

SMALL CITIES: WHEN TRANSPORT SUSTAINABILITY IS AN OPPORTUNITY –

Cremona Case Study

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POLITECNICO
MILANO 1863

The Problem

Some numbers that materialise pollution issues on Earth

35/96

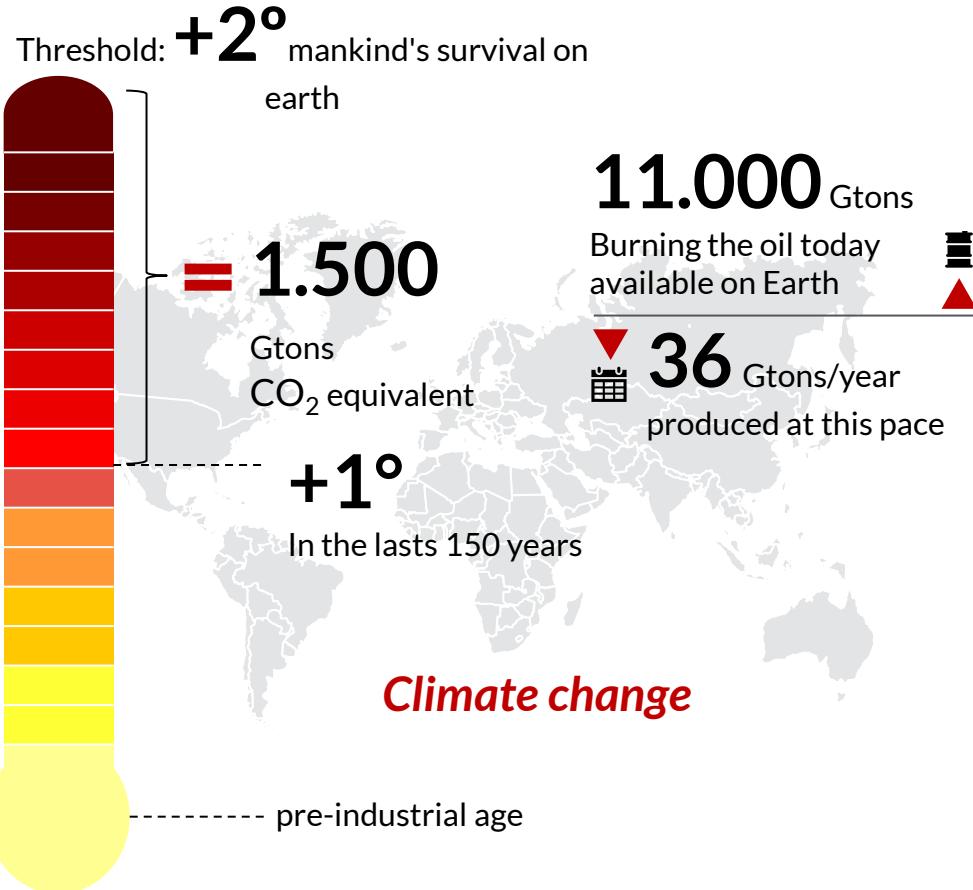
Provincial capitals surveyed on the peninsula

Outlawed for fine dust (PM10)



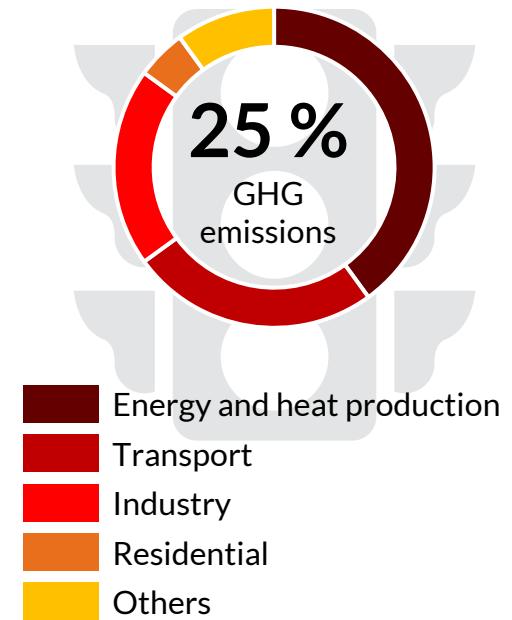
Have an annual average of PM10 higher than that indicated by the WHO

Local emissions



“ There is not a planet B ”

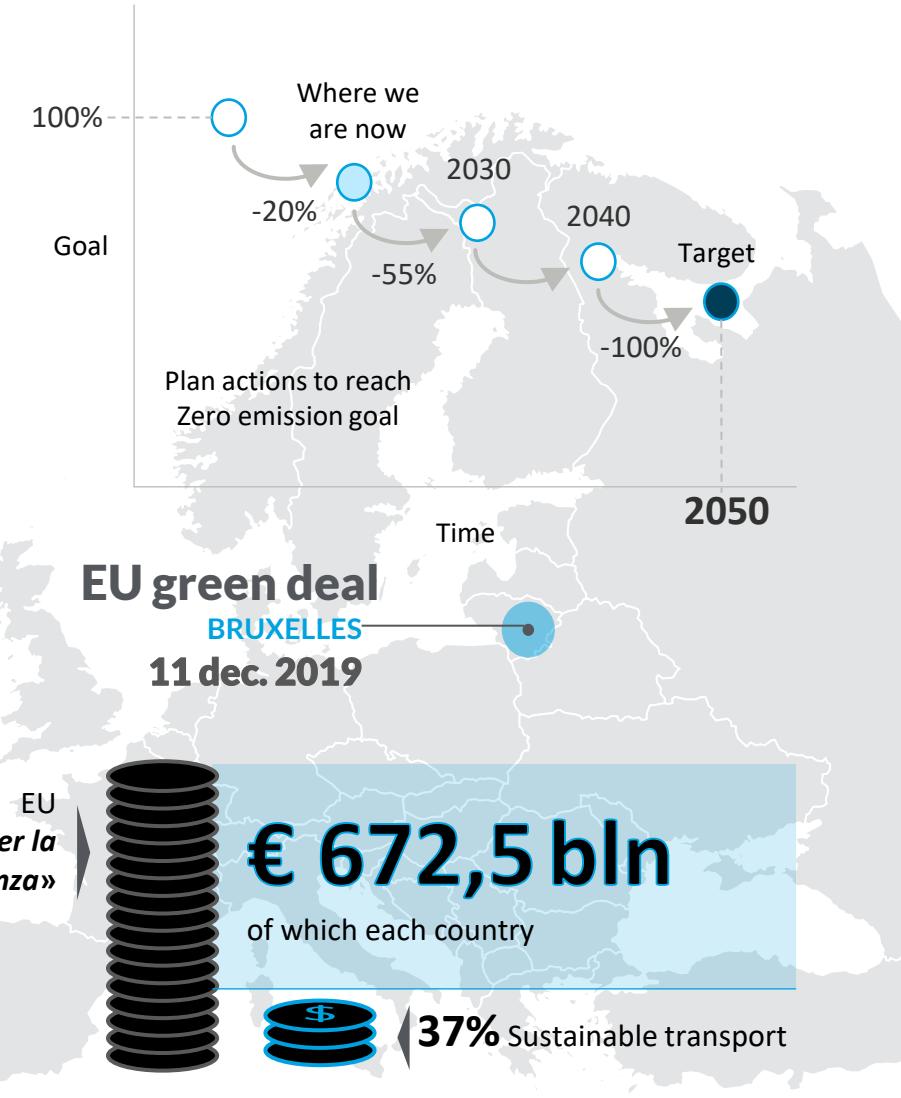
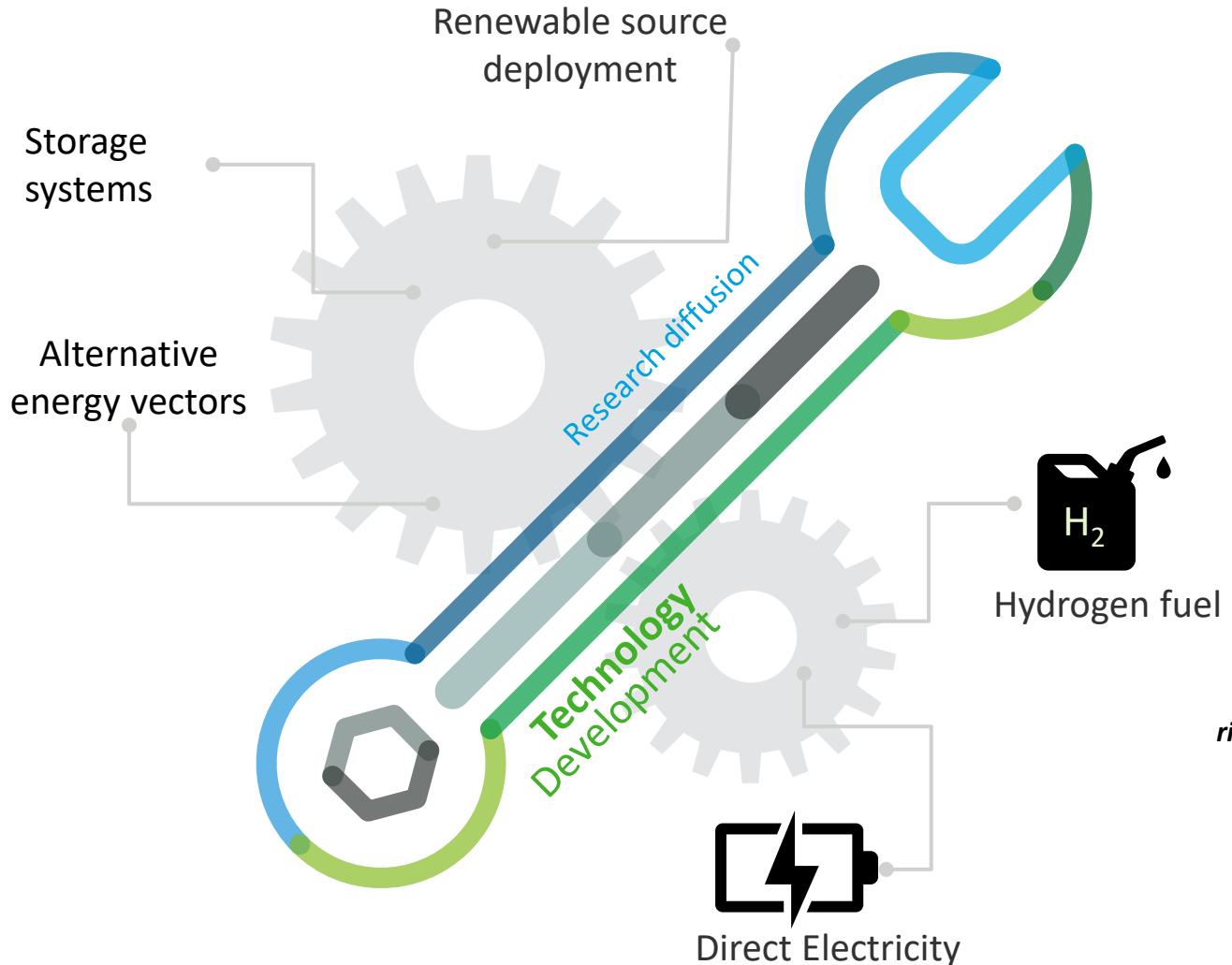
Impact of the
Transport sector



