Liten's Vision

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Convergence between climate change, energy autonomy and affordability

A common objective at the global level

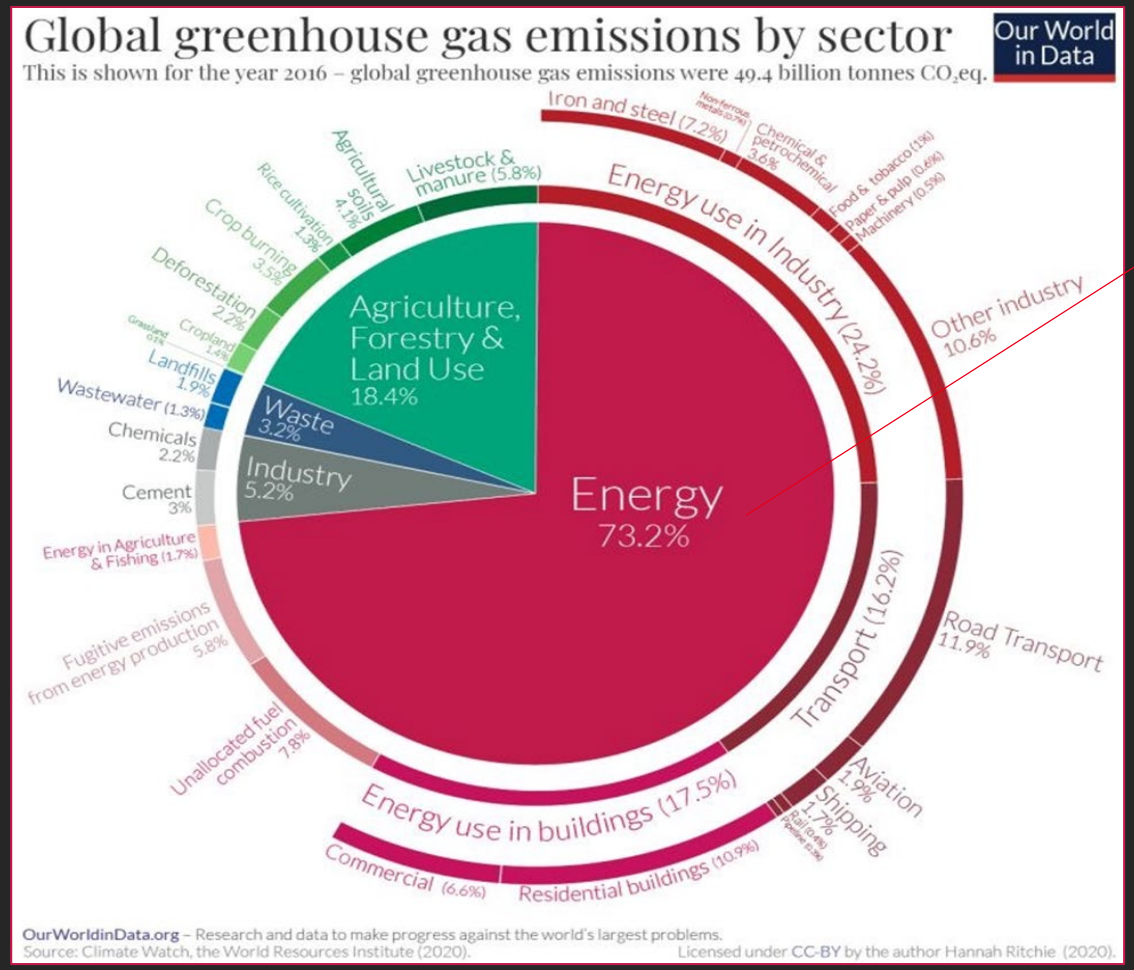
To drastically and urgently **reduce dependence on fossil fuels!**

To master the **value chains** and **critical material** supply. It is the only real guarantee of **true autonomy.**

All types of low carbon energies are needed

Why innovation?

How to limit greenhouse emissions?

