

Guiding innovative investments in public transport with the PROMETHEE method

François-Olivier Devaux, PhD
Ticket to Kyoto technical coordinator
STIB-MIVB

International MCDA Workshop
on PROMETHEE
IMW2014

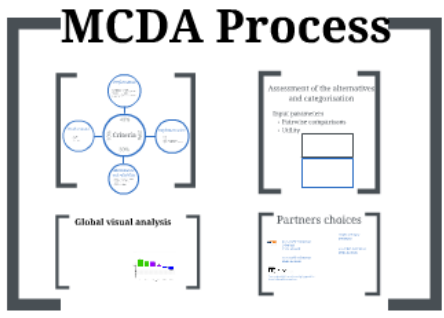
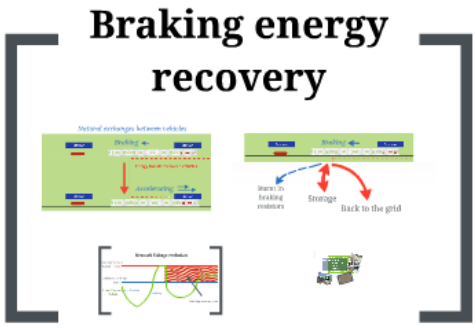
22 January 2014
VUB - Brussels



Guiding innovative investments in public transport with the PROMETHEE method



Thank you for your attention



Need for energy efficiency in public transport



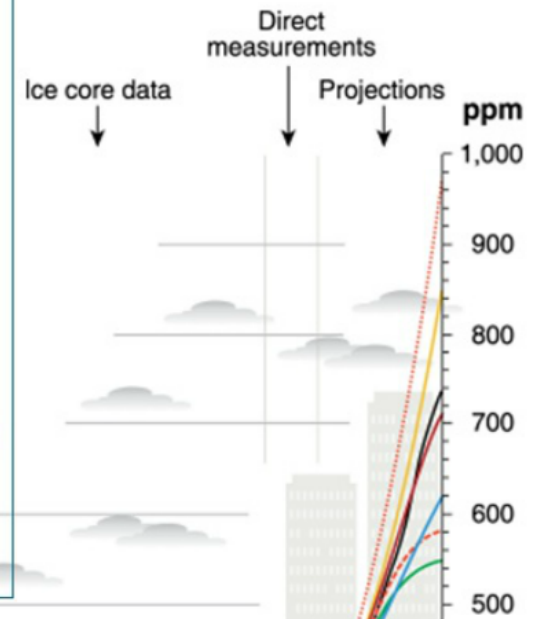
STIB: between 2007 and 2012

+52% energy bill (€)

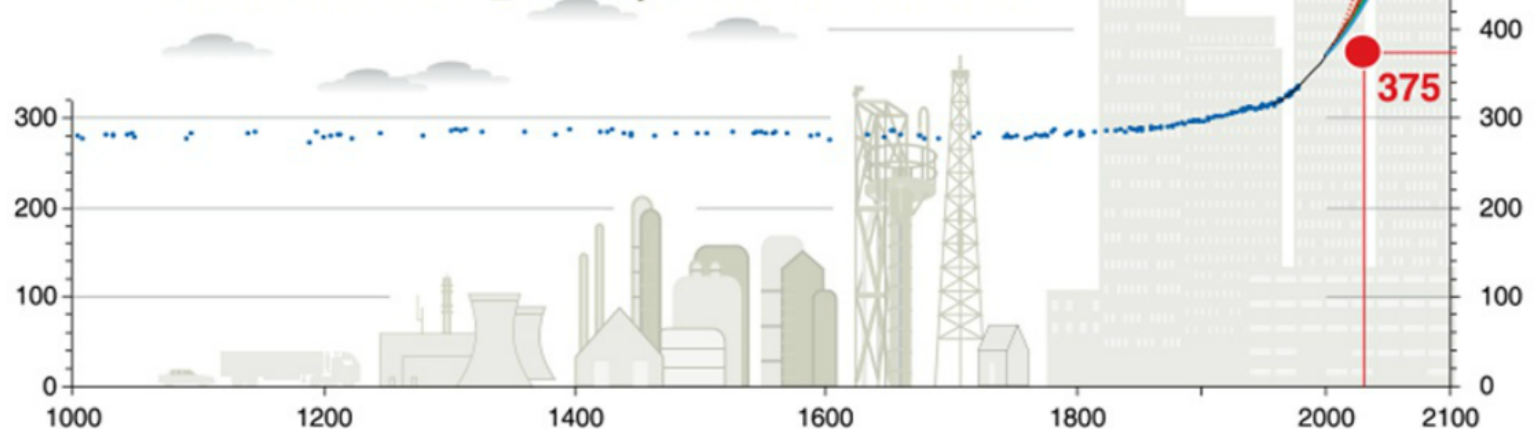
- **+41%** energy cost (€/kWh)
- **+8%** in energy consumption (kWh)

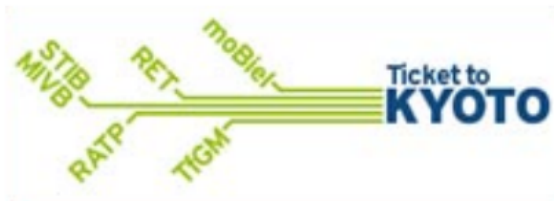
+20% in transport offer

+10% in efficiency improvement (kWh/pax)



Past and future CO₂ atmospheric concentrations





Ticket to Kyoto project

5 public transport companies joining forces through a European Project

Goal: Reduce CO2 emissions of public transport

4 years project (2010-2014)

