially for young people. It is also committed to helping to improve the presence and visibility of women in the domains of technology. It is dedicated to promoting useful and responsible technological choices as a means of improving the present living conditions as well as those of the future generations.

_ A COLLEGIAL OPERATION, GUARANTEEING AN INDEPENDENT POSITION

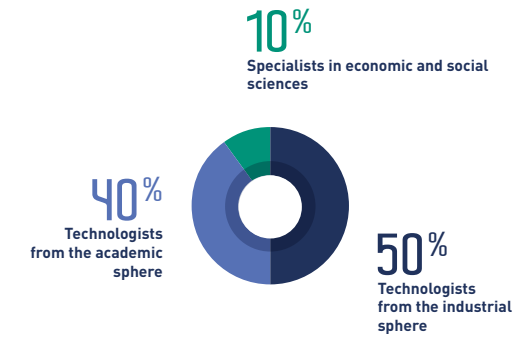
Thanks to the mobilisation of diverse competences and meticulous collegial procedures, the Academy ensures having **an independent position**, away from influences and special interests, making it possible to shed an original light, with objectivity on the studied subjects being a priority.

PARITY



Figures as on 1st January 2023

ORIGIN



Figures as on 1st January 2023

www.academie-technologies.fr

NATF WAS CREATED 22 YEARS AGO.

2000
The National Academy of Technologies of France is established as an association.

2007
It became a public administrative institution under the supervision of the Ministry of Research.

2013
It was placed under the protection of the President of the Republic.

OUR IDENTITY

Created in 2000 to provide insight and support to the public debate on matters relating to technology and its interaction with society. An independent and collegial assembly that seeks to contribute to societal debates and increase public interest and understanding.

360 elected personalities
9 sections of expertise
2 dedicated missions
1 governance
6 delegates
4 committees
1 permanent team

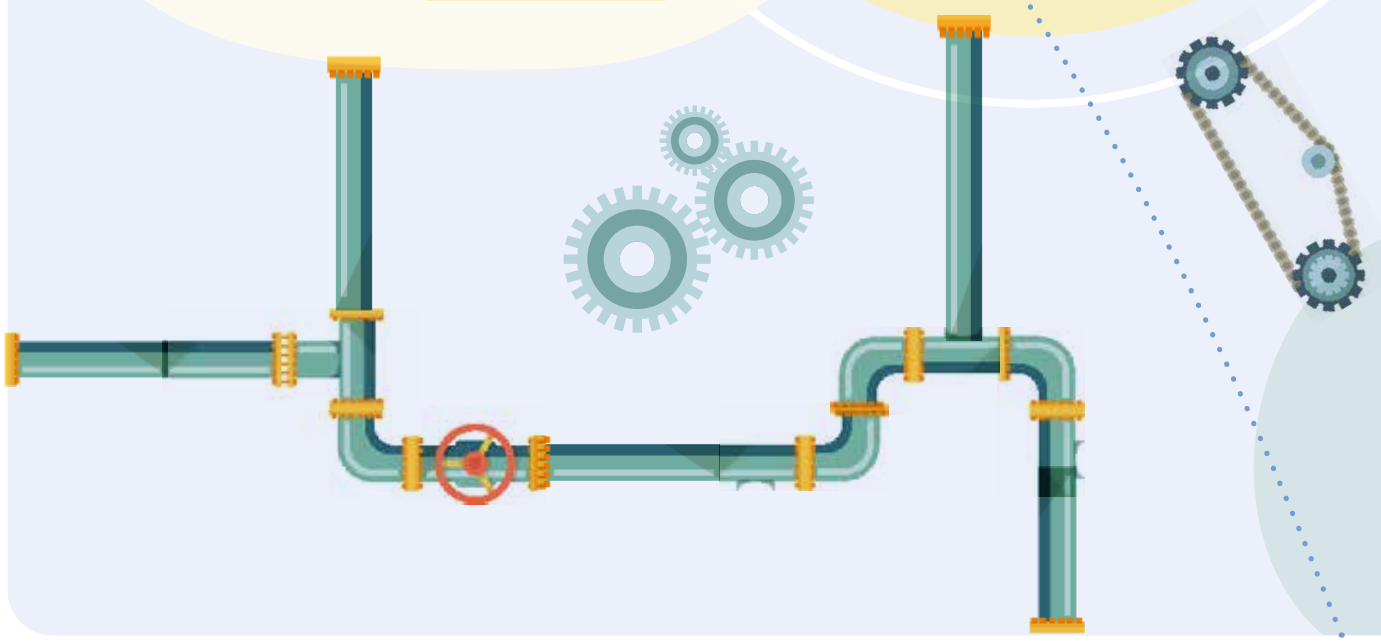
SESSIONS AND CONFERENCES

Meetings
Information
Watch
Dialogues
Prospecting
Research
Exchanges
Work international
Writing
Debates

PROJECTS

COLLABORATIONS and EXCHANGES with

- French and foreign academies
- Think tanks
- Companies
- Public research institutions



OUR ACADEMIC LIFE AND OUR WORK

PUBLICATION of

- Opinions, briefs and reports
- Session reports
- Referrals

AWARDS AND COMPETITIONS

- Awards ceremony
- Promotion
- Encouragement

TRUSTED THIRD-PARTY for

- Civil society
- Companies
- Government
  Public authorities and elected persons

OUR MISSIONS

3 principles

1. Issuing proposals and recommendations for a better use of technology for the benefit of mankind and in the general interest.

2. Enhancing the image of technology among the youth and women and encouraging associated vocations

3. Shedding light on emerging technologies and strategic choices by providing the guarantee of an independent approach and the advantage of its multiple competences

2_ OUR ASSEMBLY OF ACADEMICIANS

_ THE MEMBERS

Today, our Academy has 360 members. They are appointed through a **meticulous co-opting process** that ensures a diversity of expertise, professional backgrounds and gender.

Some are also members of other academies like the **Académie des sciences (French Academy of Sciences)** (53 common correspondents or members), the **Académie d'agriculture de France (French Academy of Agriculture)** (18), the **Académie nationale de médecine (National Academy of Medicine)** (13), the **Académie nationale de pharmacie (National Academy of Pharmacy)** (6), the **Académie des sciences morales et politiques (Academy of Moral and Political Sciences)** (2) or of foreign and European academies.

The Academy is proud to have among its members:

- **5 Nobel Prizes**
- **1 Fields Medal**
- **1 Turing Prize**

Certain distinctions in 2022:

- **Laurence DANON-ARNAUD**, appointed Commander of the Legion of Honour
- **Erol GELENBE**, awarded the title of *"Honorary Fellowship"* of the Islamic World Academy of Sciences and appointed Commander of the Order of the Crown of Belgium
- **Yannick LINTZ**, appointed Knight of the Legion of Honour
- **Anne-Catherine ROBERT-HAUGLUSTAINE**, appointed Knight of the Order of Arts and Letters
- **Michel VIRLOGEUX**, awarded the title *"Docteur honoris causa* (honorary doctorate)" of the Wrocław University of Science and Technology

_ ALAIN ASPECT, LAUREATE OF THE NOBEL PRIZE IN PHYSICS 2022, along with John F. CLAUSER and Anton ZEILINGER

All three are rewarded for their work on quantum entanglement.

Alain ASPECT is a professor at the *Institut d'optique graduate school*, professor at the *École polytechnique* and honorary researcher at the CNRS. He first completed his doctorate thesis on Bell's inequalities tests with pairs of entangled photons (1974-1983). He then worked with Philippe GRANGIER on wave-particle duality for single photons (1984-86), and then with Claude COHEN-TANNOUDJI on laser cooling of atoms under photon recoil (1985-1992). In 1992, he created the Atomic Optics Group at the Institut d'optique to develop his work on ultra-cold atoms, quantum gases and quantum simulators.

During his career, he has received numerous awards, including the CNRS Gold Medal (2005), the Wolf Prize in Physics (2010), the Balzan Prize for Quantum Information (2013), the Niels Bohr Gold Medal (2013), the Albert Einstein Medal (2013) and the Ives Medal of the Optical Society of America (2013).

Alain ASPECT is one of the founding members of the National Academy of Technologies of France. He is also a member of numerous other academies in France and abroad.

_ 360 MEMBERS OF THE NATIONAL ACADEMY OF TECHNOLOGIES OF FRANCE

(as on 1st January 2023)

ALEXANDRE Laurent • AMALBERTI René • ANDRÉ Jean-Claude • ANDRIEUX Stéphane • APPERT Olivier • ARDITTY Hervé • ARRAS (d') Diane • ARRIBART Hervé • ASPECT Alain • AURENGO André • AVRILLIER Sigrid • BAMBERGER Yves • BARBIER Bernard • BASSET Jean-Marie • BÉCHU Anthony • BECOULET Alain • BELLANGER Maurice • BELLON-MAUREL Véronique • BENCHIMOL Claude • BENHAMOU Éric • BENSAUDE-VINCENT Bernadette • BENSOUSSAN Alain • BENVENISTE Albert • BÉRANGER Gérard • BERGER Geneviève • BERNARD Alain • BERRY Gérard • BERTHOZ Alain • BERTIÈRE François • BERTRAND Guy • BLANQUET Sylvain • BLONDEL Danièle • BOHUON Olivier • BOISSIER Patrick • BOISSIEU (de) Christian • BOISVIEUX Jean-François • BOLIGNANO Dominique • BONHOMME Thierry • BONNEVIE Edwige • BORDÉ Christian • BOST Pierre-Étienne • BOTTI Jean • BOUDET Alain-Michel • BOURDONCLE François • BOURLIOUX Pierre • BRAVO Alain • BRÉANT Christian • BRÉCHIGNAC Catherine • BRETON Thierry • BREVARD Christian • BRINGER Jacques • BRONNER Gérald • BUFFET Patrick • BUSQUIN Philippe • CADIX Alain • CAEN Jacques • CANDEL Sébastien • CANTACUZÈNE Jean • CARISTAN Yves • CARON Patrick • CARREEL Éric • CARSALADE Henri • CARUEL Jacques • CASEAU Yves • CASTAING Laurent • CASTILLON Pierre • CHAMBOLLE Thierry • CHAMEAU Jean-Lou • CHANIN Marie-Lise • CHARENTENAY (de) François • CHARLÈS Bernard • CHARPENTIER Emmanuelle • CHARPIN Jean-Michel • CHENU Claire • CHERBUT Christine • CHEVALIER Jean-Pierre • CHEVASSUS-AU-LOUIS Bernard • CHIARIGLIONE Leonardo • CIARLET Philippe • CITTI Laurent • CLAIR Chloé • CLODIC Denis • COHEN-TANUGI Laurent • COIFFET Philippe • COLOMBANI Pascal • COMTE-BELLOT Geneviève • COSTES Alain • COUDREUSE Jean-Pierre • COURTOIS Michel • COURVALIN Patrice • COUVREUR Patrick • CRÉMIEUX Anne-Claude • CREUZET Gérard • CURIEN Nicolas • DALIBARD Barbara • DANON-ARNAUD Laurence • DAUGERAS Bernard • DAUTRAY Robert • DAUTRY Alice • DELAAGE Michel • DELACÔTE Goëry • DELPUECH Alain • DEMASSIEUX Nicolas • DEMENEIX Barbara • DERIAN Paul-Joël • DESMAREST Patrice • DESMOULINS Christian • DEVAUCHELLE Guillaume • DORDAIN Jean-Jacques • DUBERTRET Louis • DUBOST Bruno • DUCUING Jacques • DUFLO Esther •

DUPUIS Marie-Claude • DUPUY Jean-Pierre • EDWARDS David • ERMAN Marko • ERNOTTE Delphine • ESCATHA (d') Yannick • ESTÈVE Bernard • ÉTIENNE Jean-Louis • EVRARD Didier • EWALD François • FARDEAU Michel • FARGE Yves • FAUGERAS Olivier • FAVRAT Daniel • FEILLET Pierre • FERRIOT Dominique • FERT Albert • FINK Mathias • FLORETTE Marc • FLÜRY-HÉRARD Anne • FOUNTAINE Jean-François • FOURNIER Pascal • FREIDEL Jacques • FRÊNE Jean • FRIEDEL Paul • FROUIN André • GAILLARD Jacques • GALLAIRE Hervé • GALLE Pierre • GASET Antoine • GAST Alice • GAUTHEY Gabrielle • GAYE Henri • GELENBE Erol • GENDRON Corinne • GIGET Marc • GIRAUD Pierre-Noël • GLACHANT Matthieu • GODET Michel • GODINOT Marie Luce • GRENON Thomas • GRUNBERG Georges • GRUNBLATT Gérard • GUILLAUMONT Robert • GUILLOU Hervé • GUILLOU Marion • GUINOT François • HAIGNERÉ Claudie • HAN Zhongchao • HAREN Pierre • HARTMANN Joël • HATCHUEL Armand • HIMBERT Marc • HIS Jean-Jacques • HOUDÉ Olivier • HOULLIER François • HOURCADE Jean-Charles • IRACANE Daniel • JAMET Philippe • JARRY Bruno • JEGO-LAVEISSIERE Mari-Noëlle • JOHNSON Patrick • JOLY Pierre-Benoit • JOUANNO Chantal • JULIA Luc • KAPLAN Daniel • KÉPÈS François • KERVASDOUÉ (de) Jean • KHEDDAR Abderrahmane • KLEIN Étienne • KRAUTTER Jean • LABROYE Georges • LACASSE Suzanne • LAHLOU Saadi • LAMBERT Catherine • LAMBERT Florence • LAMICQ Pierre • LANGLAIS Catherine • LAURENT Caroline • LAROCHE Michel • LARTIGUE Norbert • LE BIHAN Denis • LE BUANEC Bernard • LE GALL Jean-Yves • LE MASSON Pascal • LE PAPE-GARDEUX Claude • LE PECQ Jean-Bernard • LE STRADIC Bruno • LEBLOND Jean-Baptiste • LECLAIRE Jacques • LECOURTIER Jacqueline • LEDERMANN Patrick • LEFAUDEUX François • LEFÈVRE Hervé • LEHMANN Jean-Claude • LEHN Jean-Marie • LENOIR Noëlle • LEPOUTRE Manoelle • LÉVI Francis • LÉVI Yves • LEWINER Colette • LEWINER Jacques • LINTZ-LAMPEL Yannick • LIONS Pierre-Louis • LORIUS Claude • LU Jian • LUCQUIN Denis • LUKASIK Jacques • MACHENAUD Hervé • MAESTRO Patrick • MAGNIN Thierry • MAIGNE Yves • MAINGUY Pierre • MALIER Laurent • MALIER Yves • MALLAT Stéphane • MARBACH Christian • MAREC Jean-Pierre • MARESCAUX Jacques • MARGERIE (de) Victoire • MARSILY (de) Ghislain • MARTIN Claire • MARTIN Jacques-François • MARTIN-NEIRA Manuel • MARTY Alain • MASSE Roland • MASSON-DELMOTTE Valérie • MATLOSZ Michael • MAUREL Olivier • MAZZA Valérie • MEYER Bertrand • MEYNADIER Marie • MEYRAN Michel • MIDLER Christophe • MILLET Jean-Claude • MINSTER Jean-François • MOLINER Jean-Luc • MONSAN Pierre • MONTBRIAL (de) Thierry • MORAND Pascal • MORDCHELLES-REGNIER Georges • MOREAU René • MORETTI Isabelle • MORTUREUX Marc • MOUGARD Sophie • MUDRY François • NAHON Claude • NEUVE ÉGLISE Michel • NOGUÉ François • OLIVIER-BOURBIGOU Hélène • PANET Marc • PAPPALARDO Michèle • PARNIÈRE Paul • PASCAL Gérard • PATÉ-CORNELL Élisabeth • PAVÉ Alain • PAYEN Gérard • PECKER Alain • PÉLATA Patrick • PÉLEGRIN Marc • PELLAN Pascal • PELLENC Roger • PERRIER Pierre • PICINBONO Bernard • PICON Antoine • PILET Charles • PINEAU André • PIRCHER Marc • PLATEAU Brigitte • PLOIX Hélène • POMPIDOU Alain • POSTEL-VINAY Grégoire • POUCHARD Michel • POUYAT Alain • PRADEL Philippe • PROUST Sophie • PUZO Joseph • QUINET Émile • RAMETTE Yves • RANQUE Denis • RAOUL Jean-Claude • RÉAU Régis • REVELLIN-FALCOZ Bruno • RICCIOTTI Rudy • ROBERT-HAUGLUSTAINE Anne-Catherine • ROQUETTE Marc • ROSA Jean • ROUCAIROL Gérard • ROUX Didier • RUELLE Gilbert • SABAH Gérard • SAGUEZ Christian • SAHEB Élie • SAHEL José-Alain • SALENCON Jean • SAMORI Paolo • SANCHEZ Clément • SANZ Germain • SAUNIER Bernard • SCHMIDT Jean-Bernard • SCHMIDT-LAINÉ Claudine • SEBAG Michèle • SEMERIA Marie-Noëlle • SERVAL Thomas • SEVERINO Jean-Michel • SIFAKIS Joseph • SIMON Patrice • SLODZIAN Georges • SMANI Mohamed • SMIRNOV Nathalie • SOUQUET Jacques • SOURISSE Pascale • SPITZ Erich • STERN Jacques • STOUFFLET Bruno • SYROTA André • TAILLANDIER Anne-Sophie • TAMBOURIN Pierre • TARDIEU Bernard • THAUVETTE Alain • THERME Jean • TISSERON Serge • TODT Jean • TOLEDANO Joëlle • TOULHOAT Pierre • TOULOUSE Gérard • TRAMIER Bernard • TRYSTRAM Gilles • VAISSIÈRE Magali • VAN BLADEREN Peter • VAN PETEGHEM Marc • VARDANEGA Roland • VARIN Philippe • VELTZ Pierre • VERNAY Dominique • VERWAERDE Daniel • VIDAILHET Pierre • VIGINIER Pascal • VIGNON Dominique • VIRLOGEUX Michel-Paul • WACK Anne-Lucie • WAGNER Anne • WEIL Thierry • WEISBUCH Claude • WOLTON Dominique • ZAOUI André • ZERHOUNI Elias •