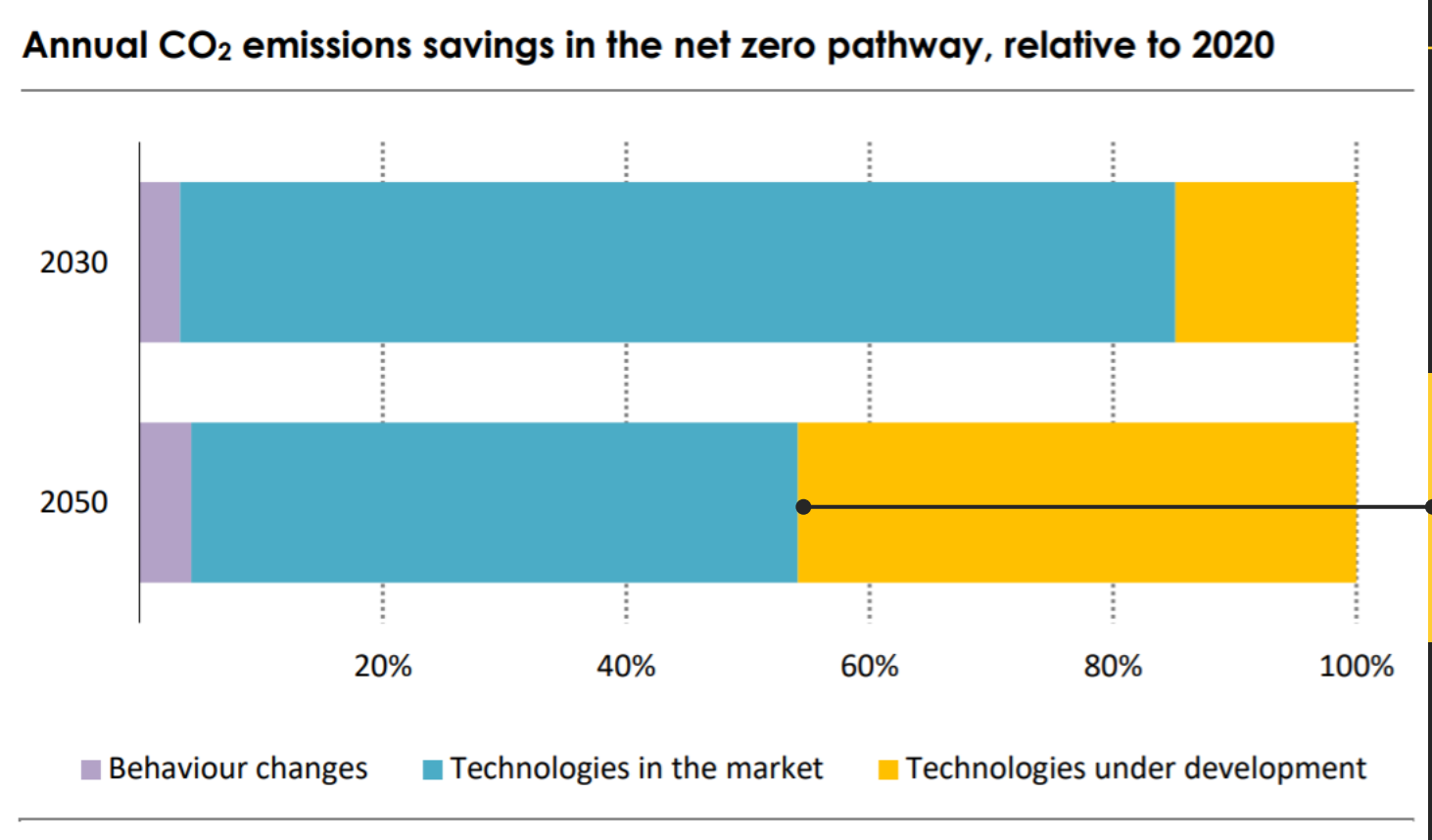


3 complementary levers

- **FRUGALITY / LOWER CONSUMPTION**
- **ENERGY EFFICIENCY**
- **DECARBONIZATION**

Technology

Toward net zero by 2050



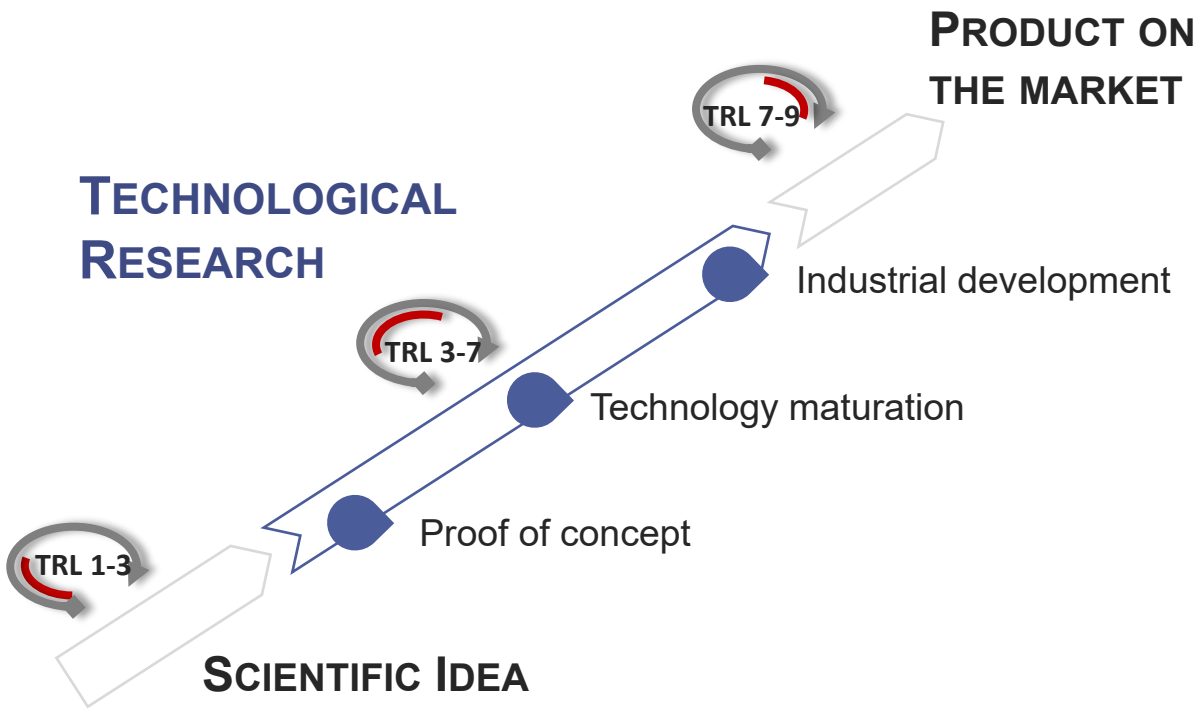
Net Zero by 2050 - A Roadmap for the Global Energy Sector – IEA, May 21