Budget of 13 million euros

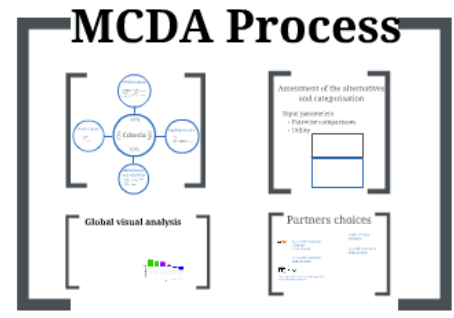
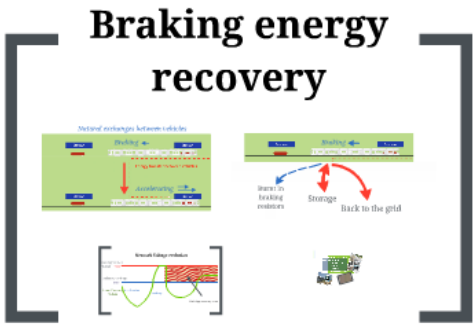
“Quick wins” projects, large investments and innovative CO2 strategies



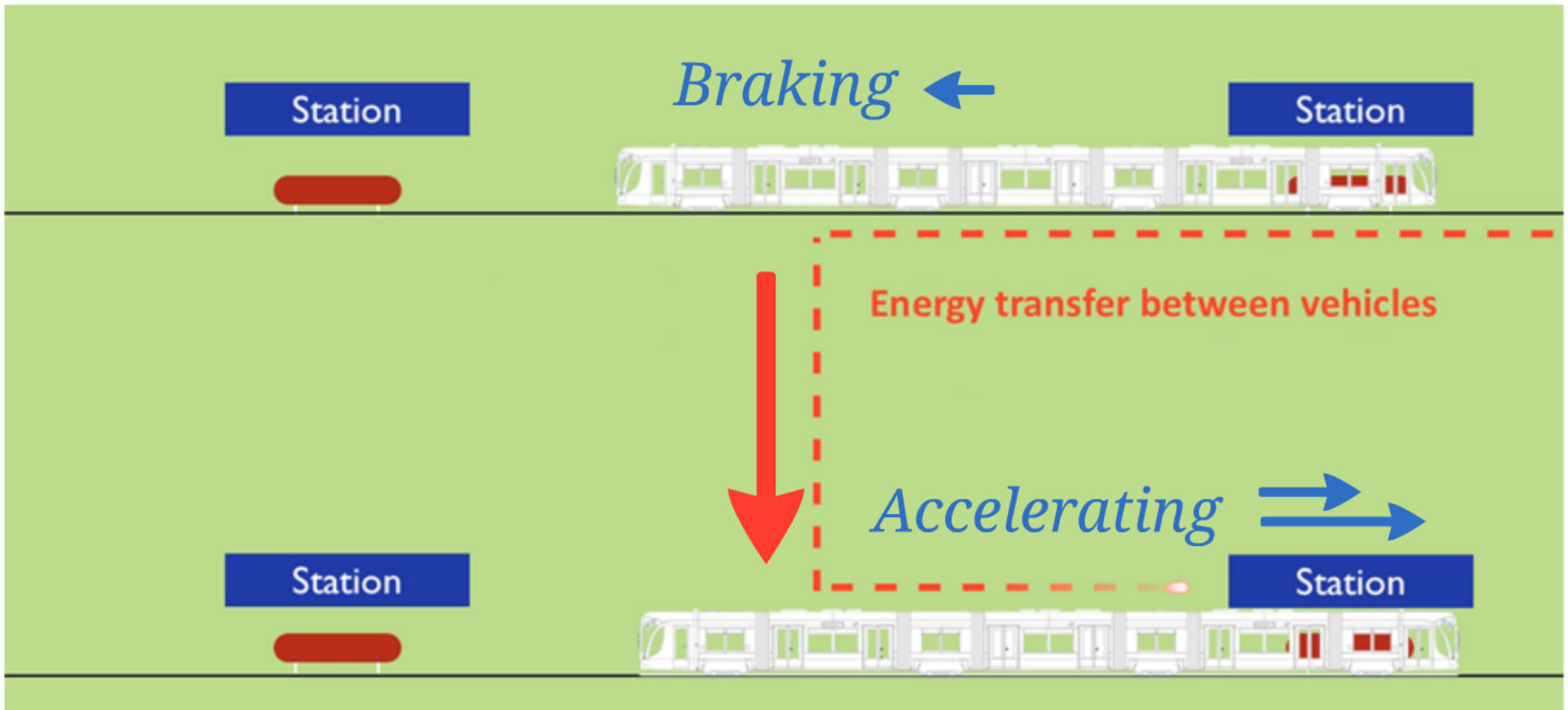
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Thank you for your attention



