PM1

Interreg
CENTRAL EUROPE
European Union
European Regional Development Fund
InterGreen-Nodes

Clean Fuel Solutions for Port Operations - Alternative Fuel Vehicles Assessment Criteria and Results

Diapositiva 1

PM1 Philip Michalk; 15/03/2022

MOTIVATION

- EU commissions 2030 Climate Target Plan: reducing greenhouse gas emissions to 55% below 1990 levels

- Other countries even more ambitious goals: Carbon neutral by 2030 (e.g. NO or regions in FI)

⇒ Pressure to implement climate friendly solutions will only rise.

INTRODUCTION

What you will have learned after todays session:

- Overview of Demonstrators in InterGreen-Nodes.
- Where to find information and Lessons Learned on these demonstrators.
- How to integrate electric vehicles into your fleet.
- Use a KPI scoreboard for decision making

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THE DEMONSTRATORS

Rattakarn- pixabay licence - original: https://pixabay.com/de/photos/hafen-kran-port-industrie-versand-4875325/

OVERVIEW DEMONSTRATORS

Interreg CENTRAL EUROPE
InterGreen-Nodes

Cargobike Hub

Full-Electric Terminal

Electric Ship

BREEAM und LEED ratings

Solar Energy

LNG Infrastructure

H2 Energy Storage systems

WPT3
Cargobike Hub

Cargobike Hub

Where:
Berlin (Westhafen port)

What:
Developing and operating an innercity-cargobike hub on the port premise.

Potential Impact:
Shifting freight from truck to cargobike on the last mile, with the potential to use rail for the main run (using the ports rail-road transshipment facilities).

WPT3
Full-Electric Terminal

Full-Electric Terminal

Where:
Berlin (Westhafen port)

What:
Changing port operation processes from conventional (diesel) fuel driven processes to electric drives (e.g. trucks, internal terminal freight transport, general purpose cars, utility vans, rail shunting vehicles).

Potential Impact:
CO_2 reduction (exact numbers still pending).

WPT3
Electric Ship

Electric Ship

Where:
Berlin (Westhafen port)

What:
Using an electric ship (with battery electric and hydrogen energy storages) instead of diesel driven ships for transport on inland waterways.

Potential Impact:
Significant CO_2 reduction (exact numbers still pending).

WPT3
BREEAM and LEED

BREEAM und LEED ratings

Marcinjozwiak - pixabay licence - original: https://pixabay.com/de/photos/produktion-einrichtung-logistik-4408573/

Where:
Port of Budapest

What:
Using BREEAM and LEED ratings to make the effects of environmental friendly building measurable.

Potential Impact:
Environmental friendly building in the areas in energy, land use, materials, pollution, transport, waste and water.

WPT3
Solar Energy

PublicDomainPictures - pixabay licence - original: https://pixabay.com/de/photos/alternative-blau-zelle-sauber-%c3%b6ko-21581/

Where:
Berlin (Westhafen port) and Port of Koper

What:
Using solar energy to complement the energy mix used by a port.

Potential Impact:
CO_2 reduction (exact numbers still pending).

WPT3
LNG Infrastructure

LNG Infrastructure

IADE-Michoko – pixabay licence – original: https://pixabay.com/de/photos/treibstoff-pumpe-energie-zapfs%c3%a4ule-1596622/

Where:
Freight Village Bologna

What:
Developing and operating an LNG gas station for trucks, to be used by customers of the freight village.

Potential Impact:
CO_2 reduction (exact numbers still pending).

WPT3

Energy storage

H2 Energy Storage systems

United States Department of Energy - public domain-original:https://commons.wikimedia.org/wiki/File:Hydrogen_cascade_storage_system.jpg

Where:
various

What:
Using hydrogen fuel cells to store electric energy during high availability times and use them when high energy demand arises.

Potential Impact:
Flattening usage peaks and storing energy from clean energy production, making clean energy use economically more viable.

