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# **An innovative approach for Industry and Territories decarbonization roadmap**

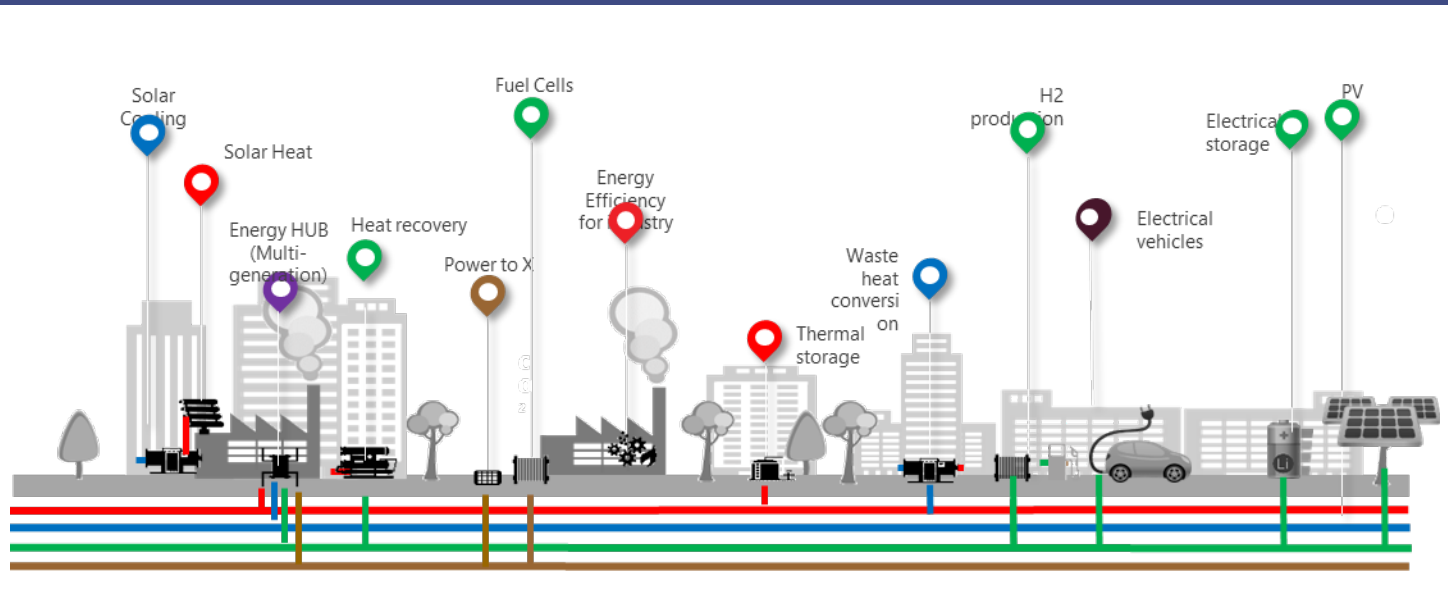
*Françoise BURGUN*



# Context of energy at industry and territory level

How to move towards zero carbon?

Necessity to modify energy systems to tackle climate change challenges, in a complex, uncertain volatile environment



Industry and territory, towards an integrated energy system

Reducing together Energy & Carbon intensity

Help is needed to navigate this complex uncertain world

Compass + Map + Pathways



# A multi-scale, multi-criteria approach, energy, resources & CO<sub>2</sub>



Objectives for industry / localities

KPI

- ✓ Economics
- ✓ Technical
- ✓ Environmental
- ✓ Societal, etc.

Economic

Technical

Market and meteorology

Environmental

Parameters & constraints

Questions to answer

Which Path to reach the goals ?  
Equipment, Architecture, control?

Cost?

Environmental impact?

SIZING

What size and means of production?