9% Italian GDP

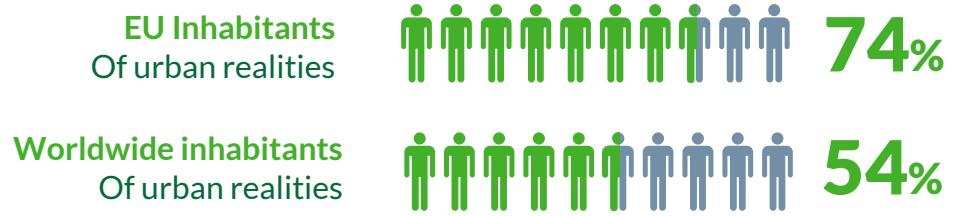
An Opportunity

From a mental shift to a new economic structure



Our Commitment

Disruptive environment



“There is no **SUSTAINABLE TRANSPORT**
without considering **COLLECTIVE** transport”

Goal



DECARBONIZATION

Of the urban bus fleet



DEMAND ATTRACTION

And mode shift from private to public

Outline a portfolio of *sustainable* alternative



**BRING THE CHALLENGE BEYOND
THE CITY BOUNDARIES**

New OPPORTUNITIES for smaller realities

METHODOLOGY

Disruptive approach



Horizontal approach

setting a multidisciplinary overview of the problem

Meet the needs to translate existing metropolitan structures in new and under dimensioned realities

Limited economic availability & peculiar mobility requirements

Punctual analysis

Empirical strategies, experience-based samples, field inspection and observation of already developed pilots to reach effective solutions .

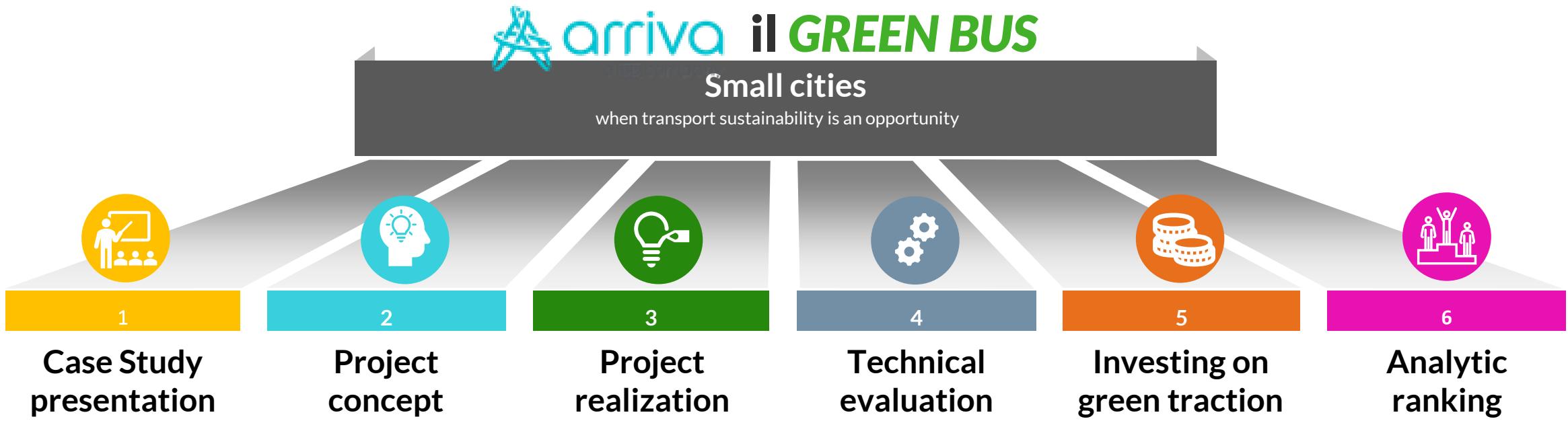
Collection of technical and computational tools

capable of addressing the issue in practice

Reproducibility oriented

Provide concrete solutions and useful algorithms

Agenda – basements of the work



Study Area

Picture of the actual scenario

70.000 inhabitants in an area of 69,7 km²

54%
trips



Reference scenario: business as usual

13 Urban Lines

Extra urban service is excluded from the analysis

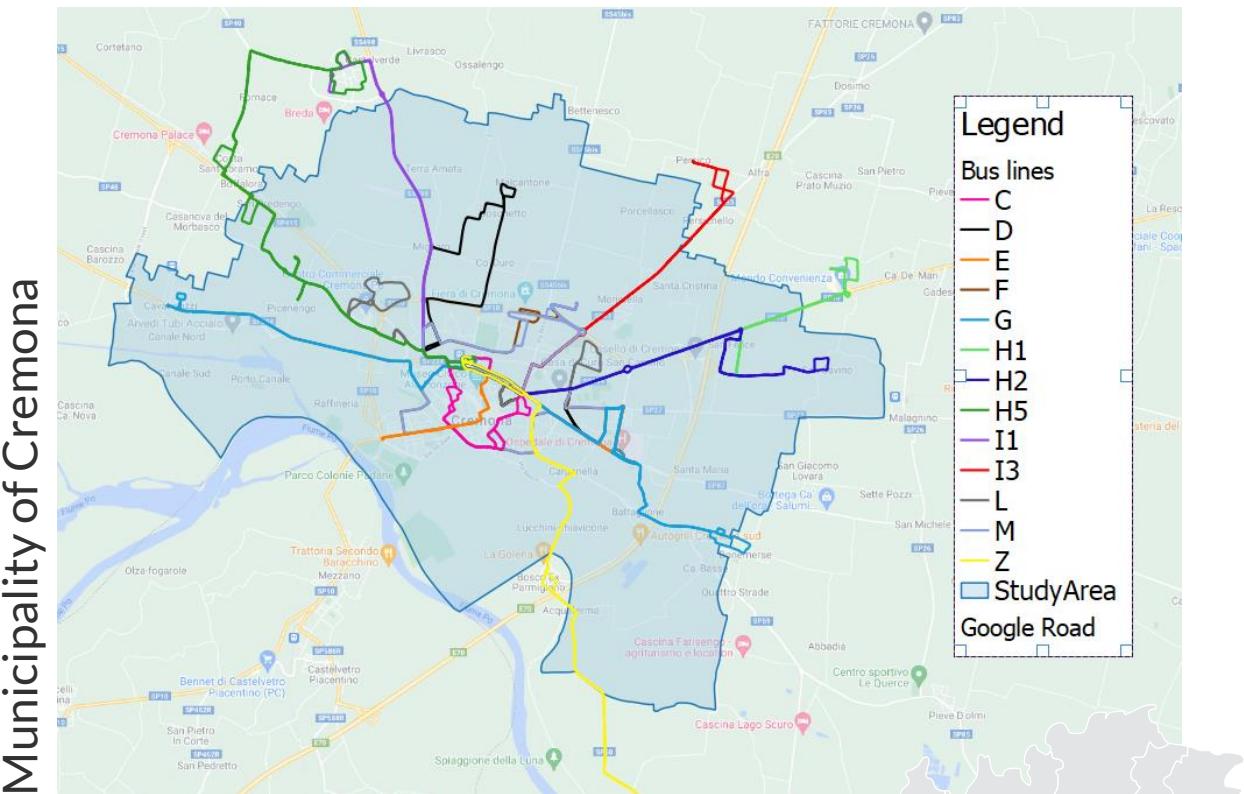
23 buses x 4100 km/day cover the service

300 operational days per year

Diesel bus

12 years old on average that is low level of comfort on board and a trashed visual impact

» PTO: Arriva Italia S.r.l.



