Human Oriented Sustainable Transport (HOST) – Report from a EU project for improved urban transport

Björn Frostell
Division of Industrial Ecology
School of Industrial Engineering and Management
Royal Institute of Technology (KTH)
Stockholm, Sweden

HOST – presentation outline

- General project description and results
- KTH stakeholder investigation
- KTH ERPA final environmental evaluation
- KTH reflections on the HOST project

Part 1 – General

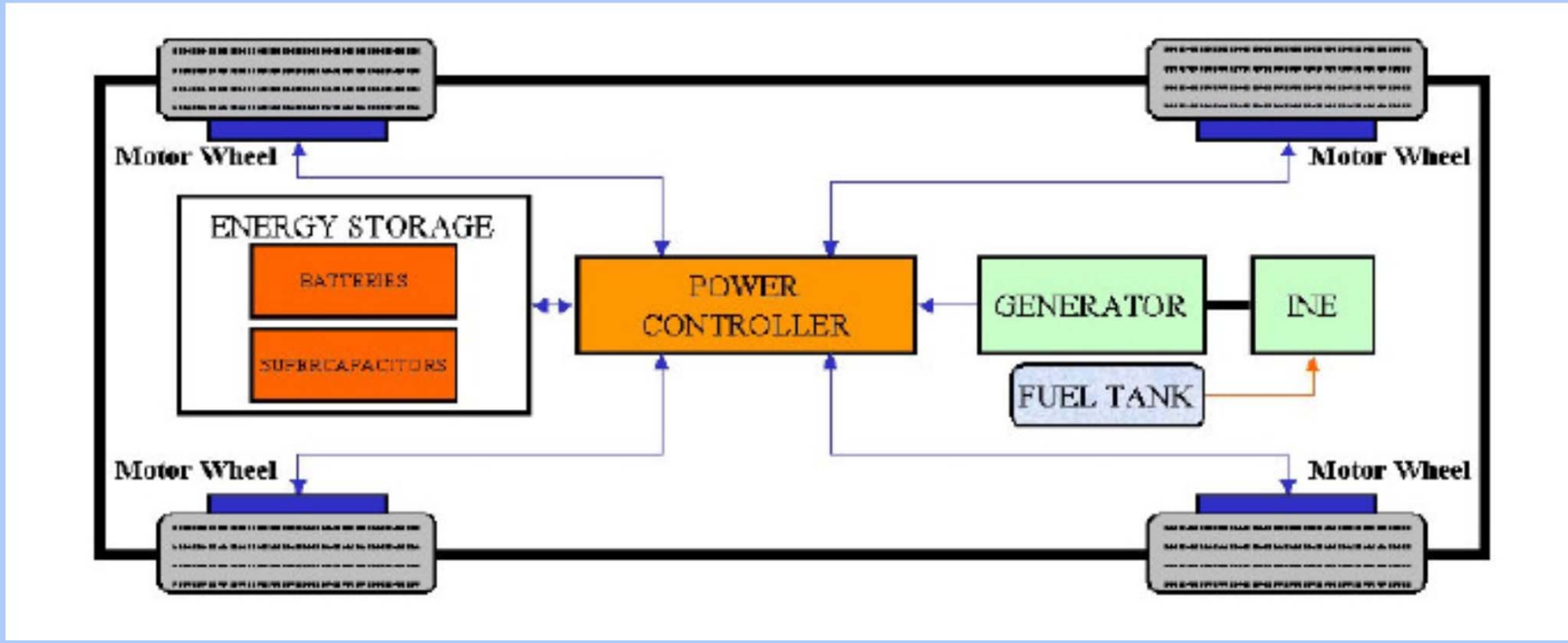
Human Oriented Sustainable Transport

HOST – Project details

- Partners:
  - CIRPS, La Sapienza Rome,
  - KTH – Royal Institute of Technology Stockholm
  - IDMEC IST Instituto Superior Tecnico – Portugal
  - University of Delft, the Netherlands
  - Stile Bertone S.p.a. – Italy
  - Robosoft – France
  - AB Volvo - Sweden
  - KVD – the Netherlands
  - Cargo Technologies - Austria
- Project time: 2005-2009
- Budget: 3 million Euros (EU contribution 2 million Euros)
- Coordinator: CIRPS - University of Rome La Sapienza

HOST is a concept to a multipurpose modular vehicle designed to work 24 hours per day in urban areas and capable to integrate, in an optimized and cost effective way, the most promising alternative fuel set and the newest combustion mode technologies.

HOST first concept



- The HOST project aimed at developing an innovative modular transport mean suitable for the urban transport of persons and goods.