KPI-SCOREBOARD

Demonstrators

Cargobike Hub

Full-Electric Terminal

Electric Ship

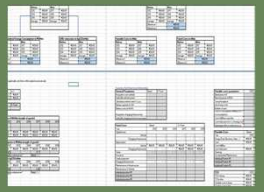
BREEAM und LEED ratings

Solar Energy

LNG Infrastructure

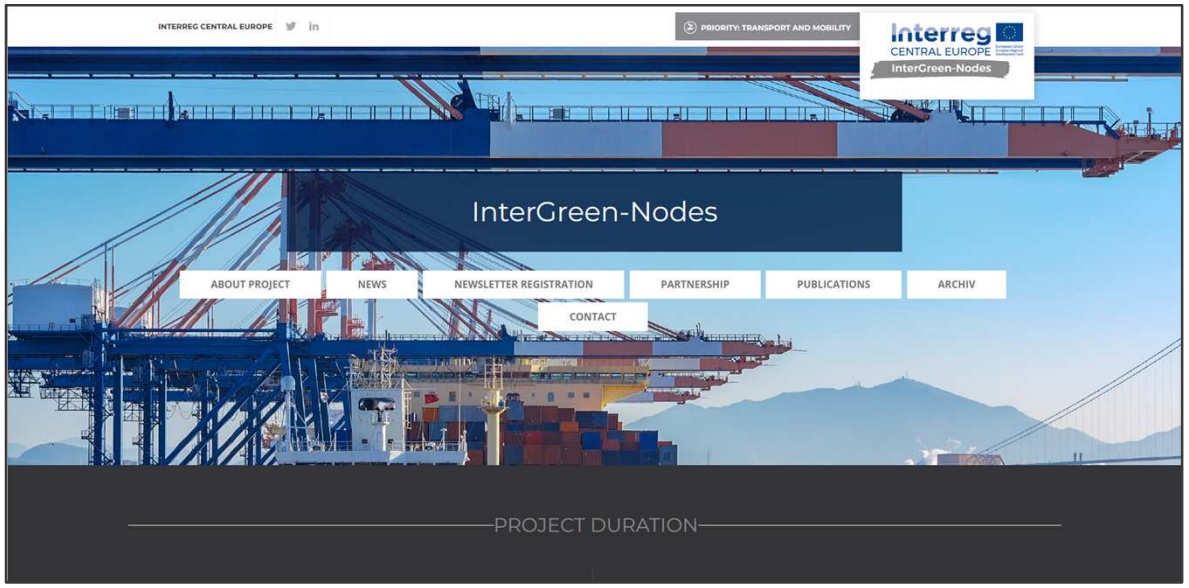
H2 Energy Storage systems

KPI Scoreboard for decision making



WHERE TO FIND MORE INFORMATION

All reports and lessons learned can be found on the project website from June on:



www.interreg-central.eu/Content.Node/InterGreen-Nodes.html

ASSESSING AND IMPLEMENTING ELECTRIC VEHICLE OPERATIONS

TH Wildau

STEP BY STEP PROCEDURE - E-VEHICLES

Step 1:
Define your objective

Define your goal:

- Do you want to save CO_2 emissions?
- Do you want to replace your complete fleet, or do you only want to introduce a few electric vehicles into your fleet?
- What is your time frame? Do you want to change your fleet on a long term or are you looking for a short-term effect?

STEP BY STEP PROCEDURE - E-VEHICLES

Step 2: Estimate the necessary range and annual mileage

First decide if:

a. You want to substitute your complete fleet by electric vehicles.

b. You want to substitute a certain conventional vehicle by an electric vehicle.

c. You want to substitute part of your fleet by electric vehicles.

Use your vehicle logbooks and analyse the vehicle trips.

STEP BY STEP PROCEDURE - E-VEHICLES

Step 3:
Decide on Gross-Mass and Payload

Use the gross-mass of your current fleet as an indicator and choose a gross-mass as large as the one of the vehicle(s) you wish to replace.

Research a vehicle that has the right gross mass. You will need this value for the next step.