Why Cremona

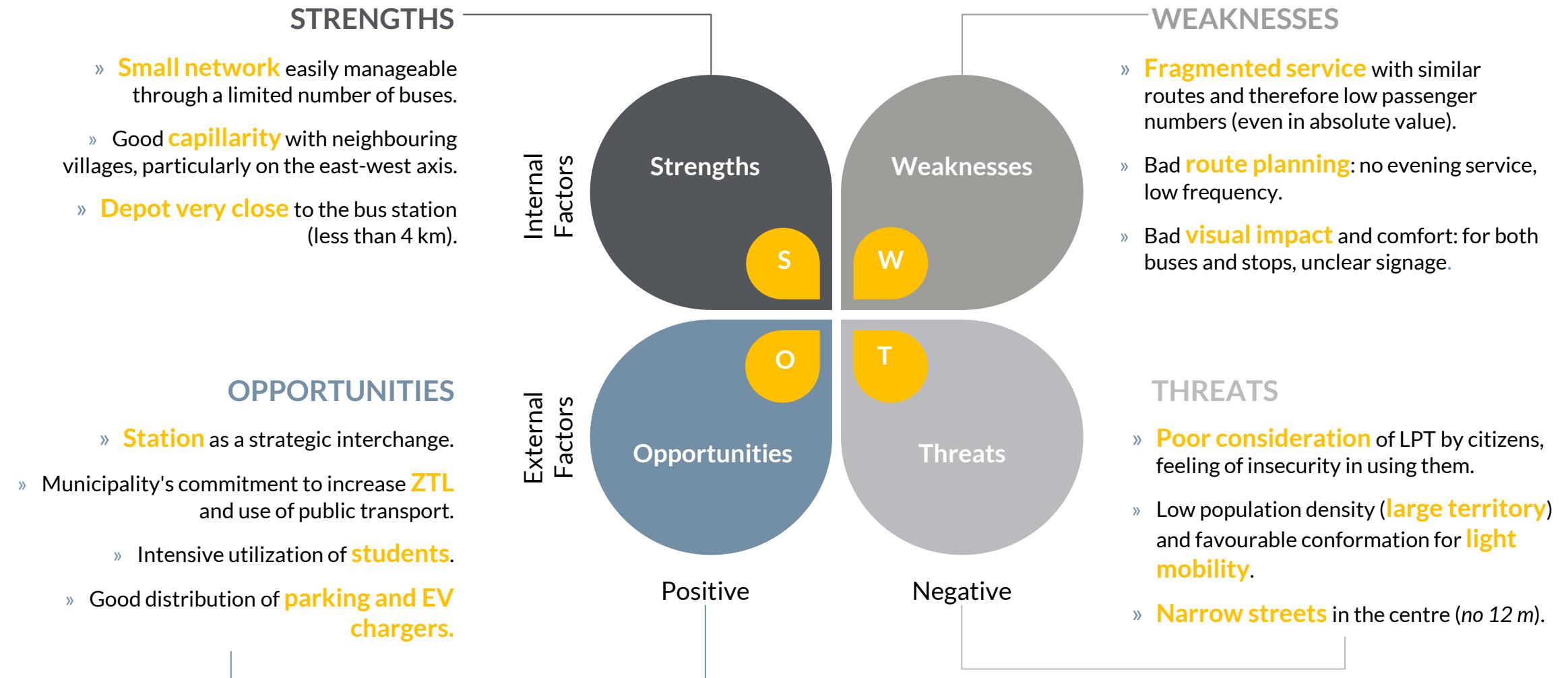
Cremona is the second city in Europe in terms of the most polluted air for annual average concentration of PM2,5.



Arriva Italia's management directory expressed its interests in green transition.

SWOT Analysis

Actual Supply evaluation



Sustainable Transport

Why LPT helps in sustainable transport



“ Condition of a development capable of ensuring that the **needs of the present generation** are met without compromising the **ability of future generations** to meet their own needs. ”

Arriva il Green Bus

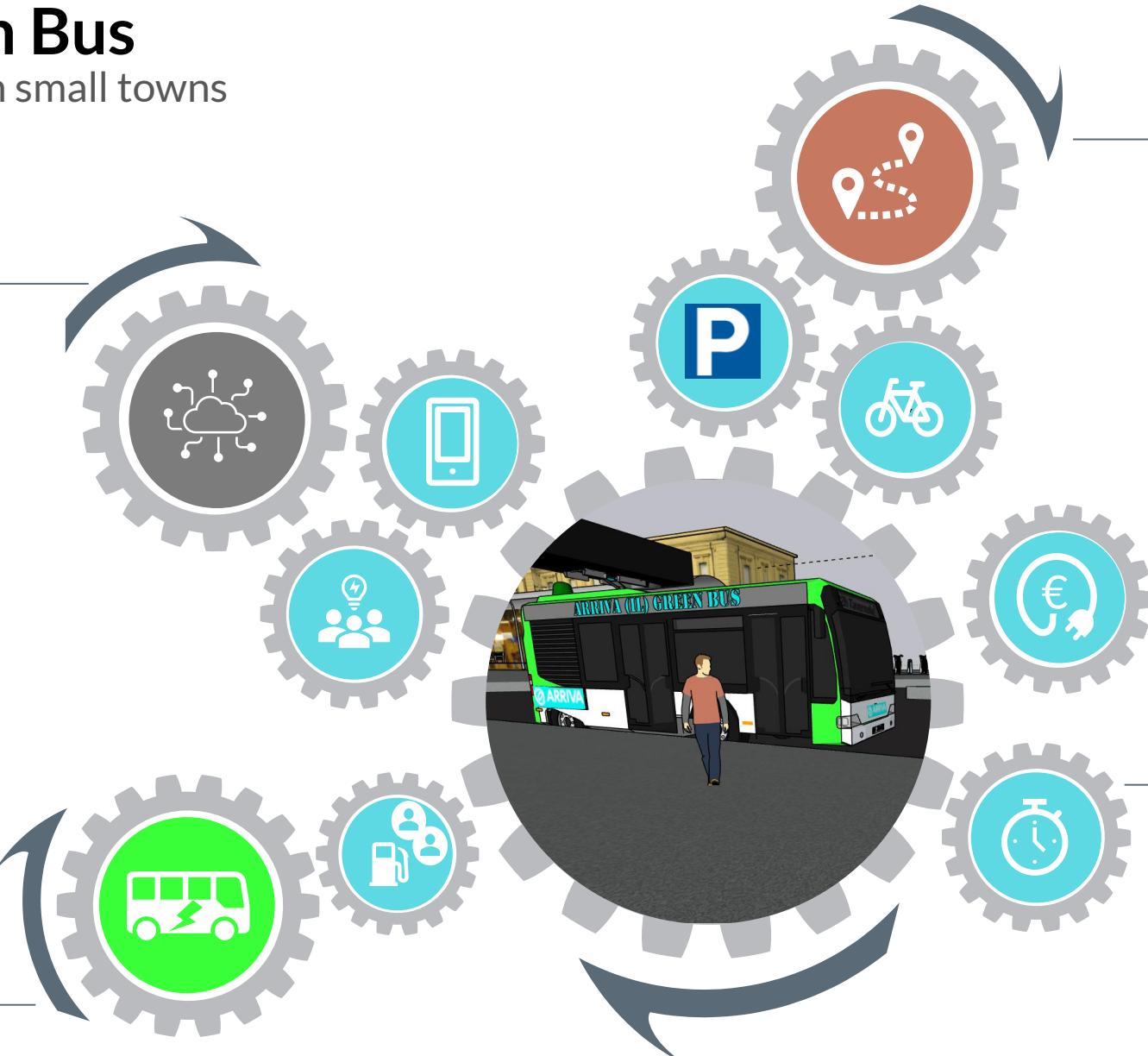
How to increase LPT in small towns

TECHNOLOGIES ADOPTION

i.e., People Counter to adapt and monitor the service, mobile applications to offer real-time updates to the users

FULLY ELECTRIC LINE

With the possibility of sharing the charging station with private vehicles to repay initial investments more quickly



ROUTE OPTIMIZATION

Integration of the service with parking and with light mobility sharing facilities – Netflix model subscriptions