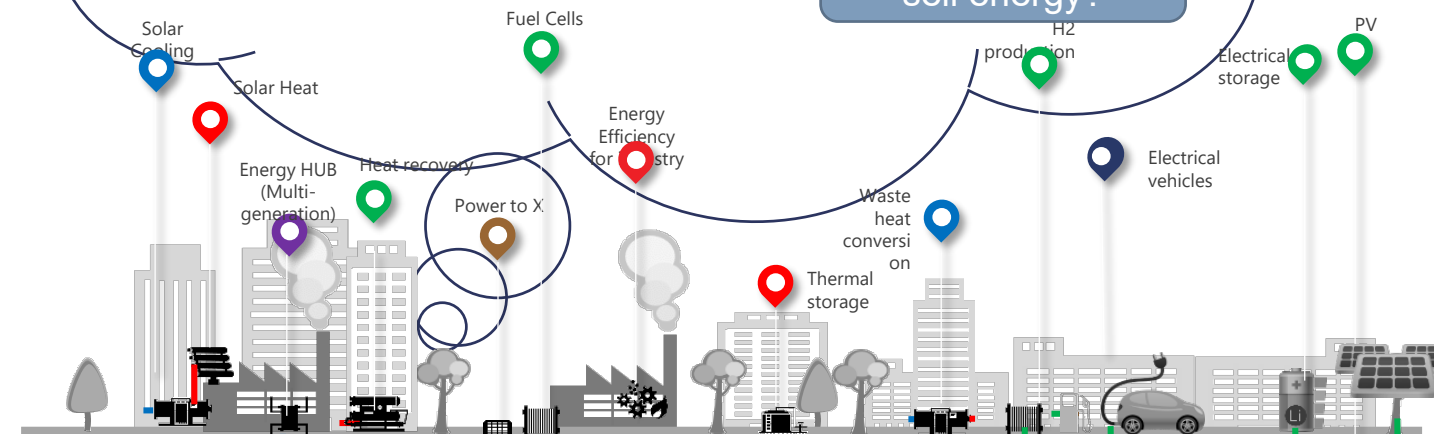
What type and size of storage?

CONTROL

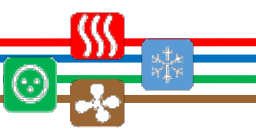
When to produce?

When to store?

When to buy and sell energy?

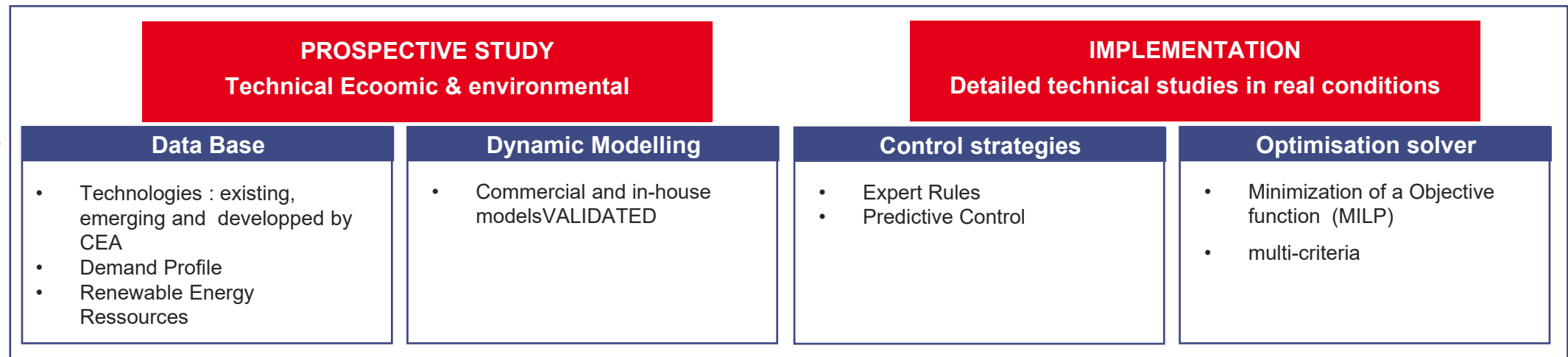
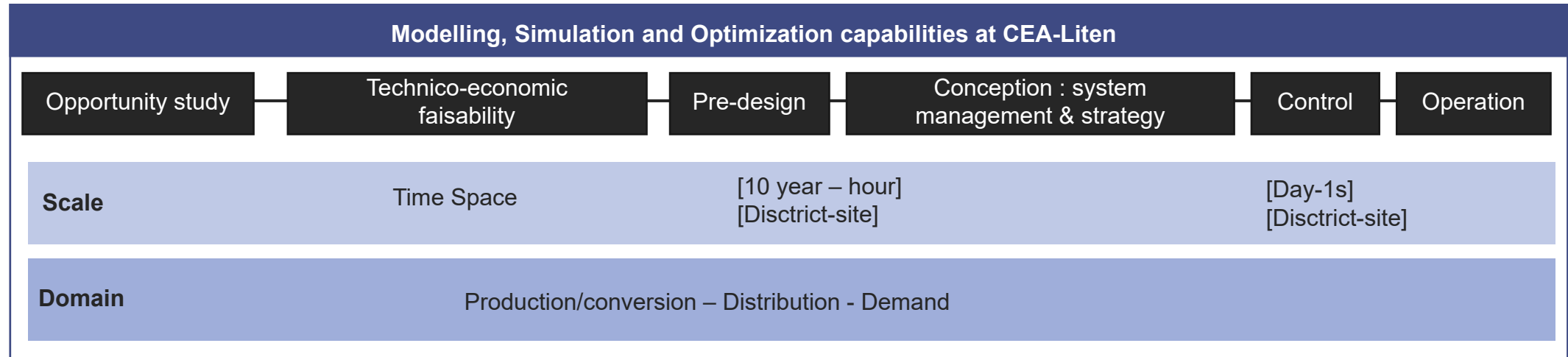