STEP BY STEP PROCEDURE - E-VEHICLES

Step 4:
Estimate the necessary battery capacity

Battery-Capacity [kWh] =
(max. Range [km] * 0,3413 + Vehicle-Gross-Mass [t] * 1,3579 + 28,57) * 1,2

STEP BY STEP PROCEDURE - E-VEHICLES

Step 5:
Estimate your costs

Purchasing price [€] = Vehicle-Gross-Mass [t] * 2810 + Battery-Capacity [kWh] * 920 + 2262

Consumption (kWh/km) = Battery-Capacity [kWh] / max. Range [km]

STEP BY STEP PROCEDURE - E-VEHICLES

Step 6: Estimate CO_2-savings

In order to estimate your current CO_2 emission, determine the average fuel consumption per km of the vehicles you wish to substitute and multiply this number with the mileage you wish to substitute. Than multiply the result with

- In case of a Diesel-vehicle: 3.16
- In case of a Gasoline-vehicle: 2.88

The results are your current CO_2 emissions in kg, for the vehicles/tours you wish to substitute.

In order to estimate the CO_2 emissions for your planned electric vehicle(s), first ask you energy supplier for the CO2-factor per kWh. Than multiply this CO_2 -factor with the total consumption, you calculated in Step 5.

STEP BY STEP PROCEDURE - E-VEHICLES

Step 7:
Choose the proper vehicle and contact the vendor

Use the data you collected and calculated and contact your vendor.

STEP BY STEP PROCEDURE - E-VEHICLES

Step 8:
Talk to your vendor about charging infrastructure and maintenance

Clarify:

Will you need your own charging stations or are there public charging stations you could use?

- ☑ What would a quick-charging station cost and how much faster would a quick-charging station charge?
- ☑ Is it possible to install the necessary charging station on your own electric house-connection/property-connection/company connection/municipal connection.
- ☑ Will the available electric-power be sufficient (especially when charging several vehicles)

STEP BY STEP PROCEDURE - E-VEHICLES

Step 8:
Talk to your vendor about charging infrastructure and maintenance

- ☑ When using a quick charging system: Will you need a load management system?
- ☑ Can/shall the charging station-status be diagnosed via the internet for maintenance purposes?
- ☑ What services are offered within the maintenance contract for your charging station?
- ☑ Where are the next maintenance service stations for your electric vehicle?
- ☑ Does the vendor offer a maintenance contract for the vehicle?
- ☑ What services are offered within the maintenance contract for the vehicle?