GREEN MOBILITY INCENTIVES

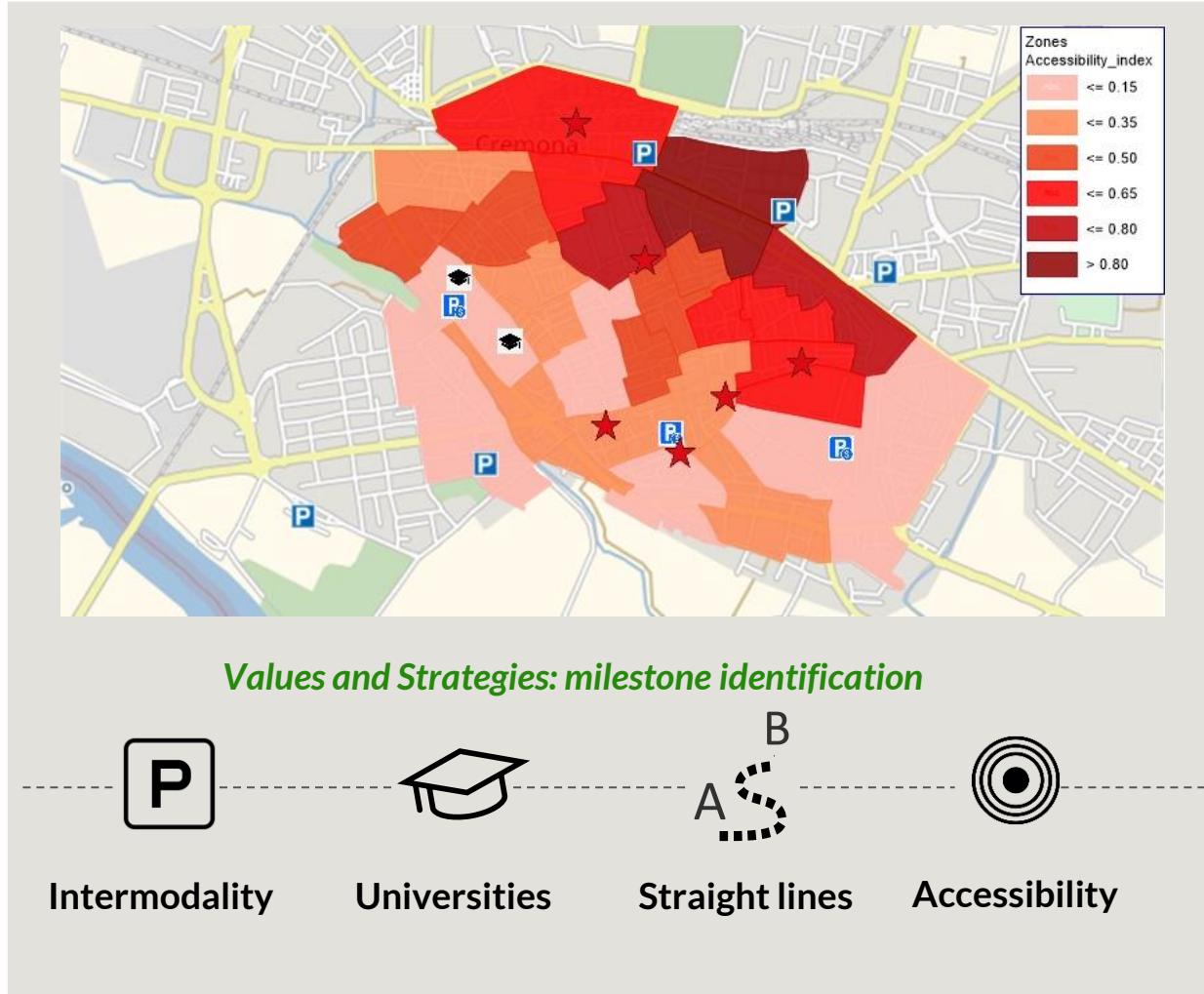
i.e., discounts if you reach a business activity (e.g., restaurant, theatre) by bus

SMART TIMETABLE

Extension of service hours, attention to interchanges possibilities

Planning Realization

Methodology



Criticalities found in working in a small-town historical centre

- 01 LOW SPACE AVAILABILITY**
Narrow streets and sharp curves make difficult the movement of a large bus
- 02 BUILDING CONSTRAINTS**
The presence of big squares and historical buildings prevents the creation of straight lines
- 03 LIMITED CIRCULATION**
The presence of one-way streets and restricted traffic zones makes designing the route difficult.
- 04 NON-CONSTANT DEMAND**
Large peaks and troughs of demand characterise the area, requiring the creation of time-dependent frequencies.
- 05 DISTRIBUTED ATTRACTIVENESS**
e.g., differently from shopping mall, many attraction poles characterise historical centre resulting in distributed demand.

NO STANDARD PROCEDURES CAN BE ACTUATED

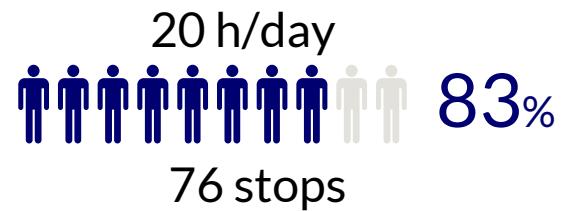
Design Results

Optimization of the network across the historical center

NOW 



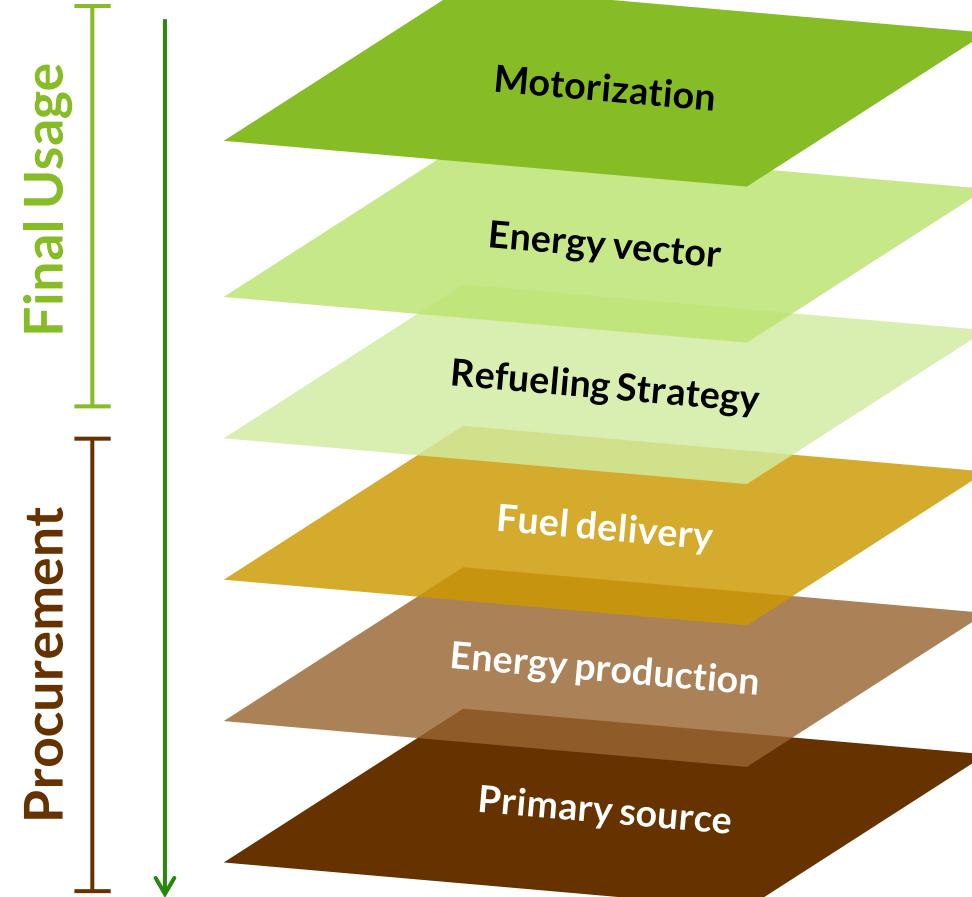
 FUTURE



Technical realization

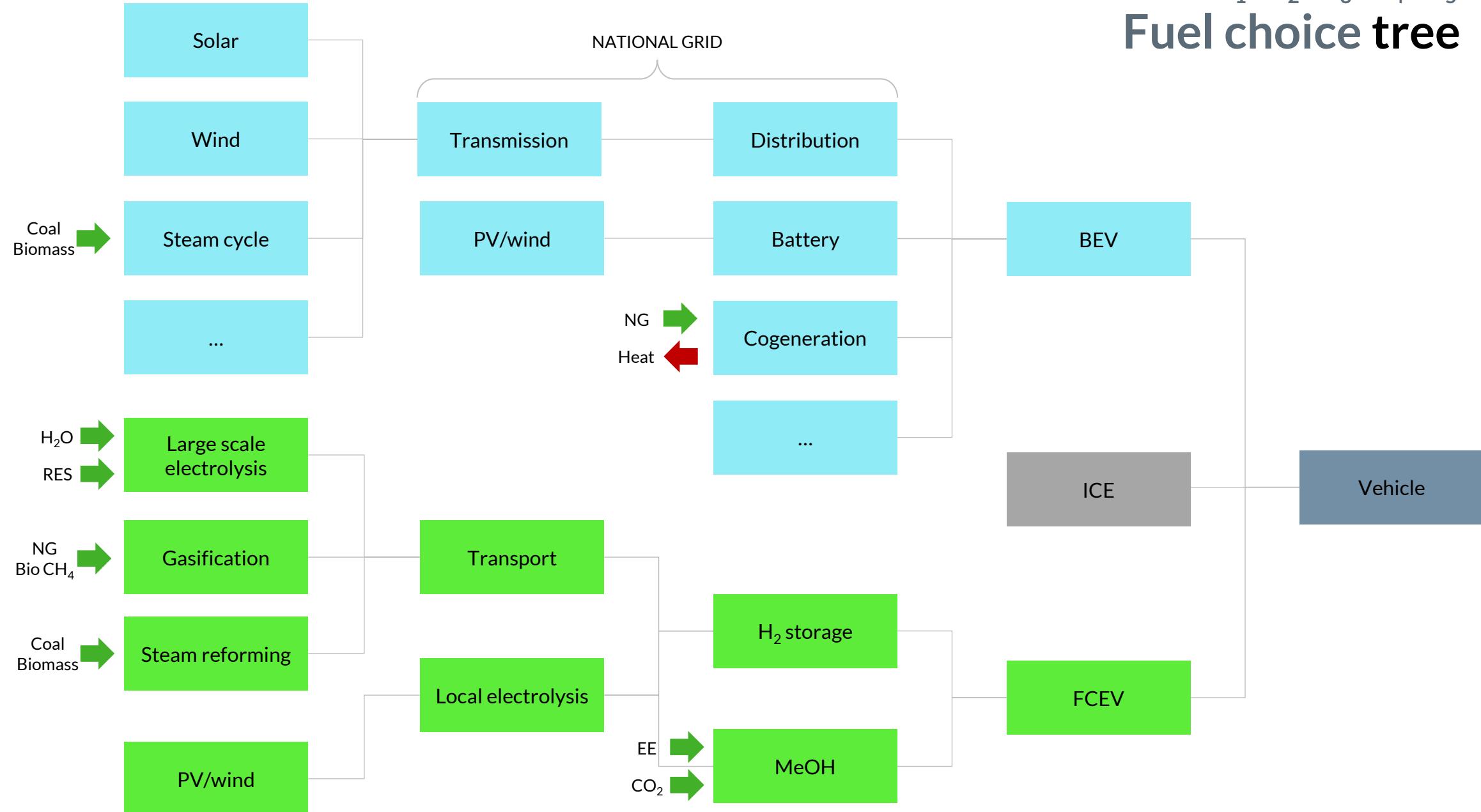
A step backward in the supply chain

We work to avoid converting the journey to decarbonization into a shift from central zones to outskirts.



