Overview of research activities at CEA-Liten

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About CEA-Liten

CEA-Liten develops innovative technologies for the clean energy transition

- renewable energy (solar photovoltaics, solar thermal energy)
- energy storage and conversion (batteries, hydrogen, heat storage and conversion)
- closing the carbon cycle (power-to-X, biomass-to-X)
- energy systems (energy-efficient buildings, power grids, heating networks)
- advanced materials and circular economy

975 staff

200+ patent applications per year

138 M€ annual budget

200+ industrial partners
100+ ongoing European projects

Grenoble campus

Chambéry campus

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RENEWABLE ENERGY – solar photovoltaics

Materials	Cells	Modules	Systems	End of life
				
Silicon materials	Silicon cells Tandem cells	Silicon modules Tandem modules Integrated photovoltaics	Power electronics Energy management	Dismantling, recycling

Characterization, test & monitoring

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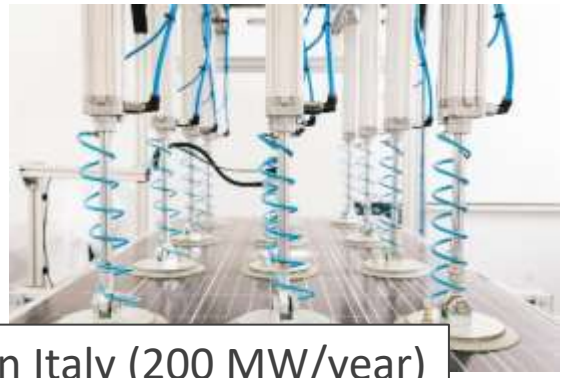
RENEWABLE ENERGY – solar photovoltaics
Example of recent activity: silicon heterojunction

CEA-Liten pilot line in Chambéry, France (2,400 wafers per hour)

Record cell efficiency on pilot line: 25.0%



ENEL production line in Italy (200 MW/year)

ENERGY STORAGE AND CONVERSION – batteries

Materials → **Cells** → **Packs & BMS** → **End-of-life**

From g to kg

1000m² dry room
From 1mAh
to 70Ah

From 100Wh to
100kWh

Second life,
dismantling,
recycling

Multi-scale modelling & characterization

ENERGY STORAGE AND CONVERSION – batteries
Example of recent activity: gel polymer electrolytes

Lab scale → **Pilot scale** → **Industry**

Since 2011

Coin cell

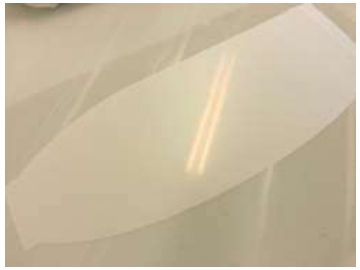
Since 2016

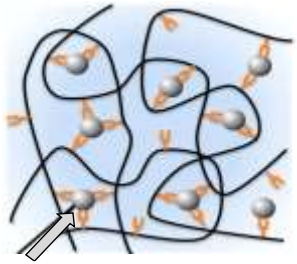
18650 cylindrical cell

Since 2019

Work in progress

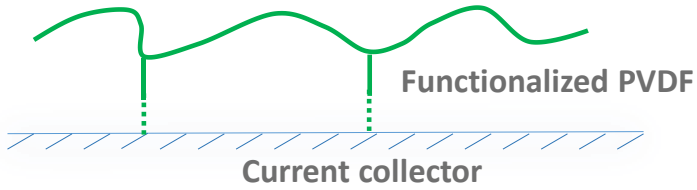
Separator:
cross-linked PVDF
+ trapped liquid
electrolyte





Cross-linked PVDF

Electrode binder:
functionalized PVDF
+ trapped liquid
electrolyte



- Stable electrochemical performances
- Improved safety
- Simplification of manufacturing process

NEXT STEP: solid-state electrolytes

SOLVAY

ENERGY STORAGE AND CONVERSION – batteries
Example of recent activity: battery packs for aviation

Hybrid E-Fan Plus
Hybrid Electric Light Aircraft
(Oshkosh, Wisconsin, July 2016)

CityAirbus
eVTOL
(Donauwörth, Germany, May 2019)

Vahana
eVTOL
(Pendleton, California, May 2018)