_ IN MEMORIAM

Bernard BIGOT
Elected to the NATF on 9 February 2022

Professor specialised in the fields of energy, high speed computing, microelectronics and medical imaging with transfer of technology to industry. He held various management positions at the École Normale Supérieure in Lyon, the Ministry of Higher Education and Research and the Atomic Energy Commission (CEA). In recent years, he was also the Director General of the ITER international research programme on deuterium and tritium fusion.

POSTHUMOUS TRIBUTE

Symposium in tribute to Bernard BIGOT organised by the Fondation de la Maison de la Chimie in October

Roland GLOWINSKI
Founding member of the NATF

Mathematician specialised in scientific computing. He was a professor and researcher at IRIA, Inria, Pierre and Marie Curie University and École Polytechnique, as well as at many other foreign universities (universities of Jyväskylä in Finland, of Tennessee-Knoxville in the United States, and Ben-Gurion in Israel).

POSTHUMOUS TRIBUTE

Publication of the book *"The response of the chemical industry to the challenges of the next thirty years"* (2021) dedicated to the memory of **Christian COLLETTE**

François GROS
Founding member of the NATF

Biologist and pioneer of cellular biochemistry in France. He was essentially one of the co-discoverers of messenger RNA. He dedicated his research and teaching career to the study of genes and their role in the regulation of cellular functions. He was Honorary Perpetual Secretary of the French Academy of Sciences and Honorary Professor at the Institut Pasteur and the Collège de France.

Jean-Émile LUNEL
Founding member of the NATF

Agricultural engineer specialised in biochemistry and biotechnology. He was director of several departments and scientific advisor at Rhône-Poulenc. In particular, he was the President of the Organisation nationale interprofessionnelle des bio-industries (ORGANIBIO, National Interprofessional Organisation of Bio-Industries), which worked extensively to establish regulations allowing the use of GMO technology for the improvement of fermentation strains and plant varieties. He played an important role in the context of Euro-CASE.

Bernard TISSOT
Founding member of the NATF

Civil mining engineer and geologist engineer, specialised in petroleum geology. He held numerous scientific and management positions in research and development at the Institut français du pétrole (French Institute of Petroleum), of which he was Honorary Director General from 1995. He has dedicated his work to the study of hydrocarbons for a better understanding and use of these energy sources and with the objective of sustainable development and respect for the environment.

POSTHUMOUS TRIBUTE

"Contribution of robotics to the repaired human" conference organised by the French Academy of Sciences, in April in tribute to **Jean-Paul LAUMOND**

THE NEW MEMBERS

This year, the Academy elected **14 new members**, invited to join it on 1st January 2023.

Reception ceremony on 7 March 2023

Alain BECOULET

Head of Engineering at the ITER Organization

"It is a matter of immense pride, and for me, personally, a legacy of our late Bernard BIGOT who accompanied me on my journey to join ITER. The Academy is a fascinating world."

Dominique BOLIGNANO

President and Founder of ProvenRun

"I feel extremely honoured! I have always been passionate about science, technology, innovation and the Academy gives me a new opportunity to put my commitment into action!"

Claire CHENU
Research Director at INRAE and Professor at AgroParisTech

"I am very honoured to be a part of this assembly. I hope to contribute to it with my rather low-tech approach to, among other things, discuss nature-based solutions with you."

Paul-Joël DERIAN
Director of Research, Innovation and Sustainable Development and Member of the Executive Committee of Avril

"I have always enjoyed the exchanges and am impressed by the diversity of skills and resources at the National Academy of Technologies of France. There are sure to be some remarkably interesting discussions!"

"A remarkable diversity in all respects!"

Denis RANQUE
President of the National Academy of Technologies of France

Christine CHERBUT
Deputy Director General for Scientific Affairs at INRAE

"Dear Academicians! You have done me the honour of welcoming me here and, many among you, are my colleagues and friends. Collegiality, mutual aid, loyalty and trust are important values for me!"

Delphine ERNOTTE CUNCI
Chief Executive Officer of France Télévisions

"Mastering new technologies constitutes the core aspect of my job and the communication and media sector. I would be delighted to participate in discussions pertaining to these topics as well as the other fields of the academy that I would be happy to explore."

Marie-Luce GODINOT

Deputy CEO of the Bouygues Group in charge of innovation, sustainable development and information systems

"I have a penchant for technology because it can help overcome the immense challenges that we face today and I would be delighted to discuss these topics!"

Chantal JOUANNO

President of the Commission nationale du débat public (National Commission for Public Debate)

"It is an honour! The question of reconciling technology and society has been a permanent one during my career. We talk a lot about technology but let's also talk about information. Let's make it accessible to the public and let's make ourselves accessible too!"

Saadi LAHLOU

Director of the Institut d'études avancées de Paris (Paris Institute for Advanced Study) and Professor at the London School of Economics

"I am delighted to be among people who I hold in high regard. Over the last two decades, I have been interested in matters pertaining to sustainability. I have developed methods to change behaviour and business models. I hope this can be useful to the Academy."

Pascal LE MASSON

Professor of exceptional rank at Mines Paris-PSL and deputy director of the laboratory in management science (UMR CNRS 9217)

"I thank the members of the Academy and I am happy with this recognition of the research work that I could conduct with my colleagues. This work mainly shows that individual and collective design is all the more inventive and creative as it rigorously mobilises knowledge. I am delighted to be joining an assembly that contributes to reinventing the conceptive sovereignty of our society."

Sophie PROUST

Chief technology officer of Atos

"I am very honoured to join the Academy. Something I have always been passionate about in my R&D work is being at the forefront of digital technologies. Today, this digital technology is everywhere and the challenges are numerous. They are a concentrate of what I think I will find at the Academy."

Paolo SAMORI

Director of the Institute of Supramolecular Science and Engineering of the University of Strasbourg and CNRS (UMR 7006)

"I am very honoured to join the National Academy of Technologies of France. I put this in a broader context: scientists and science have an obligation to develop new ideas and concepts that can drive technologies, to offer concrete solutions to societal challenges."

Philippe VARIN

Vice-president of the Board and Chairman of the France Committee of the International Chamber of Commerce

"I am very proud and honoured to join the Academy. After forty-five years in industry, I am convinced that a strong State is based on a strong economy, which, in turn, is based on a strong industry and strong technologies. The National Academy of Technologies of France is thus vital for our country to make the right choice in terms of the technologies to be developed!"

Pierre VIDAILHET

Chairman of the Housing Committee

"I wish to express the emotion I feel and my ardent desire to contribute to the work of the Academy, particularly in the sphere of housing, and, as regards useful technologies, to their assimilation by the greatest number of people, in a spirit of generous humanism and in the context of an absolute requirement of social justice."

THE SECTIONS AND MISSIONS

Our Academy organises its activities around thematic sections and missions that it has created and adapted to meet the current technological and societal challenges. These are places for questioning and gathering knowledge that is at the heart of academic life (creation of sessions and work groups). The Programme Committee, which is one of the working bodies accompanying governance (refer to page 26), intervenes to structure this work, prepares the Academy's programme and coordinates its implementation.

9 SECTIONS

The current 9 sections have the mission of developing a forward-looking vision of their domain. In particular, they adopt a systemic approach to current issues. Cross-disciplinary approaches between sections or in collaboration with sister academies are encouraged.

FOOD AND HEALTH

Focused on the analysis of the development of technologies that revolutionise the fields of health and food and on their proper use. Artificial intelligence, functional imaging, genetics, databases, platformisation, robotics, etc.; all the technical developments in these fields bring great hope but also raise ethical, economic, ecological, political and societal questions.

President of the section: **Louis DUBERTRET**

Vice-presidents of the section: **Bertrand DAUGERAS, François KÉPÈS, Jean de KERVASDOUÉ, Gilles TRYSTRAM**

CULTURE/LEISURE

Promotes the renewal of the "technical culture" by reflecting on a world of technical objects, its materiality, ingenuity and its future. At the heart of these reflections are the initiatives that seek to develop the technical culture on the web as well as more responsible and sustainable production, consumption and tourism practices.

President of the section: **Dominique FERRIOT**

Vice-president of the section: **Bernadette BENSAUDE-VINCENT**

EDUCATION, TRAINING, EMPLOYMENT AND WORK

It is the link between the technological dimensions and the human and social science dimensions. Skills are an essential lever for employment and economic development, as well as for the modernisation of our administrations. Policies pertaining to initial and continuing training, human resources policy in companies, job and skills forecasting at the level of territories, sectors or branches, are all aspects to be taken into account.

President of the section: **Alain CADIX**

Vice-presidents of the section: **Alain BERNARD, Jean-Pierre CHEVALIER**

ENERGY

Dedicated to the crucial field of energy transition, which is now a core aspect of investments. The energy transition pertains to the production of energy as well as its uses. These are two aspects that must be taken into account in the discussions and the actions to be taken.

President of the section: **Dominique VIGNON**

Vice-presidents of the section: **Isabelle MORETTI, Bernard TARDIEU**

HABITAT, MOBILITY AND CITIES

Explores these areas from the technological/environmental, social/inclusion, economic/industrial perspectives. Habitat, mobility and the city are three domains that are greatly impacted by environmental constraints and technological innovations. These disruptions cover a wide spectrum such as green urbanism, decarbonised or low-carbon construction, robotisation of the construction industry, electrification of mobility, batteries and the components required for autonomous mobility, revitalisation of medium-sized cities, decongestion of cities and accessibility in rural areas.

President of the section:
François BERTIÈRE

Vice-president of the section: **Christophe MIDLER**

DIGITAL

Provides expertise on current and high-potential digital technologies. The fields mainly concern those of artificial intelligence and machine learning, data science and algorithms, the digital transformation of companies, or even the social acceptability of new digital technologies. Issues relating to data sharing are central as in the context of the Gaia-X European cloud project involving the Academy.

President of the section:
Gérard ROUCAIROL

Vice-presidents of the section:
Jean-Claude ANDRÉ, Albert BENVENISTE

ENVIRONMENT AND IMPACTS OF CLIMATE CHANGE

Specialised in technological progress to meet sustainable development goals. Technologies develop for and within the environment. There are many subjects involved, with their associated technological issues, such as waste management, adaptation to natural risks and climate change, fight against communicable diseases, food quality assurance, etc.

President of the section:
Pierre TOULHOAT

Vice-president of the section: **Yves LÉVI**

INDUSTRY AND SERVICES

Analyses the new economic models for the energy, environmental, demographic and digital transitions. The growing deindustrialisation of France reflects a profound change in industry, which has been severely destabilised by the obsolescence of equipment and relocations and which is trying to revive itself thanks to the most innovative technologies (robotics, connectivity, data, materials, telecom, energy and transport networks, etc.), as well as in services and their uses, which are being forced to rapidly adapt to the revolution in digital platforms. There are vital transformations at work where industry and services are converging, coming together or merging.

President of the section:
Dominique VERNAY

Vice-presidents of the section: **Victoire de MARGERIE, Alain POUYAT, Yves RAMETTE**

TECHNOLOGIES, ECONOMIES AND SOCIETIES

Dedicated to reflecting on the characteristics of technical progress and its relationship with the economy and society. The mode of governance of technological development can bring about wealth-generating progress while also being accepted by society and contributing to the climate transition. There are challenges, in particular, like the low productivity gains limiting the increase in purchasing power, the increase in inequalities of all kinds and its connection with the urgency of climate policy, and society's reaction to rapid, at times spectacular, technological changes, which sometimes have more consequences for society than for the economy.

President of the section: **Christian de BOISSIEU**

Vice-presidents of the section: **Olivier APPERT, Corinne GENDRON, Joëlle TOLEDANO**

_ 2 MISSIONS

Our Academy also focuses on the presence of women in the world of technology and reaching out to the youth. Topics that are currently embodied by 2 missions.

TECHNOLOGY AND GENDER DIVERSITY

Carries out actions to strengthen the contributions and visibility of women in the world of technology.

- Ensures the application of the Academy's parity charter
- Develops the "Women in Tech" gallery of portraits of women pursuing careers in technology (refer to our projects subchapter)
- Develops partnerships in order to carry out actions that encourage women to increasingly opt for professions and training in the field of technology


Persons in charge of the mission:
Catherine LANGLAIS
and **Alain BRAVO**

YOUNG PEOPLE AND THE NATIONAL ACADEMY OF TECHNOLOGIES OF FRANCE

Strengthens the link between the Academy and young people.

- Develops partnerships to spread the Academy's work (recently, the Union of Professors of Sciences and Technology for Industry (UPSTI), the magazine dedicated to the future Usbek & Rica, the Association of Museums and Centres for the Development of Scientific, Technical and Industrial Culture (Amcsti))


Persons in charge of the mission:
Claudine SCHMIDT-LAINÉ
and **Philippe JAMET**

_ AT THE HEART OF OUR MISSIONS: BEING A TRUSTED THIRD-PARTY

The National Academy of Technologies of France regularly meets and interacts with external personalities for its work. It serves society, public authorities, elected representatives and companies as a trusted third-party, in line with its motto, to enable discussion and choice.

Our Academy takes up certain topics and examines matters submitted to it. It provides advice to public authorities and decision-makers.

REFERRALS OF THE YEAR 2022

FORWARD PLANNING IN QUANTUM TECHNOLOGIES

Referral of SGPI

Coordination **Gérard ROUCAIROL**

The Academy sheds light on quantum technology, its various applications, deadlines, priorities, the means to be deployed... for the industry.

5G AND 6G MOBILE RADIO TECHNOLOGIES

Referrals of DGE

Coordination **Thierry BONHOMME**

The Academy examines the white paper of the digital infrastructure sector on the environmental issue associated with digital technology and 5G, participates in the selection committees of the Campus Fablab 5G industrial projects, and contributes to relations with industrialists from the telecom sector.

EVALUATION OF THE PUBLIC POLICIES ON ARTIFICIAL INTELLIGENCE

Referral of the Cour des comptes (court of audit)

Coordination **Albert BENVENISTE**

The Academy is requested to participate in the evaluation of the national strategy on artificial intelligence for the 2016-2022 period. It assesses the characteristics and use of AI in the various ecosystems, mainly in industry, the opportunities and the actions to be recommended.