Natural exchanges between vehicles





Burnt in
braking
resistors



Storage

Back to the grid

Network Voltage evolution

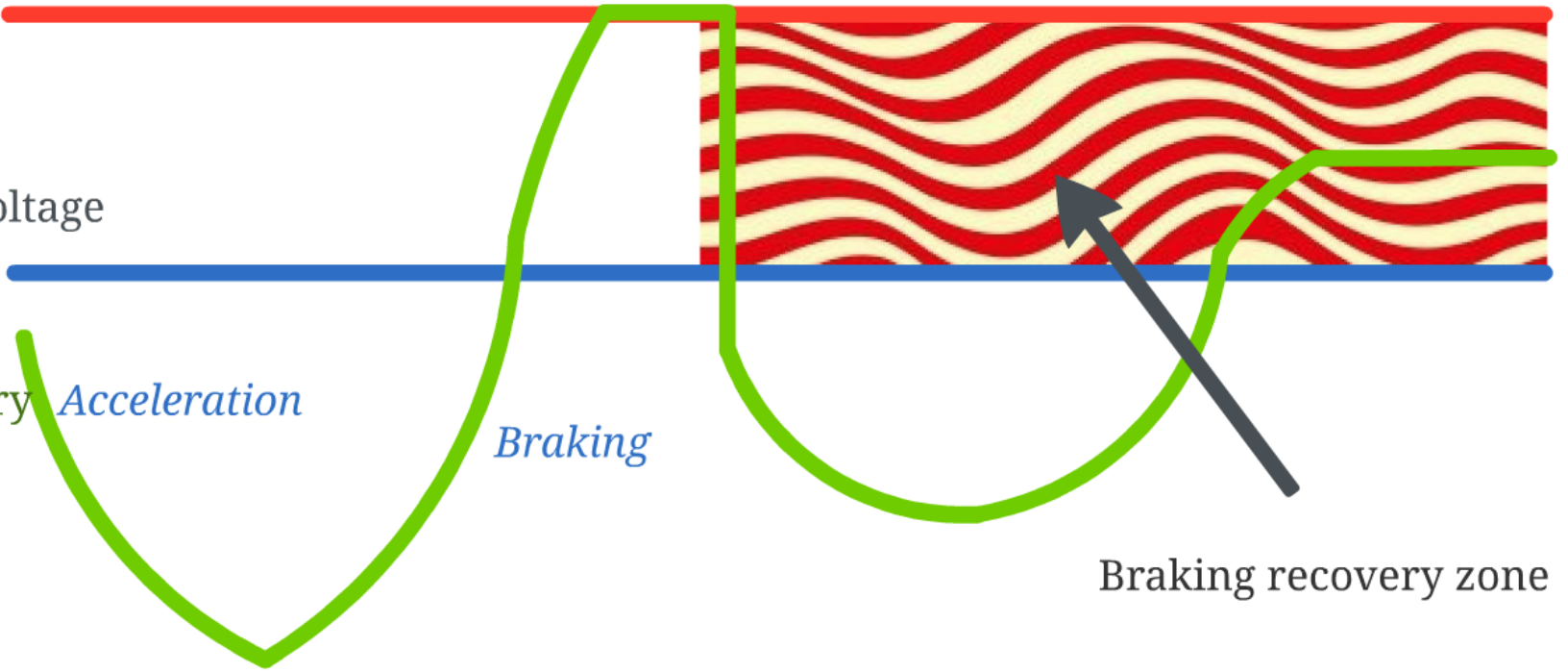
Braking resistors
voltage 925V

Substation voltage
820V

Tram / Catenary
voltage *Acceleration*

Braking

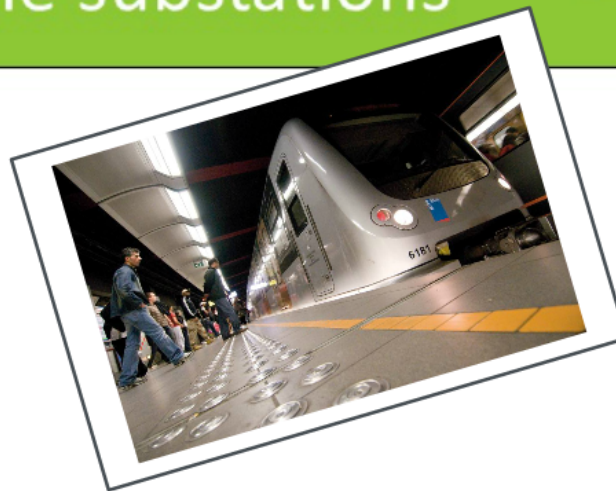
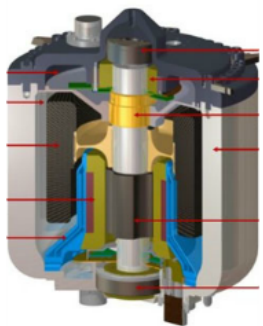
Braking recovery zone



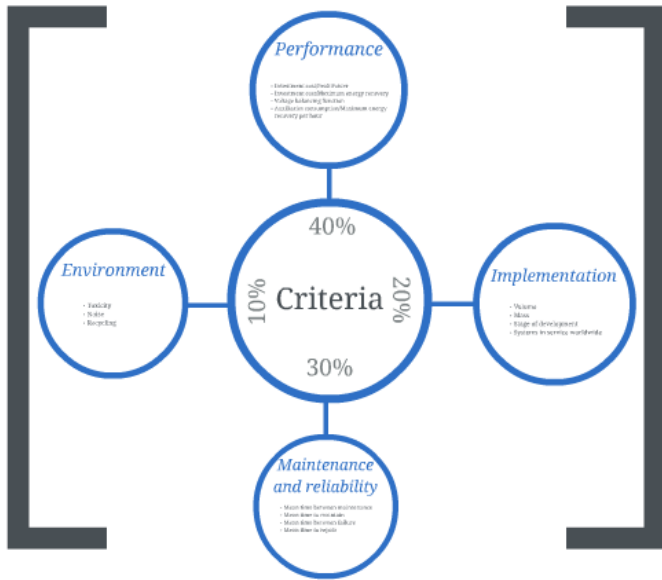


Mobile applications

- Supercapacitors
- Batteries
- Flywheels
- Reversible substations



MCDA Process



Assessment of the alternatives and categorisation

Input parameters

- Pairwise comparisons
- Utility

Global visual analysis

Partners choices

<p>3 reversible substations 1 flywheel Tram network</p>	<p>Mobile and static prototypes</p>
<p>2 reversible substations Metro network</p>	<p>Reversible substations Metro network</p>
<p>First study in 2013 concluded on high payback time New studies will be carried out</p>	