45% of technological innovations needed to reach carbon neutrality by 2050 are still under development

Target is clear, mobilization is mandatory, in particular for research centers

Liten, a leader in research and innovation for the energy transition

Our mission: create value through technology transfer to industry



Liten, a leader in research and innovation for the energy transition

1000 multidisciplinary experts committed to the energy transition

150 PHD students & post-doc

More than 1850 patents in our portfolio

+ 200 publications/year

12 world-class technology platforms

+ 200 industrial partners
+200 ongoing European projects

Strong track record on key technology bricks for the energy transition

Early bets & founding strategic technological choices

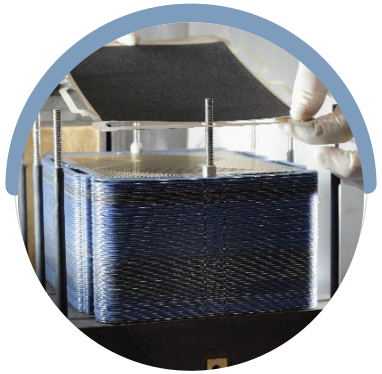
1990

Batteries

2000

Crystalline PV

2005

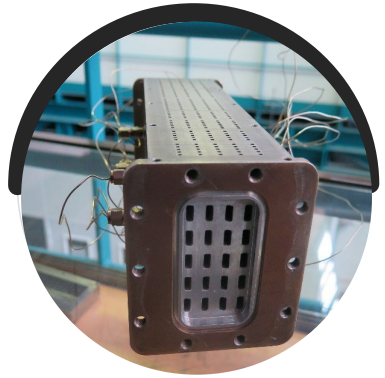


PEMFC &
Solid Oxyde Electrolyser

2010

Life Cycle Analysis
& Tech-eco Studies

2015

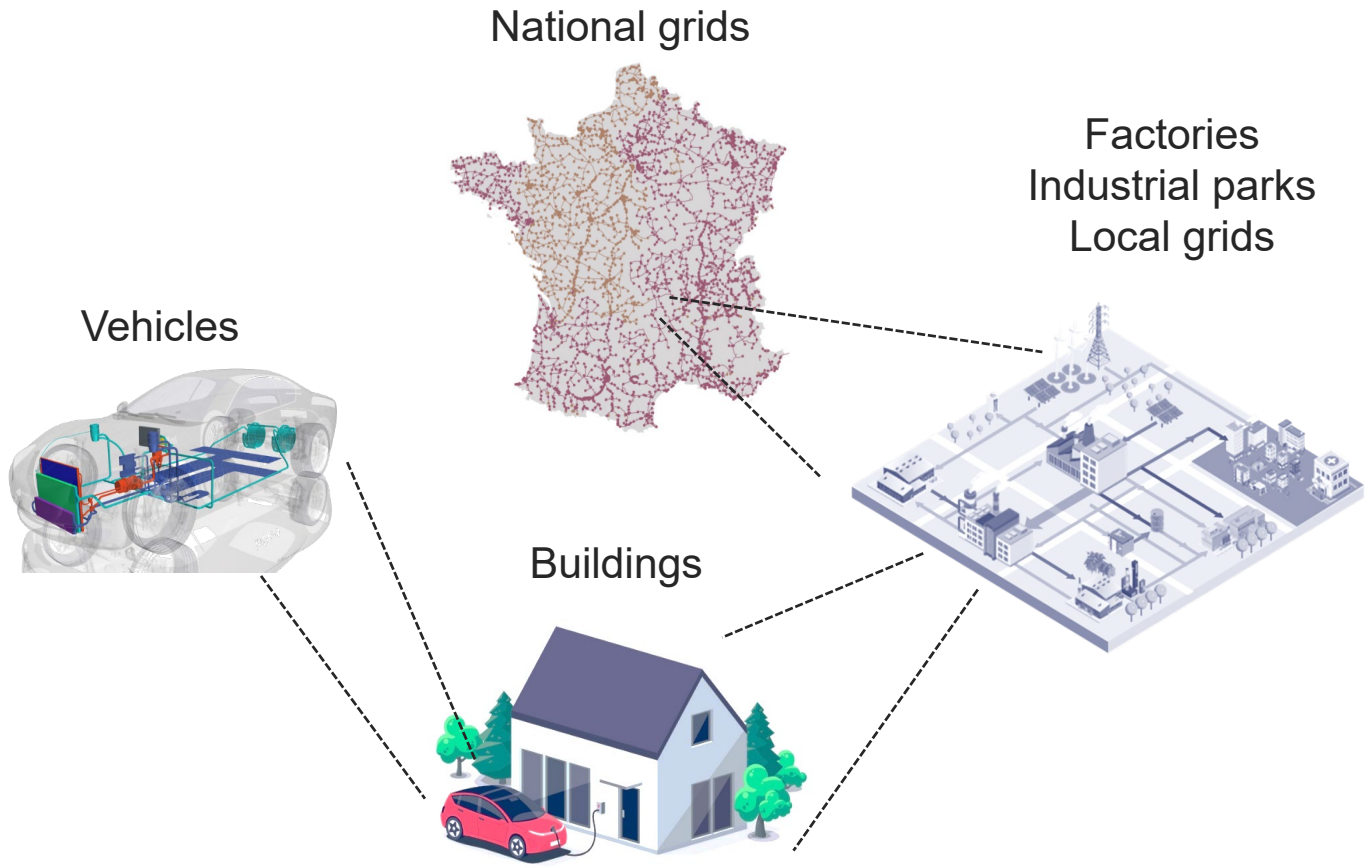


Power to X

Importance of synergies between technology bricks and along the value chain

- Key role of energy systems
- Innovation and mastering value chain are essential
- Spill over of technologies will speed up innovation

Key role of energy systems



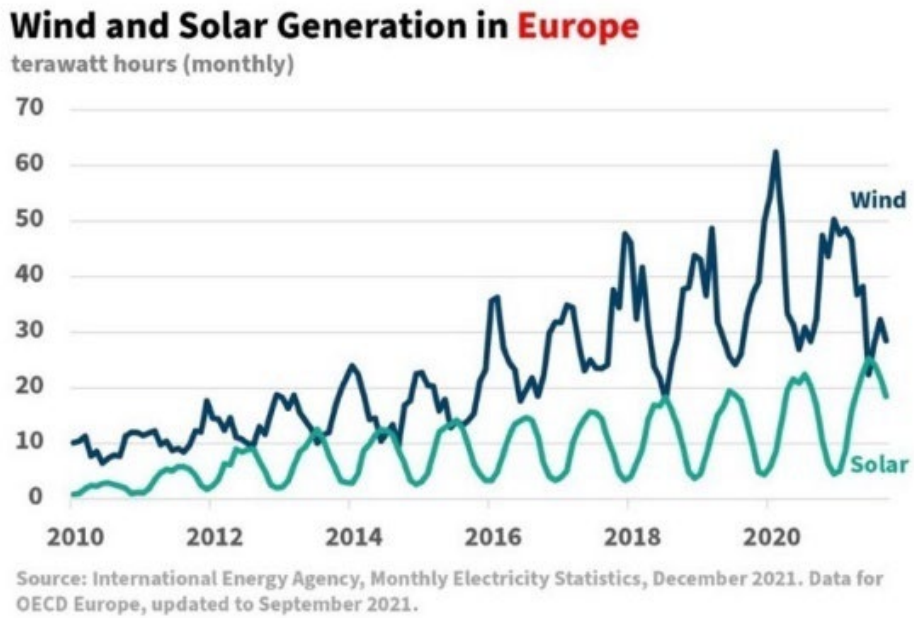
Energy systems

multi-scale & multi-vector approaches

- Customization
- Hybridization
- Optimization

Complementarity of technologies in use

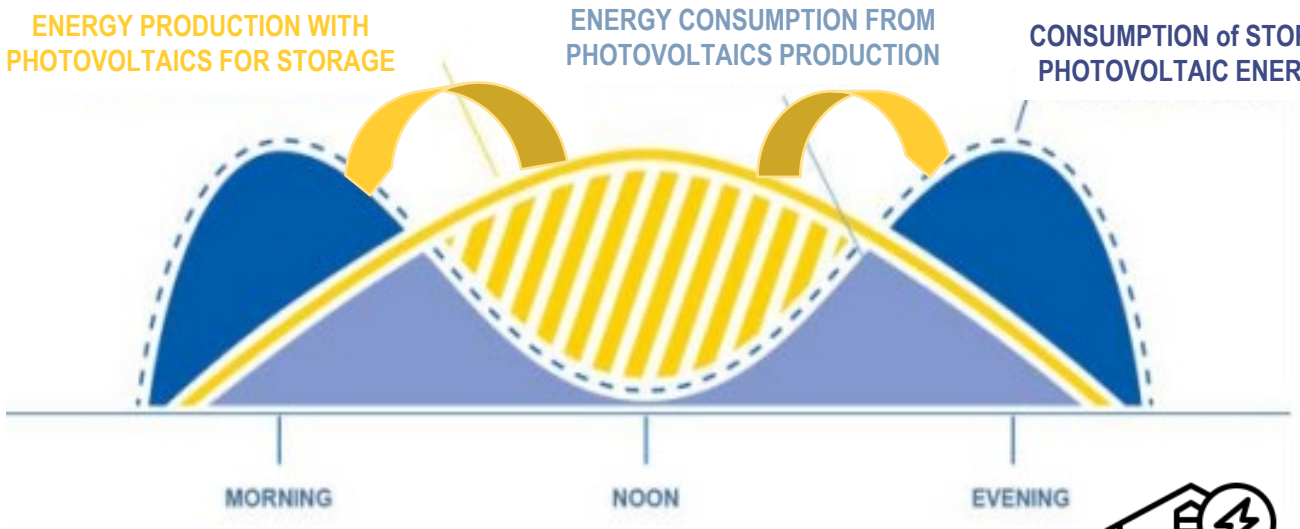
PV and Wind production are complementary



PV is strong in Summer !