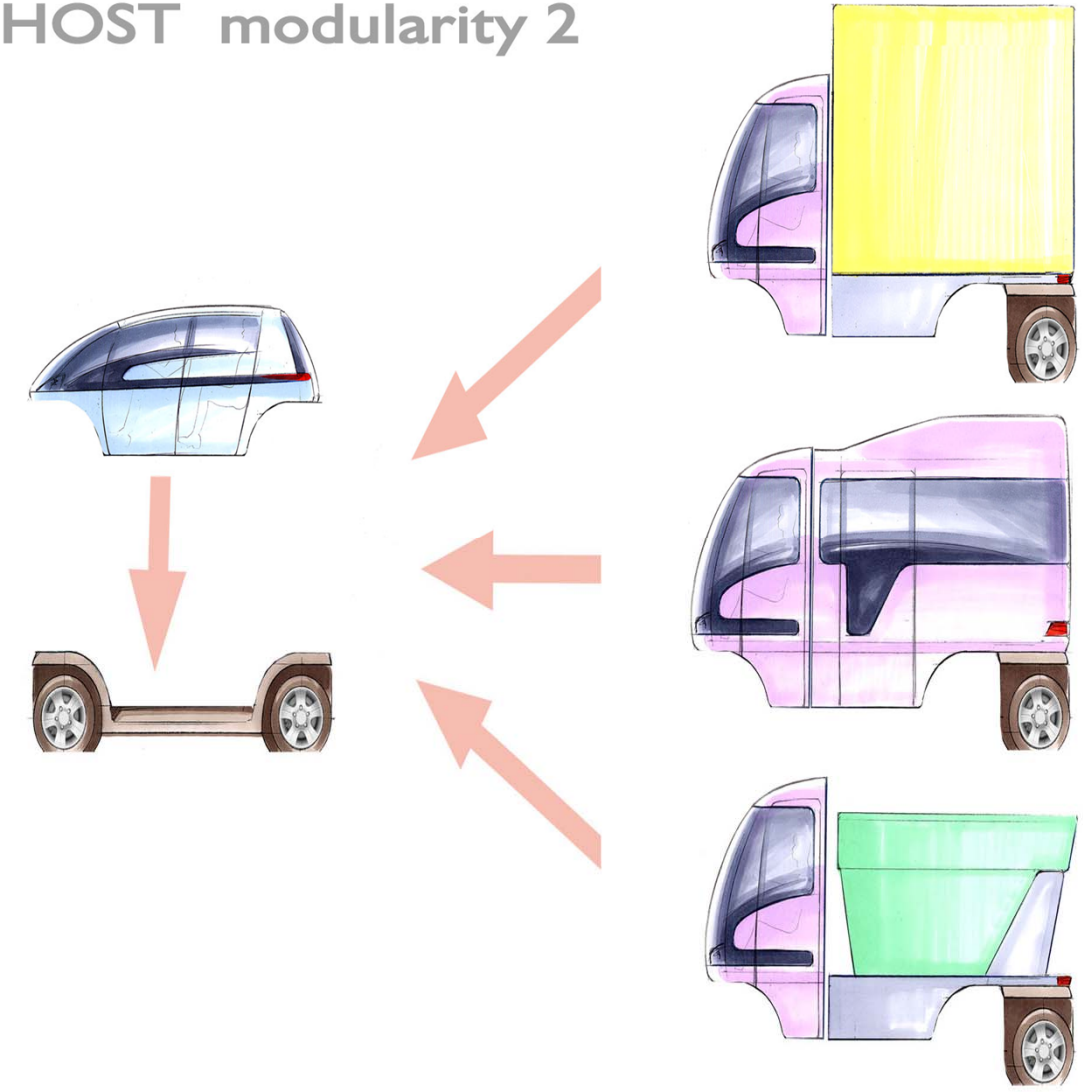
- Supposed to fulfill objectives like:
  - Extreme user flexibility
  - Extreme maneuverability
  - Extremely low CO_2 emissions
  - Gaseous and particulate pollutants reduction
  - Reduction of fuel consumption

HOST was designed to provide 4 different functions:

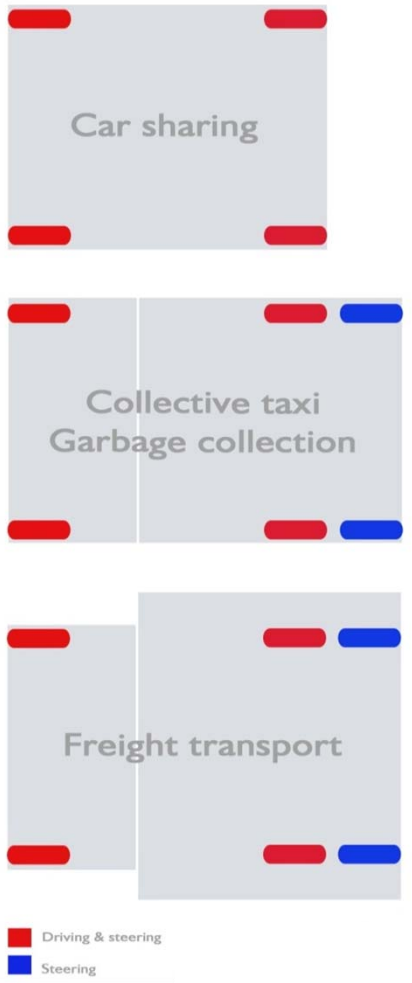
- Nighttime taxi service
- Daytime car-sharing service
- Daytime freight collection and distribution
- Nighttime garbage collection

For the HOST vehicle, one single chassis is provided and to this, four different bodyworks are used to make HOST fulfill four different functions