STEP BY STEP PROCEDURE - E-VEHICLES

Step 8:
Talk to your vendor about charging infrastructure and maintenance

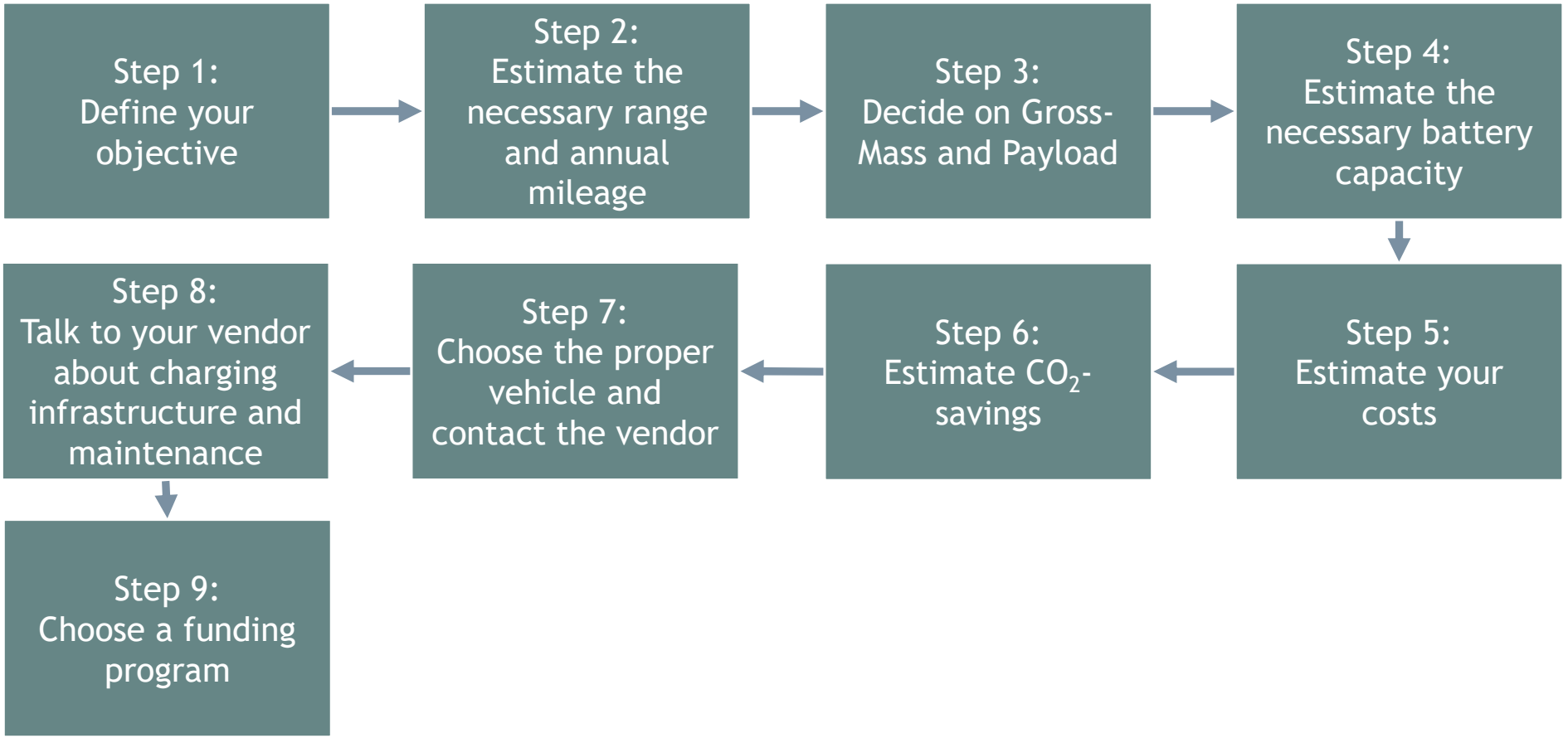
- ☑ Does the vendor offer you a guarantee on battery-life?
- ☑ Does the vendor offer you a battery exchange after a certain mileage?

STEP BY STEP PROCEDURE - E-VEHICLES

Step 9:
Choose a funding program

Contact your local chamber of commerce or economic development board and inquire about the possibility of receiving a funding for the purchase and/or operation of an electric vehicle.