Wind is strong in Winter !

PV and Li-ion Batteries for daily storage

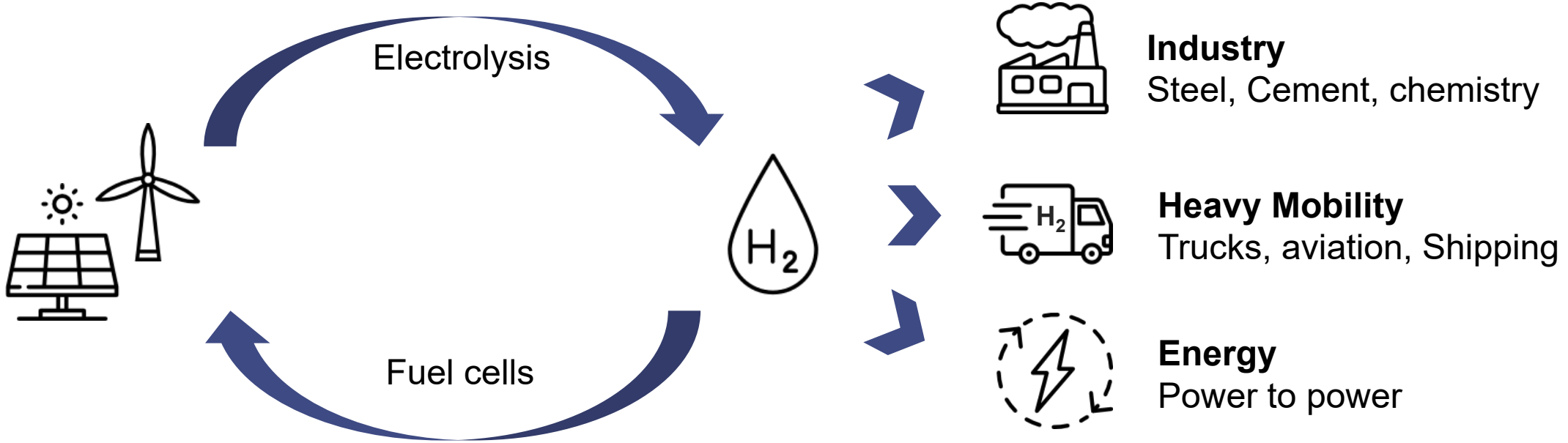


Noon peak production moved to morning/evening peak consumption

V2G or stationary storage
Smart charging

Complementarity of technologies in use

Renewable energy will provide low cost electricity to open hydrogen Markets



Industry
Steel, Cement, chemistry

Heavy Mobility
Trucks, aviation, Shipping

Energy
Power to power

Hydrogen will provide long term power storage to unlock Renewable market potential

Innovation and mastering value chain are key

Fragile and incomplete value chains

Production market share, China Alone (not taking into account APAC subsidiaries)