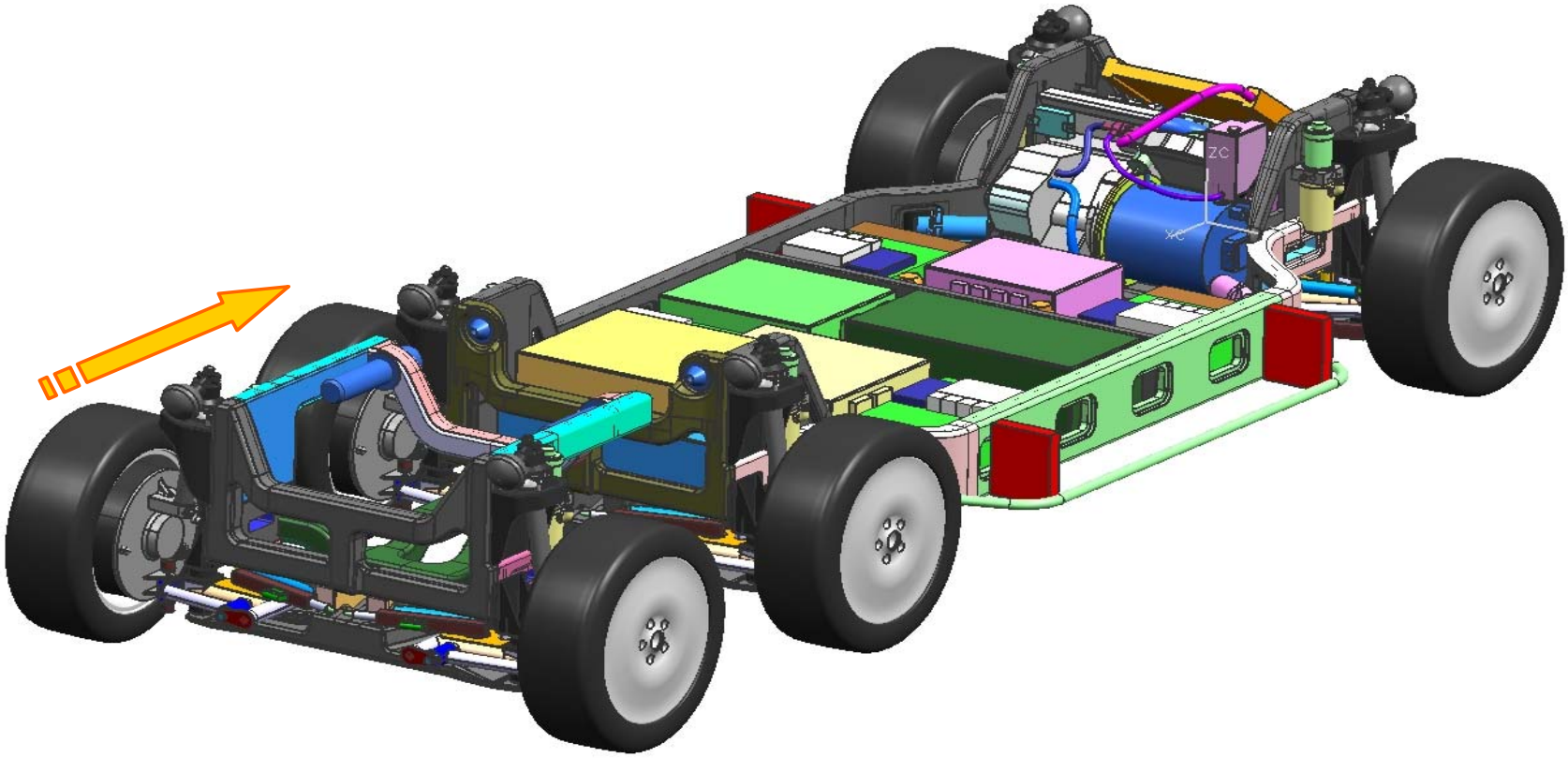
HOST modularity 2



Wheel plan view scheme



Third wheel axle addiction system



Modularity is at the core of the HOST design.

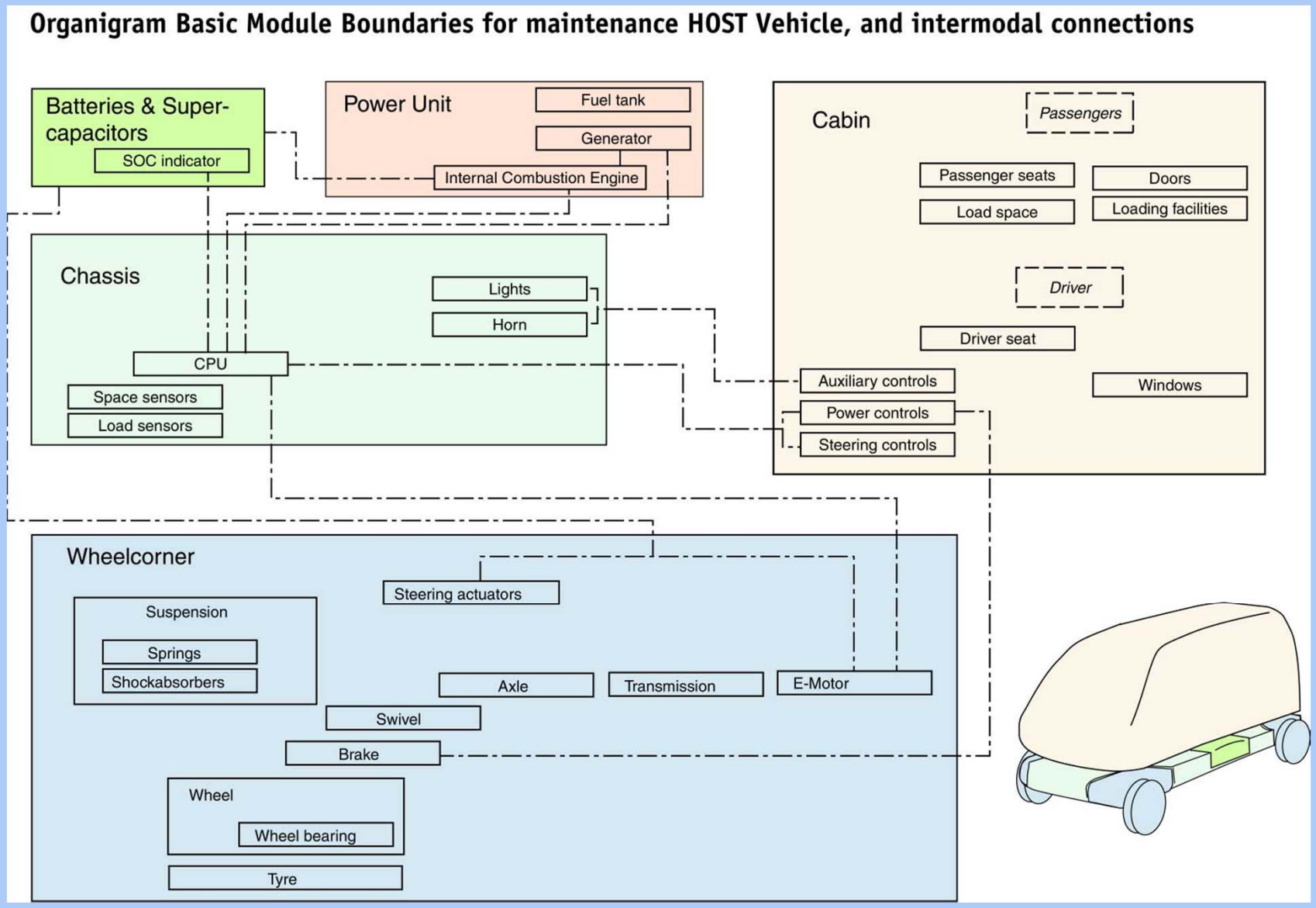
It poses advantages at several levels:

- In daily use: different configurations.
- For production and assembly.
- For maintenance and repair.
- For dismantling, recycling and disposal.

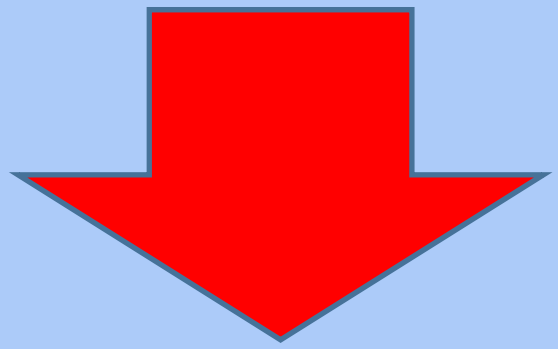
Multiple functions and high driving frequency, implies a modularity in the use phase for transhipment and maintenance operations.

Chassis, Cabin, Wheel corner, Power Unit and Battery pack and super capacitors are the five main modules in HOST

Basic module boundaries



Sustainability and environmental consciousness lie at the heart of the HOST vehicle programme.