TECHNOLOGICAL POSITIONING OF FRANCE AS REGARDS THE FRANCE 2030 PLAN

Referrals of SGPI (Secretary General for Investment), DGE (Directorate General for Enterprise) and DGRI (Directorate General for Research and Innovation)

Coordination **Denis RANQUE** and **Yves BAMBERGER**

In order to support the development of the plan, the Academy offers a complementary and cross-sectoral view on the developments and priorities pertaining to the different topics.

▶ www.gouvernement.fr/france-2030

NEW GENOMIC TECHNOLOGIES APPLIED TO PLANTS

In the context of exchanges with the Prime minister's Office

Coordination **Bernard CHEVASSUS-AU-LOUIS**

The Academy sheds light on the new genome editing technologies (particularly CRISPR-Cas9), the possibilities and limitations in terms of plant creation and the procedures to authorise and control their deployment in Europe.

The Academy and the academicians are also called upon in the context of reflections and work carried out by third-parties (refer to our work subchapter).

3_ OUR ORGANISATION

_ COMPOSITION OF THE BODIES

The Academy comprises an assembly of elected academicians, managed by an Academic Council, headed by a president who is deputised for by a vice-president and assisted by a general delegate. The governance of the Academy provides instructions about and defines the plan of action pertaining to the work, the academic life and the administrative organisation. The governance is supported by six delegates and four committees that contribute to developing the programme for the domains that pertain to them and lead its implementation. The everyday functioning and activities of the Academy are carried out in conjunction with the team of permanent staff involved in subjects as varied as the academicians' studies and projects, publications, events, management accounting, the organisation of the election process and welcoming new academicians, etc.

GOVERNANCE

Executive body
THE EXECUTIVE BOARD
President, Vice-president, general delegate and former President, with the participation of the Chairman of the Programme Committee.

Advisory body
THE ACADEMIC COUNCIL
Members of the Executive Board, ex-officio members (Chairman of the Programme Committee, Key Competences and Training delegate, International Relations delegate, Communication delegate) and the members elected for this mission.

Deliberating body
THE PLENARY ASSEMBLY
All the academician members.

THE 6 DELEGATES

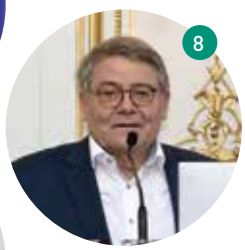
Key Competences and Training
International Relations
Communication
Awards
Publications
South-East Territories

THE 4 COMMITTEES

Working bodies
Programme
Quality
Recruitment
Ethics, Society and Technologies

THE PERMANENT TEAM

Contract staff members, civil servants on secondment (CNRS) and independent professionals supervised by the Director of the Academy.



President
(1) **Denis RANQUE**

Vice-president
(2) **Yves BAMBERGER**

General Delegate
(3) **Paul FRIEDEL**

Former President (2019-2021)
(4) **Pascal VIGINIER**

Chairman of the Prorgamme Committee
(5) **René AMALBERTI**

Chairman of the Quality Committee
(6) **Jean FRÊNE**

Chairman of the Recruitment Committee
(2) **Yves BAMBERGER**

Chairman of the Ethics, Society and Technologies Committee
(7) **Alain BRAVO**

Key Competences and Training delegate
(8) **Alain CADIX**

International Relations delegate
(9) **Gérard CREUZET**

Communication delegate
(10) **Thierry WEIL** (interim 2022),
Manoelle LEPOUTRE (from 1st January 2023)

Awards delegate
(11) **Catherine LANGLAIS**

Publications delegate
(12) **François LEFAUDEUX**

South-East Territorial delegate
(13) **Bernard TRAMIER**

The elected members of the Academic Council are:
Olivier APPERT, Philippe JAMET, Patrick LEDERMANN, Claude NAHON, Dominique VERNAY, Thierry WEIL

Director
Sylvie GOUJON (till 31 December 2022)

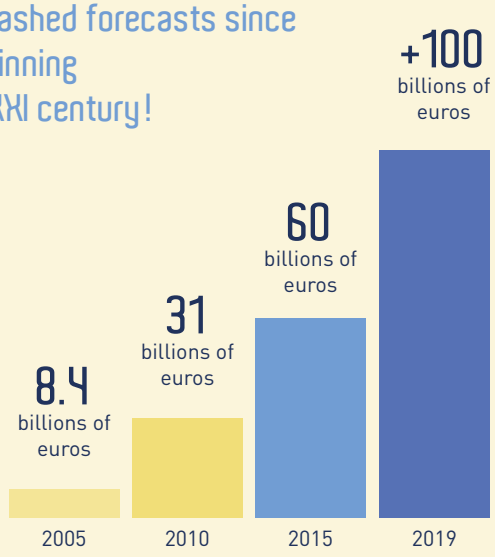
THE NATIONAL ACADEMY OF TECHNOLOGIES OF FRANCE, INTERFACES BETWEEN TECHNOLOGY AND SOCIETY

The Ethics, Society and Technologies Committee strives to draw inspiration from best practices, both abroad and in France, in the field of ethical reflection and to cooperate with similar or complementary bodies. It analyses the repercussions of science and techniques from the point of view of their purposes and impacts on individuals, particularly from a social, economic and environmental point of view and from the perspective of future generations.

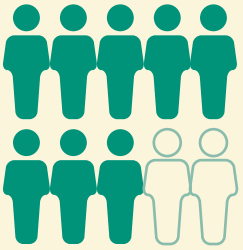
In 2022, the Committee examined the uses of technology in e-commerce.

To be published in 2023!

E-commerce has smashed forecasts since the beginning of the XXI century!



Today, 200,000 direct jobs



more than 8 French persons out of 10 buy products and services online

Source: FEVAD

We can now see that the activity is stabilising with the emergence of loyal purchasing habits. E-commerce also encourages democratisation of the circular economy. However, at the same time, we can see undesirable effects of this mode of consumption on society, resulting from the abuse of technology.

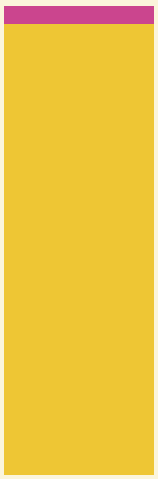
How to reduce or get rid of these negative effects?

Interviewees:
Gilles BON-MAURY, CSR permanent secretary at France Stratégie
François MOMBOISSE, President of the Federation of E-commerce and Distance selling (FEVAD)
David SARRAZIN, Associate Director at AID Observatoire
Jean-Marc STEFFANN, consumer ISD, consumer and digital branch at La POSTE

_ THE BUDGET

2022 BUDGETS/RESOURCES

1,753,679 €



2%
Own resources

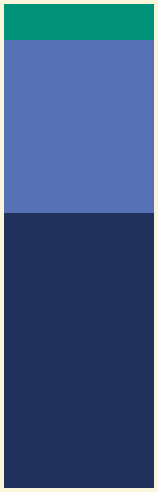
98%
State subsidies

The functioning of our Academy is based on a State subsidy that it receives in the context of its public service mission (under the supervision of the Ministry of Higher Education and Research) and some of its own resources. The Academy also has a partnership with the CNRS that contributes to its functioning by providing three staff members to the permanent team, which thus has around a dozen people.

The expenses are divided between operations, staff remuneration and investment focussing on three heads: academic production, dissemination of technical and technological culture and support functions. They correspond to overheads (staff, premises, IT, etc.) and to the Academy's activities (organisation of seminars and meetings, publications, awards ceremony, etc.). Some symposiums and awards are co-financed by private sponsors who are interested in or concerned by the topic of one of these events and wish to sponsor it.

2022 EXPENSES

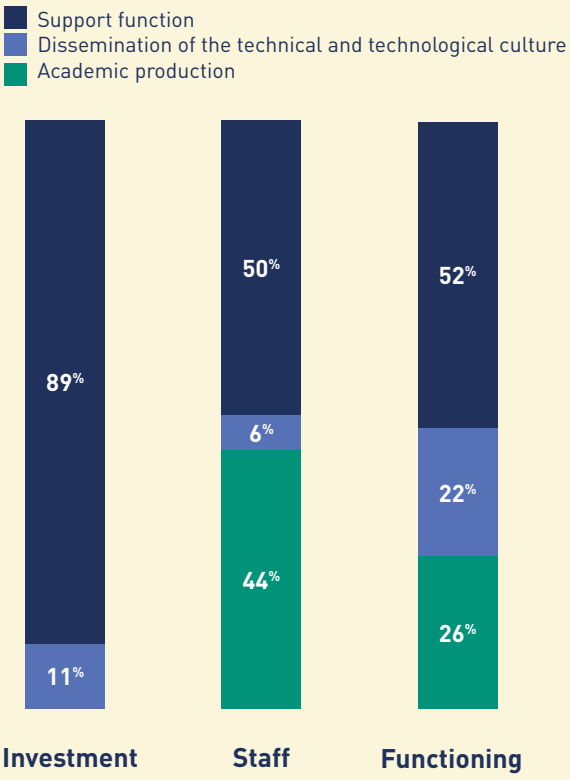
1,733,985 €



68,560 €
Investment

595,353 €
Staff

1,070,032 €
Functioning



II_ ACTIVITIES

1_ OUR WORK

MEETING-DEBATES
(Once a month)

The Academy receives a personality from the political, economic or industrial world.

THEMATIC SESSIONS
(Twice a month)

An academician gives an in-depth presentation of a scientific and technological topic in the presence of several experts.

EVENINGS AT THE ACADEMY (Once a month)

NEW !

This new cycle facilitates a special exchange with one or more academicians who share their knowledge and passion on the subject of their choice. These sessions take place at a later hour in order to be accessible to as many people as possible, especially to those who are still pursuing an active professional life and are less available.

Taking its missions into account, **the National Academy of Technologies of France carries out work in all its domains of expertise and which is supported by a rich and structured academic life.** Its academic work is thus in line with a cross-disciplinary approach of exchanges, research, reflections and meetings that the Academy communicates in various forms.

NEW IN 2022

– THE SESSION REPORTS

This year, the Academy created two series of reports for the **Thematic sessions** and **Evenings at the Academy**.

▶ www.academie-technologies.fr/publications

A session of the Academy

SESSIONS AND CONFERENCES

Academic life is based on sessions and meetings throughout the year. The Programme Committee and the Executive Board structure and organise several cycles of conferences of various formats according to the proposals made by the academicians. The Academy thus receives numerous guests and speakers, which allows it to develop its forward-looking vision. It is here that the academicians exchange and nourish their thoughts. Each year, there is also a seminar on a selected topic and, in the context of its international networks, the Academy participates in events like those of CAETS (Council of Academies of Engineering and Technological Sciences) and Euro-CASE (European Council of Academies of Applied Sciences, Technologies and Engineering) (refer to the sections on our annual seminar, the CAETS and Euro-CASE).

BIODIVERSITY

What is the take-away from the recent One Ocean Summit?
Conference-discussion of François HOULLIER

Erosion of biodiversity: some examples of how economic players are taking it into account
Thematic session organised by Bernard CHEVASSUS-AU-LOUIS and Michèle SEBAG

CYBER

Online communication drift: findings and remedies
Thematic session organised by Nicolas CURIEN

Cybercoercion in the context of the Ukrainian crisis
Conference-discussion of Bernard BARBIER

Cybersecurity
Thematic session organised by Jean-Luc MOLINER

Management of the cybernetic risk and roles of artificial intelligence
Evening at the Academy by Elisabeth PATÉ-CORNELL with Bernard BARBIER

EDUCATION/RESEARCH

Innovative Africa
Thematic session organised by Bruno JARRY and Patrick LEDERMANN

Basic research for society
Meeting-debate with Antoine PETIT, CEO of the CNRS

ZOOM ON

BIODIVERSITY Erosion of biodiversity: what science can say (and not say)

Thematic session organised by **Bernard CHEVASSUS-AU-LOUIS** and **Michèle SEBAG,** with Denis COUVET, Sylvie CRAQUIN, Étienne VERRIER, Denis LALOË and Jérôme ENJALBERT (January 2022)

A quarter of the global mammal biomass is presently made up of humans and, close to three-quarters by domestic mammals. Wild mammals represent only 5-10% of the total. Plant biomass has reduced by 50% over the last two millennia. The current rate of the extinction of species is between 100 and 1,000 times higher than the average rate since life first appeared on Earth, and it is 10 to 100 times faster than any mass extinction in the past. With regard to domestic animal biodiversity, the proliferation of breeds resulting from human selection over time is presently being challenged by a reduction in the variability in both domestic animal populations and within populations. The same goes for cultivated plant species: after a long period of diversification, the appearance of professional breeders has led to a concentration for a few 'elite' varieties by the industry. Basically, there is no doubt about the erosion of biodiversity.

▶ www.academie-technologies.fr/publications/lerosion-de-la-biodiversite-que-peut-dire-et-ne-pas-dire-la-science

ZOOM ON

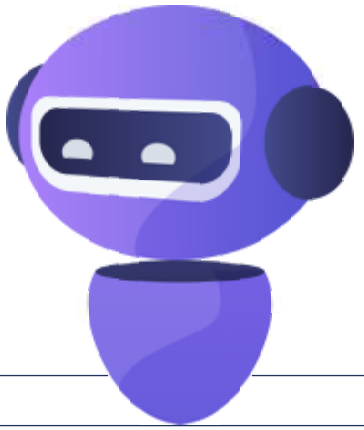
1ST WEBINAR OF THE ACADEMY

The Academy organised its first webinar at the beginning of 2022!

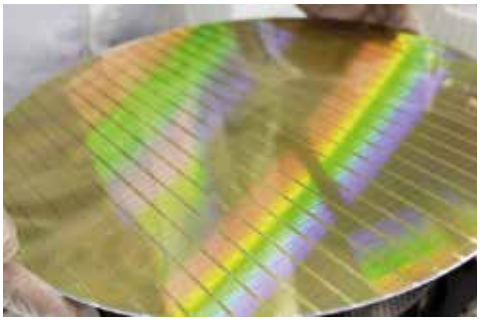
_ CYBER The price of a reliable prediction – how to validate applications of artificial intelligence?

Webinar organised and hosted by **Gérard ROUCAIROL** and **Claude LE PAPE**, with Patrick PÉREZ, Daniel DUCLOS, Julien CHIARONI, Guillaume AVRIN and Luc JULIA (January 2022)

The use of artificial intelligence techniques, and mainly machine learning, enables new applications in numerous domains. However, the validation of these applications raises many questions: how to verify that a learned model is not used outside its domain of validity, that it is not biased, and that its use does not pose any significant problems in terms of reliability, security, or fairness? The objective of this webinar is to explain the potential risks involved, their potential causes and the means available to guard against them.



ZOOM ON



_ ELECTRONIC The semiconductors industry and its future

Thematic session organised by **Gérard ROUCAIROL**, with Alain POUYAT, Joël HARTMANN, Philippe NOTTON, Sébastien DAUVÉ and Thomas ERNST (May 2022)

The semiconductors industry is the kingpin of the huge spread of digital technology and the dissemination of its uses. This market is expected to double by 2030 owing to the doubling of Internet traffic each year, the steady growth of the personal electronics market (smartphones, tablets, e-readers, watches, drones), as well as the shift of the automotive industry towards electric vehicles, and even the emergence of Industry 4.0. Characterised, for a long time, by Moore's law, the pursuit of semiconductor performance involves an increasingly laborious miniaturisation towards 3 nanometre, or even 1 nanometre, nodes, as well as numerous transformations, also associated to the need to reduce energy consumption: the emergence of alternative technologies called More than Moore, new architectures, "personalised silicon", growing interleaving and co-optimisation between soft and hard, fragmentation of the electronic components industry, and a multiplication in the number of fabless manufacturing companies placing orders with founders. Moreover, there also are new challenges of sovereignty related to the shortage of components that appeared during the health crisis and a rapidly changing geopolitical context. This is why, like the other regions of the world, Europe has decided to invest in the revival of the design and manufacture of semiconductor components on its territory, particularly in the strategic field of supercomputers, mainly through the SiPearl start-up.

