2022 – Corporate presentation CEA INES

INSTITUT NATIONAL
DE L'ENERGIE SOLAIRE

ABOUT CEA & INES

Digital Economy

Products
Services
Factories
Large systems

Defense
Terrorism hacking

Security

DISTRIBUTED INTELLIGENCE
Semiconductor
Microcomponents
Cyberphysical systems
Data intelligence
Immersive media
Advanced manufacturing

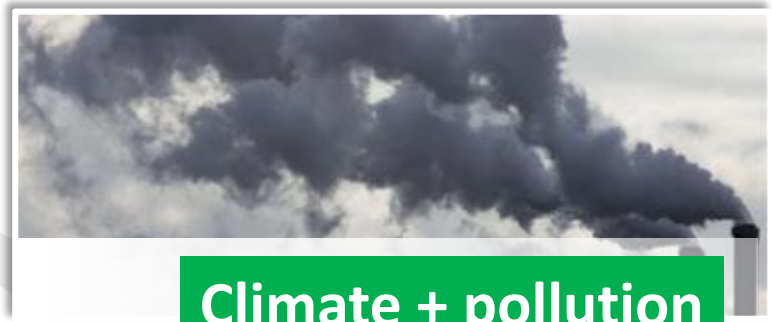
CYBERSECURITY

RENEWABLE ENERGY
ELECTRICAL TRANSPORT MOBILITY

CARBON CAPTURE & USE

GENOMICS
MEDICAL DEVICES

RAW MATERIAL SAVING
RECYCLING
PRECISION AGRICULTURE



Climate + pollution

Low carbon emission world

Personnalized healthcare
Ressources shortage

Demography

4 Organizations for each Strategic Mission

Defense
(DAM)

Energy
(DES)

Technological Research
(DRT)

Fondamental Research
(DRF)