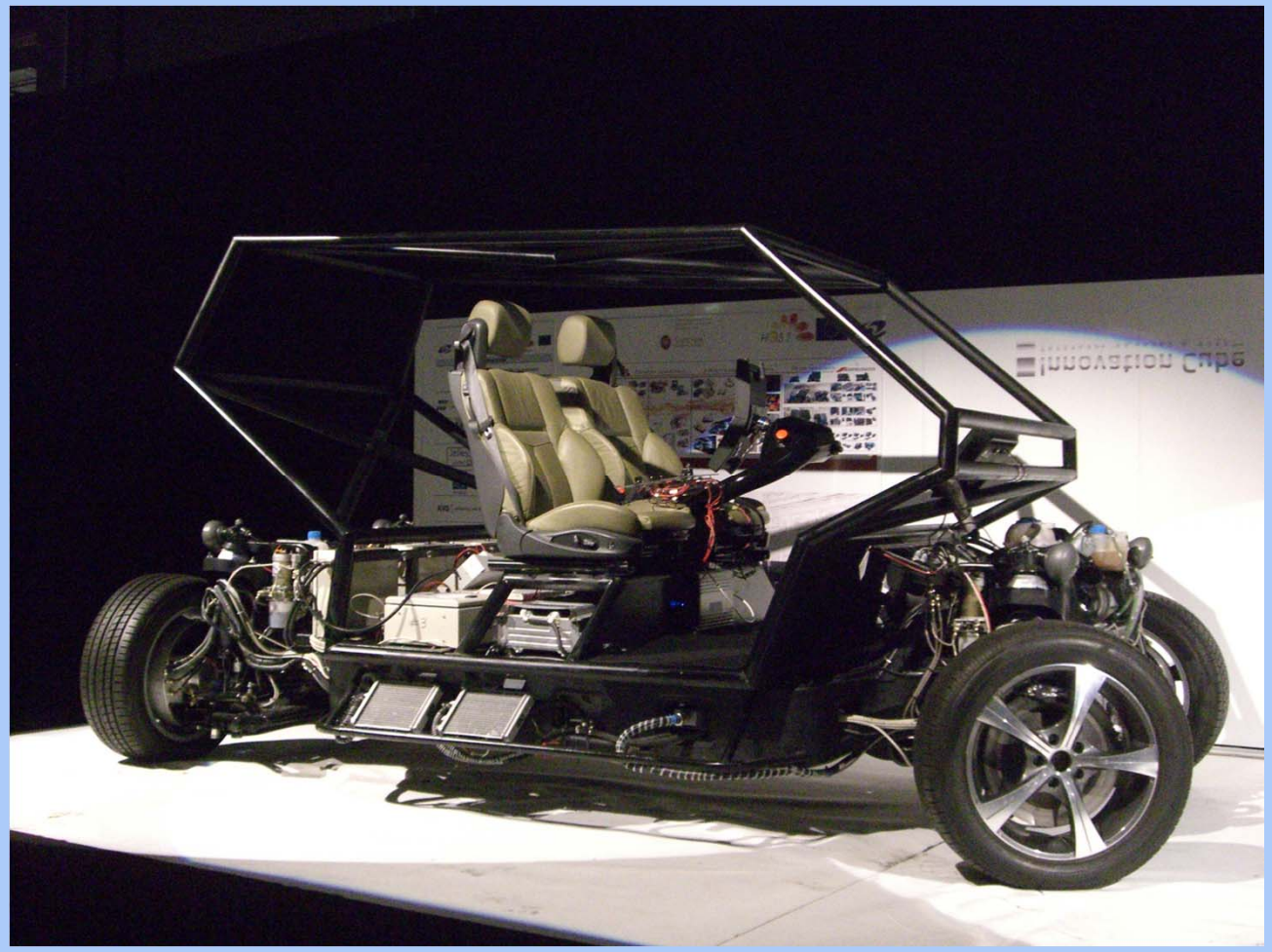


Specifically for the HOST vehicle ‘design for sustainability’ is translated into five complementary design strategies

HOST design principles

- Design for Lightness
- Design for Durability
- Design for Maintenance and Repair
- Design for Reuse
- Design for Recycling

Actual results



HOST prototype at 2008 Bologna's Motor Show

Actual results

- HOST prototype testing demonstrated a functionality of all major innovations: hybrid engine, wireless drive system, individual traction on all four wheels and maneuverability according to specifications (horizontal translation, rotation)
- A remaining question mark is the weight of the vehicle that may cause an undesired high fuel consumption

Future improvements

- Weights and performance of materials
- Optimization of individual functions
- Performance optimization of existing power-train
- Future power-train developments (Fuel cell)

Part 2 – KTH stakeholder investigation

Human Oriented Sustainable Transport

HOST - Stockholm

The Stockholm Stakeholder Investigation Subproject Team

- Sven Alexanderson, City of Stockholm
- Per Hultén, KTH-Infrastructure
- Federico Villatico, University of Rome, La Sapienza
- Björn Frostell, KTH-Industrial Ecology, coordinator

HOST - Stockholm

Core stakeholder group

- The City of Stockholm
- A neighbor municipality within the Metropolitan area of Stockholm
- A taxi company of Stockholm
- A freight company of Stockholm specialized in heavy freight transport
- A freight company specialized in small package distribution
- The Swedish Post
- The Stockholm municipal waste management company
- A car sharing pool
- An NGO
- University - Transport analyst

HOST - Stockholm

Types of interview questions

- Questions covering the general situation in Stockholm with respect to city development and transport (10 questions)
- Questions related to the different suggested HOST services (3 questions)
- Questions of a more open character where own suggestions and opinions could be forwarded (3 questions)

HOST - Stockholm

Telephone interviews

- Introduction and clarification of uncertainties and how the interview will be carried out (5-10 min),

- Interview, comprising questioning/answering of the formulated questions (20+ min),

- Extra time for personal comments and suggestions (as convenient).

In reality, the time used for the interviews varied between 25 and 48 minutes with an average of 36 minutes. Some interviews resulted in a more discussion type of situation, while others were more of a question/answer dynamics. In the former case, more comments were given in addition to the straight answers.

HOST - Stockholm

Processing and report preparation

- Collection and processing of the results, with the aim to give the result a quantitative expression if possible
- Discussion of the results and draft versions of the report in the SST
- Distribution of a preliminary report to the core stakeholder group members for comments
- Finalization of the report and its conclusions

HOST - Stockholm

Question 1

The county of Stockholm had 1,86 million inhabitants in the year 2003 (SCB, 2004). What is in your opinion the most likely population in 2015:

1,8 million or less	Around 2,0 million	2,2 million or more
0	7	3

HOST - Stockholm

Question 2

What is the more desirable development of the Metropolitan (=urban) Stockholm structure in the coming 10-15 years:

Alternative	A more dense urban structure with proportionally more tall (20-30 story) buildings	A structure mainly based on low (4-6 story) apartment buildings	A structure with proportionally more private homes with own property
No of answers	2	7	1

HOST - Stockholm

Question 3

What do you know about passenger transport in greater Stockholm?