▶ www.academie-technologies.fr/publications/lindustrie-des-semi-conducteurs-et-son-futur

The strategy of the Inria and its role in the issues pertaining to industrial recovery and development of AI for the future
Meeting-debate with Bruno SPORTISSE, CEO of the Inria

Maths in France (from School to Research): after the catastrophe?
Conference-discussion of Pierre-Louis LIONS

_ ENERGY TRANSITION

Meeting-debate with Chrystel HEYDEMANN, Executive Vice President Europe France operations in Schneider Electric

Future of natural gas
Thematic session organised by Isabelle MORETTI, Marc FLORETTE and Bernard TARDIEU

How to revive general aviation in France using green aviation?
Conference-discussion of Jean BOTTI

The views of the CEA (French Atomic Energy Commission) on decarbonised energy
Meeting-debate with Francois JACQ, General Administrator and President of the Board of the CEA

Batteries in the context of energy transition
Evening at the Academy by Patrick PÉLATA and Patrice SIMON

Meeting-debate with Marie-Noëlle SEMERIA,
R&D director of the TotalEnergies group

_ FOOD

Alternative proteins
Thematic session organised by Gilles TRYSTRAM

_ GENDER/PARITY

Gender stereotypes and systemic barriers associated to education and careers in science
Conference of Elyès JOUINI, Professor of Economics at the Université Paris Dauphine-PSL and UNESCO "Women and Science" Chair holder.

ZOOM ON

_ GREEN TRANSITION Securing raw materials

Thematic session organised by **Pierre TOULHOAT** and **Jean-Pierre CHEVALIER**, with Christophe POINSSOT, Patrice CHRISTMANN, Corinne GENDRON, Bruno JACQUEMIN and Philippe VARIN (April 2022)

Demographic growth, as well as the energy and digital transitions are leading to an explosion in the need for raw materials and their strong diversification, with an increasing use of rare materials. Supply chains are often complex and sometimes dominated by only a few countries. This creates the risk of dependence on mineral resources replacing the dependence on fossil energies. Recycling, even if it is highly developed, will cover only a part of the needs and, even if technological innovations enable replacing certain materials with others that are more widespread, new mines will inevitably have to be opened, including in Europe and in France. Considering the poor image of mining inherited from the past, and also associated with environmental and social damage caused by numerous mines around the world, a prerequisite would be to develop a model of responsible, fair and participatory mining, resulting in a standard certifiable by third-parties, which will also constitute a major element of differentiation internationally. The mining industry must also adopt a more holistic approach consisting of providing materials derived from both recycling and extraction as a solution to environmental problems rather than a source of their perpetual aggravation.

▶ www.academie-technologies.fr/compte-rendu-de-seance-securisation-des-matieres-premieres

_ GREEN TRANSITION

Reading the consequences of the war in Ukraine in terms of industry, technology and consumption
Evening at the Academy by Gérard Creuzet with Thierry de Montbrial, Olivier Appert and Gilles Trystram

The Shift Project
Evening at the Academy by Matthieu Auzanneau with Michèle Pappalardo

Sufficiency
Annual seminar of our Academy (see page 54)

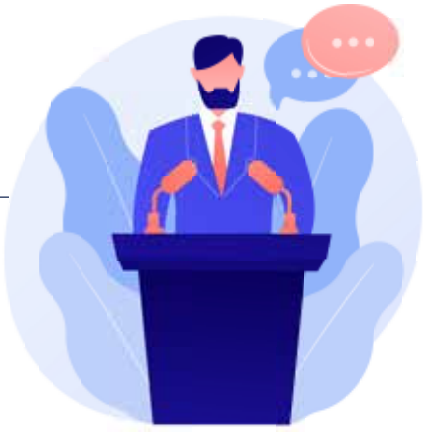
_ PANDEMIC RISK

Covid epidemic: consequences and proposals for the future of our industry
Thematic session organised by Pierre-Etienne BOST, Yves LÉVI and René AMALBERTI

Presentation of the results of the Obépine network
Conference of Christophe GRANTZER, Director of the Laboratory of Physical Chemistry and Microbiology for Materials and Environment

_ SPACE

Micro and nano-satellites: the toysats with new challenges
Thematic session organised by Stéphane ANDRIEUX and Michel COURTOIS



ZOOM ON

_ GREEN TRANSITION How to take into account the very long term and uncertainty in decisions pertaining to public investment? Role of socio-economic assessment (SEA) and public debate

Thematic session organised by **Pierre-Benoit JOLY**, with Julie de BRUX, Reza LAHIDJI and Bernadette BENSAUDE-VINCENT (November 2022)

The socio-economic assessment of the Cigéo nuclear waste deep storage project, followed by a counter-assessment under the authority of the SGPI, illustrates the difficulty of shedding light on public decisions when their impacts are very long-term (in this case, hundreds of thousands of years) and characterised by a high degree of uncertainty (will the future generations be able to maintain the current safety standards?) It raises questions about the interaction between technology and society that go well beyond Cigéo, e.g. how to exercise expertise at the limits of knowledge? What does the long-term future of our societies look like? How far should the interests of future generations be taken into account, and how should they be measured? How can the memory of present decisions be kept for millennia? What role should economic analysis play in public debate? The solutions found to carry out this socio-economic assessment (e.g. bringing out alternative solutions from public debate that can be compared with the examined option; rather than a single reference scenario, defining "envelope scenarios", i.e. the most plausible scenario taking into account the current knowledge (OK) and the worst case scenario (KO); or even varying the discount rate to test the impact of a "preference" for the present or future generations) can be used in the assessments of other long-term projects, mainly those pertaining to fighting climate change or the loss of biodiversity.

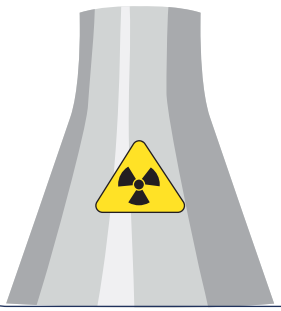
▶ www.academie-technologies.fr/publications/comment-prendre-en-compte-le-tres-long-terme-et-lincertitude-dans-les-decisions-dinvestissement-public

ZOOM ON

_ ENERGY TRANSITION Situation and prospects of small nuclear reactors (SMRs)

Thematic session organised by **Dominique VIGNON**, with Jacques CHÉNAIS, Renaud CRASSOUS, Antoine GUYOT and Mathilde GRIVET (February 2022)

In energy, the fact that more the power increases, more the specific cost decreases - while safety costs vary less - has long explained the trend towards the increase in the size of reactors. However, in parallel with the difficulties encountered with the large reactor series, the development of small reactor projects (Small Modular Reactors) is in full swing, both in terms of R&D as well as pre-industrial and industrial developments. These SMRs have many advantages enabled by the optimisation of the design, which opens up a vast field of possibilities for the safety of the systems, the intrinsic cost of the projects and their social acceptability: high level of passive safety, factory-prefabricated modules, reduced need for financing per constructed unit, simplicity, competitiveness, versatility of use, virtuous management of waste, etc. They also constitute a very promising field for iterative innovation. Several projects are being developed in France; given the time available, the session is limited to the presentation of two of them: the NUWARD SMR and the Jimmy heat-generating small reactor, which has just completed its first round of funding and is a candidate for "France 2030". Both show the dynamism of the nuclear sphere and the renewal of its image.



▶ www.academie-technologies.fr/publications/situation-et-perspectives-des-petits-reacteurs-nucleaires-smrs

ZOOM ON

_ ENERGY TRANSITION How will we get through the energy winter?

Evening at the Academy hosted by **Dominique VIGNON**,
with Olivier HOUVENAGEL and Pierre DUVIEUSART (November 2022)

We tend to focus on electricity when we think about "energy", but gas has a significant importance, especially in winter for heating. And these are, in fact, equivalent quantities in terawatt-hours that circulate in the RTE and GRTgaz networks. The crisis we are facing affects these two energy vectors, as is illustrated by the price changes. It began before the invasion of Ukraine, at the end of 2021, with the post-Covid global economic recovery. Russia being a major player on the global energy scene, the war aggravated the situation. Nevertheless, even if prices shot up since last February, not only because of the loss of Russian gas imports but also because of the low availability of our nuclear park, the storage facilities are full, and France seems capable of meeting the expected gas demand while supporting the electricity system and actively contributing to European solidarity. Even in the worst-case scenario of a very cold winter or cold spells in the second half of the season, we should have no widespread black-out. Our energy distributors have various back-up resources capable of absorbing any shortfalls and can organise limited load shedding. They are, in particular, already counting on citizen mobilisation, an essential lever to improve the security of supply. Combining efforts to restrain and control consumption is also a major asset for moderating price changes.

▶ www.academie-technologies.fr/publications/comment-allons-nous-passer-lhiver-energetique

Tuula TEERI

INTERNATIONAL

Meeting-debate with Tuula TEERI, President of the Royal Swedish Academy of Engineering Sciences and President of Euro-CASE, who presented her academy and its strategy for the coming years
(February 2022)

Johann-Dietrich WÖRNER and Denis RANQUE

Meeting-debate with Johann-Dietrich WÖRNER, President of acatech (Academy of Technologies of Germany), on innovations and development of emerging industries
(April 2022)

Euro-CASE 2022 Conference
From open science to innovation, an engineering challenge for Europe
organised by the two Belgian academies (ARB, KVAB) and celebrating the 30th anniversary of Euro-CASE - see details page 62
(September 2022)

Euro-CASE

International Conference CAETS 2022
Engineering a better world – breakthrough technologies for healthcare
hosted and organised by the NATF in Versailles - see details page 58
(September 2022)

CAETS
International Council of Academies of Engineering & Technological Sciences

2022 was a special year because the Academy organised the CAETS international conference in France. During the Meeting-debates, it also received the presidents of the academies of engineering of Sweden and Germany.

_ THE ACADEMICIANS ARE INVOLVED IN THE INITIATIVES OF OTHER ORGANISATIONS

The National Academy of Technologies of France, through its members in particular, participates in numerous initiatives that are proposed by other organisations in France and abroad. There were many events held this year in Ile-de-France. The Academy also visited Nouvelle-Aquitaine, Auvergne-Rhône-Alpes and even Japan.

March 2022

Fourth plenary session of Gaia-X Hub France, European cloud project for hosting and secure data circulation, co-hosted with the CIGREF, Institut Mines-Télécom, Inria, DGE, Numeum and the Systematic centre

"The hydrogen value chain" symposium organised by Engineers and Scientists of France in the context of national engineers' day 2022 in connection with World engineering day

April 2022

Webinar of our member Erol GELENBE "Energy consumption by information and communication technologies: facts and challenges" organised by Islamabad-COMSTECH

May 2022

Vocations festival supported by the "Les chemins du faire" association and intended for young people with the participation of the National Academy of Technologies of France and the Foundation of the National Academy of Technologies of France

"International and national challenges" round table. Technological, industrial and heritage impact" in the context of the launch of the exploratory priority research programme and equipment (PEPR) "MolecularXIV - Massive data storage on DNA and artificial polymers" organised by the CNRS

June 2022

15th National Meeting of Innovation Directors organised by the European Institute for Creative Strategies and Innovation (EICSI) and the Paris Club of Innovation Directors

"Mechanics, a key to the future" symposium of the Academy of Sciences in partnership with the CNRS, the French Association of Mechanics and the National Academy of Technologies of France

"Les Maisons des Illustres (The Houses of the Illustrious)" symposium organised by the CIMEOS (UBFC) and the EPCC Terre de Louis Pasteur

Geothermal days 2022 organised by the French Association of Geothermal Professionals

Annual symposium of engineering schoolsorganised by the Conference of Deans of French Schools of Engineering (CDEFI)

Management seminar of innovation of the École de Paris du Management organised in collaboration with Mines Paris

August 2022

"Europe in a world of disruptions" symposiumorganised by the Fondation Prospective et Innovation

Back-to-school government seminar on the challenges of climate change

September 2022

The "Cinema and Science" study days organised in the context of the Jean Painlevé exhibition by the Jeu de Paume in association with the National Conservatory of Arts and Crafts

"Science and architecture: the urgency" symposium organised by the Academy of Sciences and the Academy of Fine Arts with the support of Saint-Gobain

October 2022

Annual international symposium of the Science and Technology in Society forum organised in Kyoto in Japan

November 2022

"Challenges of digital professions" seminar organised by the Cnam

December 2022

"Science and society" symposium on the role of education organised by France Universités, the Academy of Sciences, the Foundation La Main à la Pâte and the National Academy of Technologies of France

Second Academy-Industry meetings organised by the Comité National de la Chimie

_ MEETINGS

We thank all our guests for their time and valuable contributions.

Serge ABITEBOUL, research director at Inria and member of the Academy of Sciences

Mohammad AFSHAR, ArianaPharm

Eric ALIX, CEO of RATP Smart Systems

Jean-Eric AUBERT, Fondation 2100

Florian AUGAGNEUR, vice-president of the Cndp (National Commission for Public Debate)

Cécile AUGOR-THEBAULT, director of Naval Group University

Matthieu AUZANNEAU, director of The Shift Project

Gildas AVOINE, head of PEPR (Priority Research Programmes and Equipments) Cybersécurité (CNRS and IRISA)

Guillaume AVRIN, head of the "Evaluation of artificial intelligence" department of the LNE (National Laboratory of Metrology and Testing)

Sabine BATTEGAY, General Association of Maize Growers (AGPM), head of Analysis and Defence of Environmental and Water Issues and FNSEA (National Federation of Agricultural Holders' Unions)

Anton'Maria BATTESTI, head of Public Affairs France at Facebook

Sylvie BÉNARD, president of La Dame à la Licorne

Delphine BERILLOUX, director of talent and skills development in SAFRAN

Gilles BON-MAURY, CSR permanent secretary at France Stratégie

Patrice de BONNAFOS, vice-president of the Community of municipalities of the island of Noirmoutier and president of the Commission "Securing people and property from the sea"

Mathieu BORDIGONI, head of the HVA design office in Enedis

Xavier BOUIS, president of the Commission "Energy and environment" of the French Air and Space Academy

Pascale BOURRAT-HOUSNI, assistant director of territory-society-knowledge in a joint DGES and DGRI department at the Ministry of Higher Education and Research

Alix BOUXIN, specialist in the capture, storage and use of CO_2 in Ademe

Marie BRESSON, diversity and outreach delegate of the École polytechnique

Jean-Noël BRICOUT, head of the "Central Project Authority" team of the Orbital Systems and Applications Department at Cnes

Julie de BRUX, founder of Citizing Consulting and head of the socio-economic assessment of Cigéo

Manuel BURNAND, managing director of the FEDEREC (French Federation of Recycling Companies)

Pierre CAPELLE, industrialisation in Genvia

Bruno CARLOTTI, director of the "Environment" research programme in EDF

Eric CARREEL, Withings

Gaëtan CASANOVA, ISNI

Ilaria CASILLO, vice-president of the Cndp (National Commission for Public Debate)

Thierry CHAMBOLLE, Fondation 2100

Jacques CHÉNAIS, engineer, former director of nuclear propulsion and advisor for the SMRs in CEA and director for engineering at TechnicAtome

Julien CHIARONI, director of the great challenge "Securing, certifying and ensuring reliability of the systems based on artificial intelligence" with the participation of Rodolphe Gelin (Renault), Flora Dellinger (Valeo) and Morayo Adedjouma (CEA)

Patrice CHRISTMANN, independent researcher, former deputy scientific director of BRGM and member of the IRP (staff representative bodies) for the United Nations

Laure CLERGET, director of the ARTEMISE factory of collection and recycling of light sources and president of the industrial ecology club of Aube, France

Jean COLDEFY, advisor to the president of Transdev and director of the ATEC ITS France Mobility 3.0 programme

Anne-Sophie CORBEAU, researcher at the Columbia University

Bruno COURTOIS, INRS (National Institute for Research and Security)

Denis COUVET, professor at the MNHN (National Museum of Natural History) and president of the FRB (Foundation for Biodiversity Research)

Sylvie CRAQUIN, research director at the CNRS

Renaud CRASSOUS, engineer at EDF

Sébastien DAUVÉ, director of the LETI

Ana DAVID, domain of AI for industrial automation and energy management at Schneider Electric

