



Current Status & Perspectives of Clean Energy Research Activities at CEA

Collaboration with Global Zero Carbon Emission Research Center

Evelyne Etchebehere
CEA Tech representative in Japan

- **National Low Carbon Strategy (2015, reviewed in 2019/2020)**
 - French roadmap for low emission economy
 - Industry, Housing, Energy, Agriculture, Transport, Waste
 - Sets targets for five-years periods towards 2030
- **Multiannual Energy Plan (2016, reviewed in 2019/2020)**
 - Presents the trajectory to be followed in terms of energy production and distribution in 2023 and 2028, for gas, electricity and heat
 - Energy efficiency, security of supply, renewable sources, demand side, grid developments





- **Greenhouse gases reduction targets**

- **-40%** between 1990 and 2030
- **Carbon neutrality** by 2050

- **Reduction targets for consumption, fossil and nuclear**

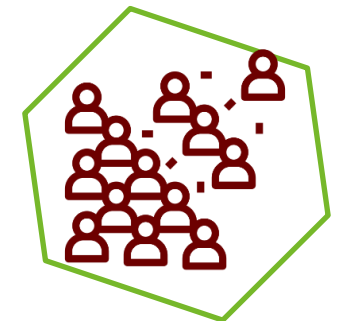
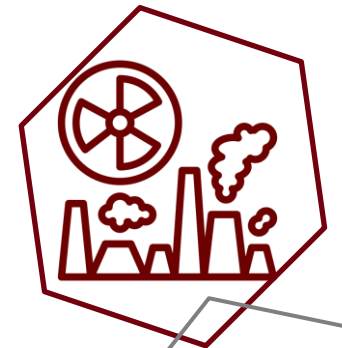
- Final energy consumption: **-7%** (2023) and **-14%** (2028) (vs. 2012)
- Fossil fuels consumption : **-20%** by 2023, **-35%** by 2028 (vs. 2012)
- Decrease nuclear in the electricity mix to **50%** by 2035

- **Increase targets for renewable energy**

- Renewable heat: **+25%** (2023) and **+50%** (2028) (vs. 2016)
- Renewable electricity capacity: **+50%** (2023), **+100%** (2028) (vs. 2017)