Alternative	Very much	Much	Average	Little	Very little
No. of answers	3	5	1	1	0

HOST - Stockholm

Question 4

What is your general opinion on the Stockholm transport system?
In an international context, is it

Alternative	Very good	Good	Average	Bad	Very bad
No. of answers	1	4	5	0	0

HOST - Stockholm

Question 5

In your opinion, what is the most important strength of the Stockholm transport system?

Show by marking 1 to 5 where 5 is best.

Evaluation Inventory 1 - HOST - Question 5											
	SH-1	SH-2	SH-3	SH-4	SH-5	SH-6	SH-7	SH-8	SH-9	SH-10	**Ave**
Metro + Commuter trains + trams	4	5	5	5	5	5	3	2	5	5	**4,4**
Busses	5	2	3	4	4	4	5	3	4	3	**3,7**
Private cars	2	3	2	3	1	1	4	4	3	4	**2,7**
Motorbike + moped + bicycles	3	1	1	2	3	2	2	5	2	2	**2,3**
Others - Taxi + Special taxis (färdtjänst)	1	4	4	1	2	3	1	1	1	1	**1,9**

HOST - Stockholm

Question 6

What is the most important issue to handle in Stockholm passenger transport?

SH-1:	Congestions and queues during rush hours
SH-2:	Reduce emissions; introduce a transfer to renewable fuels; the government has to take a stronger hold on the issues; negative with all small projects that only lasts for 2-3 years
SH-3:	The infrastructure – the way the roads are laid out in a north-south direction; there is a need for more cross-roads
SH-4:	Keep schedules for Metro, commuter trains and buses
SH-5:	Construct beltways – to organize passages around or under the city
SH-6:	Improved public transport – More frequent bus traffic; improved price policies
SH-7:	Improved cross connections for railway traffic – More frequent bus traffic
SH-8:	Stimulate initiatives for new transport means – free parking, tax instruments, eco-vehicles
SH-9:	Congestions in the traffic system – introduce congestion fees
SH-10:	A more efficient railway bound traffic with low driver costs

HOST - Stockholm

Question 7

What is the most important issue to handle in Stockholm freight transport?

SH-1: The large number of badly planned daily transports to the same client with big vehicles; introduction of more re-loading stations and improved overall logistics

SH-2: The fleet is operated on fossil fuels – the city could demand the use of renewable fuels

SH-3: The congestion issue – the ability to reach a certain destination in a short time

SH-4: The terminal culture needs improvement – from distribution company by company to an improved co-transportation

SH-5: Improve passage ability and infrastructure barriers for freight transport – more and better crossways

SH-6: Remove heavy transports through the city to the sea harbour(s)

SH-7: More crossways for passenger transports would improve the space for freight transport in the city centre

SH-8: Remove congestion during peak hours, especially morning rush hours; improve loading/reloading conditions

SH-9: Remove existing time-bound congestion – introduction of wise congestion fees

SH-10: Co-transportation of goods; improved logistics by introduction of more reloading terminals

HOST - Stockholm

Question 8

Which of these passenger transport means are most important to improve (rank from 1 to 5 with 5 having highest priority)?

Evaluation Inventory 1 - HOST - Question 8											
	SH-1	SH-2	SH-3	SH-4	SH-5	SH-6	SH-7	SH-8	SH-9	SH-10	**Ave**
Others - Taxi + Sp. taxis (färdtjänst) + car pools	3	4	2	2	4	2	2	5	1	3	**2,8**
Busses	4	2	4	4	2	5	5	3	5	2	**3,6**
Metro + Commuter trains + trams	5	5	1	5	1	4	4	4	2	5	**3,6**
Private cars	1	3	5	1	5	1	1	2	3	1	**2,3**
Motorbike + moped + bicycles	2	1	3	3	3	3	3	1	4	4	**2,7**

HOST - Stockholm

Question 9

When during the day is it most important to improve passenger transport (rank from 1 to 5 with 5 having highest priority) :

Evaluation Inventory 1 - HOST - Question 9											
	SH-1	SH-2	SH-3	SH-4	SH-5	SH-6	SH-7	SH-8	SH-9	SH-10	**Ave**
Morning rush	4	4	4	5	5	5	5	5	5	5	**4,7**
Mid-day	1	2	3	2	3	2	3	3	3	2	**2,4**
Afternoon rush	5	5	5	4	4	4	4	4	4	4	**4,3**
Evening	2	3	2	1	2	3	2	2	3	1	**2,1**
Night	3	1	1	3	1	1	1	1	3	3	**1,8**

HOST - Stockholm

Question 10

How could the HOST services best be improved in the Stockholm Metropolitan area (give 1-2 suggestions)?

Answers car sharing

SH-1: Organize it in larger companies (or one company)

SH-2: Improve availability of cars (distance to terminals) and easiness of booking (use Internet); generally: Improve availability in space and time.

SH-3: Improved information on options and availability, use of Internet; use tax relief instruments

SH-4: No real opinion – perhaps organize it through apartment house associations (bostadsföreningar).

SH-5: Don't know – Does not suit the Swedish mentality and has only reached a limited penetration despite many years of service

SH-6: Car pools can only give a marginal contribution since everyone wants to go at the same time-not a good answer but that is the situation

SH-7: Make it more economically interesting and improve logistics of car pools

SH-8: Improve information on what car pools good do and how it might work

SH-9: There are a number of incentives (e.g. taxes) that could be introduced in order to increase the use of car pools; Look at Switzerland, they have a good system.

SH-10: Introduce tax relieves for cars and fuels serving in car pools; increase the availability of cars to elevate the usage level.

HOST - Stockholm

Question 11

From the initial description of the HOST vehicle, do you believe there is a need for such a vehicle in the Stockholm Metropolitan area? In a positive case, would you be interested in taking part in the implementation of such a new transport concept?

Evaluation Inventory 1 - HOST - Question 11											
	SH-1	SH-2	SH-3	SH-4	SH-5	SH-6	SH-7	SH-8	SH-9	SH-10	**Ave**
Is there a need for HOST in Stockholm?	0.8	1	1	0.2	0.7	0.3	0.7	0.2	0.3	1	**0.6**
1= Yes Absoulutely; 0 = No											
Are you interested to participate?	1	1	1	0	1	0.8	1	0.3	0.8	1	**0.8**

HOST - Stockholm

Question 12

Given that the HOST concept is technically feasible, what incentives could be introduced to push its market penetration?