- Vehicle component - performance impact
- Vehicle and infrastructure - local emissions
- Infrastructure planning - operational issues
- From plant to final use
- Production strategies - local or centralized
- Extraction - global emissions

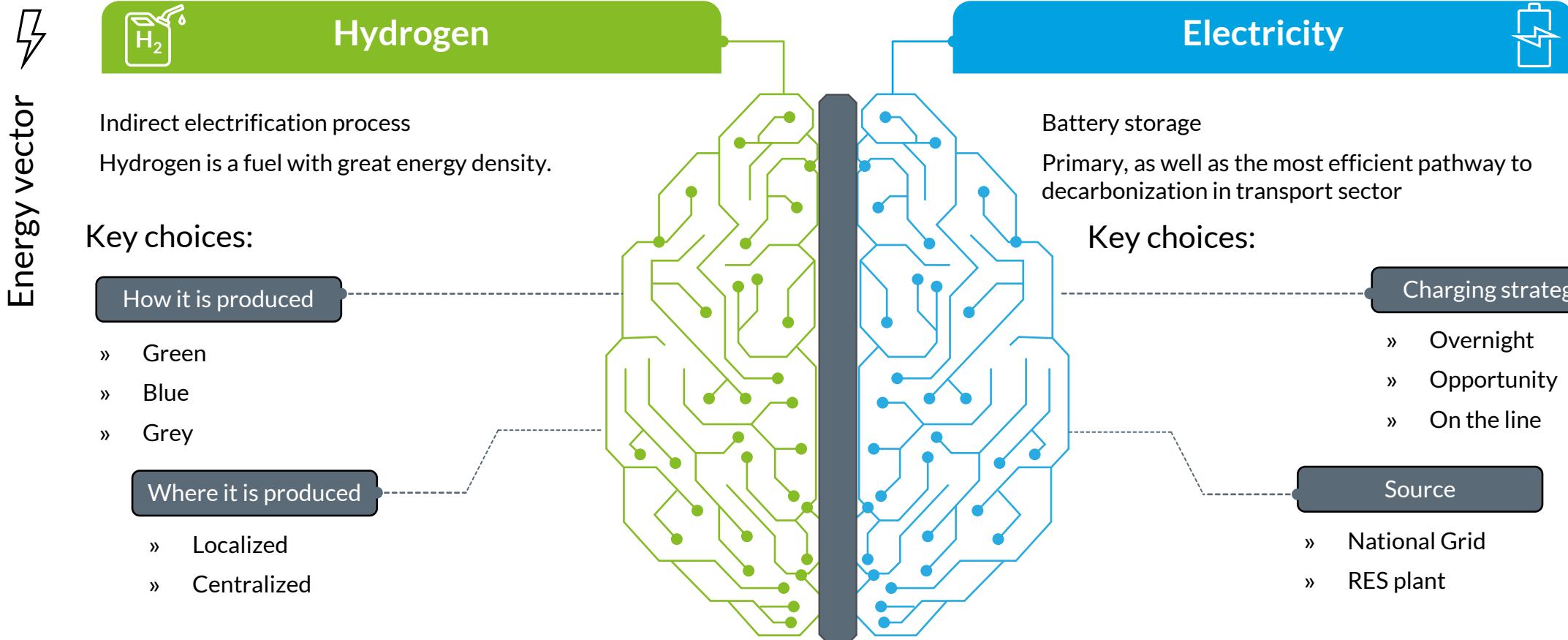
Fuel choice tree



Sustainable fuel strategy

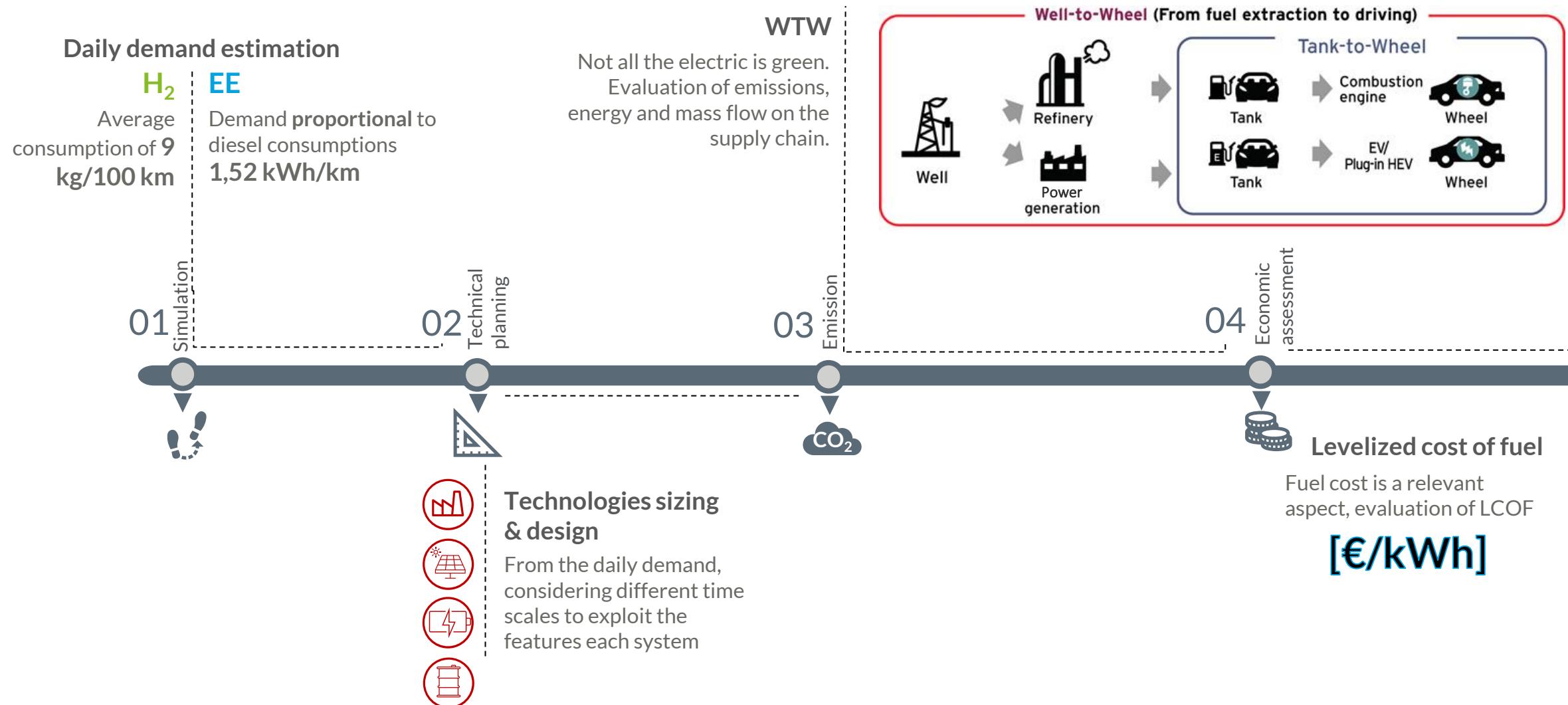
Major branches in structuring the supply chain