STEP BY STEP PROCEDURE - E-VEHICLES SUMMARY

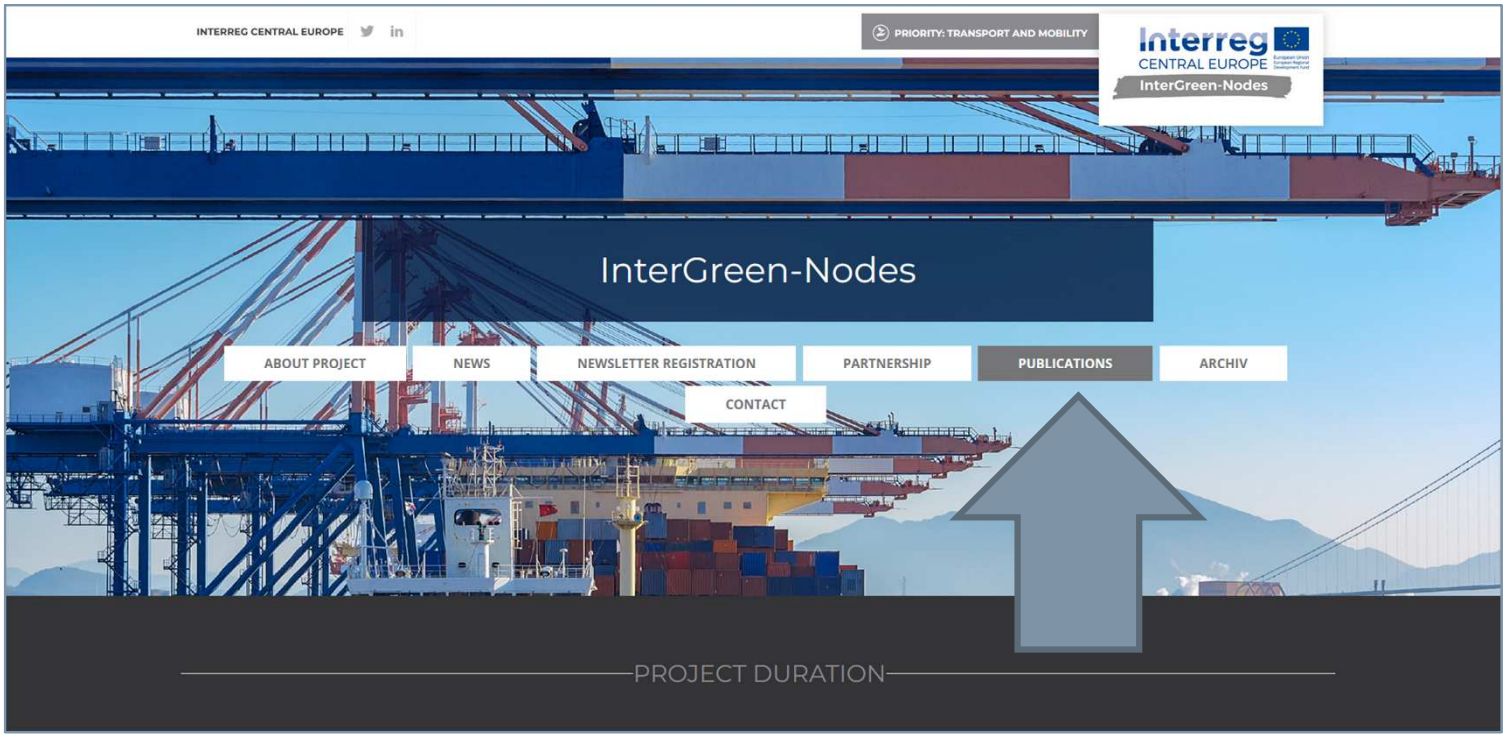


KPI SCOREBOARD

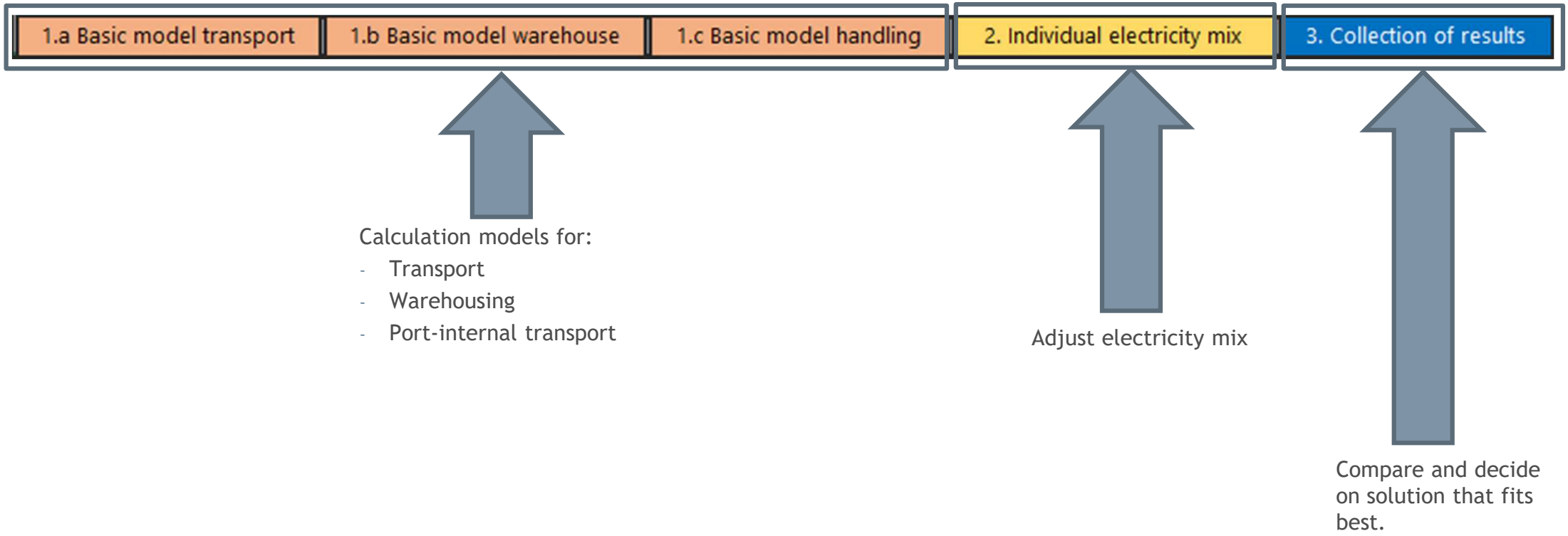
Mohamed_hassan- pixabay License - original: https://pixabay.com/de/illustrations/kpi-indikatoren-leistung-analyse-4266500/