SH-1: Free parking permits granted, business parking permit granted (value 8500 SEK/yr), congestion fees not demanded, other subsidies, The municipality could demand the services offered by such a vehicle.

SH-2: The municipality and other authorities will have to look at the regulations and overall politics. This is a community issue that needs overarching approaches where authorities take the lead

SH-3: It is necessary to create a market, perhaps initially through subventions; I have worked with combination vehicles together with the regional authority Landstinget, one moment transporting Ericsson managers and the next wheel chair bound persons using a rebuilt Volkswagen Caravelle.

SH-4: Grant operational advantages to the new vehicle; use specific bus lanes, tax advantages etc.

SH-5: "Money talks" – there must be a financial effect. It is necessary to achieve a high co-distribution capacity; perhaps not so efficient for goods delivery; introduce subsidies/fees to redirect transports from day to night.

SH-6: There has to be cost advantages; financing/subsidies to make the new concept profitable for the operator; must be low intensity system with respect to personnel employed.

SH-7: Subsidies to compensate for higher costs during an introductory phase (economic incitements); political decisions (assist the client to order the service); create a market and declare that we want this.

SH-8: There must be an easy access to the vehicle (for personal transports); Booking through the Internet, open/close vehicle by use of mobile phone.

SH-9: Introduce economic instruments and have the vehicle classified as eco-vehicle. The paradox is that with greater transport problems than Stockholm, there would be a greater need for HOST and thus the possibility for more actions would be greater.

SH-10: Organize the stakeholders in a broad way – a task for society; it is necessary to support the development work with broader social initiatives.

HOST - Stockholm

Question 13

Which of the following HOST services would you choose to improve in case you were forced to take a decision in relation to the Stockholm urban area? Please assign them a relevance order from 1 to four with 4 being highest relevance:

-Car sharing
-Nocturne collective taxi
-Freight pick up and delivery
-Garbage collection

Evaluation Inventory 1 - HOST - Question 13											
	SH-1	SH-2	SH-3	SH-4	SH-5	SH-6	SH-7	SH-8	SH-9	SH-10	**Ave**
Car pools	1	2	1	3	3	1	2	4	2	1	**2.0**
Nocturne collective taxi	2	3	4	4	1	2	1	2	1	3	**2.3**
Freight pick up and delivery	4	1	3	2	2	4	4	3	4	4	**3.1**
Garbage collection	3	4	2	1	4	3	3	1	3	2	**2.6**

HOST - Stockholm

Question 14

Are you willing to renounce (or limit) your car ownership if there is an efficient car sharing service in Stockholm?

SH-1:	**No, I depend on the car at present; perhaps in the future if I would live downtown.**
SH-2:	**Yes, reduce (I have presently 2 cars); stimulate employers to introduce car pools.**
SH-3:	**No, it would not work**
SH-4:	**Yes; availability of the car sharing is of greatest importance.**
SH-5:	**No, spontaneously no, perhaps if the system proves good.**
SH-6:	**Yes.**
SH-7:	**No, not today, I need a car for family transports and hobbies, but maybe tomorrow.**
SH-8:	**Yes.**
SH-9	**Yes – already done!**
SH-10:	**Yes.**

HOST - Stockholm

Question 15

Being in charge of the Stockholm transport system, what would be your first action to take?

SH-1: Try to decrease congestion; (i) stimulate personal co-transportation, (ii) improve the service of public transport, (iii) limit the access for private cars downtown and (iv) introduce smarter freight delivery and rest product pick-up).

SH-2: Improve co-distribution and remove unnecessary transport movements

SH-3: Create incentives for the implementation of a flexible vehicle that could be in operation 24 hours a day and build more cross-ways.

SH-4: Improve goods distribution through co-distribution; personal transport improvement through an improved availability of public transport.

SH-5: Build beltways and belt railways round the city.

SH-6: Improve public transport and thus stimulate people to leave the car at home; Stop short time experiments and put efforts on improving the bus service where flexibility and environmental efficiency may best be combined at present.

SH-7: Improve public transport; (accept a maximum of 5 min waiting time); give an improved possibility to get from A to B.

SH-8: Create improved parking possibilities and services for car pool users

SH-9: Introduce congestion fees (a great mistake that congestion fees are not tried on the Essingeleden, this will limit the value of the congestion fee experiment).

SH-10: Improve the rail bound traffic capacity, here we have the greatest potential

HOST - Stockholm

Question 16

How should a large metropolitan area organize its future urban transport system in terms of both passengers and goods transport?

SH-1: Basic approach: Personal transports are best accommodated by public transport – it is faster and cheaper than personal car transport; Properly organized commuter parking spaces for combined car/public transport functions; For freight transport, decrease number of vehicles in operation compared to amount of goods distributed; introduce certain zones free of vehicle traffic; introduce reloading stations outside the city center.

SH-2: It is necessary to centralize a bit more the organization of the transport system in a large city and this is an authority task; Today, every stakeholder tries to optimize her own sphere of action and there is a need for an improved overall optimization.

SH-3: Improve information about different alternatives and what they may offer; redirection of traffic flows in order to improve the use of time and space; improved co-operation between different means of transport to improve efficiency and profitability

SH-4: Co-distribution in the freight transport sector, more cross-bound traffic for personal transports.

SH-5: There must be a central body in charge of the system that represents a broad common will and ambition.

HOST - Stockholm

Question 16

How should a large metropolitan area organize its future urban transport system in terms of both passengers and goods transport?

SH-6:	**Increase the combination of person and freight transports; introduce congestion fees combined with an improved public transport.**
SH-7:	**Organize an improved public transport, try to improve freight transport efficiency.**
SH-8:	**The most important: There must be pre-booked parking places for car sharing activities and a good system for booking and opening of vehicles; the vision is a future where there is full access to vehicles and where these vehicles are used most of the time thanks to a well developed system for booking, pick-up and return of vehicles.**
SH-9:	**The base is to find a proper pricing mechanism, motivating people to behave in a sound manner from an overall point of view. This will influence the overall local social structure and personal behavior.**
SH-10:	**The most important single component is to establish a good co-functioning of different rail bound traffic solutions.**

HOST - Stockholm

Conclusions 1-3

1. The Stockholm region may expect a continued population increase in coming years resulting in a population of more than 2 million people 2015. The general urban structure will remain very much the same, perhaps with a slight densification of residential areas.