Electric traction



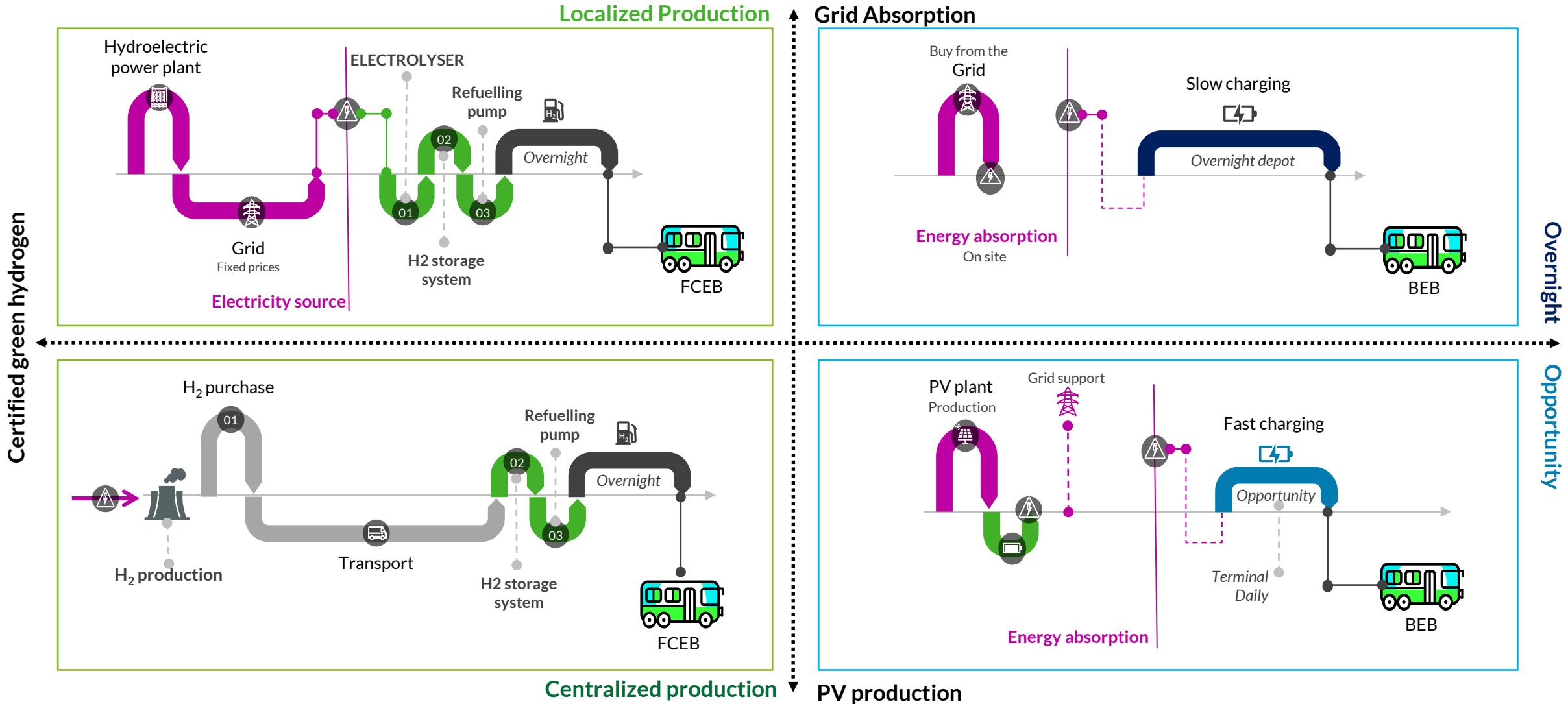
Technical Evaluation

Work Flow



Supply Chain Sets up

Design alternative evaluated in the case study



PROJECT SCENARIO : Summary

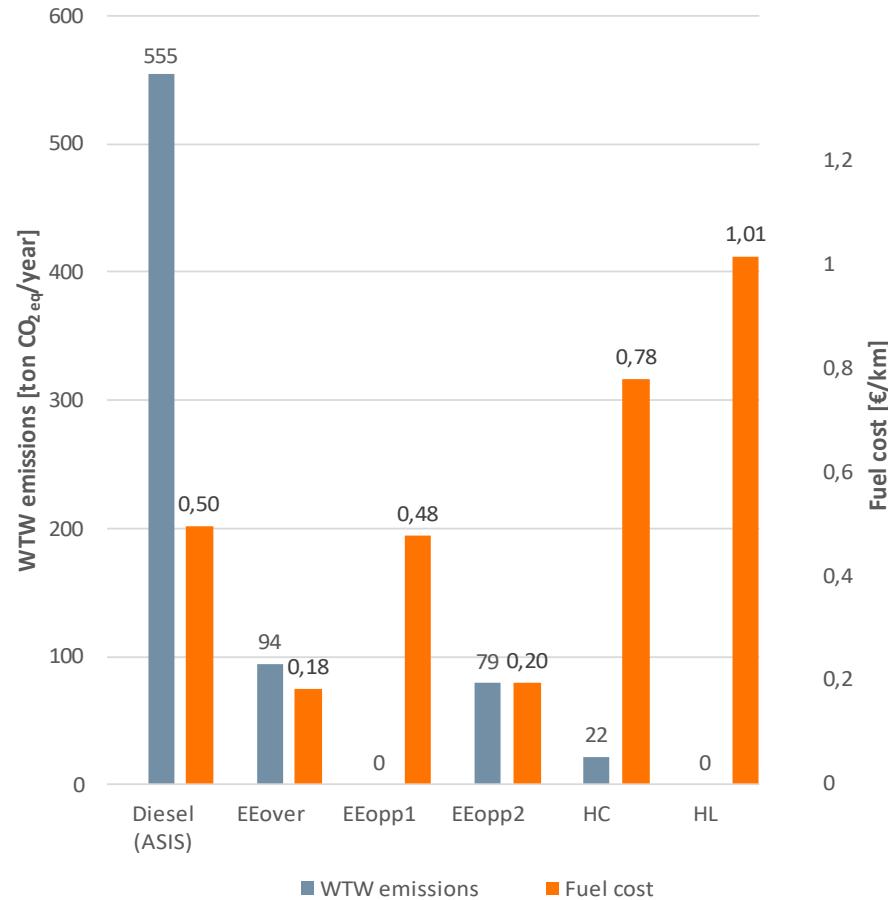
Both **technical** and **economical** analysis will be performed for the selected project scenarios.

- » Consistent-based indicators are used to assess the alternatives
- » Any settings wins out the others but rather their inspection reveals strengths and weaknesses



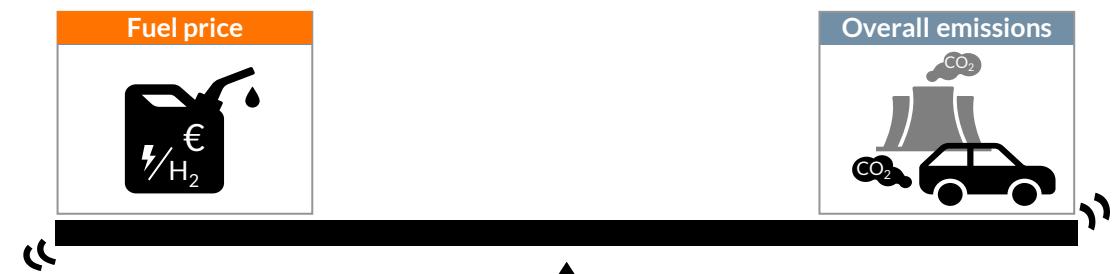
Technical Results

Overall emissions and costs are consistently measured following the alternative fuel path



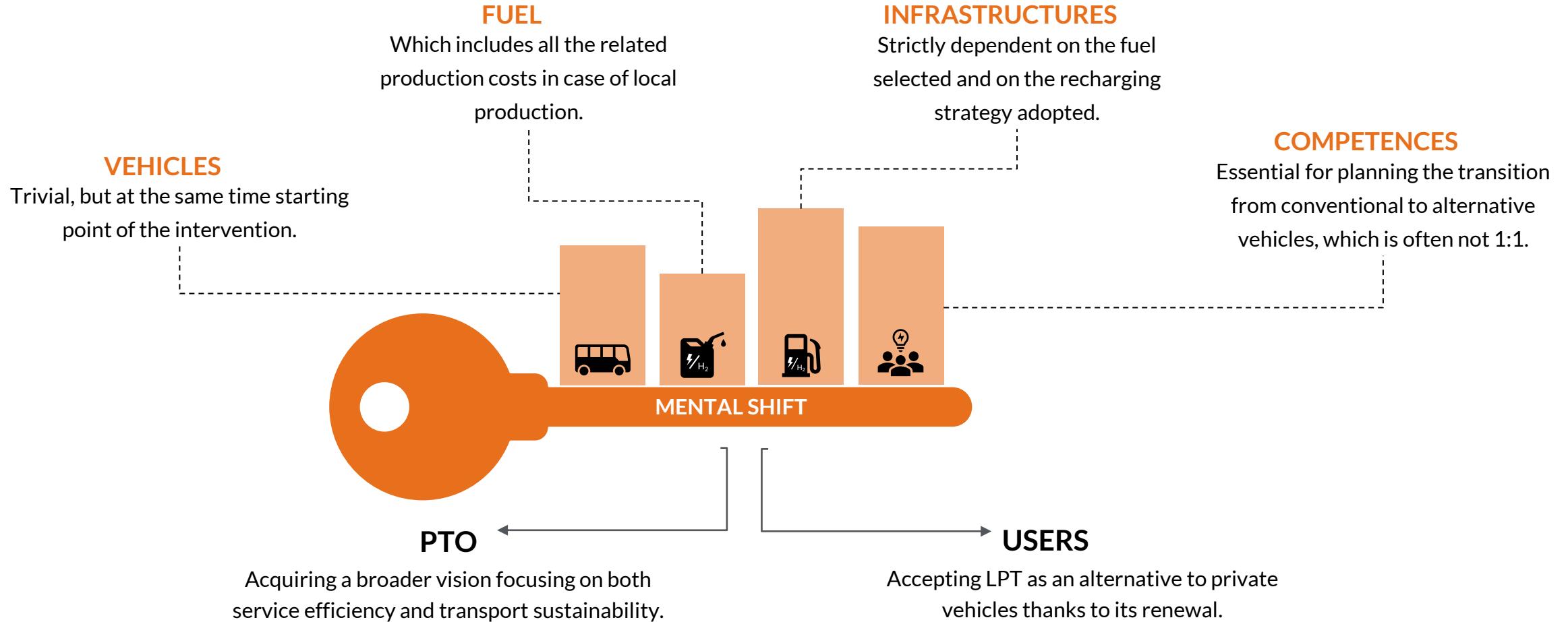
**There is no a win-win solution;
compromises are required.**

- » **Electricity-based** scenarios seems competitive with respect to the actual diesel situation, used as reference, both in economic and environmental aspects.
- » **Green hydrogen** guarantee a strong improvement regarding emissions but is still not financially competitive.