Performance

- Investment cost/Peak Power
- Investment cost/Maximum energy recovery
- Voltage balancing function
- Auxiliaries consumption/Maximum energy recovery per hour

Implementation

- Volume
- Mass
- Stage of development
- Systems in service worldwide



Maintenance and reliability

- Mean time between maintenance
- Mean time to maintain
- Mean time between failure
- Mean time to repair



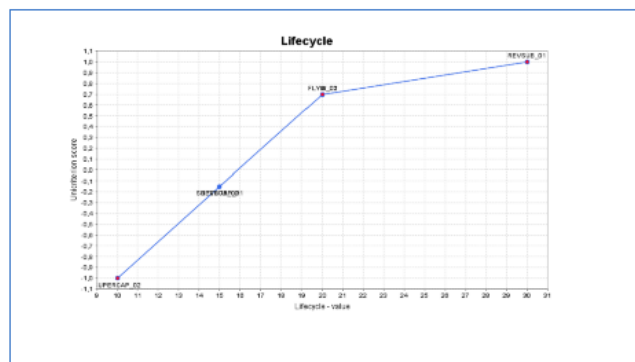
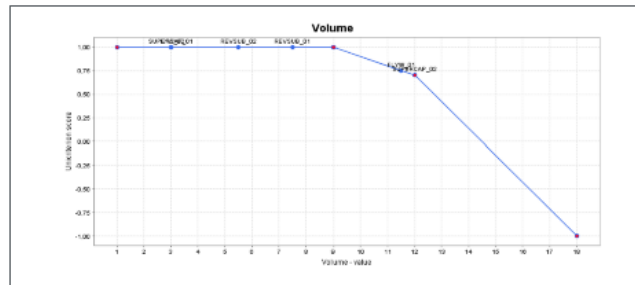
Environment

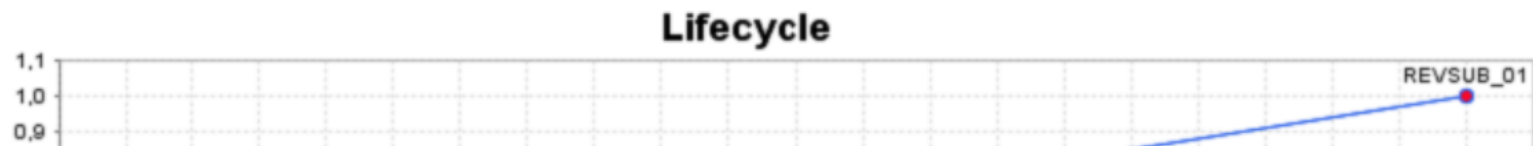
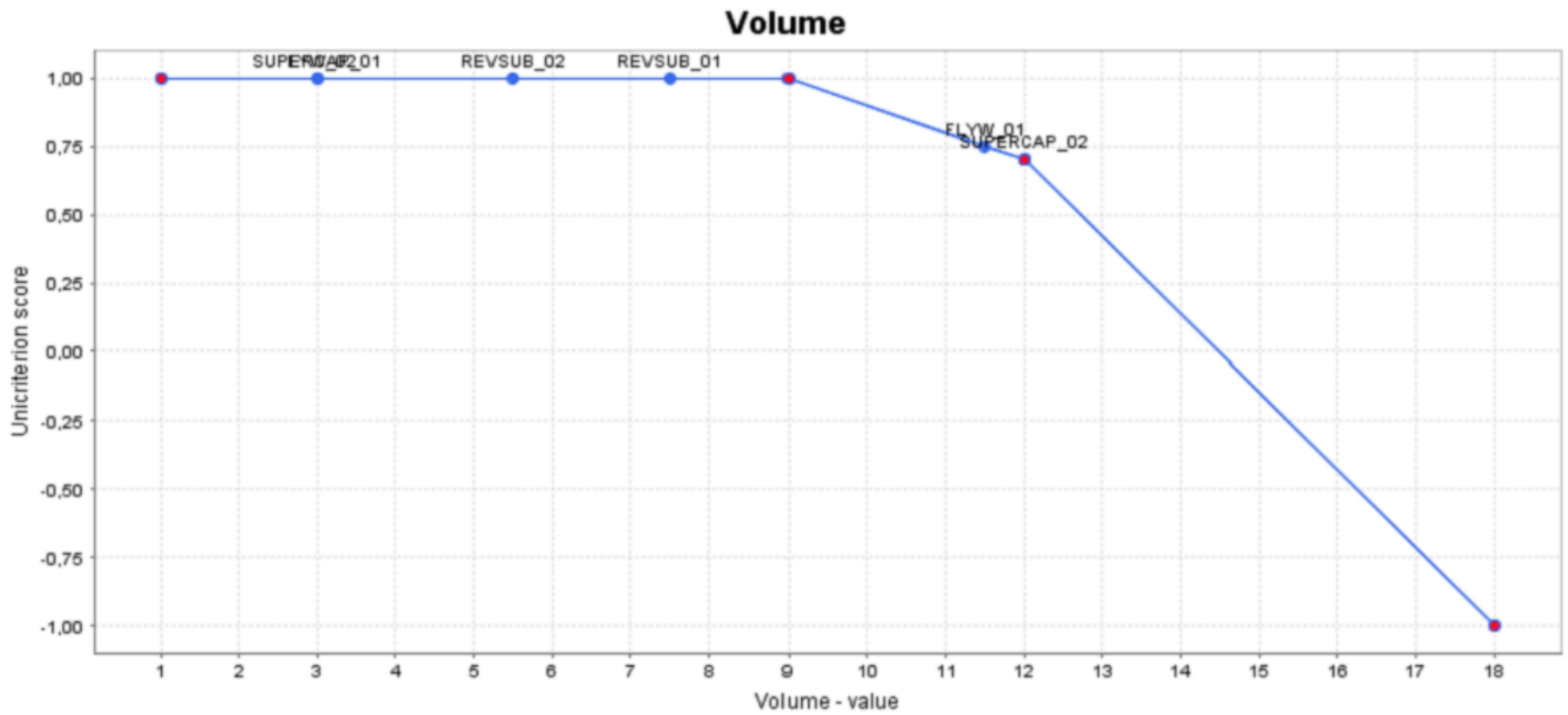
- Toxicity
- Noise
- Recycling