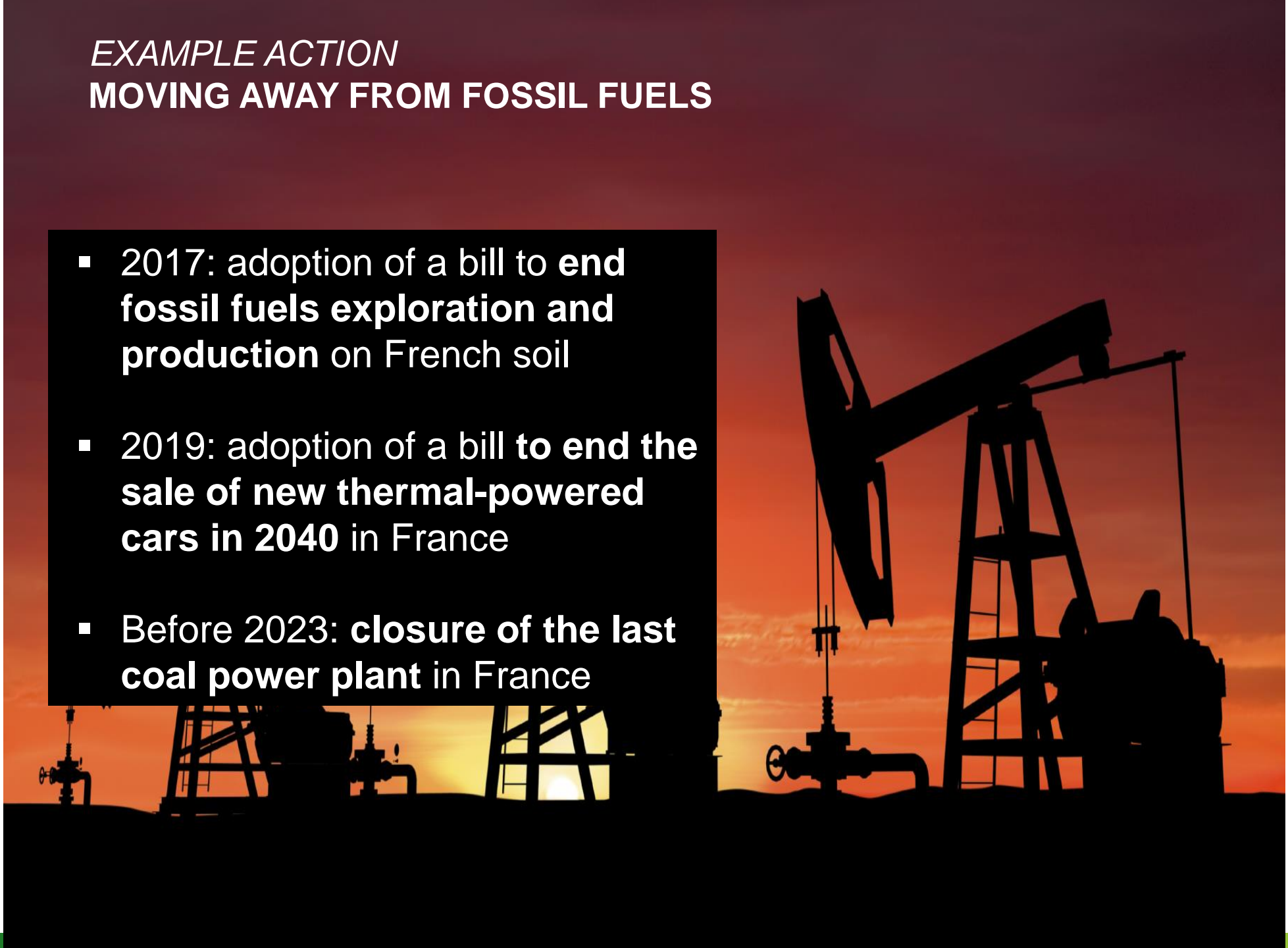
- **Economic development**

- Creation of **246 000** jobs (2023), **413 000** (2028)



EXAMPLE ACTION
MOVING AWAY FROM FOSSIL FUELS

- **2017: adoption of a bill to end fossil fuels exploration and production on French soil**
- **2019: adoption of a bill to end the sale of new thermal-powered cars in 2040 in France**
- **Before 2023: closure of the last coal power plant in France**



A leader in technological research

TOP 100 GLOBAL INNOVATORS



For 8 years in a row, CEA has been ranked among the « **Top 100 Global Innovators in the Clarivate** » for its proactive intellectual property policy.