4 Institutes

leti
Micro & Nanotechnologies

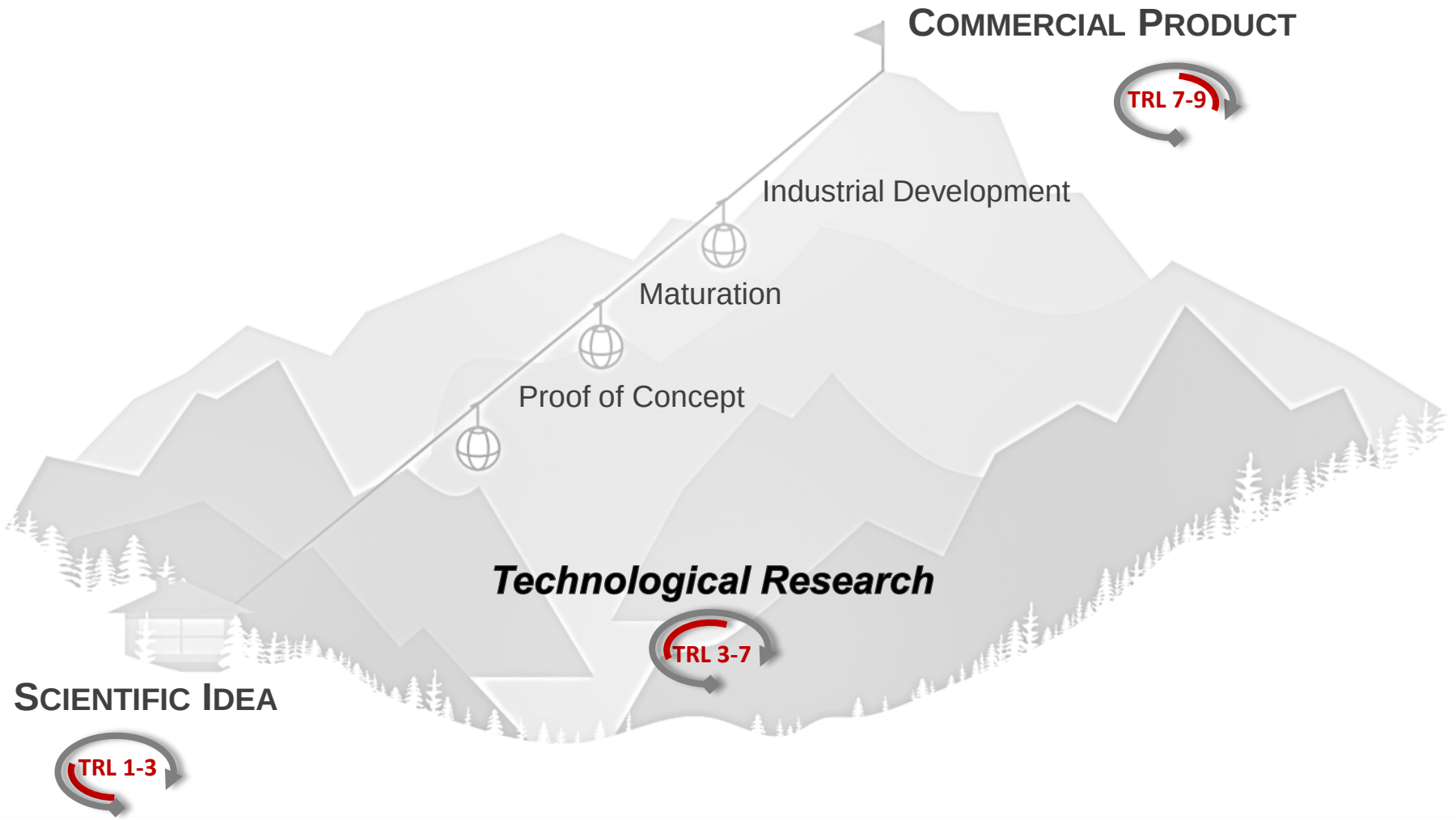
liten
New Energies & New Materials

list
Smart Digital Systems

Regions
Regional Dissemination

OUR MISSION

INDUSTRIAL TECHNOLOGY TRANSFER



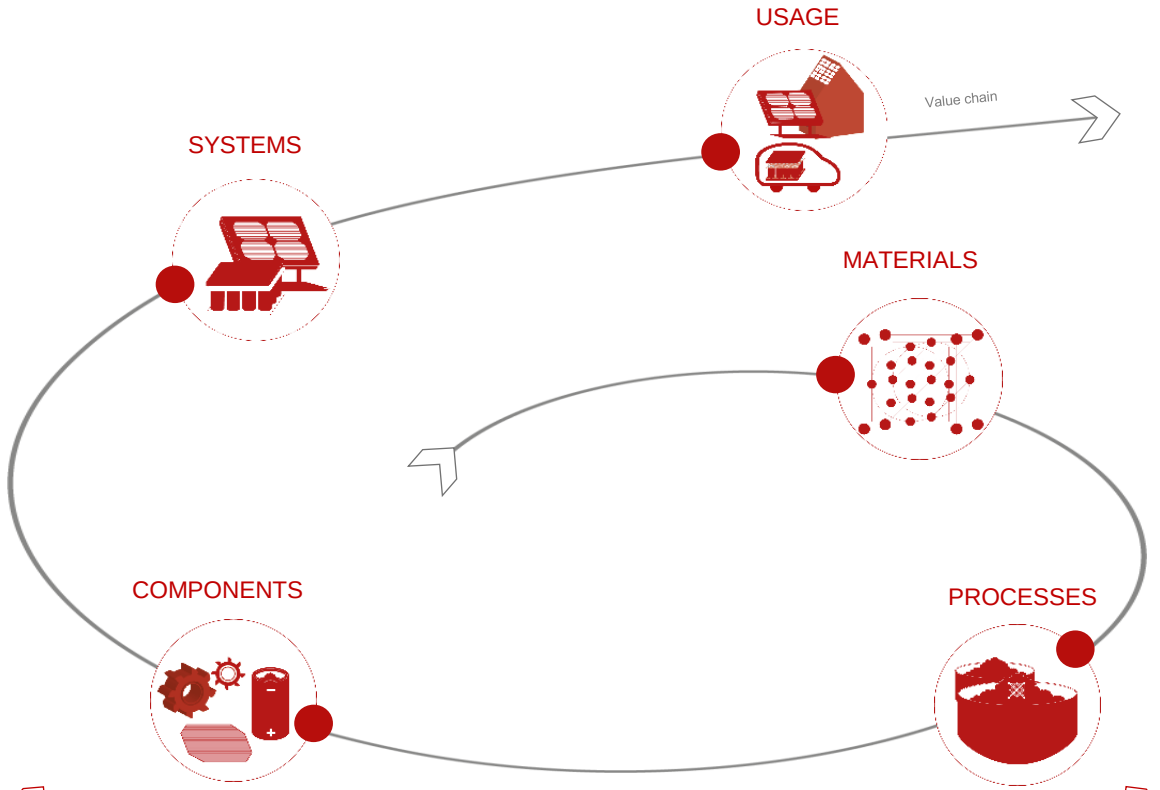
Convergence between means and skills along the entire value chain