Investing in green transport

What is practically needed to undertake this choice



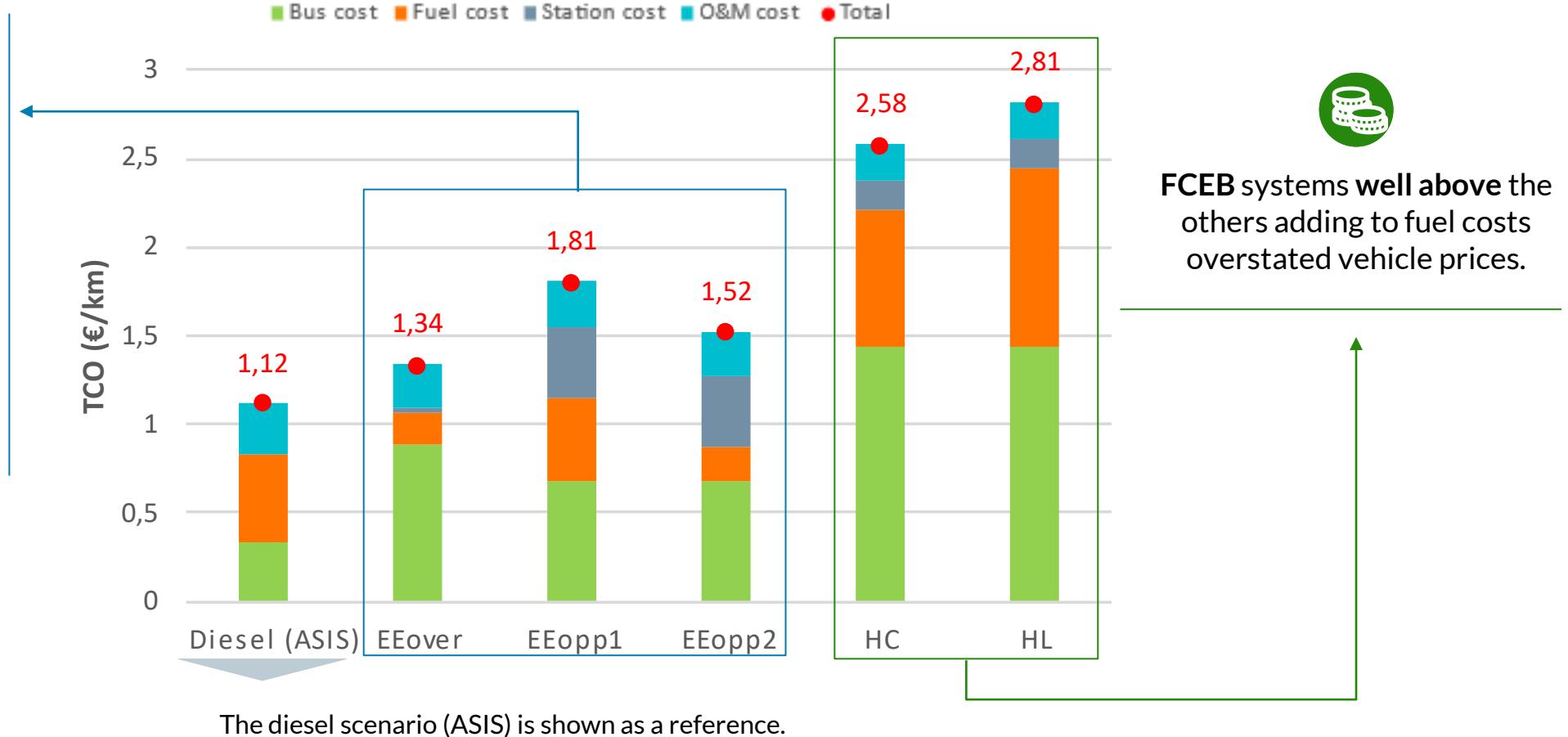
Total Cost of Ownership

What does really mean investing in sustainable transport



Battery prices are the bigger slice of the pie and significantly increase with capacity in **overnight** solutions.

Opportunity recharging increases **infrastructure** costs and balances the reduction in battery costs



FCEB systems **well above** the others adding to fuel costs overstated vehicle prices.

“ Local independent production (of both H₂ and EE) reveals to be unfeasible in small realities. ”

Analytic ranking

Support decision making process in alternative fuel set up selection

CRITICALITY: **CONFICTING CRITERIA**

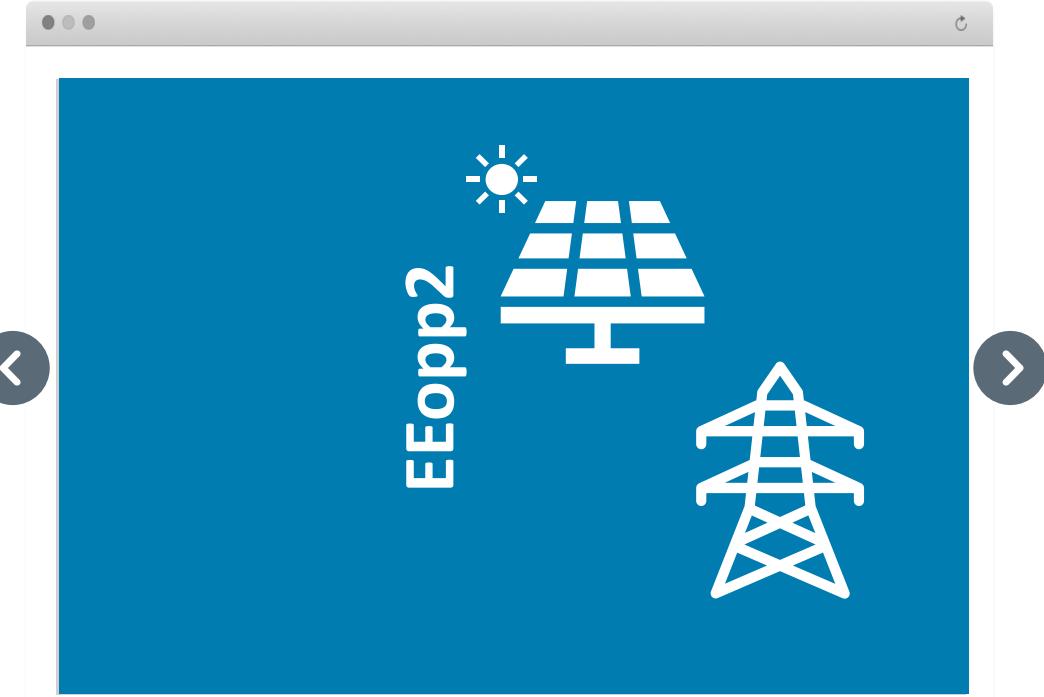
All eco-friendly bus technologies identified coexist with relative costs and benefits and it is hard to define an absolute preferable choice

Key Pillars considered:

-  Performance
-  Economic
-  Environmental

GENERAL SCOPE: **ASSESS THE SUSTAINABILITY**

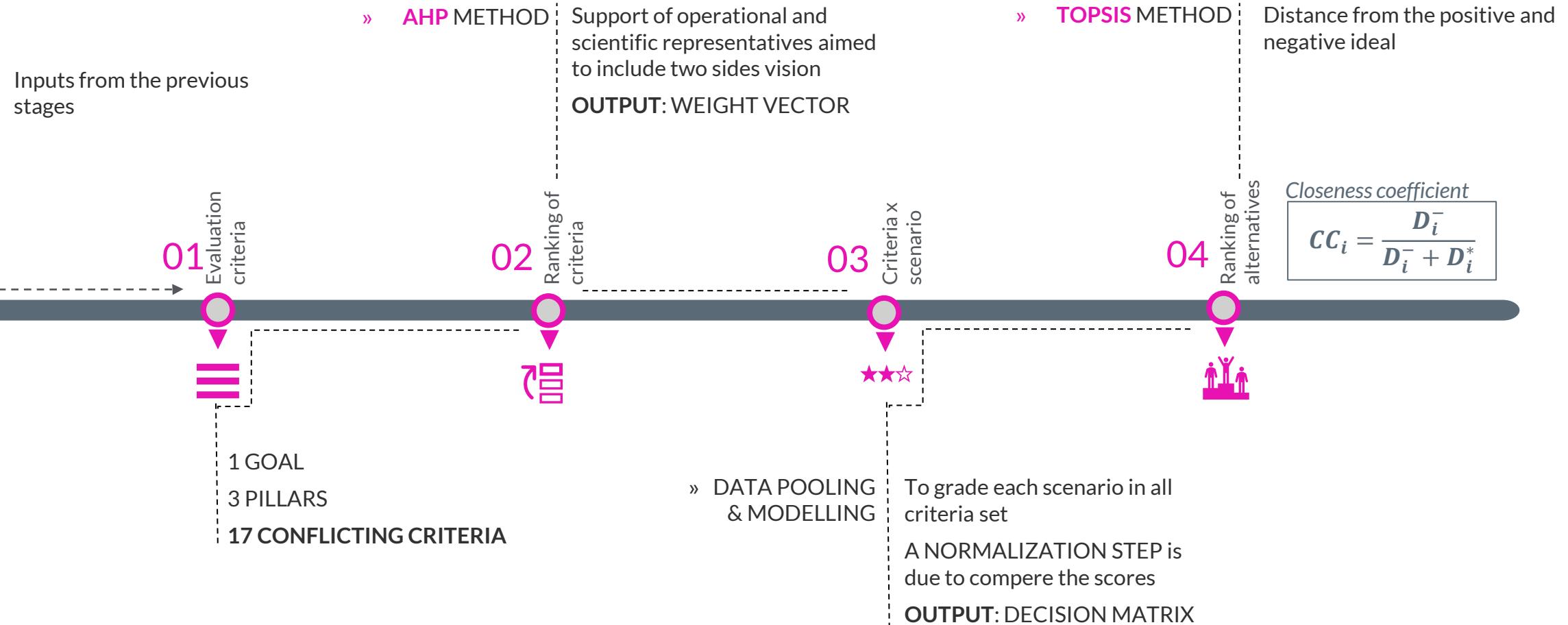
Provide solid tool for the **hierarchy of alternatives**.