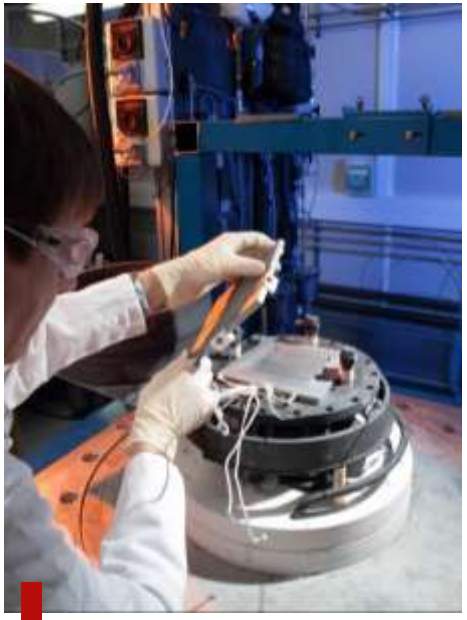
E-Fan
Full Electric Light Aircraft
(Lydd UK-Calais France Chanel Cross, July 2015)

Skyways
Drone
(Singapore, February 2018)

AIRBUS

ENERGY STORAGE AND CONVERSION – hydrogen

H_2 production



Solid-oxide steam electrolysis

H_2 storage

Compressed storage
Liquid organic hydrogen carriers

H_2 use

PEM and solid-oxide fuel cells
CO_2 conversion into fuels and chemicals

Modelling, characterization and techno-economic assessments

ENERGY STORAGE AND CONVERSION – hydrogen
Example of recent activity: solid-oxide water electrolysis

- Development and fabrication of **solid-oxide electrolysis** stacks & systems (5 kW)
- System tested by an industrial partner (more than 2000 h of operation so far)

Technology	System-level efficiency
Solid-oxide electrolysis (CEA-Liten)	87% *
Alkaline or PEM electrolysis (literature)	45-71%

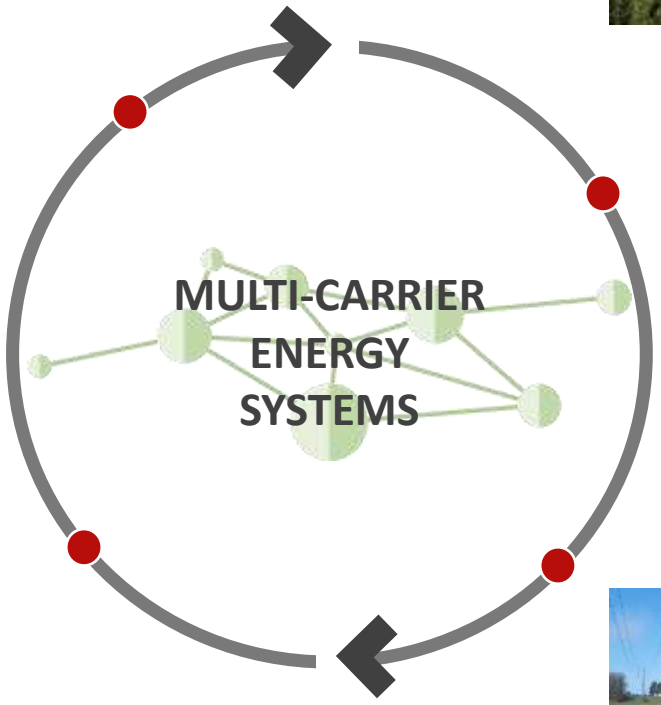
**Considering the availability of a waste heat source at 150°C for steam generation*

NEXT STEP: upscaling to 100 kW and then MW scale

ENERGY SYSTEMS – tools and methods

Modelling & simulation
- Multi-criteria analysis
- Optimal sizing
- EMS development

Validation at pilot scales
- Experimental buildings
- Electric smart grid platform
- Thermal smart grid platform