Accelerate the development of innovations

Predict the behavior of the component/system

Optimize the target properties of the specific function in real usage conditions

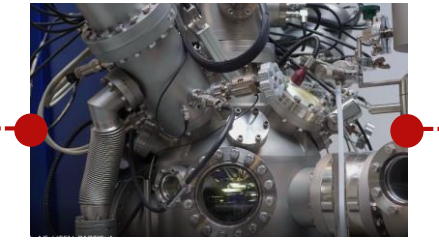
Integrate into the technical and socio-economic environment



Technological Platforms

Simulation, modeling multi physics, multi scale

Advanced Characterization and Testing



LITEN AT A GLANCE

TARGETS

- Reduction of greenhouse gas emissions
- Energy efficiency
- Anchoring in a “Circular Economy” approach

And creating value when transferring technologies to industry and the economic world.

1000 EMPLOYEES

+ 200 INDUSTRIAL PARTNERS

1 856 PATENTS

150 PhD & POST-DOCS

12 PLATFORMS

+ 200 PAPERS/y

The Liten Divisions

DTS : **Solar & Grids**

≈ 300

Chambéry / Cadarache

DEHT : **Electromobility**

≈ 250

Grenoble

DTNM : Advanced materials and printed electronics

≈ 200

Grenoble

DTCH : Thermal engineering, Hydrogen, Biomass

≈ 250

Grenoble / Chambéry / Cadarache

MARKET REVOLUTIONS

Energy transformation

Multi-energies Networks

Digital transition & Change of use

ines
INSTITUT NATIONAL
DE L'ENERGIE SOLAIRE

Born in 2005

22 000 sqm

Equipment > **120 M€**

~ 500 employees

Research, innovation

12 labs liten + 2 labs UNIVERSITÉ SAVOIE MONT BLANC cnrs

& partners : 2CA, ECM, SERMA, Steadysun

Education, capacity building

ines INSTITUT NATIONAL DE L'ENERGIE SOLAIRE Education & Evaluation Platform

GRADUATE SCHOOL SOLAR ACADEMY

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ines
INSTITUT NATIONAL
DE L'ENERGIE SOLAIRE

Since 2005, supported by

SAVOIE
LE DÉPARTEMENT

La Région
Auvergne-Rhône-Alpes

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

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OUR ACTIVITIES

► For hardware …

Premium PV Cells and modules I Process & equipment I X-IPV I Power electronics I PV plants Architectures

& software developments

Grid integration I Diagnosis & Data I Energy management systems I Storage I Smart grids & Smart cities

PV PREMIUM TECHNOLOGIES
Towards 30% efficiency

HETEROJUNCTION PILOT LINE

R&D / prototyping of solar cells for high performance & high throughput manufacturing

2005
HJT solar cells research starts at CEA Tech's Labs in Grenoble.

2010
1st institute to reach 20% efficiency obtained on >100 cm² on HJT

2012
Creation of the Pilot Line : 13,000 sq. ft., ISO8 clean room.

2015
4-year $40 million R&D partnership

2015-2019 Milestones

High performance industrial scale HJT equipment
Throughput up to 2,400 wafers/hour

Innovative SmartWire Connection Technology; next generation bifacial encapsulation technology and equipment; and thinner wafers without yield degradation

High capacity cell testing & metrology equipment.

towards 420W modules (500 W including bifaciality) with solar cell efficiency over 25%

cea ines

Enel and French PV institute achieved an efficiency of 25.0% for a heterojunction solar cell

The solar cell calibration laboratory ISFH CalTeC has certified the efficiency of the cell, which was made with a standard M2 wafer.

AUGUST 28, 2020 CATHERINE ROLLET

MODULES & UPSTREAM MANUFACTURING | TECHNOLOGY AND R&D | FRANCE

25% !!!