Intrinsic complexity to address multicriteria optimization



# Holistic approach

Technical, economic and environmental fostering energy efficiency and limiting ecological impact



All Energy Carriers And WATER



# Holistic approach

Technical, economic and environmental fostering energy efficiency and limiting ecological impact

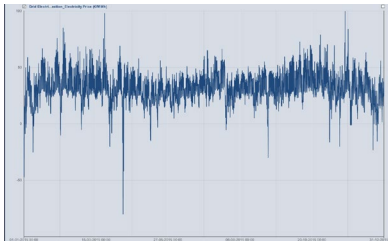
1

## Site description & KPI definition

### Data collection

Boundary conditions  
→ Time series

REn Producible



Load profiles

Tech-Eco-Env DATA  
KPI

2

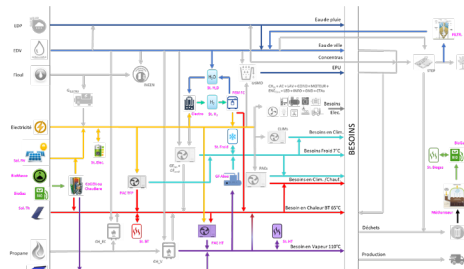
## Identification & integration of potential solutions

### Construction of a superstructure

Representation of site

Identification of relevant new equipments  
- Existing and new techno

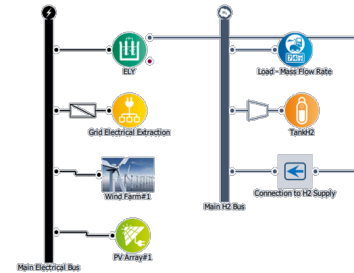
Integration on a « combined model »



3

## Dynamic Modelling & Optimisation

### System description Library models assembly



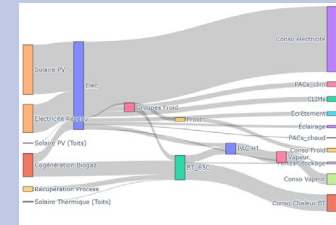
Under Tec & Env constraints  
& System constraints

All energy carriers  
System design in dynamic transients  
Predictive Control

## RESULTS: Identification of Pathways

### System Indepth Analysis

Component dynamic operation  
Production unit commitment...



Optimal sizing of storage and Renewable

Key performance indicators

- Cost breakdown,
- CO2, etc.