<https://clarivate.com/top100innovators>



19 925 employees

9 Research centers

Budget: **G€ 5,3**

Scientific publications **6 159**

6700 Active Patent families

148 tech. start-ups created since 2000

+700 patents deposited every year

Defence & Security
strategic independence



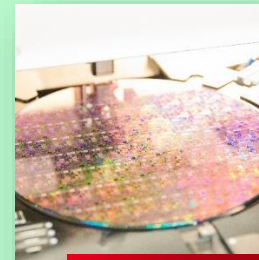
Nuclear Energy
energy independence



Fundamental Science
Material and Life Science



Technological Research:
Digital, Energy and Medical Transitions



AN INTEGRATED APPROACH FOR CARBON FREE ENERGY SYSTEMS

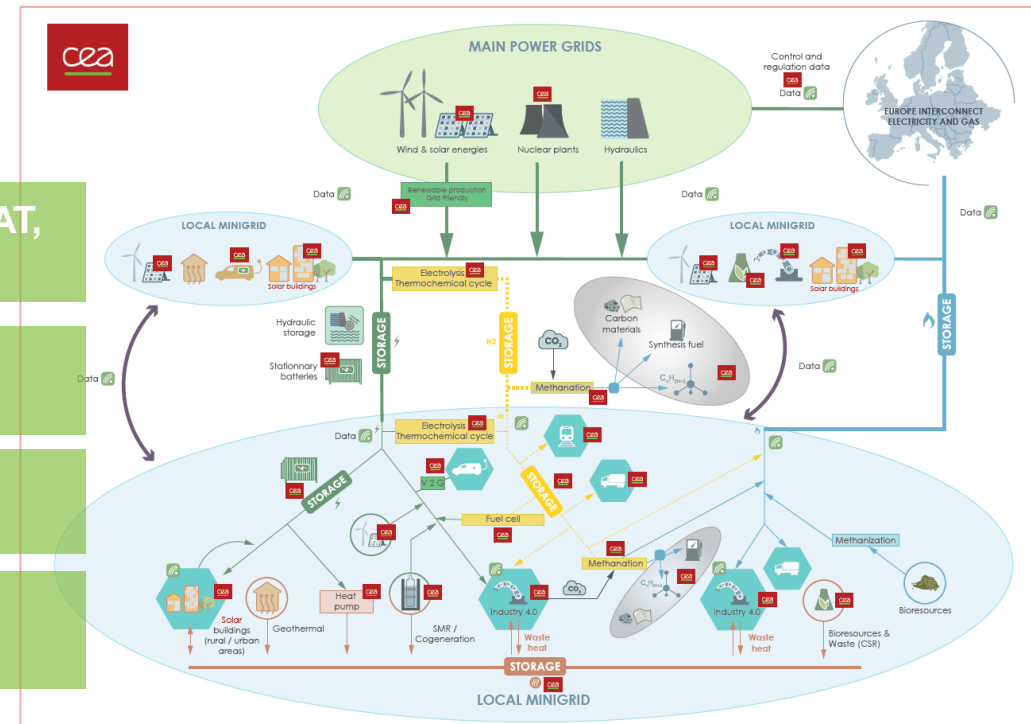
- Taking into account the **3 pillars of the energy policy** (Security of supply, Competitiveness, Environment)
- Setting **a long term vision** and an timescale approach of the continuum research-> technological development -> industrial deployment
- Understanding the evolutions and the **interactions between the components** of the energy system :

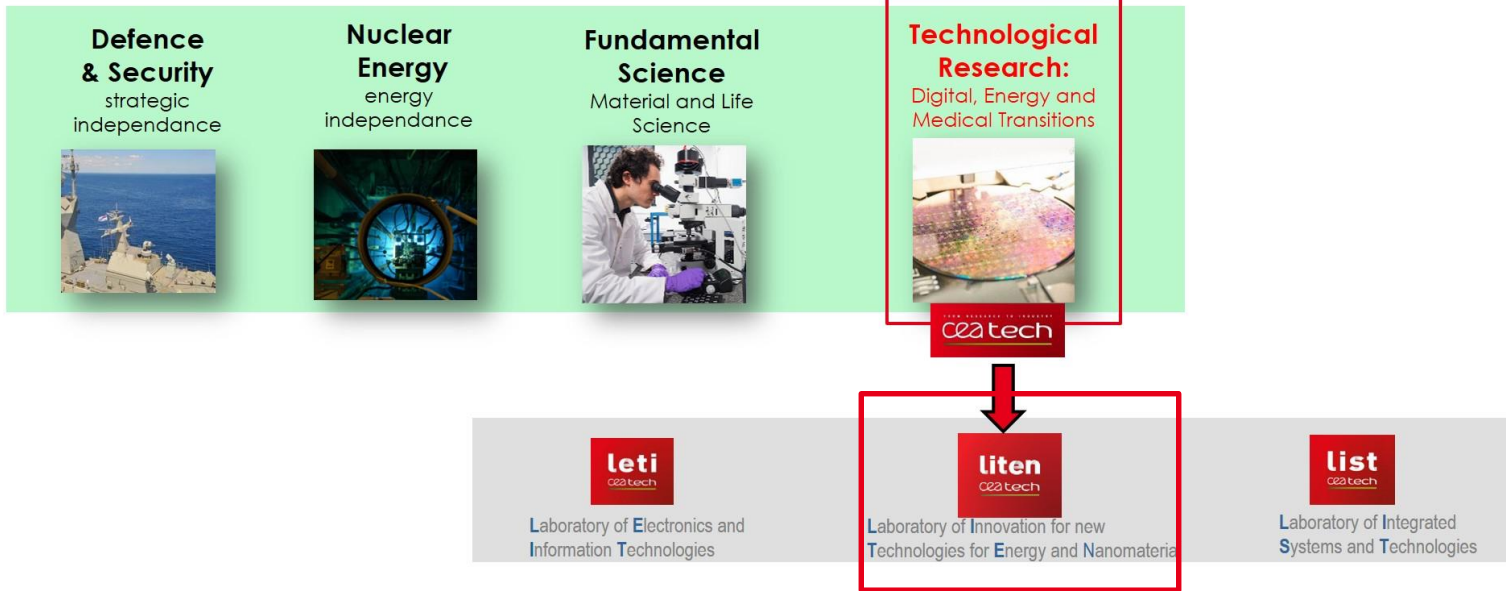
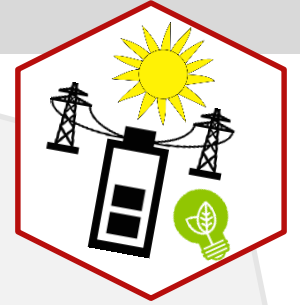
MULTI-ENERGY VECTORS: ELECTRICITY, HEAT, GAS / HYDROGEN