THE SCOREBOARD

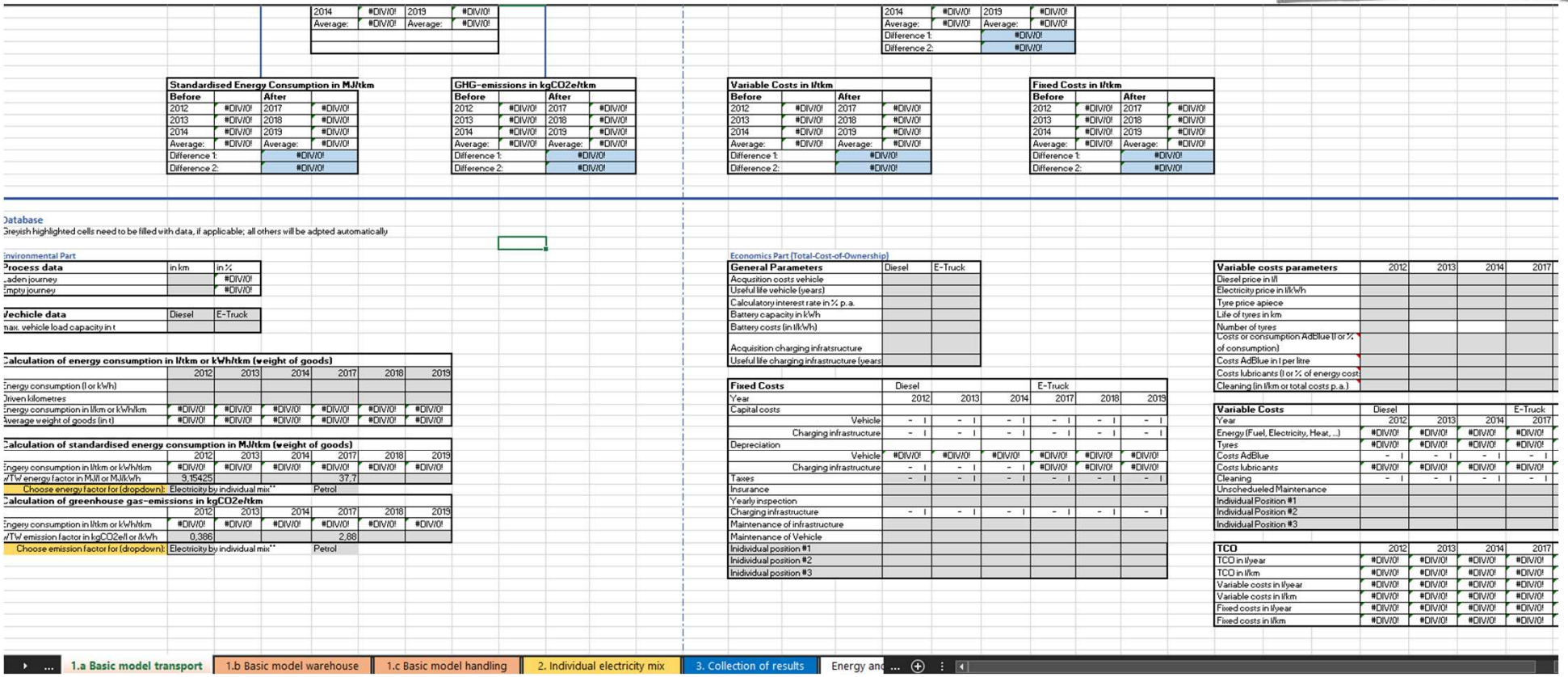
An xls-table and step by step process to decide between different climate friendly solutions.