Sensitivity & Uncertainty analysis

# Case study

## Decarbonization of an industrial site with high environmental ambitions

- Total Energy Consumption: ~10GWh/year
- CO<sub>2</sub> Emissions: 800t/an





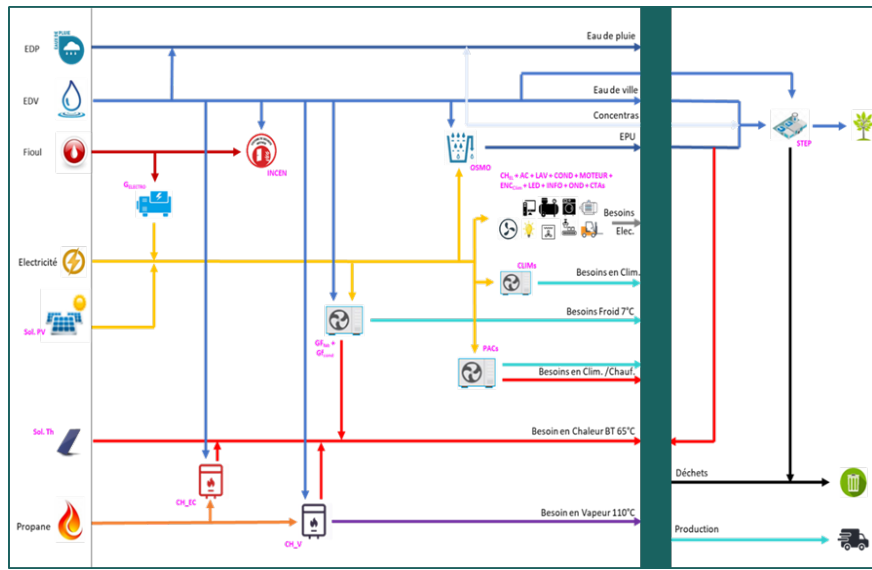
# Case Study

2

## Identification & integration of potential solutions

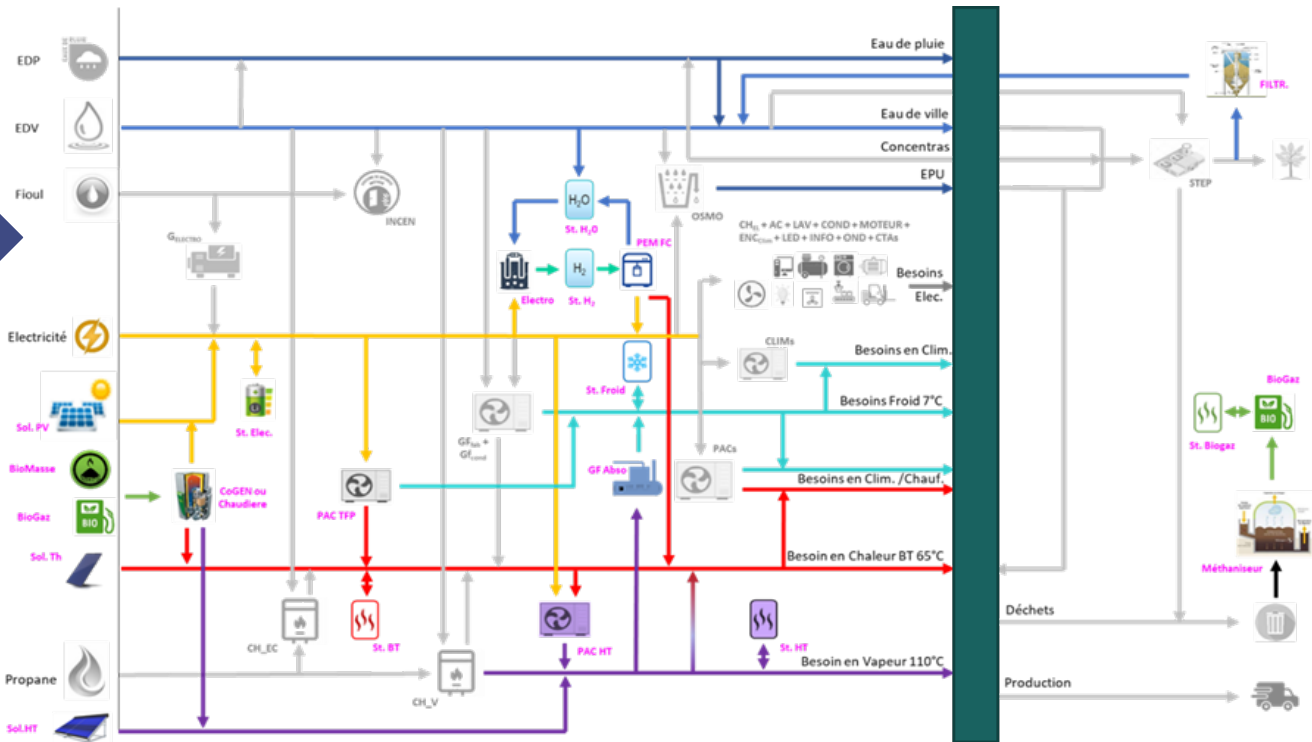
### SUPERSTRUCTURE

Representation of the site and identification of the field of possibilities in terms of technological bricks and architectures



## Integration of all the relevant potential technologies in the superstructure

→ based on a combined "needs driven" representation)