2. The Stockholm transport system is good in an international context, the public transportation (metro, suburban trains, trams and buses) being the strongest part of the passenger transport system. There is a strong need for improvement of freight distribution logistics and reloading terminals from regional to local freight transport.

3. For a continued improvement of the Stockholm passenger transport system, most emphasis should be put on a continued improvement of public mass transport to make it even more attractive.

HOST - Stockholm

Conclusions 4-6

4. There is a severe congestion situation mainly during morning rush hours that affects freight and private car transports considerably. The congestion situation could be improved mainly by (i) use of congestion fees, (ii) improving infrastructure (new cross-roads) and (iii) new smarter vehicles and logistics improvement.

5. For introduction of new transport means and for a general improvement of the transport situation, it is important that society takes a strong lead, since sector representatives in the form of individual stakeholders will not be able to take such a position.

6. There is a curious but somewhat hesitant attitude towards new transport means such as the HOST concept. There are mixed opinions on whether transport vehicles should be multifunctional or be more specialized in the future.

Part 3 – KTH final evaluation ERPA results

ERPA (Environmentally Responsible Product Assessment)

ERPA = Screening LCA method

Rob Kutter, Ronja Krische, David Lazarevic, Shuncheng Guo, Björn Frostell

The aim of this project was to perform a screening LCA of the HOST vehicle using the ERPA method and compare it to conventional vehicles providing the same services in order to identify areas of improvement, benefits, and disadvantages with respect to sustainability

- ❑ Define/develop the specific ERPA methodology to be used
- ❑ Conduct a screening LCA of the HOST vehicle and relevant conventional vehicles (car-share vehicle, taxi, and freight truck)
- ❑ Compare HOST vehicle and conventional vehicles
- ❑ Identify sustainability improvements for the HOST vehicle

SLCAs – Advantages and disadvantages

Advantages

- SLCAs are quicker and less costly than LCAs
- SLCAs can complement LCAs by evaluating design attributes
- SLCAs can be used in the early stages of design, where there can be a lack of quantitative information

Disadvantages

- SLCAs have little ability to track material flows
- There is minimal ability to compare dissimilar approaches to fulfilling a need with SLCAs
- SLCAs have minimal ability to track improvements over time

Graedel and Allenby (2003)

The ERPA Matrix

The Environmentally Responsible Product Assessment Matrix					
	Environmental concern				
Life stage	Materials choice	Energy use	Solid residues	Liquid residues	Gaseous residues
Resource extraction	1,1	1,2	1,3	1,4	1,5
Product manufacture	2,1	2,2	2,3	2,4	2,5
Product delivery	3,1	3,2	3,3	3,4	3,5
Product use	4,1	4,2	4,3	4,4	4,5
Refurbishment, recycling, disposal	5,1	5,2	5,3	5,4	5,5

* The numerical entries in the table are matrix element indices.

Source: Graedel & Allenby, 2003, p.217

Reasons for using ERPA

- ✓ The ERPA methodology was created for product development
- ✓ The ERPA matrix can utilize qualitative data but does not rely on this data
- ✓ The ERPA matrix can be completed in a relatively short period of time
- ✓ The ERPA matrix identifies areas of poor environmental performance, which can be the focus of further design development

Procedures of the ERPA Method

Procedure	Step
Environmental Performance Score	▪ Identification of environmental factors for each cell ▪ Development of checklist for environmental factors ▪ Development of scoring guide for each question ▪ Generation of environmental performance score
Double weighting	▪ Weight of life cycle stages by AHP ▪ Weighting of environmental concerns by Delphi Method
Environmental responsibility	▪ Multiply of environmental score and double weight factors
Priority for Improvement	▪ Setting up a criteria for priority identification ▪ Identification of priority order for improvement

Source: Hur et al., 2005

Functional units adopted

- **HOST vs. Nocturnal Collective Taxi**

  Person kilometers of transportation (person km)

- **HOST vs. Daytime Car Sharing Service**

  Person kilometers of transportation (person km)

- **HOST vs. Daytime freight collection and distribution**

  Kilogram kilometers of freight transported (kg km)

Weighting factors decided upon

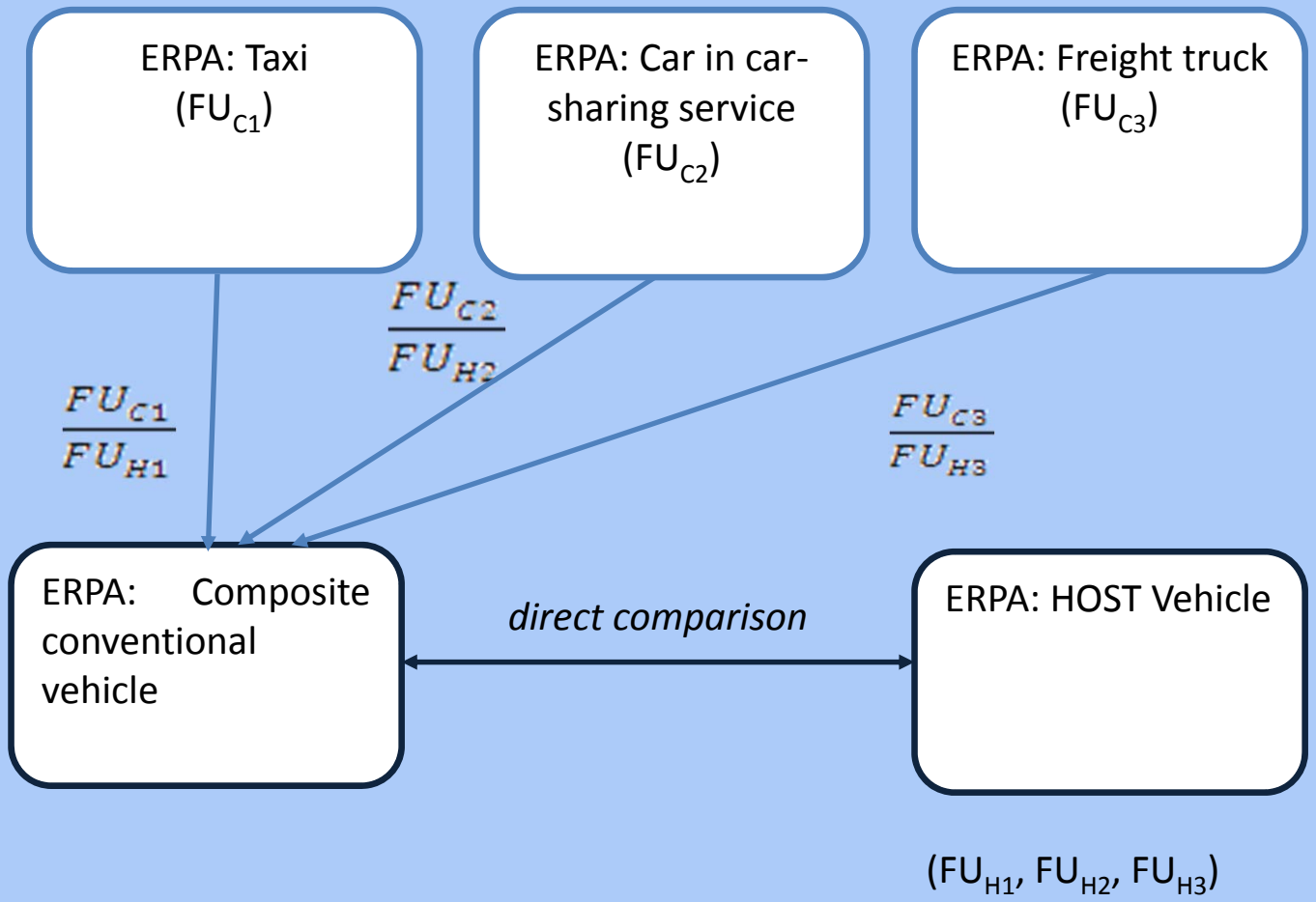
Life cycle stage	Weighting
Resource extraction	20 %
Product manufacture	20 %
Product delivery	1 %
Product use	55 %
Refurbishment, recycling, disposal	4 %