Assessment of the alternatives and categorisation

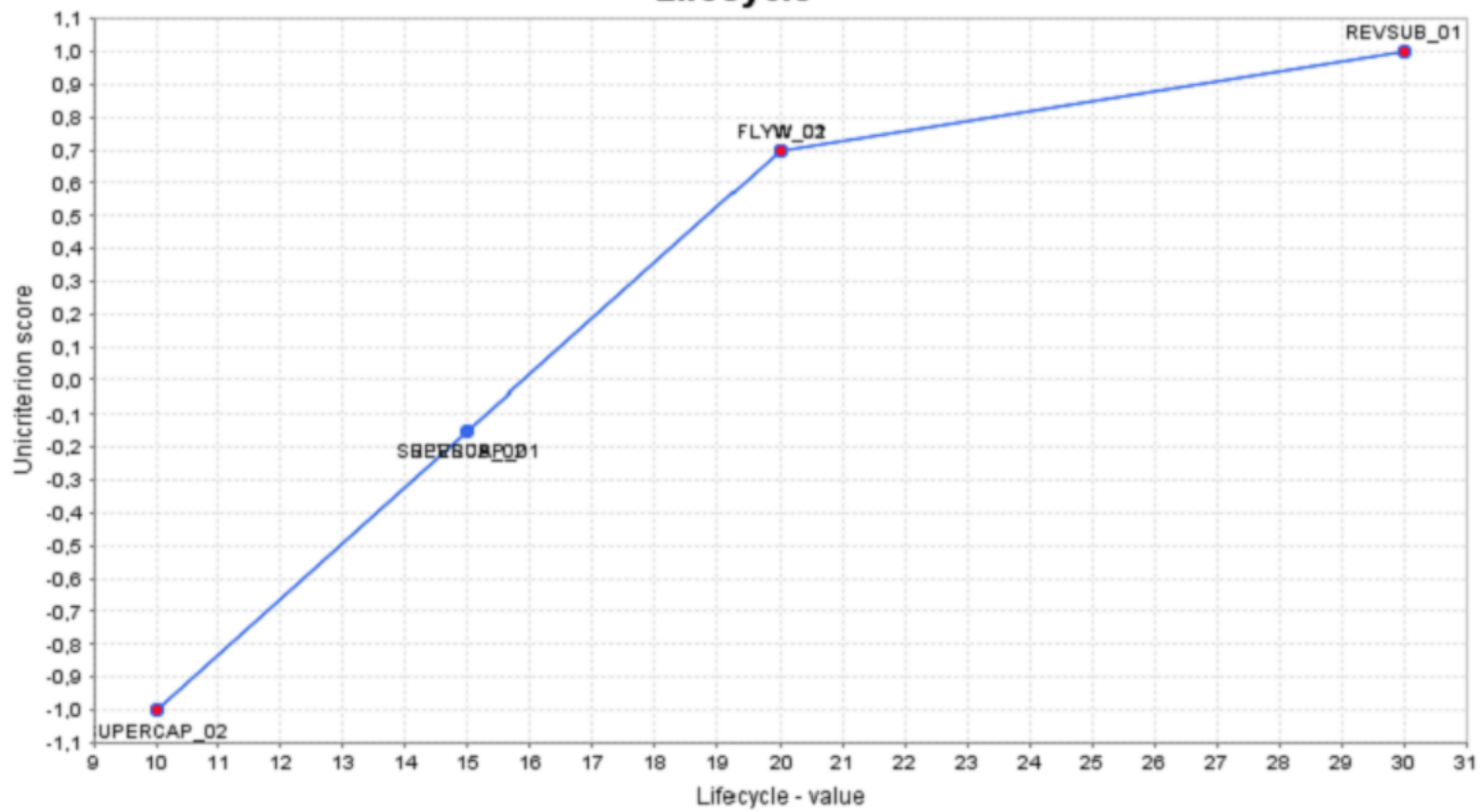
Input parameters

- Pairwise comparisons
- Utility

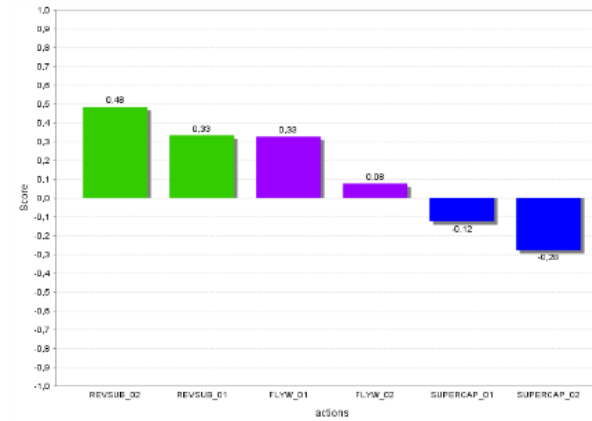
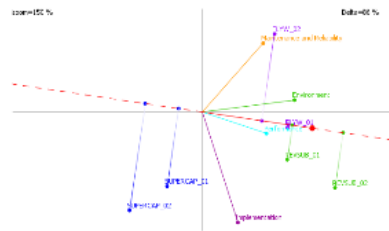
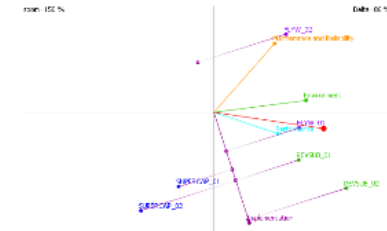
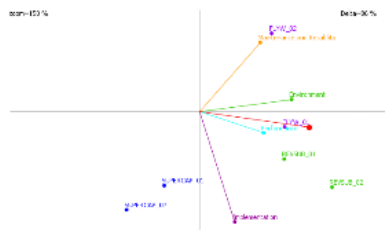