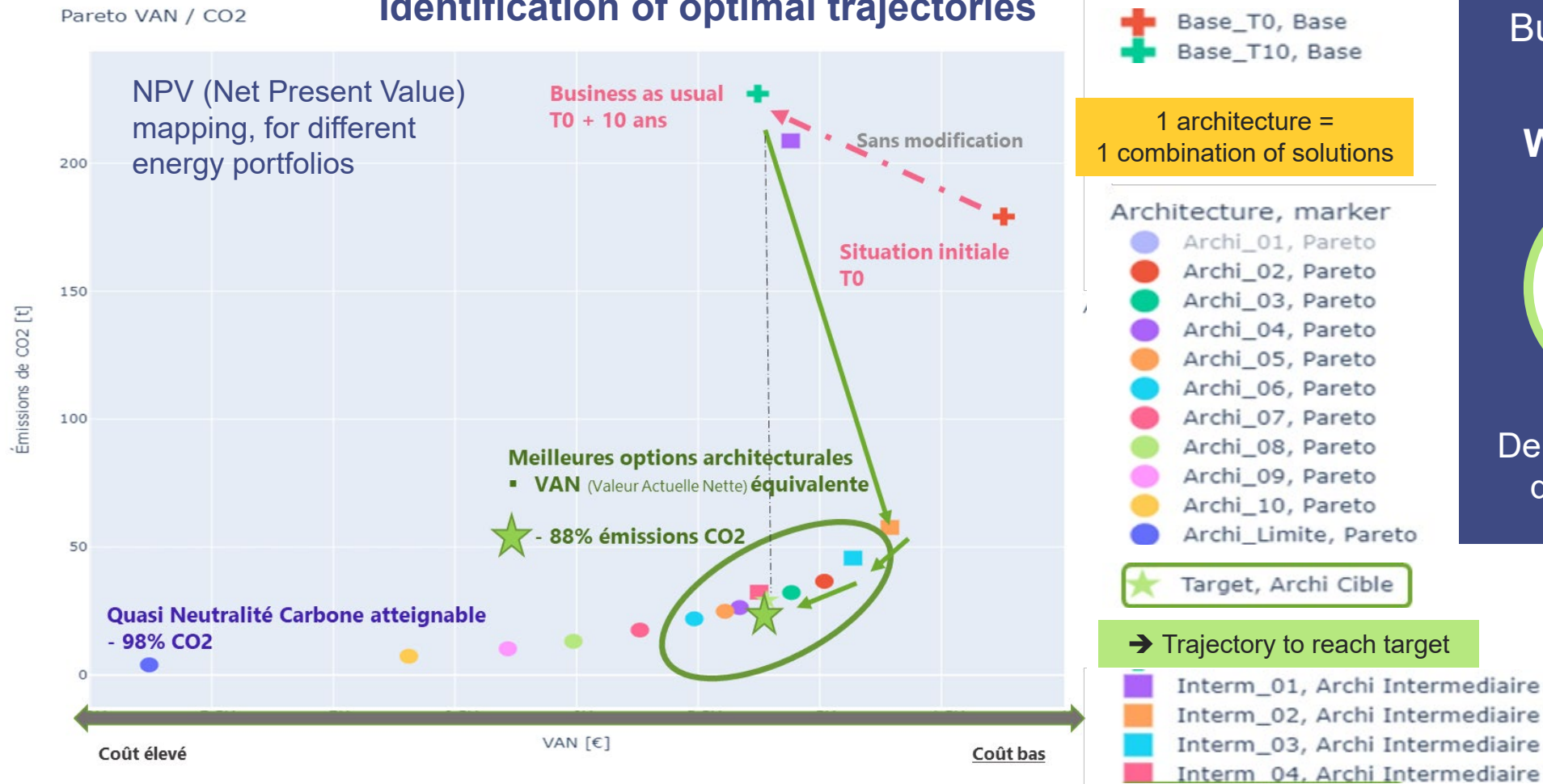


# Case Study

3

## Modelling, validation, optimization & simulation

### Identification of optimal trajectories



In this case a 10-year projection incorporating an increase in production volumes:

Business as usual

+36%  
CO<sub>2</sub>

With our approach NPV

-88%  
CO<sub>2</sub>

69%  
Electricity  
autonomy

Demonstration feasibility to reach quasi neutrality: -98% de CO<sub>2</sub>