Valérie DAVID, director of sustainable development and cross-cutting innovation in Eiffage

Benoît DECOURT, director of operations at Elyse Energy and manager of the BioTJet project

Serge DEGALLAIX, executive officer of the Fondation Prospective et Innovation

Hovsep DER KEVORKIAN, director of the "Water, climate, waste" operations at Artelia

Paul-Joël DERIAN, VP innovation and sustainable development and director of the incubator of the Avril group

David DERRE, employment and training department of the UIMM

Bruno DESPREZ, scientific director at Florimond-Desprez

Daniel DUCLOS, technical director at the "Digital Science and Technology" research department of Safran Tech

Charles DUPREZ, student researcher in Canada of social responsibility and sustainable development

Jean-Marc DURAND, Basechem Europe Refining director and director of Renewable Fuels Refining and Chemicals Division at TotalEnergies

Etienne DUTHOIT, co-founder and CEO Vital Meat

Pierre DUVIEUSART, deputy managing director of GRTgaz and member of the executive committee

Jérôme ENJALBERT, research engineer at INRAE

Thomas ERNST, scientific director at LETI

Didier EVRARD, Airbus hydrogen propulsion developments

Marc-Antoine EYL-MAZZEGA, director of IFRI's Centre for Energy & Climate

Gwenaelle FLEURY, project head "Water treatment, sanitation and drinking water" at Artelia

Astrid FONTAINE, curator of the exhibition "Industrial evolutions" of the Cité des sciences et de l'industrie

Elisabeth FONTEIX, vice-president learning & development at Orange

Chantal GASCUEL, research director at the INRAE and head of the joint research unit "Soil, agro and hydrosystems, spatialisation"

Thierry GAUDIN, co-founder and honorary president of Fondation 2100

Roger GENET, managing director of Anses, along with Karine Fiore, Brice Laurent and Matthieu Schuler

Patrick GENISSEL, Servier

Pierre GENTHON, research director at IRD Noumea, New Caledonia (HydroSciences Montpellier)

Martin GIARD, scientific delegate for Space Affairs (INSU, National Institute of Sciences of the Universe) of the CNRS

Françoise GOULARD, advisor in charge of research and forward planning at the Adour-Garonne Water Agency

Catherine GOUTTE, president of the board of Ponts Formation Conseil

Jean-Yves GRALL, ARS Auvergne

Paula GRANT, former vice-president of strategy and innovation at GTI Energy

Marie-Laure GRIFFATON, head curator of heritage and director of the scientific department and collections of the Air and Space Museum

Mathilde GRIVET, COO of Jimmy

Valérie GUILLARD, professor at the Paris Dauphine University

Michèle GUIMON, INRS (National Institute for Research and Security)

Kristell GUIZOUARN, director of the new energy strategy of the Avril group and president of the European Biodiesel Board

Antoine GUYOT, engineer and CEO of Jimmy

Frédéric HENDRICKX, expert research engineer in EDF

Jean-Philippe HÉRAUD, process design division at IFP Énergies Nouvelles

Chrystel HEYDEMANN, executive vice president Europe France operations in Schneider Electric

Olivier HOUVENAGEL, director of Power System Economics at RTE (Electricity Transmission Network)

Elisabeth HUBERT, FNEHAD

Francois JACQ, general administrator and president of the board of the CEA

Bruno JACQUEMIN, general delegate of A3M and permanent delegate of the Strategic committee of the field "Mining and Metallurgy"

Patrick JOHNSON, 3DS

Philippe JOUGLA, administrator and president of the FDSEA of Tarn, France

Elyès JOUINI, professor of economics at the Université Paris Dauphine-PSL and UNESCO "Women and Science" Chair holder

Michael A. KOCK, Swiss patent attorney and European patent attorney

Patrick LACHASSAGNE, director of the HydroSciences Montpellier laboratory (IRD/CNRS)

Fabien LAGRIFFOUL, director at the EDF DRH Group

Reza LAHIDJI, associate researcher and chair of "Climate Economics" at the Paris Dauphine University and member of the expert committee for the socio-economic assessment of Cigéo

Denis LALOË, research engineer at INRAE

Philippe LAMOUREUX, managing director of LEEM (professional organisation of pharmaceutical companies)

Thomas LE DOURION, founding director of Impulse Partners

Élisabeth LE HOT, department head and deputy to the managing director of media and cultural industries at the Ministry of Culture

William LECAT, coordinator of the national cybersecurity strategy at the SGPI

Alix LEGOFF, PhD student at LAET

Frédéric LEGROS, Ynsect engineering director

Stéphane LEMARIÉ, agricultural engineer, INRAE

Valérie LEVKOV, vice president Africa, Middle East and Eastern Mediterranean at EDF

Françis LÉVI, Paris Saclay University and AP-HP

Sandra LEYMONERIE COMBET, director of new energy and SAF at Air France KL

Isabelle LITRICO, head of the department of plant biology and breeding, INRAE

Xavier LITRICO, vice-president "Research, science and technology" of the Suez group

Elie LOBEL, RDS

Etienne LOIC, MedVir and Medecine Explorer

Daphné LORNE, department of economics and environmental assessment at IFP Énergies Nouvelles

Nathan MALKA, SYNTHESIS

Ioana MANOLESCU, Inria and LIX, elected president of IEEE

Véronique MARTIN, directorate general for civil aviation, assistant director for sustainable development and ICAO correspondent, accompanied by Ms Nora Susbielle

Séverine MAYO-SIMBSLER, assistant to the head of the department of statistics on research at the Ministry of Higher Education and Research

Nora MEGDER, general delegate of the CME (Confederation of Environmental Professions) and permanent delegate of the Strategic committee of the field "Waste recovery and processing"

Stéphane MICHEL, president - gas, renewables & power at TotalEnergies

Caroline MINI, economist

Laurent MOGNO, president of the ECT group

Philippe MOINGEON, Servier

François MOMBOISSE, president of FEVAD

Nicolas MORIN-FOREST, co-founder and CEO Gourmey

Sylvain NIZOU, deputy programme head "Circular Carbon Economy" at CEA

Philippe NOTTON, CEO of SiPearl

Sylvie PADILLA, industry department head at Ademe

Martin PAILLART, head of the Coastal Observatory of the Noirmoutier Island and coordinator of the SIG

Aurélien PALIX, assistant director of digital networks and uses in the Directorate-General for Enterprise of the Ministry of the Economy and Finance

Frédéric PÂQUES, CEO Standing Ovation

Delia PASTORELLI, director of the desalination of sea water sector of the Suez group

Bernard PÉCOUL, DNID – MSF

Denis PÉLANCHON, managing director of Cartesian Lab

Laure PELLET, director of the national laboratory of hydraulics and environment of EDF R&D

Thomas PELTE, department head "Water resources, environments and the Rhône River" of the Rhone-Mediterranean Corsica Water Agency

Jacques PERCEBOIS, professor emeritus of energy economics at the faculty of Montpellier

Patrick PÉREZ, scientific director of the artificial intelligence laboratory of Valéo

Antoine PETIT, CEO of the CNRS

Lucile PETIT, director of online platforms at ARCOM

Aurélie PICART, general delegate of Nouveaux Systèmes Énergétiques

Jean-Yves POICHOTTE, head of the security of information systems at Sanofi

Christophe POINSSOT, deputy director general and scientific director of BRGM

Gérard de POUVOURVILLE, Essec

Sarah POUYAUD-ELY, "Professional equality and diversity in fields" mission at the Ministry of Higher Education and Research

Tess POZZI, in charge of institutional relations at Derichebourg Environnement

François QUÉRÉ, deputy chief executive officer of the Cité des Sciences et de l'Industrie

Saifur RAHMAN, president of the IEEE

Oualid RAHMANI, head of the coastal management department of the Community of municipalities of the island of Noirmoutier

Rocco RANTE, scientific curator of "The Treasures of Uzbekistan" exhibition and archaeologist at the Islamic arts department of the Louvre museum

Peter ROGOWSKY, plant reproduction and development unit of the INRAE

Grégoire de ROUX, technical director for offshore wind power at EDF Renouvelables

Nicolas de RYCKE, co-founding partner of Axis&Co and teacher at the École de Guerre Économique (school of economic warfare)

Gilles SAINTEMARIE, employment and training department of the UIMM

David SARRAZIN, associate director at AID Observatoire

Edouard SAUVAGE, deputy managing director in charge of infrastructure activities at Engie

Luc SEMAL, lecturer at the National Museum of Natural History

Didier SICARD, physician

Jean-Michel SOUBEYROUX, deputy scientific director of climatology at Météo-France

Jacques SOUQUET, founder and CEO of SuperSonic Imagine

David SOURDIVE, Cellectis

Ariette SOURZAC POLLET, researcher on the management of the strategy for the use of non-conventional water of the Adour-Garonne Water Agency

Bruno SPORTISSE, CEO of the Inria

Jean-Marc STEFFANN, consumer ISD, consumer and digital branch at La POSTE

Tuula TEERI, president of the Royal Swedish Academy of Engineering Sciences and President of Euro-CASE

Alexandre TEMPLIER, Quinten

Frédéric TESTON, head of the space systems engineering department at ESTEC (European Space Research and Technology Centre)

Patrice TOCHON, R&D manager at Genvia

Emmanuel TRA BI, director general of Industry at the Ministry of Trade and Industry of Ivory Coast

Laurent VANDEBROUCK, Chronolife

Philippe VARIN, former president of France Industrie

Étienne VERRIER, professor at AgroParisTech and president of the Ethnozootechnics Society

Thomas VEYRENC, director of strategy at RTE, along with Cédric LÉONARD

Marion VIDEAU, CTO of Quarkslabs

Johann-Dietrich WÖRNER, president of acatech

Jean-François ZAGURY, Cnam

Given its mission to shed light on public debate, the National Academy of Technologies of France holds discussions with and meets representatives of the government, central administrations and other organisations.

PRIME MINISTER'S OFFICE

Benoît DELAUNAY, head of the division for education, higher education, research, youth and sports
Matthieu LANDON, technical advisor for industries, research and innovation

COMITÉ CONSULTATIF RÉGIONAL POUR LA RECHERCHE ET LE DÉVELOPPEMENT TECHNOLOGIQUE DE BRETAGNE (REGIONAL ADVISORY COMMITTEE FOR RESEARCH AND TECHNOLOGICAL DEVELOPMENT OF BRITTANY)

COMMISSION NATIONALE DU DÉBAT PUBLIC (NATIONAL COMMISSION FOR PUBLIC DEBATE) (CNDP)

DIRECTORATE-GENERAL FOR ENTERPRISE (DGE)

Thomas COURBE, managing director

FRANCE STRATÉGIE

Gilles de MARGERIE, general commissioner

INGÉNIEURS ET SCIENTIFIQUES DE FRANCE (IESF, ENGINEERS AND SCIENTISTS FO FRANCE)

Marc RUMEAU, president

MINISTRY OF HIGHER EDUCATION AND RESEARCH

Claire GIRY, director general of Research and Innovation (DGRI)
Sylvie RETAILLEAU, minister

MINISTRY FOR INDUSTRY

Agnès PANNIER-RUNACHER, minister delegate for Industry

MINISTRY OF ECOLOGICAL TRANSITION AND SOLIDARITY

Thomas LESUEUR, general commissioner for Sustainable Development

GENERAL SECRETARIAT FOR INVESTMENT (SGPI)

Bruno BONNELL, general secretary

SIGNATURE OF A COOPERATION AGREEMENT WITH THE FRENCH ACADEMY OF SCIENCES

creating an interacademic liaison committee

THE NATIONAL ACADEMY OF TECHNOLOGIES OF FRANCE AND RAENG **(The Royal Academy of Engineering of the United Kingdom)**

are contemplating future collaborations for research and innovation

_ PROJECTS

Our Academy drives its deliberations and collective projects around its 9 sections and 2 dedicated missions, in collaboration with its sister academies, in France and abroad. The Programme Committee coordinates and follows up on the same based on the proposals of the academicians and the Executive Board. The academicians coordinate their work by means of numerous activities that include monitoring, discussions and interviews. Their reflections and recommendations are expressed in written communication that is made public, e.g. in the form of opinions or even reports.

_ ATMOSPHERE/GREENHOUSE EFFECT

Methane leakage now measured by space techniques

●●●

_ BIOTECH

New production and manufacturing processes for alternative food proteins

●

New genomic technologies applied to plants (referral of the Prime minister's Office)

●●●

_ CULTURAL INNOVATION

Creative and cultural industries

●

_ DIGITAL SYSTEMS

The global transformation of society by digital technology

●

Forward planning in quantum technologies (referral of SGPI)

●●

Evaluation of the public policies on artificial intelligence (referral of the Cour des comptes)

●●

The uses of technology in e-commerce

●

5G and 6G mobile radio technologies (referrals of DGE)

●●

Developing the infrastructure of digital society - cloud networks and virtuous data circulation (referral of the SGPI, DGE and DGRI)

●●

_ EDUCATION

Educational innovations related to the use of digital technologies (EdTech) in higher and vocational education

●

Digital technology for teaching and learning (project of the Directorate of Digital Technology for Education)

●●●

Mathematics, along with science and technology, lay the foundation of the country's future

●●

_ ENERGY TRANSITION

The fundamentals of decarbonizing economies by the Hydrogen vector (co-operation with the Chinese Academy of Engineering)

●●●

For a new European energy policy

●●●

Moving away from dependence on Russian fossil energy

●●●

What developments in the electricity market?

●

Role of hydrogen in a decarbonised economy (updating of a previous publication)

●

● Works started ●● Works in the process of validation or recently validated ●●● Published works (in 2022 or beginning of 2023)

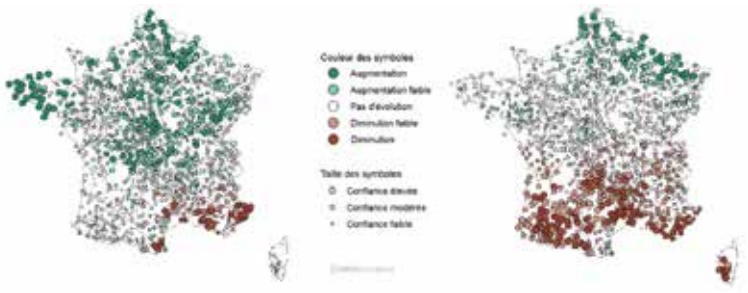
ZOOM ON

_ FRESHWATER #Water scarcity

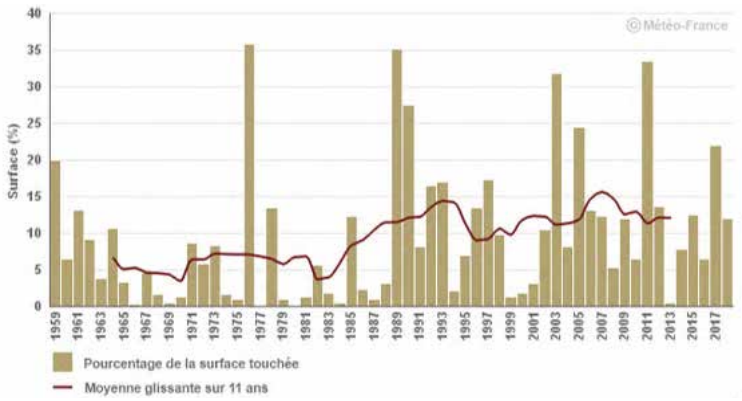
Technological contributions to meet freshwater needs in France in the context of climate change

●● Coordination by the **Environment and Impacts of Climate Change section**

The section carries out work dedicated to the role of technology in meeting the need for freshwater in the face of climate change. It studies the changes in precipitation, snow cover and glaciers, and river flows for the next thirty to fifty years in France. It also takes a look at the development needs in agriculture. Its work highlights a deterioration of conditions that would lead to scarcity of freshwater, with a very uneven distribution across regions. It examines the different technologies that can help resolve these crisis situations and conflicts of use, their advantages and limitations (desalination, use of treated wastewater, storage, dewatering, etc.). A three-step approach is recommended - Diagnosing water bodies and freshwater consumption, identifying possible saving measures and then identifying the technologies to be used. This work relates to the development of a French policy on water and will be presented to the public authorities.