The presented research pretends to evaluate the alternative-fuel strategy suitable for the urban area and that better fit the bus line designed. Several decisions should still be undertaken downstream to fully define the project

Multi Criteria Analysis (MCA)

Work Flow



Criteria ranking

Expert engagement brought a value added to the study

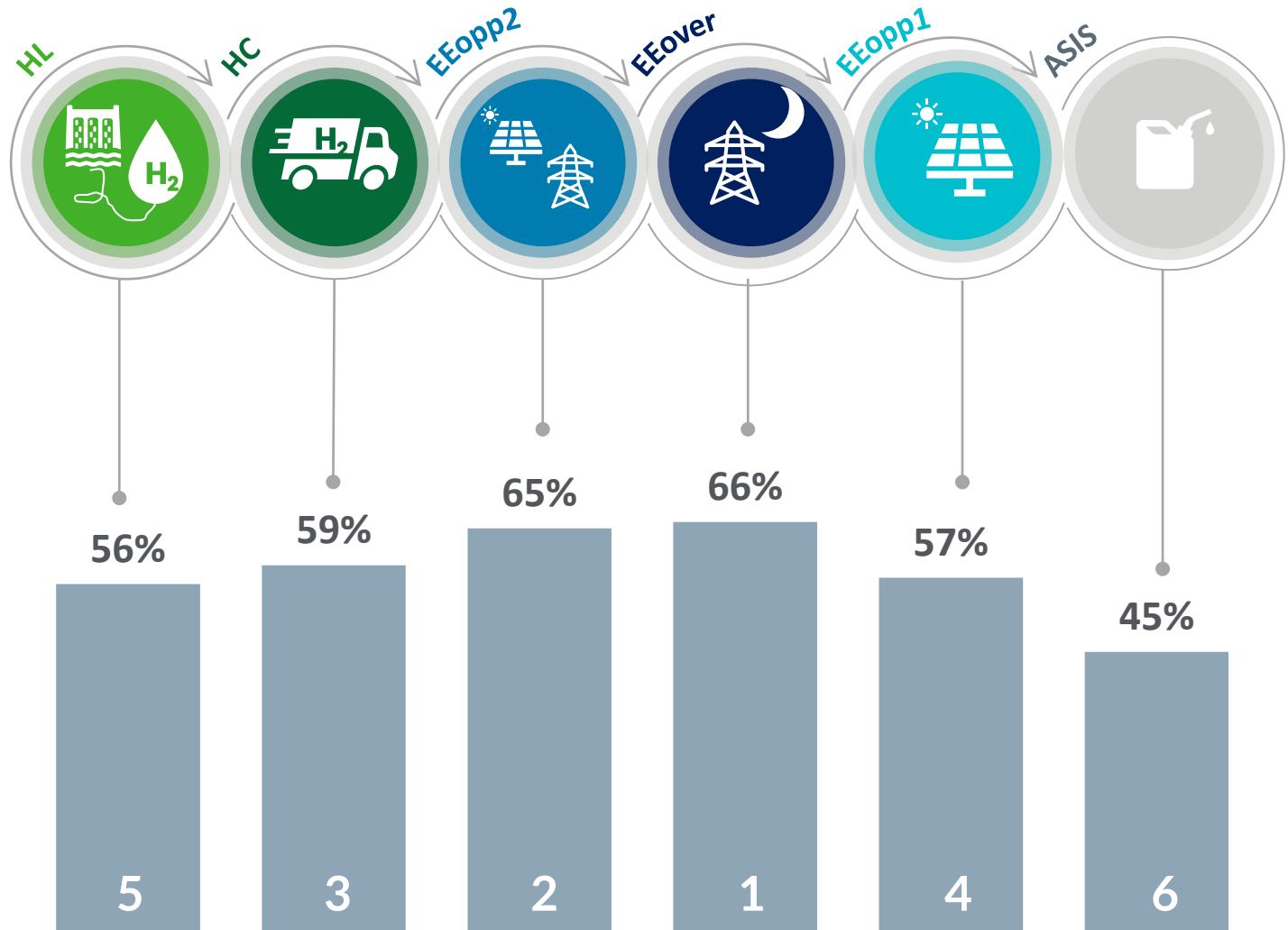
Pairwise comparison* of all the 17 KPI to get the relative importance



*Saaty's scale

Alternative ranking

Results





Small cities

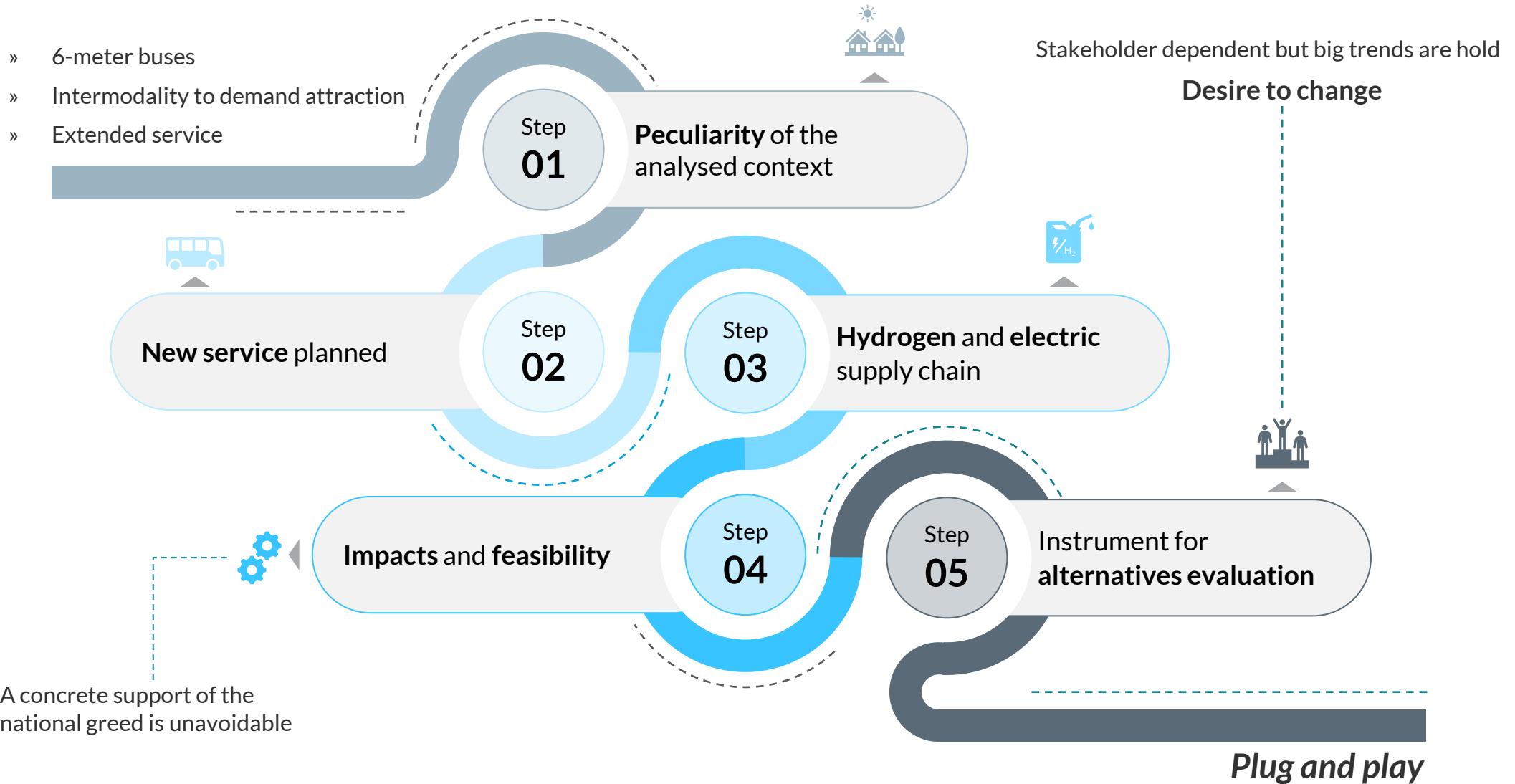
when transport sustainability is an opportunity

1 2 3 4 5 6

Is Green Transition possible even in smaller realities?

Case Study Remarks

A deepening in what does really mean bet on green transition



Research Remarks

Conclusions and future research

- » Sustainable transport may be a renewal opportunity thanks to incentives availability.
- » Necessity of open systems for service optimization.
- » No transition is possible without grid decarbonization
- » FCEVs are not out of the games and may fit extra-urban requirements

— *on topic conclusion*

- » Investments planned on electric fleet
- » Hydrogen not in the actual plans
- » Range anxiety seemed a problem

— working with  arriva

- » More systematic data acquisition
- » Demand supply interaction simulation
- » Deeper emissions evaluation (e.g., LCA)

— *limits and future research*

“

Green transition is possible even in small realities even if the task goes beyond a trivial renewal of the bus fleet

”

QUESTIONS?