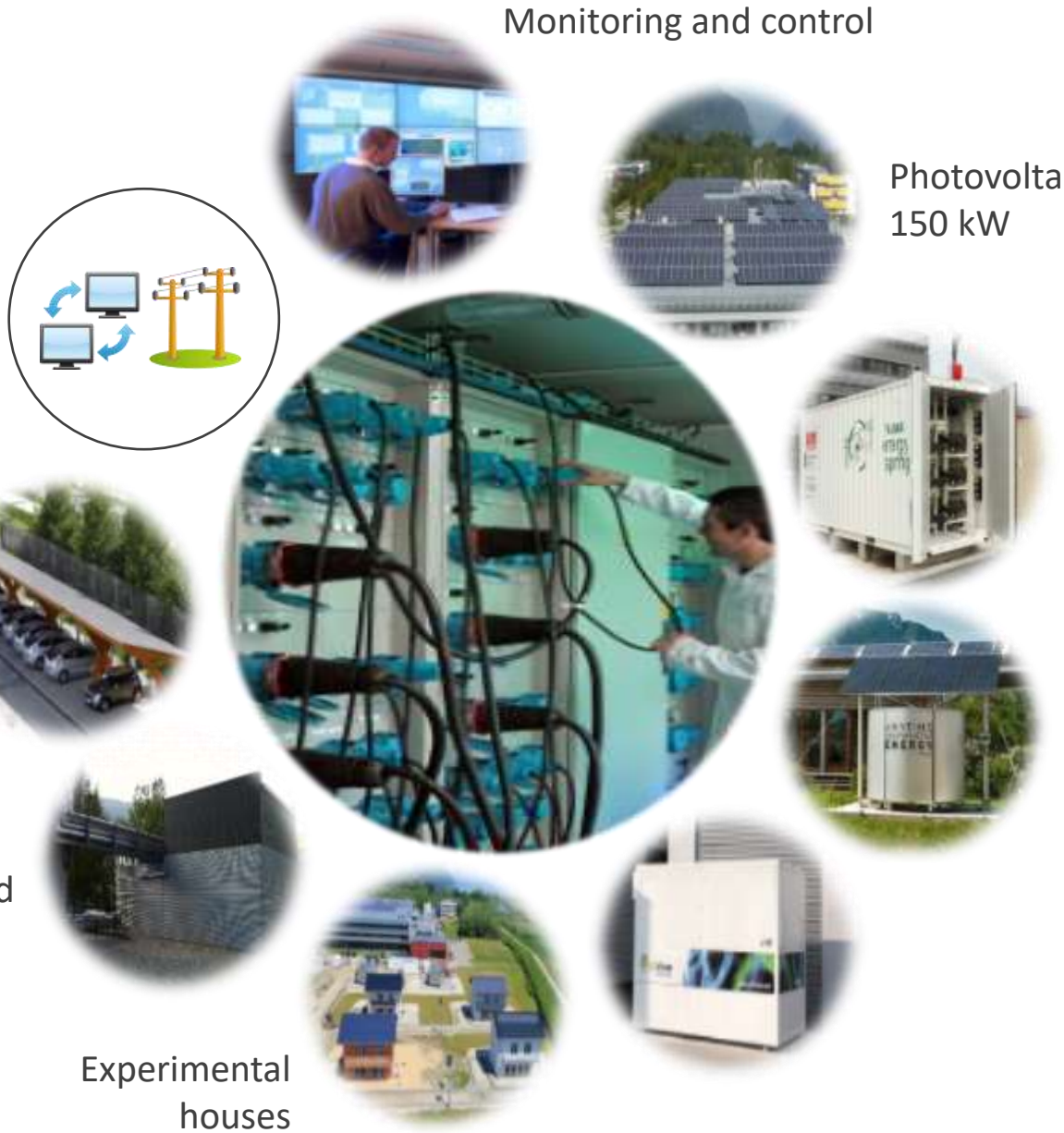
Monitoring

Field deployment

ENERGY SYSTEMS – experimental building platform

- 4 instrumented full-size experimental houses (‘INCAS’, 100 m² each)
- 10 rooftop component test benches (35 m² each)
- 4 quasi-adiabatic cells (‘PASSYS’, 3×3×5 m³ each)
- 1 versatile facility (‘FACT’, 8-meter-high twofloor building)