NEW WORLD-CLASS CERTIFIED RECORD FOR HETEROJUNCTION SOLAR CELL EFFICIENCY

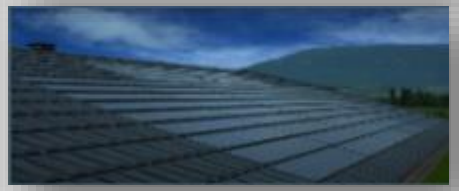
CEA and Enel Green Power have reached a heterojunction solar cell record efficiency of 25.0% active area (213 cm^2) on M2 wafer on industrial pilot line at INES.
World-class result certified by CalTeC

PV EVERYWHERE
X-IPV & Space applications

PV EVERYWERE

Plants

Residential



Building, roadways, rivers, lakes, railways…

PV EVERYWERE ▶ X-IPV

Among innovations **from CEA at INES**

Defense & building
Lightweight 4kg/m²

BIPV
Autonomous systems

COMMUNICATION
Ultralight stratospheric

MARINE
Bifacial/shaped

ROADWAY INTEGRATION
Mutlifunction

VIPV
Electrical vehicles

SMART GRID & INTEGRATION

DIGITAL SOLUTIONS FROM DESIGN TO DEPLOYMENT AND OPERATION OF MULTI-ENERGY SMART GRIDS

FROM LOCAL TO GLOBAL

Optimized design of systems & networks

- Software designed for various applications, with several criteria
- In-house libraries of models : PV system, storage, electric vehicles and other consumptions, network infrastructures

Energy Management System (EMS) :

- Predictive and real-time control strategies
- Mathematical optimization methods
- Information system for feedback of operating data and control

► For Micro grid stability, system services, and sales on the energy markets

Coupling energy vectors & networks at different scales

- New opportunities to dimension and manage territorial energy systems
- Design and management at relevant geographical scales

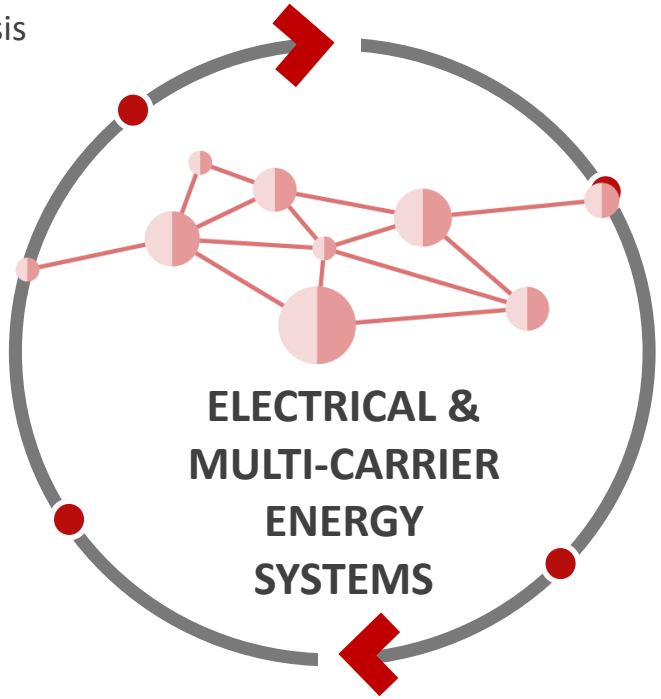
► For connected or off-continental network, from local to global

ENERGY SYSTEMS

Modelling & simulation

- Multi-criteria analysis
- Optimal sizing
- EMS development

Monitoring

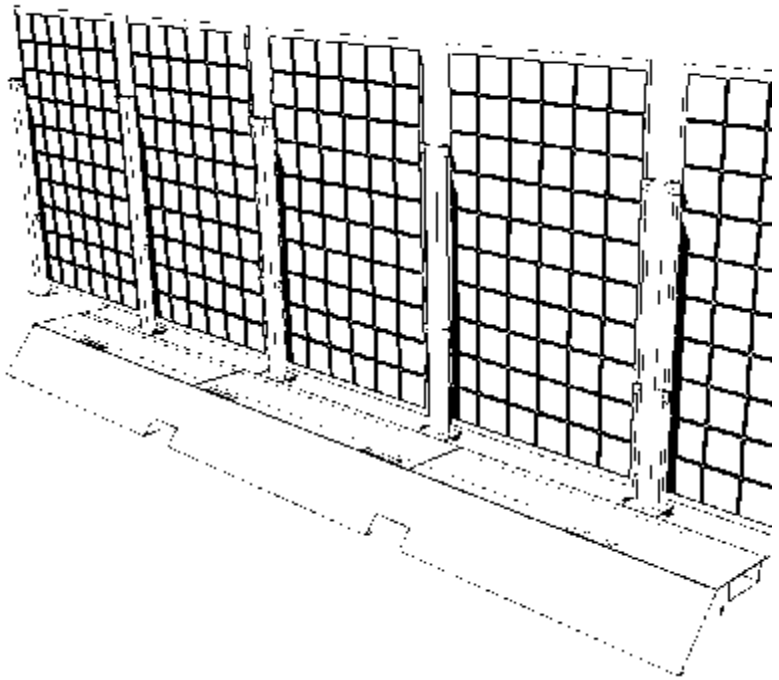


Validation at lab and pilot scales

- Hardware in the loop
- Electric micro-grid coupled to a thermal energy network @ INES campus