SMART ENERGY GRID & DEMAND-RESPONSE MANAGEMENT

ADVANCED MATERIALS AND CIRCULAR ECONOMY

ENERGY SCENARIOS GOVERNANCE AND ECONOMIC MODEL





975 Employees
120 PhDs and Post Doc
202 Publications & **192** Patent Application
1 612 Patents *in the portfolio*
> 250 Industrials Partners
Budget 138 M€
Research Contracts
40% competitive public funding
60% industrial
13 Platforms



Innovation for Recycling
Prize in 2019 (FEDEREC)



3 STRATEGIC RESEARCH AREAS

For Creating Solutions, to Address Climate, Energy & Environmental Issues

1

LOW-CARBON POWER GENERATION

▼

Decentralized Renewable Energy

- Pilot scale **solar production** (PV & CSP)
- High added-value PV solutions (BIPV, Autonomous systems).



2

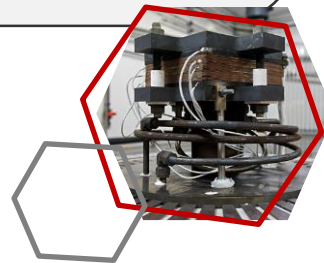
MANAGEMENT OF ENERGY GRIDS

▼

Components & Digital tools for « **Smart Energy Grid** » with Demand-Response Management