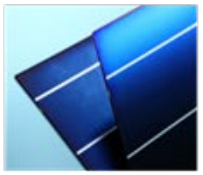
> 80 % > 96 % > 96 % > 85 % > 75 %


Si - MG


Polysilicon


Ingots


Wafers


Cells

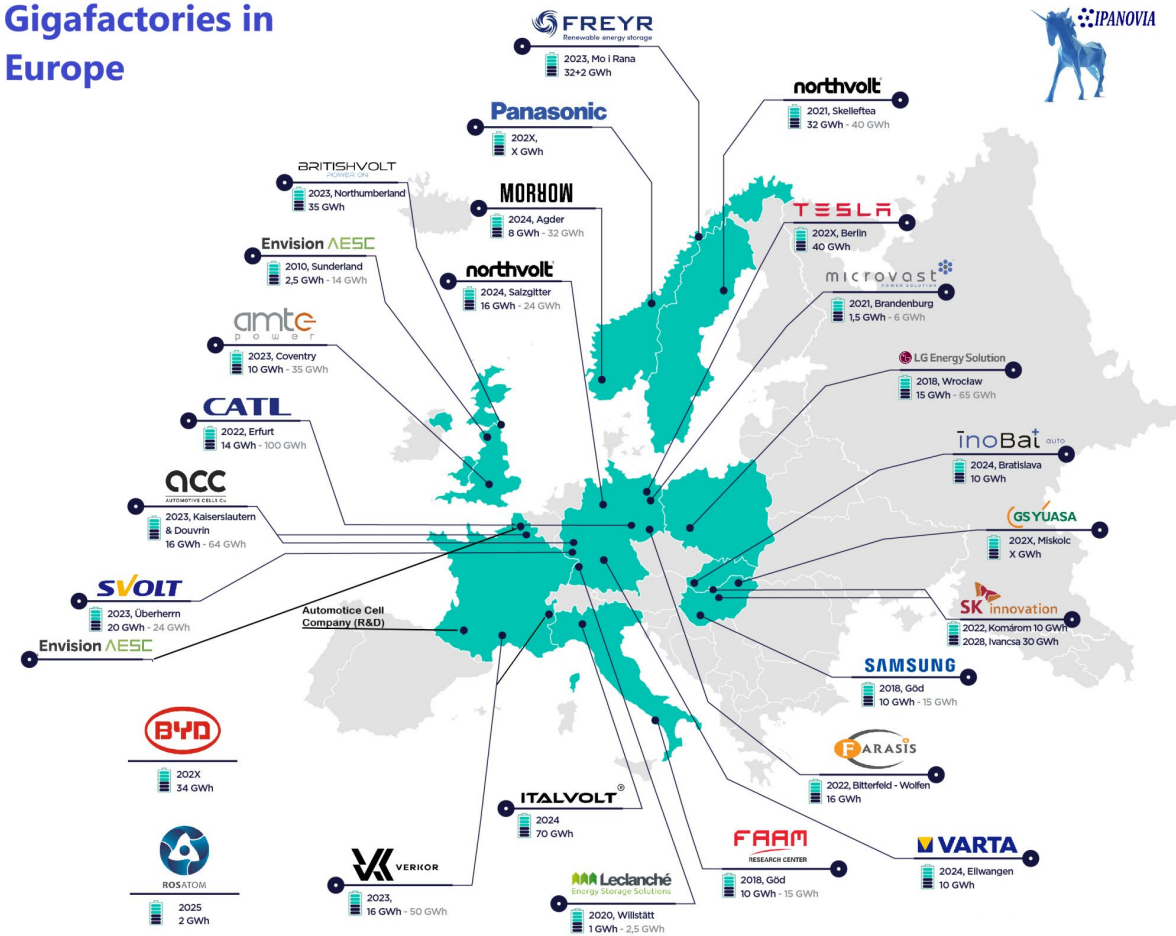

Modules


PV Systems

Components are key elements of **competitiveness** and **innovation**

Complete value chain: batteries giga-factories & ecosystems

Gigafactories in Europe

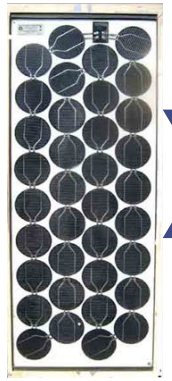


PV: multiple generation development fostering innovation and performances

Two levers: innovation & mass manufacturing

INNOVATION

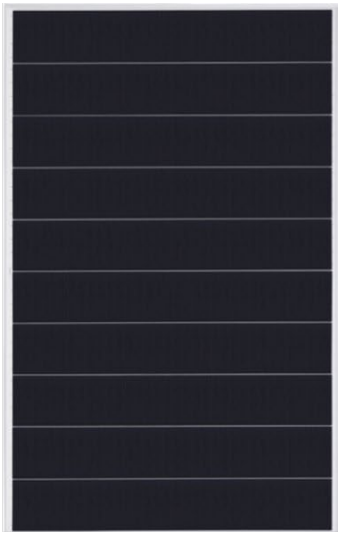
6-8 % efficiency
40 $/W
40 W
5 years warranty



70's

90's

2015



2020-2030

20 % efficiency ---- x3
0,2 $/W ---------- ÷80
600 W ---------- x15
30 years warranty -- x6