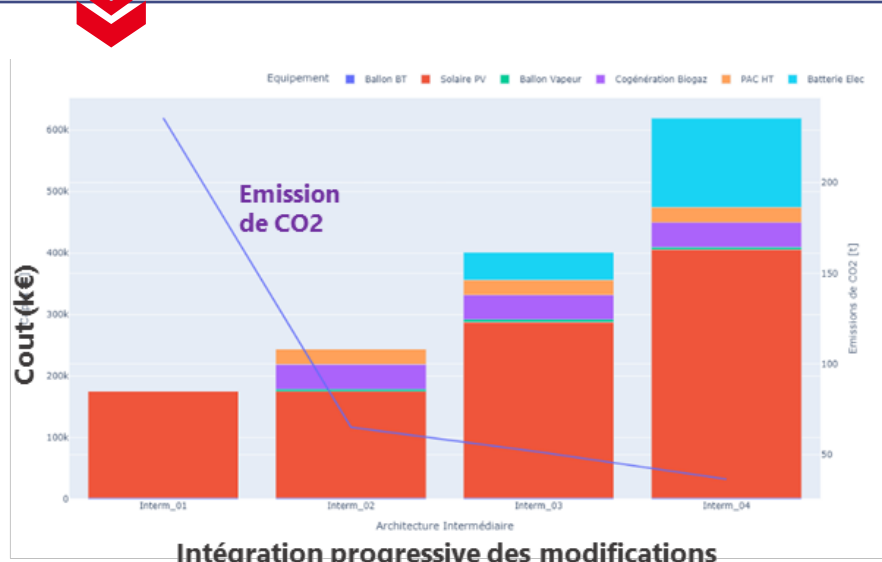
# Case Study

Representation of energy flows  
by Sankey diagrams

## RESULTS

Definition of a target architecture and associated path

Specification of the associated optimal sizing and CAPEX



Intégration progressive des modifications

- Interm\_01, Archi Intermediaire
- Interm\_02, Archi Intermediaire
- Interm\_03, Archi Intermediaire
- Interm\_04, Archi Intermediaire