Field deployment

NEW POWER ELECTRONICS & PLANT ARCHITECTURES



Innovative power plant architectures

- Floating photovoltaic,
- Agri-voltaic,
- Photovoltaic along railways and rivers
- Medium-voltage applications

► Mechanical integration and electrical architectures

New generation inverters

- Electronic architecture / topology
- Use of latest generation semiconductors such as SiC and GaN

► Compactness, lower cost, improved performance and lifetime

STATIONARY STORAGE

Dimensioning and control design hybrid power plants: renewable energy + storage

► **control additional costs**

Digital solutions to dimension the storage and optimize control of the complete system

- Modelisation
- Real-time and predictive controls on the other
- Information system for energy management

FROM LOCAL TO GLOBAL

DIGITAL SOLUTIONS & ENERGETIC INTEGRATION TOWARDS MULTI-ENERGY SMART GRIDS & SMART CITIES

Optimized design of systems & networks

- Software designed for various applications, with several criteria
- Modelling PV system, storage, electric vehicles, buildings and other consumptions, network infrastructures

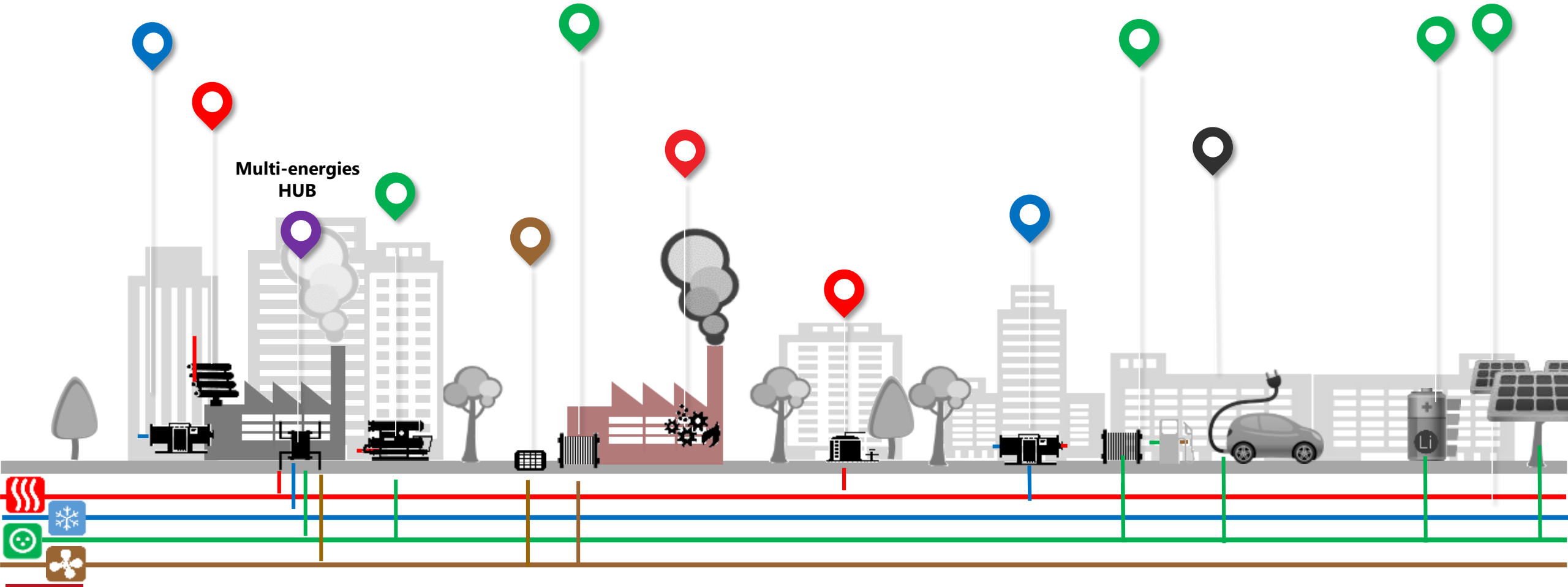
Energy Management System (EMS) for Micro grid stability, system services, and sales on the energy markets