MASS MANUFACTURING

Few MW/year

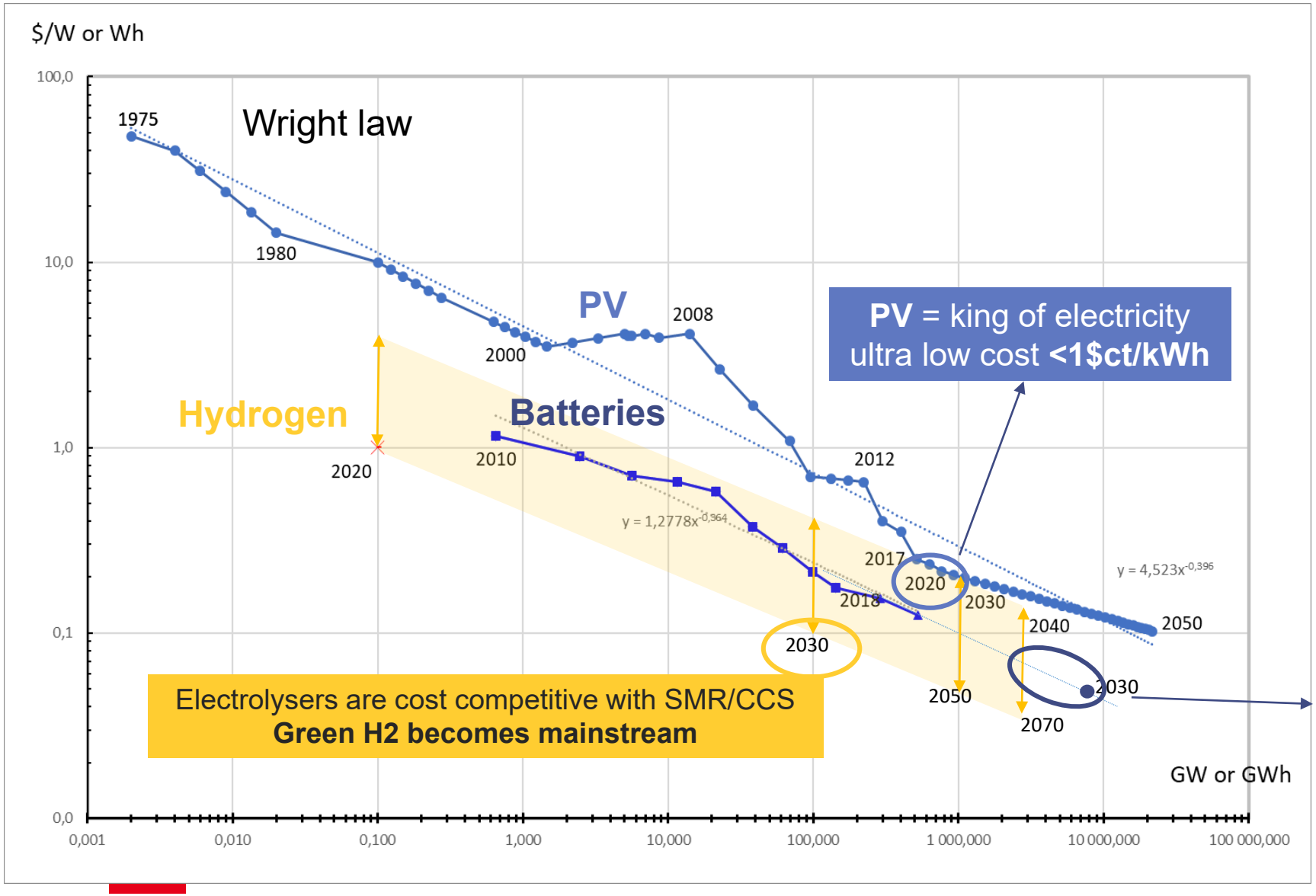
Annual production

(2020)
200 GW/year
x200000

(2030)
Toward TW/year
x1000000

The challenge of the coming decade

Cost reduction with innovation and mass production!



Similar learning rate for PV and Li-Ion

Same trend for Hydrogen /5-10 in 10 years between 100 et 500 $/kW

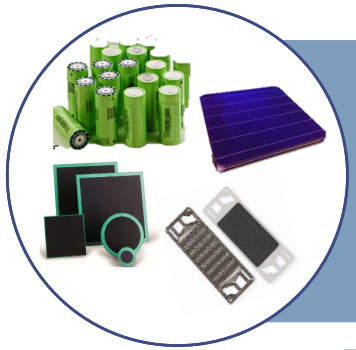
2030, ~ 60 $/KWh for Li-ion

- EV could be cheaper than ICE
- **Stationary storage** from 4 to 10h could become **mainstream**

Spill over of technologies will speed up innovation

Strength of these technologies

Batteries, PV, Electrolysers & Fuel Cells…



CELLS

Performance
Mass manufacturing

STACKS MODULES

Modularity
First level of integration

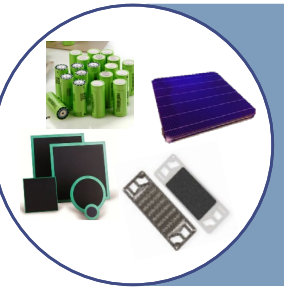
SYSTEMS

Customization
Smart integration

Common characteristics and synergies of major disruptive value chain to accelerate the energy transition

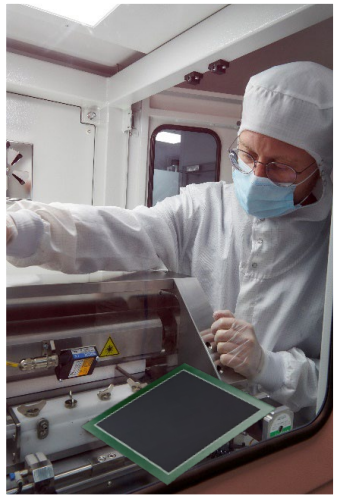
Spill over of technologies will speed up innovation

Same equipments/ process, approaches and methodologies



CELLS

Screen printing



Coating, thin film technologies (PVD / CVD / etc…)