ERPA Scoring Guide

Score	Value Guide*	Explanation
0	Minimum Legal Requirements	Minimum legal requirements for residue emissions, energy use and use of materials are met
1	Below Industry Standard	Residue emissions, energy use and use of materials are below that of the standard automotive industry
2	Standard Industry Average Practice	Residue emissions, energy use and use of materials are those of standard industry practice
3	Best Practice	Residue emissions, energy use and use of materials are those of best industry practice
4	Above Best Practice	Residue emissions, energy use and use of materials reflect the use of innovative, state of the art technology

* The industry average and legal requirements refer to the European situation

Study ERPA comparison



Nocturne Collective Taxi Reference Vehicle

Mercedes-Benz, Viano CDI 2.0	
Fuel type	Diesel
Transmission	Automatic
Fuel consumption (l/100km) during	
City driving	11,4
Country driving	7,0
Mixed driving	8,7
CO_2 emissions, mixed driving (g/km)	231
Maximum speed (km/h)	164
Kerb weight (kg)	2090
Total weight (kerb + cargo) (kg)	2770

Daytime Car-sharing Reference Vehicle

Toyota Avensis 1.8 VVT-i	
Fuel type	Gasoline
Transmission	Automatic
Fuel consumption (l/100km) during	
City driving	10,3
Country driving	6,3
Mixed driving	7,7
CO_2 emissions, mixed driving (g/km)	151
Maximum speed (km/h)	195
Kerb weight (kg)	2090
Total weight (kerb + cargo) (kg)	1820

Daytime Freight transport Reference Vehicle

Renault Master	
Fuel type	Diesel
Transmission	6 speed gearbox
CO_2 emissions, mixed driving (g/km)	120
Power ratings: (hp)	100
Engine	100HP DCI2.5
Wheelbase (mm)	3080
Body length (mm)	2654
Body width (mm)	1870
Max body + payload (kg)	1133
Total weight (GVW) (kg)	2800

HOST ERPA Matrix with baseline assumptions

Life Cycle Stage / Criteria	Material Choice	Energy Use	Solid Residues	Liquid Residues	Gaseous Residues
Resource Extraction	-0,02	-1,02	0,11	0,11	0,11
Product Manufacture	-0,01	-1,02	-0,02	-0,02	-0,02
Product Delivery	-0,04	-0,02	-0,04	0,01	0,01
Product Use	-3,17	2,33	0,29	0,29	2,33
End of Life Stage	0,21	-0,11	0,17	0,17	0,17

HOST ERPA Matrix with optimistic assumptions

Life Cycle Stage / Criteria	Material Choice	Energy Use	Solid Residues	Liquid Residues	Gaseous Residues
Resource Extraction	-0,02	-0,02	0,11	0,11	0,11
Product Manufacture	-0,01	-0,02	-0,02	-0,02	-0,02
Product Delivery	0,01	-0,02	0,01	0,01	0,01
Product Use	-0,42	5,08	0,29	0,29	5,08
End of Life Stage	0,21	-0,11	0,17	0,17	0,17

Conclusions from ERPA study

- The analysis of this report shows that the HOST vehicle does not perform better in terms of ecological sustainability than the conventional vehicles which it replaces. However, these results can be regarded as a "first shot" analysis, since there is a strong lack of data about the HOST vehicle, especially how it will be used. These results suggest that the HOST vehicle should be evaluated more carefully; the assumption that this vehicle is more ecologically sustainable than its alternatives may not prove to be true

- Assuming that the materials in the vehicle can be altered allowing HOST to be lighter and more fuel efficient, a future HOST can become considerably more efficient than conventional solutions as indicated by the results in Table 9. Thus the two examples of ERPA analyses suggest that the next important step in the HOST development should be a focus on (i) materials for lighter construction and (ii) fuel efficiency
of the vehicle

- LCA thinking and LCA work should be incorporated to a substantially higher degree in projects of this kind. They should also be performed earlier in the design process and perhaps be used as a design process tool. This might be a speeding-up factor in future sustainable product design

Part 4 – KTH final reflections

Rob Kutter, Ronja Krische, David Lazarevic, Shuncheng Guo,
Björn Frostell

KTH final reflections on HOST project

- Large European projects with high environmental ambitions may still have severe limitations in product specifications and design due to an insufficient environmental competence and limited experience from incorporating environmental aspects into product development
- Simplified LCAs using easily achievable environmental information and qualified guesses may provide very important insight into strengths and weaknesses of research projects and support detailed planning of the same
- Using less than 1 % of the financial budget of the project, it was possible to gain very important information on the strengths and weaknesses of the HOST vehicle. This knowledge should have been gathered at the end of the project and not at the end
- The project offered a very good personal experience with an interesting mix of partners from southern, central as well as northern Europe. The cultural interaction should be regarded as a good project gain besides the scientific experiences