- Predictive and real-time control strategies
- Mathematical optimization methods
- Information system for feedback of operating data and control

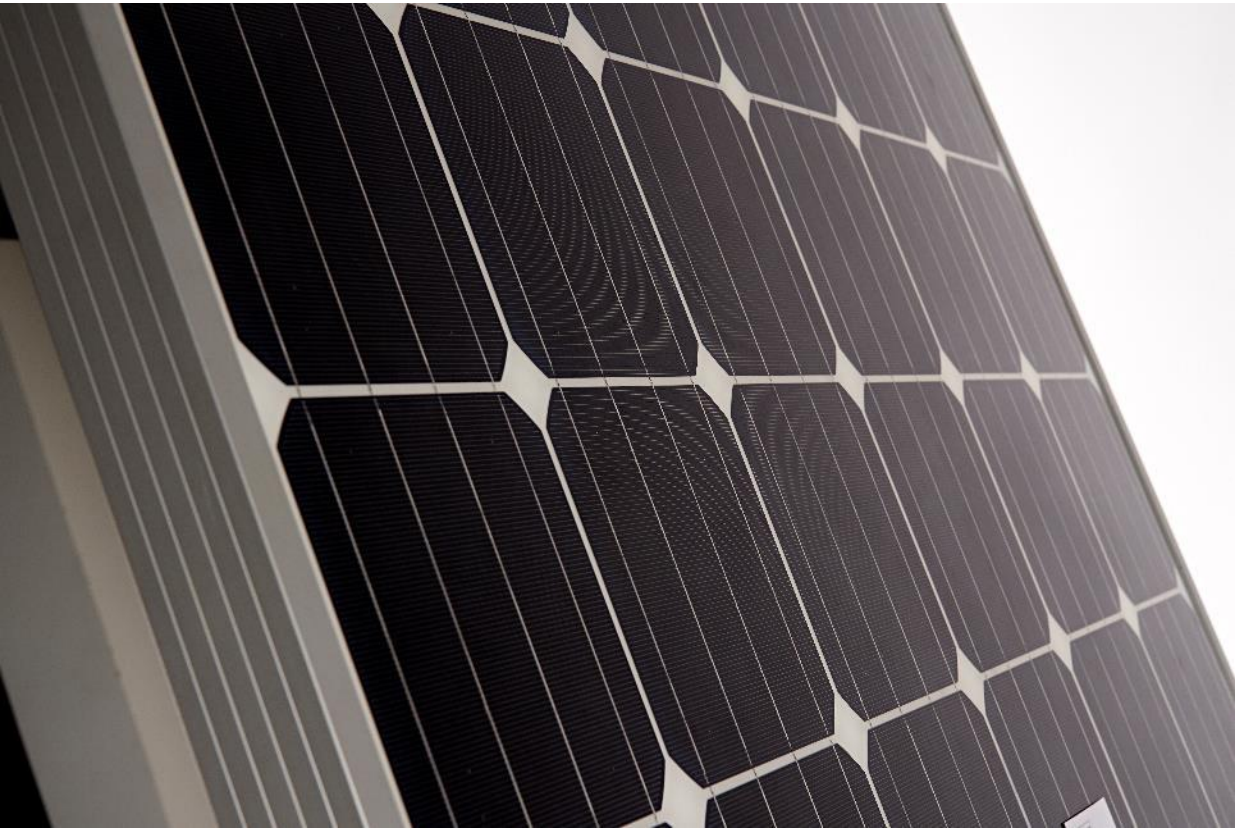
Coupling energy vectors & networks at different scales for connected or off-continental network

- New opportunities to dimension and manage territorial energy systems
- Design and management at relevant geographical scales

MULTI-ENERGIES NETWORKS



ECONOMY & ENVIRONMENT FOR PV



R&D for tools and competitive technologies for a better control of the environmental impact of crystalline silicon-based photovoltaic

► Tools for life cycle analysis and evaluation of the economic and environmental impact of technologies

► Innovative technological solutions for the management and recycling of end-of-life devices.

► New generations of eco-designed photovoltaic panels : recyclability, reliability and durability.

THANK YOU