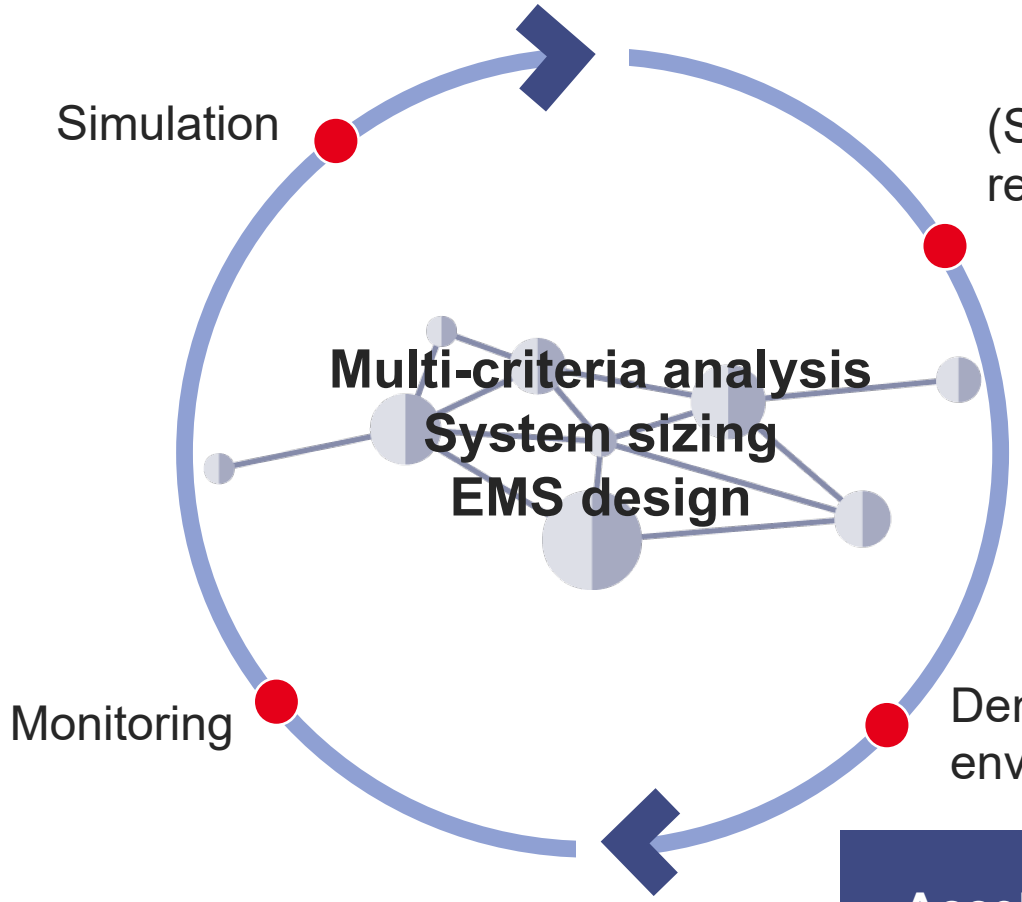
Automation for mass manufacturing

Acceleration through common equipment / process, learning, skills…

Spill over of technologies will speed up innovation

State of the art methods and tools for system design

SYSTEMS



Acceleration through common tools, methodologies, skills…

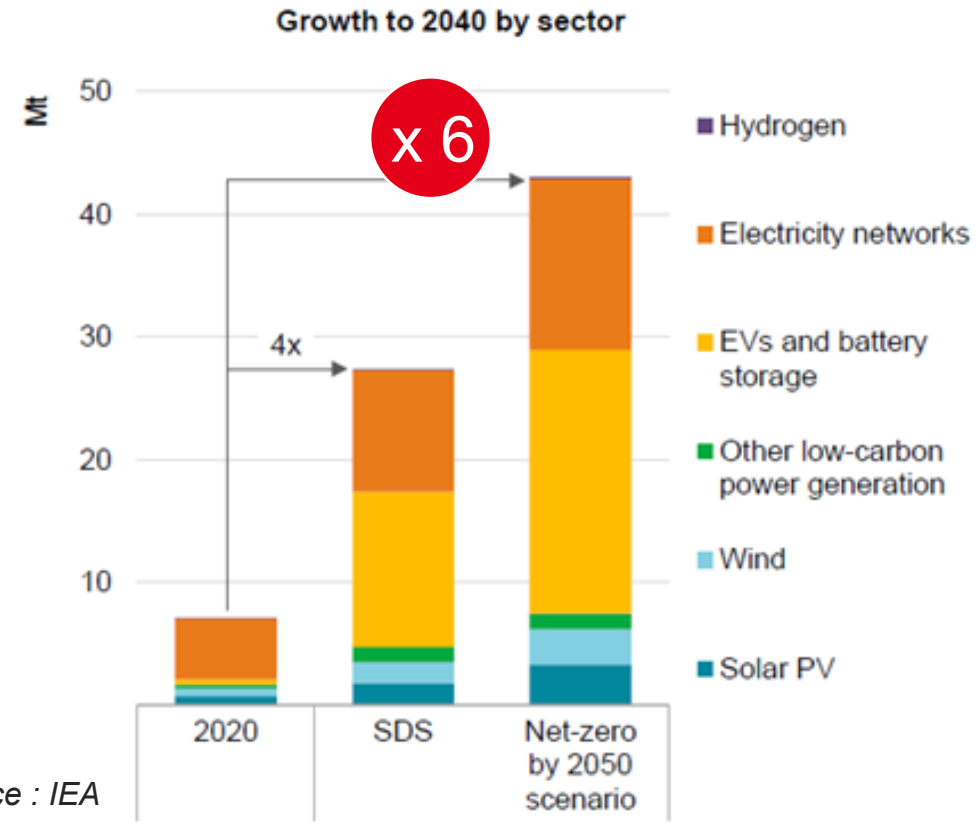
Don’t forget critical materials!

All scenario for energy transition will require a high quantity of raw materials

Don’t forget critical materials!

From an era of fossil fuels to an era of materials

Mineral demand for clean energy technologies



Source : IEA

Develop a circular economy approach for all technologies

Reduction or substitution of critical raw materials

Near-net-shape manufacturing processes

Durability and second life

Disassembly and recycling processes

Acceleration through new process, business models & ecosystems …

How to move fast and in the same direction?

- Innovation & volume effect
- Partnerships & ecosystems

Accelerating the transition to sustainable energy

INSTITUT CARNOT Energies du futur

cea liten

Thank's for your attention