ENERGY SYSTEMS – electric smart grid platform



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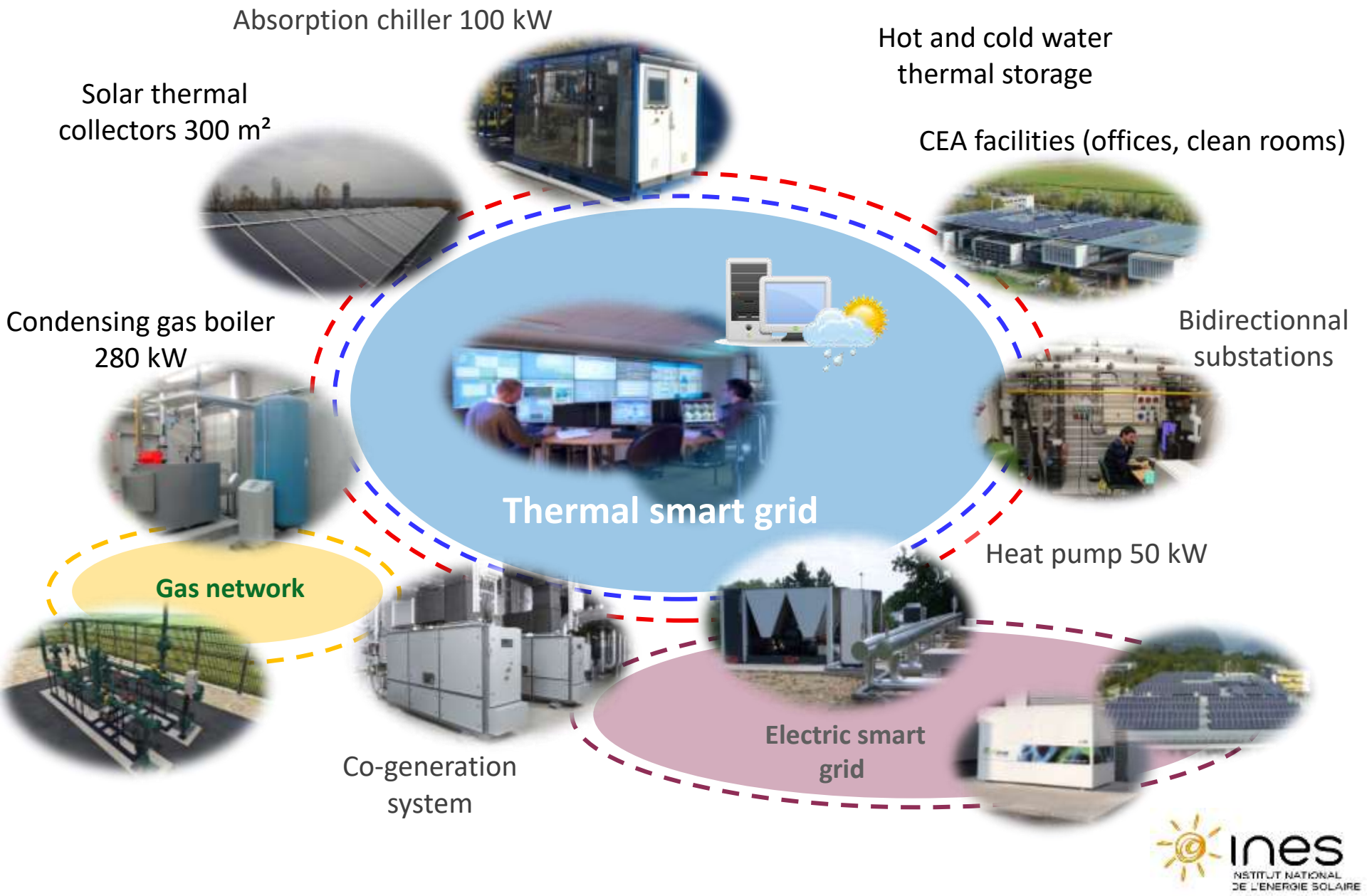
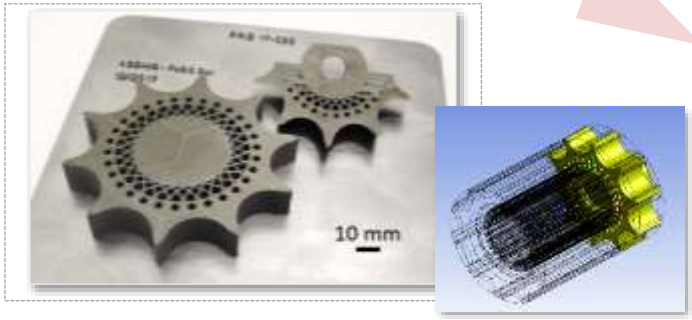
ENERGY SYSTEMS – thermal smart grid platform



ADVANCED MATERIALS AND CIRCULAR ECONOMY

Additive manufacturing and **powder metallurgy**



Reduction or **substitution** of **critical raw materials** (photovoltaics, batteries, fuel cells, magnets, etc.)

REDUCE

REUSE

RECYCLE

Second life (batteries)

Dismantling and **recycling** (photovoltaics, batteries, magnets)

Thank you very much for your attention