Observed territorial changes in precipitation over the 1961-2012 period, for the two seasons summer (left) and winter (right) in metropolitan France and Corsica. (Météo-France, 2022).



Changes in the annual percentage of the surface of metropolitan France affected by drought from 1959 to 2018. (Météo-France, 2020).

Regional disparities are noticeably clear with an increase in cumulative seasonal rainfall in certain northern areas (North-East, Brittany, Centre) and a decrease throughout the year, which is more marked in the south (particularly, the South-East and Corsica) and leads to difficulties in refilling underground and surface reserves. In climate projections, these trends continue as the level of global warming increases, with the addition of significant inter-annual variability. Observations show a worsening of soil surfaces in drought and composite events combining a rainfall deficit and very high temperatures tend towards a rapidly intensifying drought.

Interviewees: Sabine BATTEGAY, Bruno CARLOTTI, Hovsep DER KEVORKIAN, Gwenaelle FLEURY, Chantal GASCUEL, Pierre GENTHON, Françoise GOULARD, Frédéric HENDRICKX, Philippe JOUGLA, Patrick LACHASSAGNE, Xavier LITRICO, Delia PASTORELLI, Laure PELLET, Thomas PELTE, Jean-Michel SOUBEYROUX and Ariette SOURZAC POLLET

The reference price of CO_2 (updating of a previous publication)

Inter-seasonal heat storage

Measurement of the productivity applied to the energy sector

For the renewal of the French nuclear industry (referral of the SGPI, DGE and DGRI)

For the development of industrial production of photovoltaic panels in France and Europe (referral of the SGPI, DGE and DGRI)

_ EROSION OF COASTLINE

Receding coastline and the effects of climate change: what role does technology play?

_ HEALTH

Technologies and access to healthcare

Public policies on prevention and control of tuberculosis (co-operation with the National Academy of Medicine, the Chinese Academy of Engineering and the Chinese Academy of Medicine)

_ INDUSTRY OF THE FUTURE

Decarbonisation of heavy industry

Digital transformation of industry and services

Jobs for the "reindustrialisation" of France

Innovations in industry and services and changes in their ecosystems

A new paradigm for the industry: customisation of semiconductors, an opportunity towards more European sovereignty! (referral of the SGPI, DGE and DGRI)

ZOOM ON

_ DIGITAL SYSTEMS #Circuit, quantum, polymer

The supporting hardware technologies of the future digital world. Three questions

Authors: **Joël HARTMANN, François KÉPÈS, Alain POUYAT, Gérard ROUCAIROL, Boris BOURDONCLE** (academic affairs officer)

A working group of the Digital section has published its work on the issues relating to medium-term industrial feasibility of three types of hardware technologies: circuits integrated on silicon, quantum computing and data archiving on DNA-type polymers. The development of digital processing devices specific to applications is a promising way to overcome the slowdown in the miniaturisation of integrated circuits while providing Europe with new opportunities for innovation and independence. Abandoning the versatility of hardware digital devices could then lead to breaking the principle of hardware/software independence that constitutes the base of the enormous development of digital technology over the last fifty years.

▶ www.academie-technologies.fr/publications/les-technologies-materielles-supports-du-numerique-futur-trois-questions

ZOOM ON

_ ENERGY TRANSITION #Sustainable Fuels

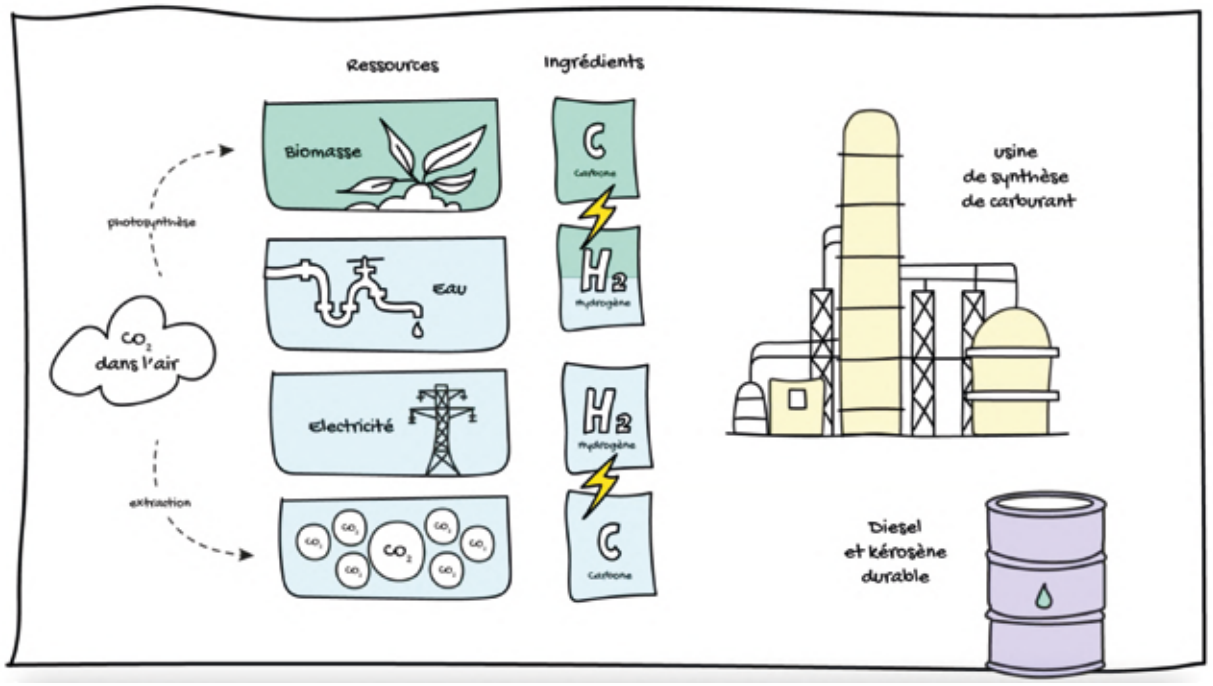
The decarbonisation of the air sector by the production of sustainable fuels

●●● Carried out by **Daniel IRACANE** and **Patrick LEDERMANN**

A working group conducted a technical and economic study on the decarbonisation of aviation through the large-scale production of sustainable fuels, which was the main component of this decarbonisation. It examined the preliminary steps of an energy and industrial policy through the role of biomass and low-carbon electricity in the production of bio-kerosene and synthetic kerosene. Owing to its decarbonised electricity mix, France is one of the rare countries that can consider the deployment of such an industrial sector on a significant scale in the next decade. A significant increase in the production of decarbonised electricity will then be needed by 2040-50. In the context of the decarbonisation of aviation, and, on the whole, society, the production of sustainable fuels thus appears possible and desirable. This study was presented at a thematic session of the Academy in February 2023 and will lead to the publication of an opinion and then a report.

Interviewees: Xavier BOUIS, Benoît DECOURT, Paul-Joël DERIAN, Jean-Marc DURAND, Kristell GUIZOUARN, Jean-Philippe HÉRAUD, Florence LAMBERT, Sandra LEYMONERIE COMBET, Daphné LORNE, Véronique MARTIN, Stéphane MICHEL, Sylvain NIZOU and Thomas VEYRENC

Decarbonising air transport by a ratio of 10 to 1, without jeopardising airport infrastructure and the current and future fleets, is possible thanks to sustainable aviation fuel (SAF). France will thus be able to produce the 6 million tonnes of sustainable kerosene it will need in 2050.



▶ www.academie-technologies.fr/publications/la-decarbonation-du-secteur-aerien-par-la-production-de-carburants-durables-rapport-et-avis

ZOOM ON

_ ENERGY TRANSITION #French strategy on energy and climate

Energy sufficiency or new technologies

●●● Carried out by **Dominique VIGNON**

The Academy has submitted two opinions in the context of public consultations of the Ministry of Ecological Transition, which mainly lament the fact that new technologies and sufficiency are pitted against each other, as the latter alone cannot ensure the decarbonisation of economies. Leaving fossil fuels leads to a considerable increase in the demand for electricity. Renewable energies will not be enough to meet this need and nuclear power is indispensable. All technologies must be mobilised. France has a very limited carbon budget and it must accelerate the reduction of its emissions. It is urgent to take action. Certain technologies are essential as regards the capture and storage of CO_2, or even to generate electricity from fissile mineral resources. These operations also take into account the quantitative limits of biomass, the potential contribution of surface geothermal energy, the energy levelling of old buildings, the positive prospects of electric mobility, etc.

There is an urgency to reduce the greenhouse gas emissions quickly in order to limit the global warming to less than 1.5°C by 2050. Sufficiency and technical progress are complementary. All technologies are necessary and the price of the avoided carbon emissions for each of them must be the criterion for selection.

▶ www.academie-technologies.fr/publications/concertation-nationale-sur-le-mix-energetique-contribution-de-lacademie-des-technologies

_ SOCIETY/CONTROVERSIES

Social acceptability of technologies

●

_ SUSTAINABLE CAR AND CITY

Research pathways for the development of recycling in a circular dynamic: what conditions for an increase in power in the construction industry and sustainable city? (cahier Futuris, ANRT project)

●●●

ZOOM ON

_ SUSTAINABLE CAR AND CITY #Circular economy

Recycling: towards efficient industrial systems for an effective green transition

●● Coordination **Michael MATLOSZ**

An inter-section working group studied the industrial and regulatory organisation in the field of recycling, and more particularly the recycling of waste from private individuals. This work highlights the salient elements of industrial systems that are indispensable for the effective attainment of national and European recycling objectives. It proposes recommendations in the domains of packaging, plastics and composites, electrical and electronic equipment and the construction industry. Its report is brought to the attention of political, technological and industrial decision-makers and is more broadly intended for the public. It was presented during the second Academy-Industry meetings of the Comité National de la Chimie of December 2022.

Interviewees: Manuel BURNAND, Laure CLERGET, Nora MEGDER, Tess POZZI

Comparison of strategies to achieve the target of net zero emissions by 2050 in the automobile and building sectors

●

French policy on energy renovation, particularly in terms of thermal insulation of housing

●●

Decarbonisation of the automobile sector (co-operation with acatech)

●

A FEW OTHER PARTICIPATIONS OF THE ACADEMY

Our Academy and our members are involved in other committees and think tanks led by third-parties.

Science and technology plan for the continuing education of schoolteachers of the Ministry of National Education in which the Academy of Sciences also participates

France 2030 Plan: 8 individual members of the Academy participate in the governance of the plan that promotes a constant exchange between the State and the ecosystems setting the 10 major objectives and the 5 identified levers.

- Spatial: **Stéphane ANDRIEUX** and **Magali VAISSIÈRE**
- Electronics and robotics: **Joël HARTMANN**
- Digital technology: **Luc JULIA** and **Catherine LAMBERT**
- Training and education: **Alain CADIX**
- Agriculture and agri-food: **Marion GUILLOU**
- Transport: **Guillaume DEVAUCHELLE**

National plan for the development of quantum technologies steered by Neil Abroug, national coordinator of the acceleration strategy for quantum technologies at SGPI

Input on the organisation by the Cndp (National Commission for Public Debate)of a **public consultation on the French energy system**

Academy of Sciences:

- **The Foundation La main à la Pâte**: scientific and pedagogical council, administrative council, awarding of the Foundation's prize, "Les Maisons pour la Science (Houses for science)" project
- **"Science and Biosafety" committee**: "Laboratory accidents" working group
- **"Open Science and Evaluation" committee** for a transparent and meticulous evaluation of researchers and their teams

_ YOUNG WOMEN IN SCIENCE AND TECHNOLOGY

Carried out by Catherine LANGLAIS and Alain BRAVO

The "Technology and Gender Diversity" mission works along three specific lines:

1. **developing the Academy's practices toward parity in all its activities,**
2. **analysing the obstacles encountered in attracting women to scientific and technical domains and identifying the possible levers,**
3. **and getting more young women to pursue careers in technology.**

The mission consults with various people to shed light on the obstacles encountered by young women throughout their educational and professional journeys.

Persons met:

• **Delphine BERILLOUX**, director of talent and skills development in SAFRAN (actions as regards parity and access to positions of responsibility for women)

• **Pascale BOURRAT-HOUSNI**, assistant director of territory-society-knowledge in a joint DGES and DGRI department at the Ministry of Higher Education and Research

• **Marie BRESSON**, diversity and outreach delegate of the École polytechnique (actions to increase the number of candidates seeking to enter the school, their integration and their well-being as students)

• **Elyès JOUINI**, professor of economics at the Université Paris Dauphine-PSL and UNESCO "Women and Science" chair holder.

• **Séverine MAYO-SIMBSLER,** assistant to the head of the department of statistics on research (information systems and statistical studies) at the Ministry of Higher Education and Research

• **Sarah POUYAUD-ELY,** "Professional Equality and Diversity in Fields" mission at the Ministry of Higher Education and Research

_ The Women in Tech gallery

The mission regularly adds to the *"Women in Tech" gallery*, created in 2021, that seeks to encourage young girls to pursue careers in science and technology. The gallery showcases inspiring women, each sponsored by a member of the Academy, who share their visions and experiences.

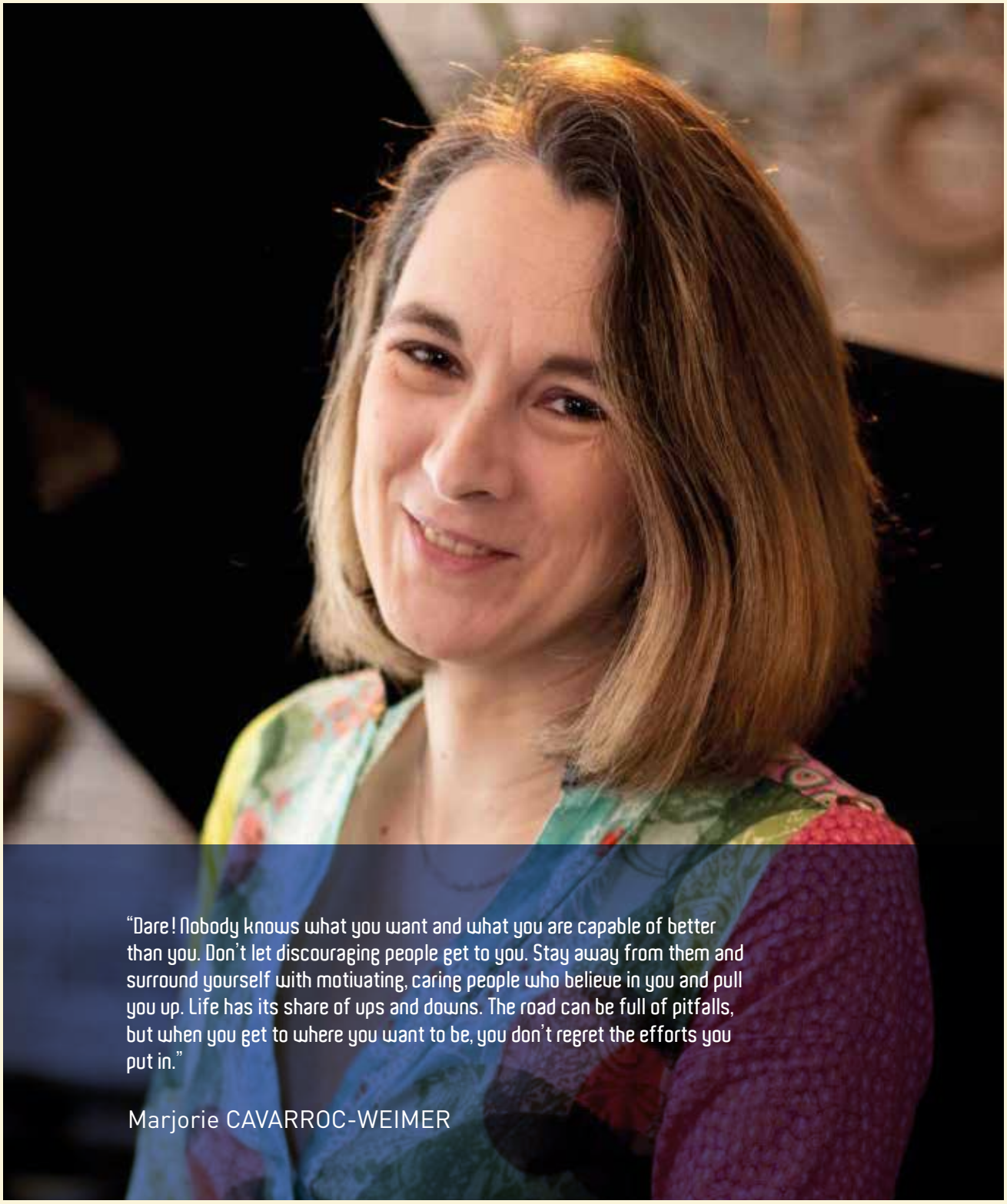
It now features more than 35 portraits.