Lifecycle

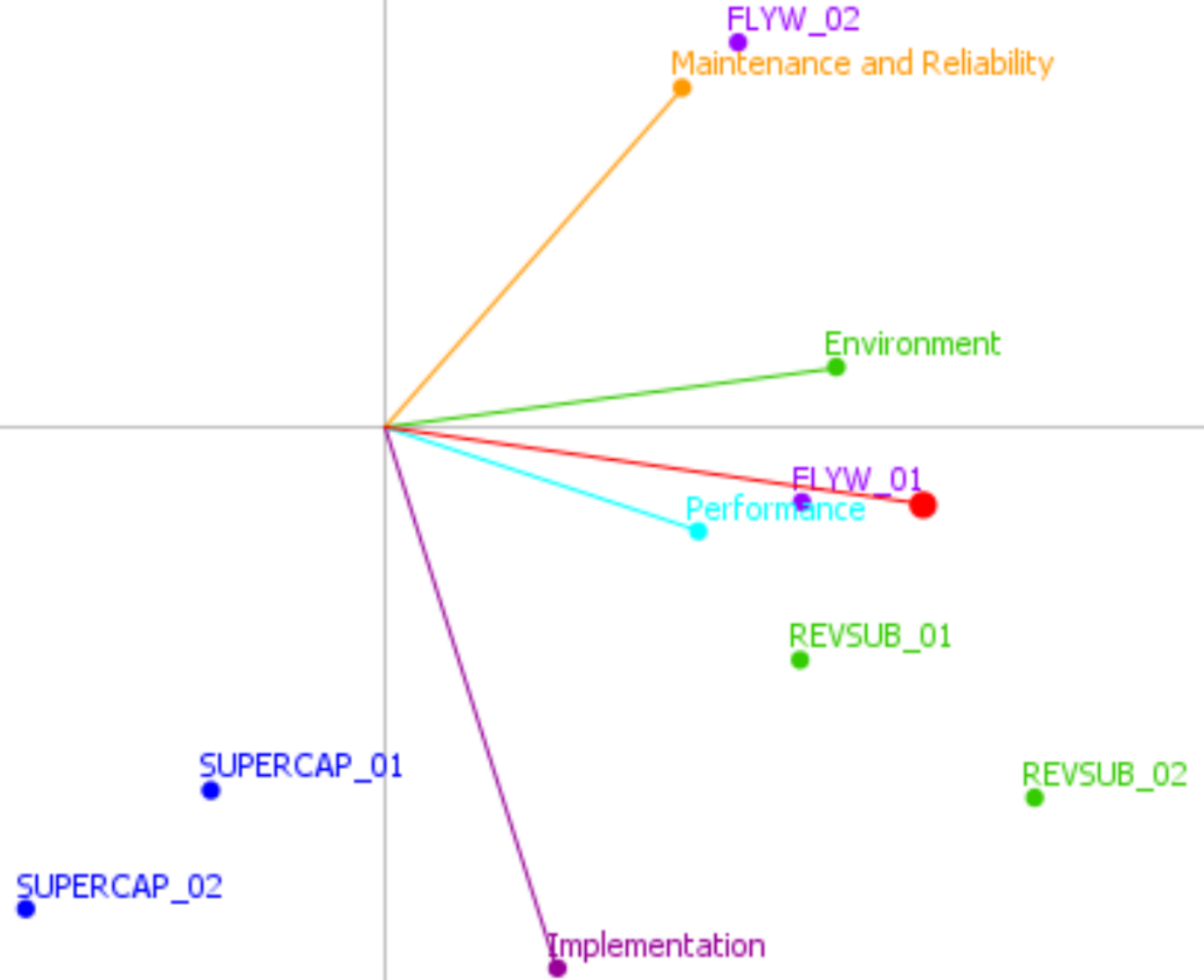


Global visual analysis



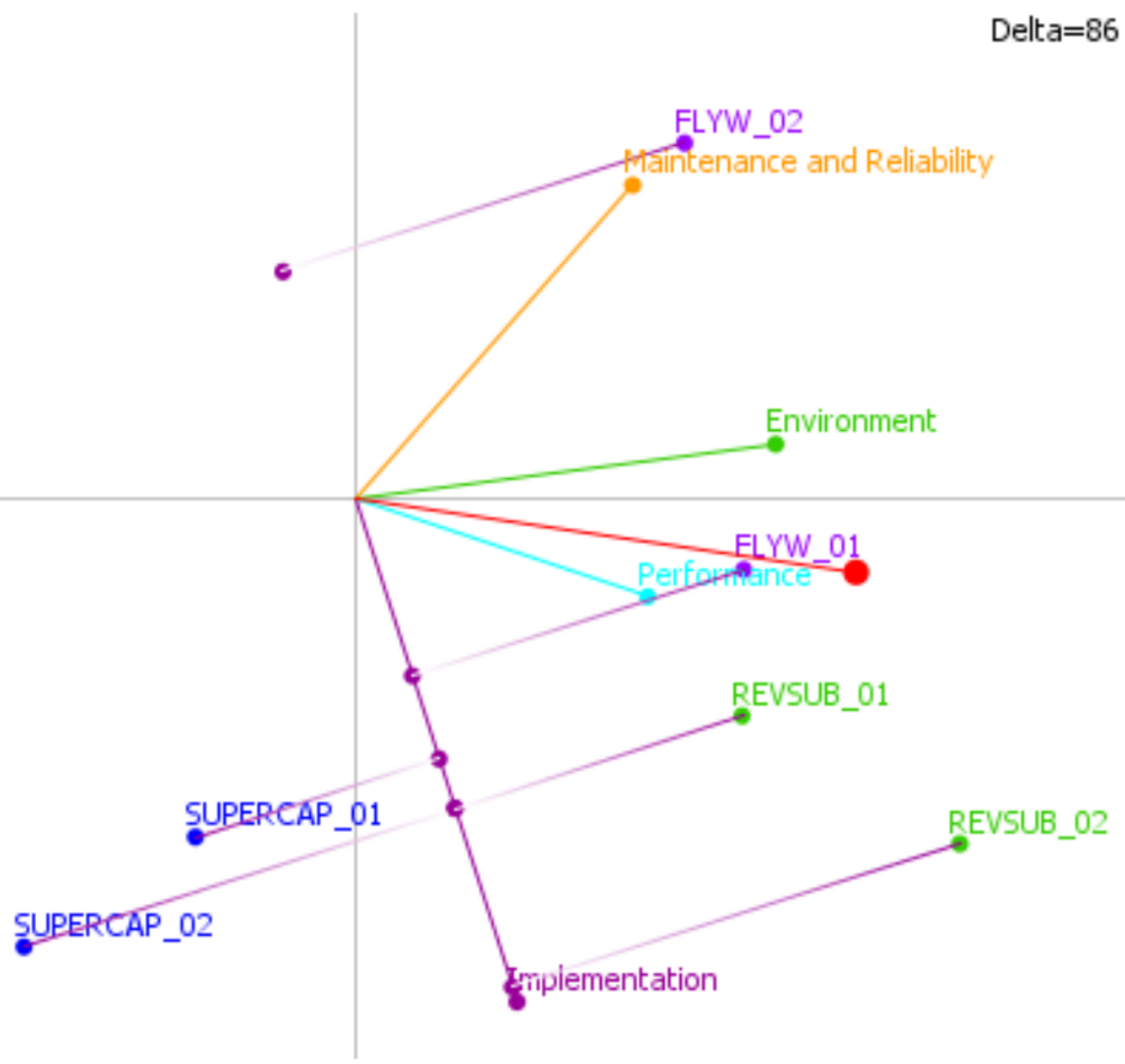
zoom=150 %

Delta=86 %



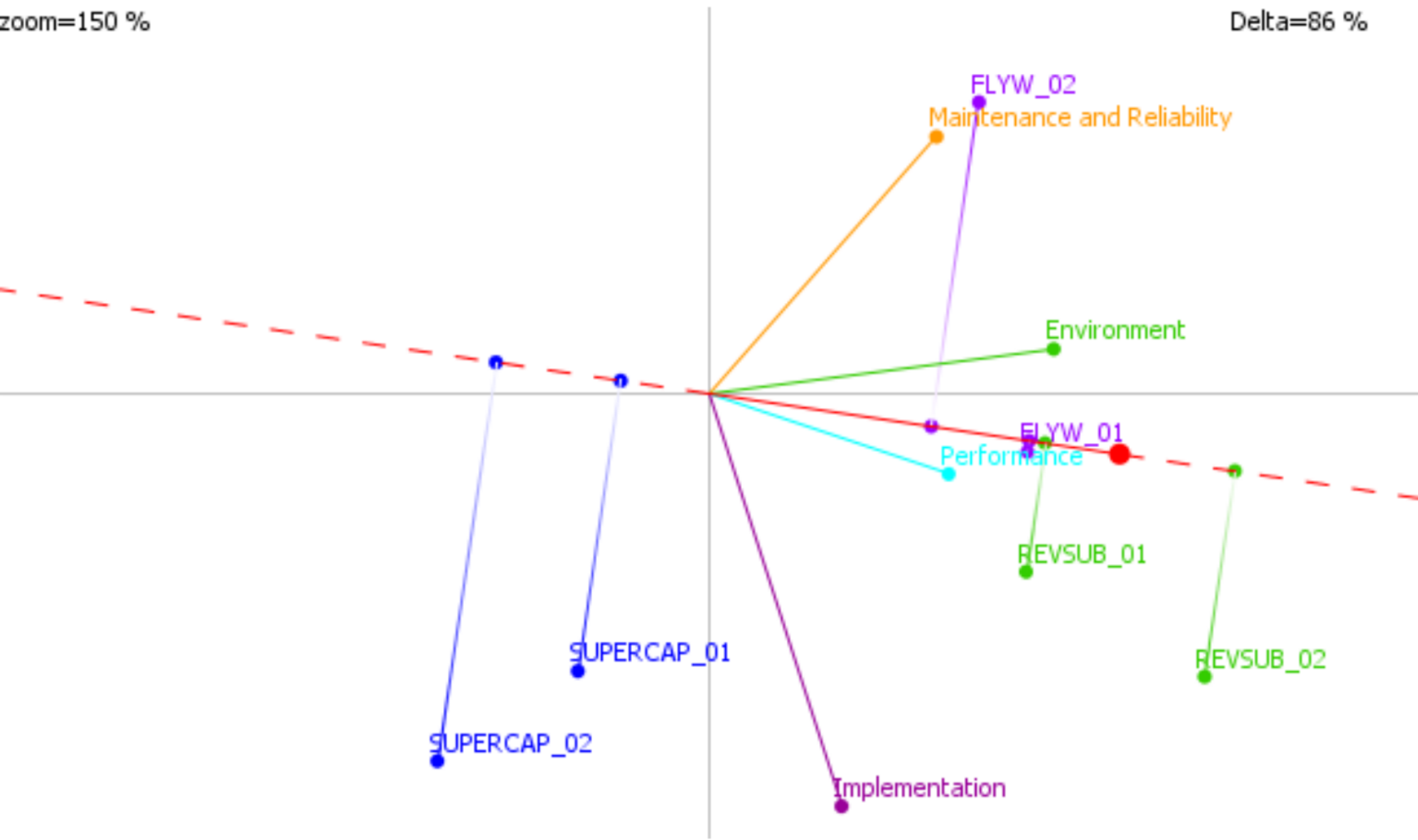
zoom=150 %

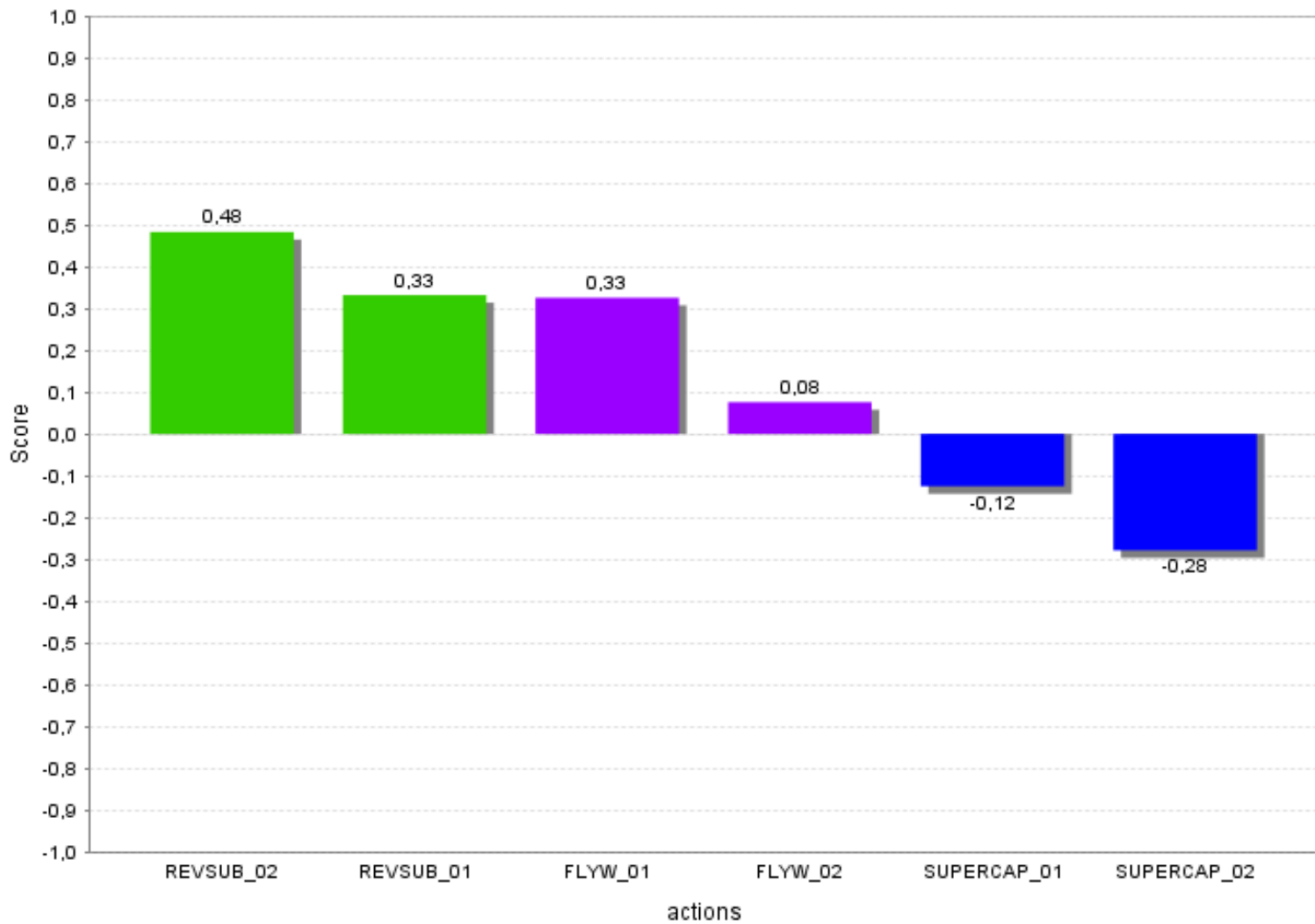
Delta=86 %



zoom=150 %

Delta=86 %





Partners choices



3 reversible substations
1 flywheel
Tram network



2 reversible substations
Metro network



First study in 2011 concluded on high payback time
New studies will be carried out



Mobile and static
prototypes



Reversible substations
Metro network



Conclusion

The PROMETHEE method has help the T2K partners in their braking energy recovery investment by

- *Structuring the evaluation of selection criteria and leading the collection of important data*
- *Simplifying the analysis of the multi-dimensional data and supporting the decision process*

This process has helped several real world implementations in T2K project with savings up to 12% depending on network characteristics

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