Solutions for Flexibility

- Storage (electrochemical, thermal)
- Hydrogen Vector
- Grid coupling



3

ENERGY AND MATERIAL EFFICIENCY IMPROVEMENT

▼

Energy Efficiency

- In operation
- During product lifetime

Material Resource Efficiency

- Additive manufacturing

Reducing the Environmental Footprint

- Life-cycle analysis
- Recycling
- Closing the carbon cycle

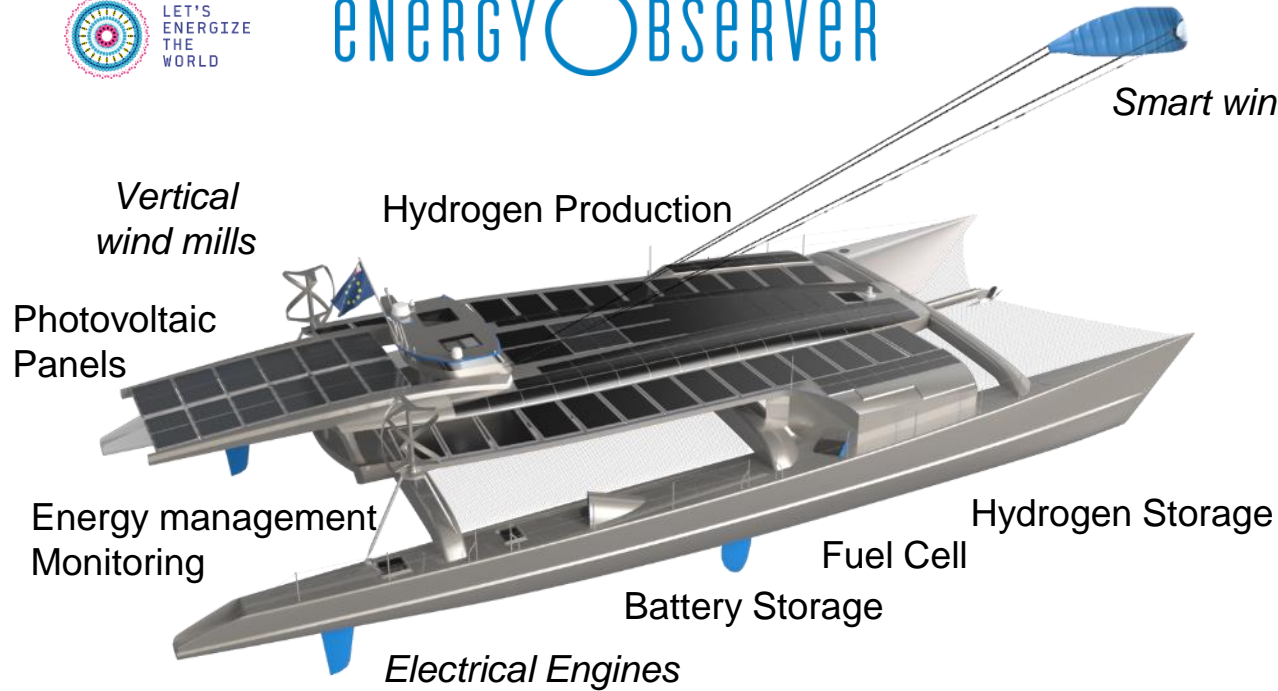


OUR TECHNOLOGICAL AND DIGITAL PLATFORMS





ENERGY OBSERVER



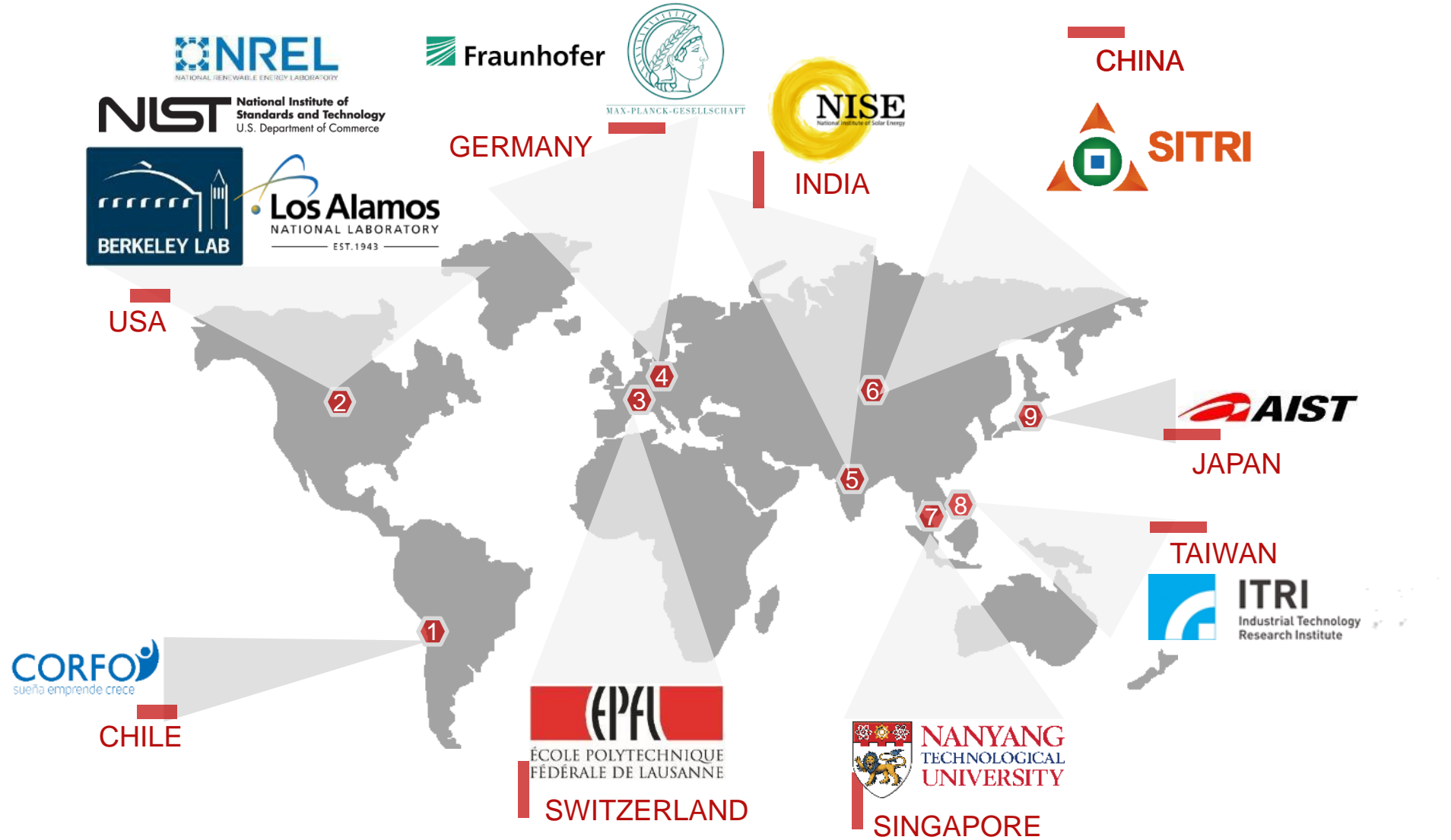
- ❖ A technical challenge
- ❖ An open lab
- ❖ A pedagogic support

- First **Hydrogen** ship in the world
- **No greenhouse gases** emission



Visit of the French Prime Minister, E. PHILIPPE, August 25, 2017

INTERNATIONAL ACADEMIC COLLABORATIONS



CEA Tech and AIST have established a MoU for the first time in 2010 renewed in 2015 on microelectronics topics.

Several interactions between AIST and CEA-Liten showed complementary competencies also on energy topics.

□ A 5-years Academic Agreement has been signed between AIST and CEA-Liten 7th June 2018:

- ✓ Title: Development of quantum dot based photovoltaic materials and cells
- ✓ Purpose: development of hybrid quantum dots/perovskite and perovskite/crystalline silicon tandem solar cells

□ A second 5-years Academic Agreement is currently being signed between AIST and CEA-Liten:

- Title: Development of clean energy materials and devices based on advanced materials analyses and on modelling
- Purpose: Improvement of materials and devices through in-depth understanding of the chemical/physical properties
 - With a focus on 3 topics:
 - Lithium-ion battery
 - Solid-oxide cells (for fuel cell and electrolysis)
 - Phonon and electron transport properties simulation applied to thermoelectric materials
 - Taking advantage of:
 - Exchange of materials,
 - Reciprocal use of equipment and platforms
 - Enhanced reciprocal mobility of researchers

- CEA/Liten will be glad to collaborate with Global Zero Emission Research center of AIST on topics included in the Academic Agreement with AIST (Batteries, Solid Oxide Cells & PV technologies)
- Collaborations could be strengthened, in topics such as:
 - Eco design / Eco conception & recycling of energy components (including power electronics)
 - Carbon cycle closure including CO₂ reuse, Power-to -X approaches with low carbon footprint H₂
 - Environmental impact assessment (LCA)
- How to strengthen collaboration?
 - Take advantage of mechanisms for promoting mobility of young researchers
 - Contribute to IEA working groups
 - Benchmarks
 - Discussions on common protocols and standards ...

liten
cea tech

Thank you for your attention