20 new portraits this year!

Teacher, executive assistant, welder, engineer, researcher, entrepreneur, airline pilot...!

▶ www.academie-technologies.fr/femmes-de-tech

We warmly congratulate **Marjorie CAVARROC-WEIMER** who received the prestigious Irène Joliot-Curie award in the *"Woman, Research and Enterprise" category*. Marjorie CAVARROC-WEIMER is an expert in materials and processes, a research engineer at Safran Tech and an operational reserve officer in the Government armaments agency. You can read her full profile on our page.



"Dare! Nobody knows what you want and what you are capable of better than you. Don't let discouraging people get to you. Stay away from them and surround yourself with motivating, caring people who believe in you and pull you up. Life has its share of ups and downs. The road can be full of pitfalls, but when you get to where you want to be, you don't regret the efforts you put in."

Marjorie CAVARROC-WEIMER

THE ANNUAL SEMINAR

Opening of the annual seminar by René Amalberti, chairman of the Programme Committee

Our Academy organises a thematic seminar every year with the encouragement of the Programme Committee. It mobilises all the sections over several months through a round of conferences and round tables that prepare for the seminar day held in the fall. The Academy publishes its outcomes in different forms.

The topic of 2022 is sufficiency and, more specifically, the role and/or impacts of technology as regards what is a compelling direction for the future years. **The Academy has thus pondered on the emergence of the concept of sufficiency in the face of the challenges of climate change** and mainly as regards ecology, on the forced and short-term shortages of energy and raw materials (especially food) associated to the conflict in Ukraine, and more globally on the emergence of a political concept of chosen sufficiency, echoing the growing willingness of the population to change in terms of consumption till changing the model of society as a whole.

> The urgency of deadlines requires combining the approaches of efficiency and sufficiency.

This round of work fed and inspired internal discussions around the first written contributions that continued after the seminar.

THE ANNUAL SEMINAR IS

+6 months of exchanges
from May to October

5 round tables and conferences

4 guests

- **Matthieu AUZANNEAU**, director of The Shift Project
- **Charles DUPREZ**, student researcher of social responsibility and sustainable development (Canada)
- **Valérie GUILLARD**, professor at the Paris Dauphine University
- **Luc SEMAL**, lecturer at the National Museum of Natural History

8 thematic preparatory notes

1 day of seminar
bringing together all the academicians


Olivier APPERT


Gérard ROUCAIROL


Dominique VIGNON


Gérard CREUZET


Aurélie PICART, general delegate of New Energy Systems


Jean-Luc MOLINER


Pierre TOULHOAT

The 2022 seminar was held on 12 October, at the Hôtel Le Marois, Paris 8th.

Bernard CHEVASSUS-AU-LOUIS

Christian de BOISSIEU

Sufficiency, changes in our consumption behaviour, complements efficiency, which consists in doing better with less and is a constant driving factor in the progress of companies The challenge is to combine all measures and daily practices that make it possible to limit the greenhouse gas emissions as well as the use of materials, space and water, while ensuring the well-being of all within the limits of keeping the planet liveable. Sufficiency is necessary for progress and progress for sufficiency.

A SPECIAL PUBLICATION
compiling these reflections
and the recommendations of the Academy
is scheduled for 2023!


Christophe MIDLER


Marion GUILLOU


René AMALBERTI

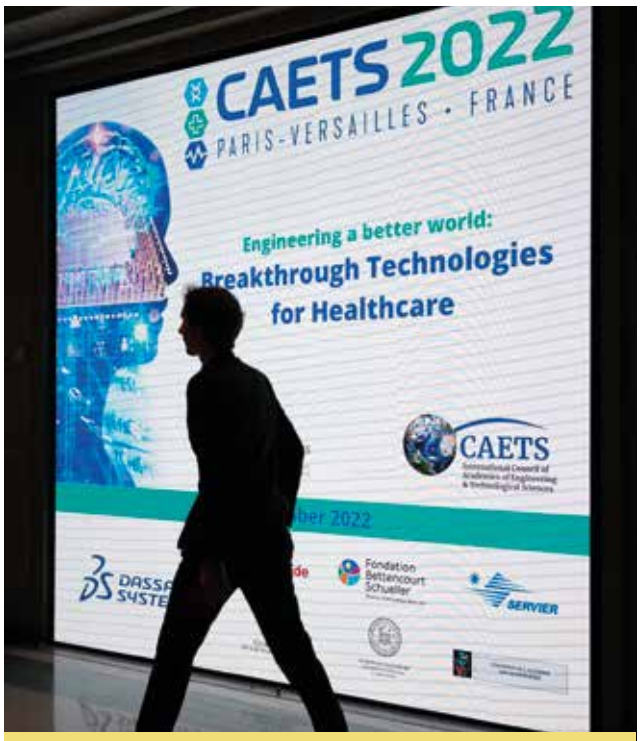

Nicolas DEMASSIEUX

The challenge is to combine all measures and daily practices that enable limiting the greenhouse gas emissions.

Sufficiency in behaviour is often based on technical, societal and organisational innovations. Technological progress enables consumption reductions and decarbonisation, but the existing or developing technological innovations will probably not be deployed on a large scale at the speed needed to attain the set targets, and a change in consumption behaviour is required. Behaviour results from complex interactions between the social context, education, incentives, regulations, norms, prices as well as the structuring of time and space, infrastructure, work organisation and representations. This systemic character and the need to deal with this as a whole are emphasised.

The sufficiency required to avoid the unavailability of resources and to limit climate change also influences the pursuit of progress, which is not reduced to market production. Otherwise, we can expect considerable regression in human development in many spheres such as health, food, mobility, etc. Therefore, individual and collective choices must take various concerns into account: climate change, erosion of biodiversity, poverty, inequalities of opportunity and access, pollution, etc. A better understanding and quantification of the direct and indirect impacts will make it possible to make acceptable decisions (with the least drawbacks) and to define measurable progress objectives. As regards technological choices, discernment is vital in terms of their benefits, costs and risks for the community: the existence of a viable market cannot guarantee that an innovation is suitable. Efforts must be shared equitably.

_ THE CAETS



The Annual International Conference on 27 and 28 September 2022 was organised by France at the Palais des Congrès de Versailles.

The Council of Academies of Engineering and Technological Sciences (CAETS) creates a network of the academies of technology from around 30 countries across the globe. For our Academy, which is a major player, this is fertile ground to develop its international relations and strong, global actions at the global scale.

Every year, the CAETS meets during its conference, which is organised by a different host academy. **In 2022, the National Academy of Technologies of France hosted and organised this conference in Versailles on the topic*Engineering a better world – Breakthrough technologies for healthcare*.**

The edition was focused on several sessions:

- Emerging technologies for innovative treatments and drug discovery (session 1)
- Information and Communication Technologies for Biology and Health (session 2)
- Disruptive technologies and global R&D trends(session 3)
- Virtual brain (session 4)
- Technologies for repair - Repairing the human body (session 5)
- Ethics and societal impacts of technological breakthroughs (final session)

A real success, eventful and of the highest level. Fruitful exchanges !

Gérard CREUZET, president of the organisation and steering comittees of the 2022 conference

ROUND TABLES

Session 1: Thomas CLOZEL, Melissa MOORE, Patrick COUVREUR

Session 2: Egidio d'ANGELO, Sushmita MITRA, Kristin LAUTER, Erol GELENBE, Patrick JOHNSON

Session 3: G. K. ANANTHASURESH, Mathias FINK, Denis LE BIHAN, Carmel HILLYARD

Session 4: Randy MCINTOSH, Sridevi SARMA, Viktor JIRSA, André SYROTA

Session 5: Serge PICAUD, Stéphanie LACOUR, Zhong CHAO HAN, Bruno JARRY

Final session: Christiane WOOPEN, Thierry MAGNIN, Virginia DIGNUM, Patrick COUVREUR, Alison NOBLE, Claudie HAIGNERÉ

It was the chance for more than twenty member countries to meet face-to-face for the first time since the pandemic period, to revive exchanges and plan future collaborations.

The representatives of the different academies attending the conference

With the exceptional intervention of two personalities from the French political sphere:

- **Sylvie RETAILLEAU**, minister of Higher Education and Research
- **Thierry BRETON**, European commissioner for the Internal Market and member of the National Academy of Technologies of France

Keynote address by Christiane WOOPEN

"TOWARDS LOW-GHG EMISSIONS FROM ENERGY USE IN SELECTED SECTORS"

The *"Energy"* work group presented its report, which was the outcome of two years of work. Under the direction of Yves Bamberger, vice-president of the National Academy of Technologies of France, this work resulted from the unprecedented collaboration of a large majority of member academies of the CAETS. It provides a **perspective on the decarbonisation of the most emissive energy consumption in areas such as sustainable cities and buildings, the iron and steel industry, the oil industry, food industry and agriculture**... Sustained R&D efforts should help to find new solutions to attain these objectives. However, the necessary changes also have economic, industrial, and even environmental and societal dimensions.

This report is submitted, early in 2023, to the public authorities and the players in the energy field of different countries.

Watch all the conferences on our YouTube channel

▶ youtube.com/user/AcademieTechnologies

This conference was organised with the support of the Foundation of the National Academy of Technologies of France, in partnership with Dassault Systèmes and thanks to our sponsors Air Liquide, the Club de Paris des Directeurs de l'Innovation (Paris Club of Innovation Directors), the Bettencourt Schueller and Servier Foundation.

_ EURO-CASE

Euro-CASE is an association of the academies of technology and engineering of twenty-three European countries and of which the National Academy of Technologies of France is one of the founding members. It functions around working platforms that specialise in the given work themes.

The Euro-CASE conference is held each year and is organised by a member academy. The **2022 conference marked the 30th anniversary of Euro-CASE.** It was organised by the two Belgian academies (ARB, KVAB) in Brussels on 19 September on the topic *"From Open Science to Innovation, an Engineering Challenge for Europe"*.

- President: **Tuula TEERI** (Royal Swedish Academy of Engineering Sciences, Sweden)
- Vice-president: **Eloy ÁLVAREZ PELEGRY** (Real Academia de Ingeniería, Spain)
- General secretary: **Patrick MAESTRO**, member of the National Academy of Technologies of France
- Treasurer: **Ric PARKER** (Royal Academy of Engineering, England)

_ "FRONTIERS OF ENGINEERING" PROJECT

Euro-CASE organises with the American Engineering Academy (NAE) exchange cycles aimed at bringing together young European and American engineers and scientists, from industry, universities and other research institutions, and thus encourage the transfer of knowledge and interdisciplinary methodologies and collaborative networks. The 2022 symposium was organised with the Slovenian Engineering Academy (IAS) in Bled, Slovenia, focussing on four topics: post-lithium batteries, artificial intelligence and prosthetics, supply chain/logistics and sustainability in buildings.

▶ www.naefrontiers.org

"CHALLENGES FOR EUROPEAN SCIENCE AND TECHNOLOGY DRIVEN INNOVATION IN EUROPE"

The working group chaired by Erol Gelenbe, member of the National Academy of Technologies of France, which reviews the elements of the journey from research to innovation in Europe, publishes its report this year.

▶ www.euro-case.org/wp-content/uploads/Eurocase/Publications/PDF/ReportEuro-CASE2_260722.pdf

_ SAPEA

Launched in 2016, the Science Advice for Policy by European Academies (SAPEA) relies on the collaboration of several European academic networks, including Euro-CASE. SAPEA seeks to bring together the independent scientific expertise of European academies (about a 100 in around 40 countries). It is part of the scientific advisory mechanism of the European Commission, which funds it through the Horizon Europe mechanism. SAPEA is renewed until 2024.

This year, it publishes two reports in which our Academy collaborated: *"Improving cancer screening in the European union"*, which presents the real potential of tests and new technologies for multicancer screening, and *"Strategic crisis management in the EU"* that promotes training and the development of standards to guide risk management, decision-making and information sharing.

▶ sapea.info/wp-content/uploads/cancer-screening-report.pdf

▶ sapea.info/wp-content/uploads/crisis-management-report.pdf

2_
OUR AWARDS AND COMPETITIONS

Each year, our Academy awards and contributes to the awarding of numerous awards for technological work. These distinctions seek to promote the dissemination of knowledge in the domain of technology and particularly to encourage young people, especially young women, to pursue careers in science and technology. These initiatives are at the heart of the missions of the Academy.

THE GRAND AWARDS

Each year, our Academy presents its Grand Awards (les Grands Prix) dedicated to encouraging, supporting and promoting young innovative companies in specific industrial sectors. They are organised in partnership with the Foundation Arts & Métiers (arts & crafts), the Foundation of the National Academy of Technologies of France and Bpifrance.

The 2022 edition honoured startups in the domain of health during a ceremony organised on 16 November at the EDF Group Foundation.

Bruno JARRY

The programme includes a round table *"The medtechs in France"* followed by the award ceremony with our academicians, **Yves BAMBERGER** (vice-president of the Academy), **Anne-Claude CRÉMIEUX**, **Bernard DAUGERAS**, **Alice DAUTRY**, **Louis DUBERTRET**, **Bruno JARRY** (president of the Foundation of the National Academy of Technologies of France), **Catherine LANGLAIS**, **Patrick LEDERMANN, Jacques LEWINER, Denis LUCQUIN, Pierre MONSAN, Thomas SERVAL, André SYROTA** and **Dominique VERNAY**, as well as several invited personalities:

- **Sandra CLAVEAU**, health sector manager at Bpifrance
- **Patrice DEBRÉ**, professor emeritus of immunology at Sorbonne University and member of the National Academy of Medicine
- **Charles DEHELLY**, president of the Foundation Arts & Métiers
- **Rosalie MAURISSE**, head of the health sector of the department for innovation at Bpifrance
- **Yves RÉMOND**, director of the Institute of Technologies for Health of AVIESAN
- **Roxane SPINARDI**, head of health project, DGE, MEFSIN

André SYROTA


"The medtechs in France" round table: Bruno JARRY, Louis DUBERTRET, Thomas SERVAL, Denis LUCQUIN, Roxane SPINARDI, André SYROTA

THE LAUREATES

The Grand Awards, presented by Yves BAMBERGER and Charles DEHELLY, was given to **RDS (Rhythm Diagnostic Systems)** for its MultiSense® connected digital medical device for remote cardiac and respiratory monitoring of post-surgical patient. It received €15,000.
▶ rdsdiag.com

Also **rewarded**:

AVATAR MEDICAL, French developer of software solutions for 3D surgical planning.
▶ avatarmedical.ai

and **LATTICE MEDICAL**, at the origin of a breakthrough technology in the sphere of breast reconstruction
▶ www.lattice-medical.com

each of whom received €7,500.

Charles DEHELLY and Elie LOBEL, CEO of RDS

" We are extremely honoured to receive this award, which recognises the work of an exceptional team, consisting of young men and women of high quality, with expertise and know-how that are highly complementary and required for our approach to both hardware and software."

Elie LOBEL (RDS), laureate of the Grand Award

▶ www.academie-technologies.fr/grands-prix-de-lacademie-des-technologies-2022-les-startups-recompensees

Charles DEHELLY and Yves BAMBERGER gave AVATAR MEDICAL and LATTICE MEDICAL their award.

– OUR PARTICIPATION IN OTHER AWARDS

_ THE IRÈNE JOLIOT-CURIE AWARD

▶ www.enseignementsup-recherche.gouv.fr/fr/prix-irene-joliot-curie-89451

Created in 2001 by the Ministry of Higher Education and Research, **it promotes the place of women in research** and highlights the exemplary careers of women in science. Members of the Academy of Sciences and the National Academy of Technologies of France form its jury.