With our approach NPV

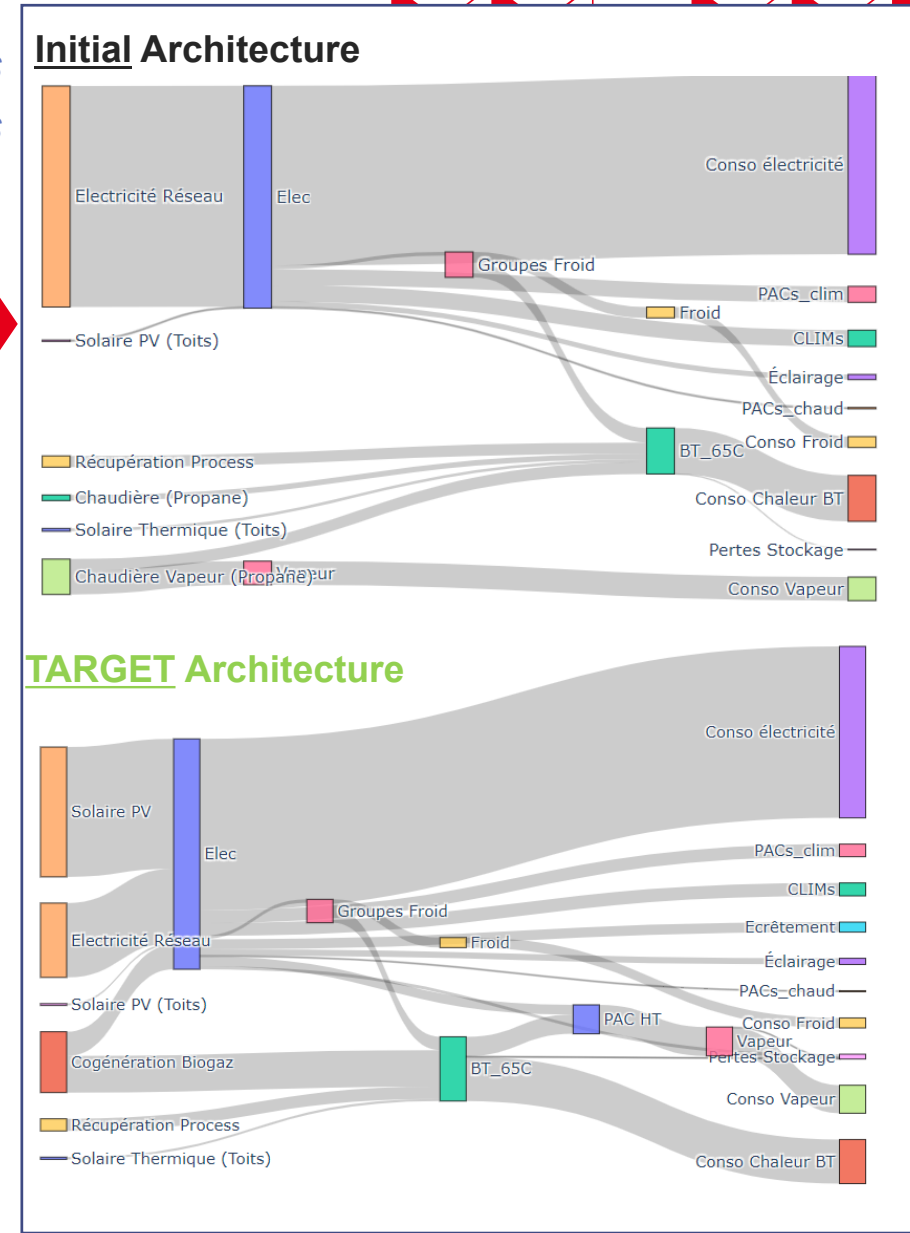
**-88%**  
**CO<sub>2</sub>**

**69%**  
**Electricity  
autonomy**

CAPEX < 0,3% CA

Implementation in 4 Steps

1. Solar PV
2. High Temperature Heat Pump
3. Cogeneration
4. Electric Battery



# CONCLUSION - OUTLOOK

Agnostic and holistic approach helping to roadmap definitions towards improved energy efficiency and carbon neutrality

**MULTI:** scales, objectives, criteria, constraints, energies, resources...

**Adaptable**

**Implemented** and **validated** on various application cases

In **constant progress** in terms of:

- Methodology
- Data analysis
- Modelling/optimisation tools
- Simulation and studies



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**Thank's for  
your attention**