For this 21st edition, the *"Woman Scientist of the Year" award* was given to **Bérengère DUBRULLE** for her remarkable multidisciplinary research at the interface between mathematics, non-equilibrium physics, non-linear physics, fluid mechanics, astrophysics and geophysics in connection with climate.

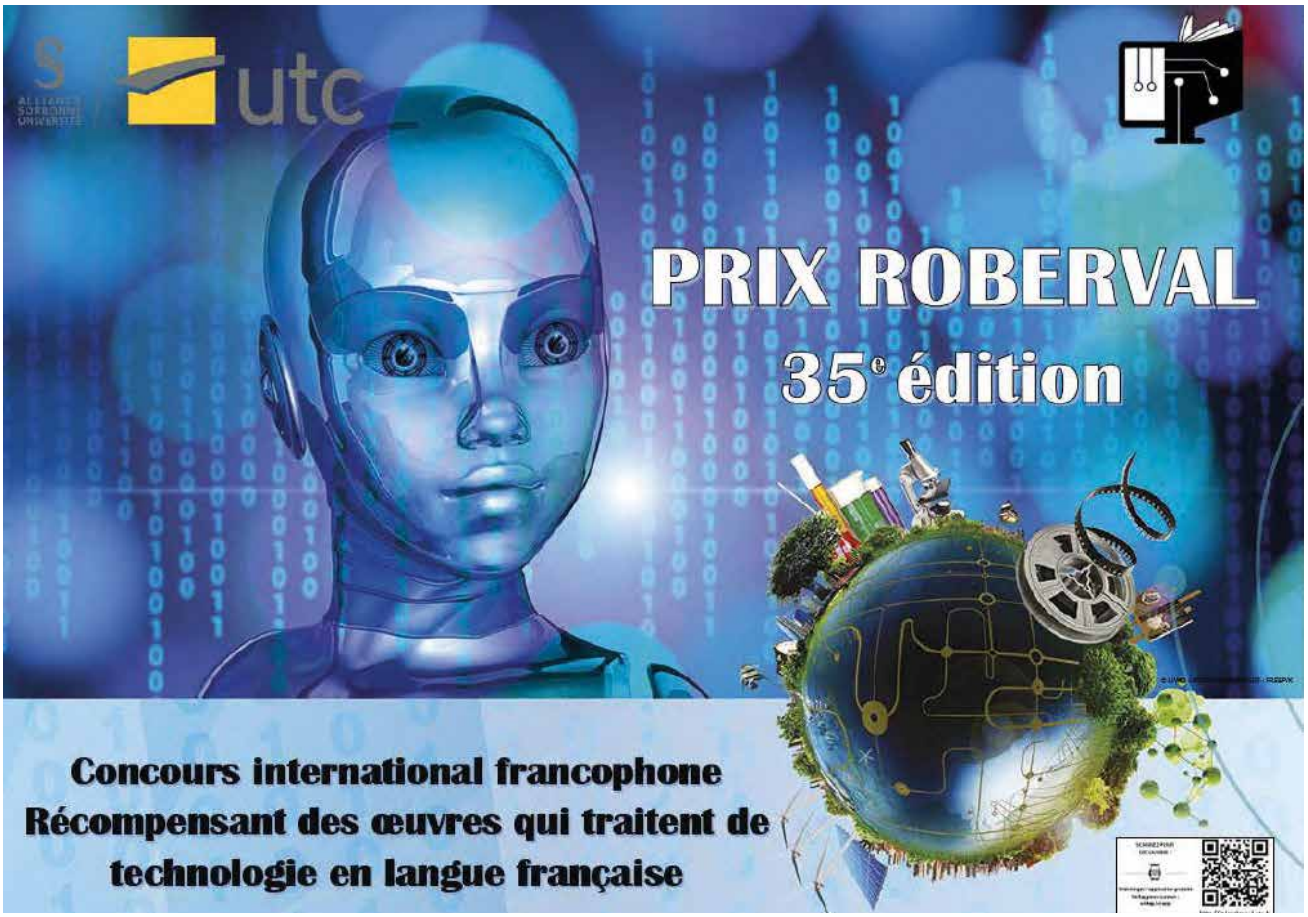
The *"Young female scientist" award* was given to **Nina HADIS AMINI**, researcher in automation applied to the control of quantum systems.

Céline BELLARD received *the special award for commitment* for her innovative research work on biodiversity to better understand the vulnerability of island systems to global changes.

Our Academy contributes more particularly to the "Women, Research and Enterprise" category that rewards a woman having developed scientific and/or technical innovations in a research and development function, while working in a company or helping to create a company. This award has been presented to **Marjorie CAVARROC-WEIMER**, a researcher specialising in the field of plasma physics. Her profile was published in the *"Women in Tech"* gallery of the Academy earlier this year.

▶ www.academie-technologies.fr/femme_de_tech/marjorie-cavarroc

The jury consisted of the members of the National Academy of Technologies of France **Catherine LANGLAIS** (chair), **Olivier APPERT, Geneviève BERGER, Alain BRAVO, Alice DAUTRY** and **Clément SANCHEZ**.



THE ROBERVAL AWARD OF THE UNIVERSITY OF TECHNOLOGY OF COMPIÈGNE

This international francophone competition rewards works (books and communication) dealing with technology in French and our Academy is proud to support it.

Until now, the Academy presented the award of the *"Youth" category*. This year, it presented the award of the *"Technical and scientific journalism" category*, a favourite of the National Academy of Technologies of France, during the ceremony that was held on 19 November. This award was presented to **Romain RAFFEGEAU** for his article on the extraordinary machinery of the Grand Paris construction: *"Tunnel boring machine: the beast comes out of its hole"*, published in the journal Science & Vie junior.

The jury, consisting of the members of the Academy, was presided by **Catherine LANGLAIS** with **Jean-Pierre CHEVALIER, Patrick LEDERMANN, Anne-Catherine ROBERT-HAUGLUSTAINE** and **Thierry WEIL**.

You can find the complete list of laureates online.
▶ www.utc.fr/wp-content/uploads/sites/28/2022/11/rob22-communique-et-dossier-de-presse-novembre-2022.pdf

Catherine LANGLAIS with Romain RAFFEGEAU, recipient of the Roberval award for the "Technical and scientific journalism" category

_ THE ENGINEERING SCIENCE OLYMPIADS OF THE UNION OF TEACHERS OF INDUSTRIAL SCIENCES AND TECHNIQUES

An unmissable annual event for young scientists, this national competition is intended for **high-school students of the eleventh and twelfth grades** (IS and STI2D specialities) who compete in teams (two to five high-school students supervised by one or two teachers). Their projects integrate multi-technological experimental work in the domain of engineering sciences.

The 2022 edition, in which our academicians **Alain BERNARD, Gérard CREUZET, Philippe JAMET, Catherine LANGLAIS, Isabelle MORETTI** and **Claudine SCHMIDT-LAINÉ** participated, rewards projects like

the Push3000
and the Ecarteur de danger++
(the danger keeper++)

To know more and for the complete list of winners, go to

▶ www.upsti.fr/nos-evenements/olympiades-de-si/palmares-osi-2022

Our Academy is also proud to become an official sponsor of the **Engineering Science Olympiads** driven by its *"Young People and the National Academy of Technologies of France" mission.*

_ THE JEAN JERPHAGNON AWARD OF THE INSTITUT MINES-TÉLÉCOM

This award recognises innovation in the optics-photonics field in tribute to **Jean JERPHAGNON,** who was one of the founding members of the National Academy of Technologies of France. The ceremony takes place during a special session at the annual OPTICS conference.

This year, the jury and its president, **Alain ASPECT**, a member of the academies of sciences and technologies, presented this award to **Kate GRIEVE** for her research on optical imagery.

▶ www.imt.fr/imt/prix-et-distinctions decernes/prix-jean-jerphagnon

THE PAUL CASEAU AWARD

Created in 2012 by the National Academy of Technologies of France and EDF, with the support of the Institut de France and the Academy of Sciences, this award honours the memory of Paul Caseau who was a founding member of the National Academy of Technologies of France. **Each year, it honours young doctors whose scientific work, applied to the field of energy (or likely to be applied to it), is of an exceptional and original nature.**

This year, the four award winners are **Rem-Sophia MOURADI** for her thesis titled *"Non-linear modelling of data-driven multidimensional fields: application to hydro-morphodynamic coastal flows)"*, **Rebecca RICCIOLI** for her thesis *"Mechanical modelling of superconducting cables for fusion under cyclic electromagnetic and thermal loads"*, **Vincent LE GUEN** for his thesis in the domain of the development of the uses of electricity, energy efficiency and technical and economic analysis of the electricity system, as well as **Paul BONIOL** in the domain of scientific data processing and high performance computing.

▶ www.edf.fr/groupe-edf/inventer-lavenir-de-lenergie/rd-un-savoir-faire-mondial/toutes-les-actualites-de-la-rd/2022-qui-sont-les-laureats-du-prix-de-these-paul-caseau

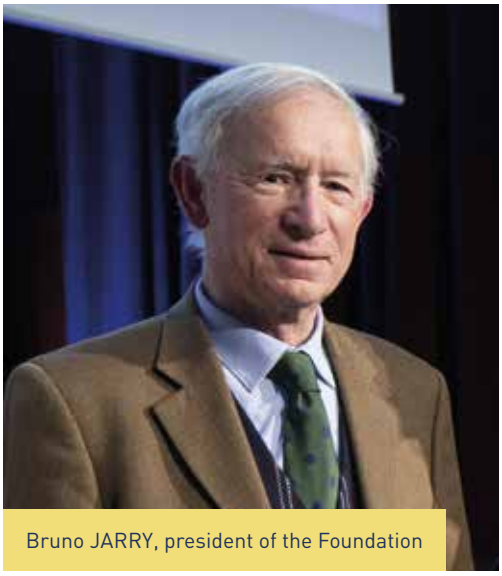
The jury was presided by **Gérard ROUCAIROL**, honorary president of the National Academy of Technologies of France, and the award was presented by **Denis RANQUE**, the actual president of the National Academy of Technologies of France.

3_
OUR FOUNDATION

The Foundation of the National Academy of Technologies of France is intended for the general public, professionals and the world of education, particularly relying on the work carried out by the Academy. In its missions, the Foundation endeavours to enhance the use of technologies and is oriented towards dissemination and entrepreneurship, particularly through technological projects with an educational purpose. It is authorised to receive donations and legacies and it mainly receives donations from academicians.

Directed by **Bruno JARRY** and **Patrick LEDERMANN**, members of the Academy
Under the aegis of the Foundation Arts & Métiers

▶ fondationartsetmetiers.org/les-differentes-fondations/la-fondation-de-lacademie-des-technologies



Bruno JARRY, president of the Foundation

ACADÉMIE DES TECHNOLOGIES
FONDATION

_ ACTIONS IN 2022

Support to the National Academy of Technologies of France to organise and finance the conference of CAETS 2022 (refer to the part concerning CAETS) as well as the Grand Awards and the a posteriori support for the awarded startups (refer to the part concerning the awards)

Financing of the category of the National Academy of Technologies of France of the Roberval award (refer to the part concerning the awards)

Contribution to the financing of the Festival of Vocations supported by the "Les Chemins du Faire" association

Setting up pilot incentive and training workshops pertaining to technology in relation to the education system and in collaboration with the industry (refer to the TINA and Africa projects)

_ THE TINA PROJECT

The Foundation is involved in **the TINA (Intelligent Tutor for New Learners) project intended to promote the appropriation of the steps involved in executing a technology project.** The TINA1 component focuses on the continuous training of secondary school technology teachers for design and implementation of technological learning sequences. TINA2 pertains to the training of students of BTS (advanced technician's certificate), IUT (University Institute of Technology) and licence pro (vocational degree) in collaborative engineering using teaching aids and modules developed on the 3D-Experience digital platform of Dassault Systèmes.

This year, a licence to use the TINA2 educational modules was obtained from Dassault Systèmes for training purposes in higher education. This will allow a deployment on the national territory in the production engineering and mechanical engineering IUTs.

_ THE AFRICA PROJECT

ABROAD, the Foundation collaborates with industrial and academic players in French-speaking African countries on the "Frontiers of Engineering" project. **It aims to train African technical managers through specialised seminars.**

The group thus prepares the second edition of the seminar that will be held in 2023 in Senegal in partnership with the Senegalese Academy of Sciences and Techniques. It will address two topics involving members of the National Academy of Technologies of France:

- **Sustainable cities: how to improve urban resilience** (François BERTIÈRE)
- **Energy: the synergy of centralised and decentralised electrification systems and pricing of electricity** (Bernard TARDIEU et Yves MAIGNE)

4_
OUR WORK ORGANISED WITH FRIENDLINESS

The members of our Academy work voluntarily and appreciate the opportunity and richness of their exchanges. Certain visits and friendly meetings enable them to meet more informally and to create connections.

VISIT TO THE "Industrial (R)evolutions" EXHIBITION

Paris, 13 September 2022

The Culture/Leisure section conducts a collective reflection on the **cultural and creative industries** and meets with **Aurélien PALIX** and **François QUÉRÉ** in the context of the exhibition at the Cité des sciences et de l'industrie.

VISIT TO THE AIR AND SPACE MUSEUM

Bourget, 13 May 2022

The Culture/Leisure section meets with **Thierry GAUDIN and Marie-Laure GRIFFATON** in relation to the project of the **Fondation 2100** presented at the museum.

BEHIND THE SCENES TOUR OF THE CHATEAU DE VERSAILLES

Versailles, 30 September 2022

In the context of the CAETS conference organised by our Academy, the participants were able to visit the technical backdrop of the castle focussing on several aspects:

- **"The secret of the fountains",**
- **"Scientific life at Versailles",**
- **"Scenic effects",**
- **"Textile decoration, from brocades to Indians"**.

VISIT TO THE EXHIBITION "Do you need to travel to be happy?"

Paris, 16 November 2022

During the presentation of the Grand Awards of the Academy, the members could visit the exhibition **"Do you need to travel to be happy?" of the Foundation EDF Group**.

VISIT TO COSQUER MÉDITERRANÉE, the prehistoric cave under the sea

Marseilles, 23 September 2022

Discovered by **Henri COSQUER**, this submerged cave, which is fragile and threatened by rising water, was classified as a historical monument in 1992. Having been studied at length, it is restored in this original tour that was opened to the public in June 2022. The entire history of the cave through its inhabitants, fauna, flora and climatic changes is recorded there.

VISIT TO THE "Treasures of Uzbekistan" EXHIBITION

Paris, 29 November 2022

The Digital and Culture/Leisure sections work on the subject of **"Museums and digital technology"** highlighted by the exhibition of the Louvre museum and meets with **Élisabeth LE HOT** and **Rocco RANTE**.

MENTIONS

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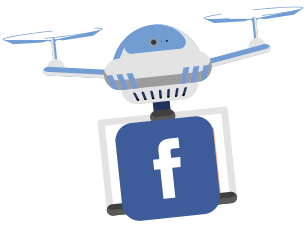

A heartfelt thank-you to the academicians and the permanent staff of the Academy for all their contributions in this new annual activity report.

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Translation: **Tradutec**

Graphic design: **SUNNY Marie** (Marie-Laure Issenmann)

Illustrations credit: **Marie-Laure ISSENMANN** (cover, p. 48), Freepix

Photo credits: Adobe Stock (p. 35, 71)**, Felix REINDERS** (p. 73)**, Gaël KAZAZ** (p. 3, 7, 18-21, 22-23, 58-61, 70), gouvernement.fr/france-2030 (p. 25), **Hélène LOUVEL** (p. 4, 7, 11), Météo France (p. 46), **Laurent WEIMER** (p. 53), **Pierre CASTILLON** (p. 73), **Stéphanie THINE** (p. 6, 17, 22-24, 27, 33, 39, 54-57, 64-65, 67, 72-73)

Print: **Afortiori**

April 2023

NATIONAL ACADEMY OF TECHNOLOGIES OF FRANCE / Actiuity report 2022 /

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