THE SCOREBOARD



THE SCOREBOARD



2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!

2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!
Difference 1:		#DIV/0!	
Difference 2:		#DIV/0!	

Standardised Energy Consumption in MJ/tkm

Before		After	
2012	#DIV/0!	2017	#DIV/0!
2013	#DIV/0!	2018	#DIV/0!
2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!
Difference 1:		#DIV/0!	
Difference 2:		#DIV/0!	

GHG-emissions in kgCO2e/tkm

Before		After	
2012	#DIV/0!	2017	#DIV/0!
2013	#DIV/0!	2018	#DIV/0!
2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!
Difference 1:		#DIV/0!	
Difference 2:		#DIV/0!	

Variable Costs in l/tkm

Before		After	
2012	#DIV/0!	2017	#DIV/0!
2013	#DIV/0!	2018	#DIV/0!
2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!
Difference 1:		#DIV/0!	
Difference 2:		#DIV/0!	

Fixed Costs in l/tkm

Before		After	
2012	#DIV/0!	2017	#DIV/0!
2013	#DIV/0!	2018	#DIV/0!
2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!
Difference 1:		#DIV/0!	
Difference 2:		#DIV/0!	

Database

Greyish highlighted cells need to be filled with data, if applicable; all others will be adpted automatically

Environmental Part

Process data	in km	in %
Laden journey		#DIV/0!
Empty journey		#DIV/0!

Vechicle data	Diesel	E-Truck
max. vehicle load capacity in t		

Calculation of energy consumption in l/tkm or kWh/tkm (weight of goods)

	2012	2013	2014	2017	2018	2019
Energy consumption (l or kWh)						
Driven kilometres						
Energy consumption in l/tkm or kWh/tkm	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Average weight of goods (in t)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Calculation of standardised energy consumption in MJ/tkm (weight of goods)

	2012	2013	2014	2017	2018	2019
Engery consumption in l/tkm or kWh/tkm	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
WTW energy factor in MJ/l or MJ/kWh	9,15425			37,7		
Choose energy factor for (dropdown):	Electricity by individual mix**			Petrol		

Calculation of greenhouse gas-emissions in kgCO2e/tkm

	2012	2013	2014	2017	2018	2019
Engery consumption in l/tkm or kWh/tkm	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
WTW emission factor in kgCO2e/l or /kWh	0,386			2,88		
Choose emission factor for (dropdown):	Electricity by individual mix**			Petrol		

Economics Part (Total-Cost-of-Ownership)

General Parameters	Diesel	E-Truck
Acqusition costs vehicle		
Useful life vehicle (years)		
Calculatory interest rate in % p.a.		
Battery capacity in kWh		
Battery costs (in l/kWh)		
Acquisition charging infratsructure		
Useful life charging infrastructure (years		

Fixed Costs	Diesel			E-Truck		
Year	2012	2013	2014	2017	2018	2019
Capital costs						
Vehicle	- l	- l	- l	- l	- l	- l
Charging infrastructure	- l	- l	- l	- l	- l	- l
Depreciation						
Vehicle	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Charging infrastructure	- l	- l	- l	#DIV/0!	#DIV/0!	#DIV/0!
Taxes	- l	- l	- l	- l	- l	- l
Insurance						
Yearly inspection						
Charging infrastructure	- l	- l	- l	- l	- l	- l
Maintenance of infrastructure						
Maintenance of Vehicle						
Inidividual position #1						
Inidividual position #2						
Inidividual position #3						

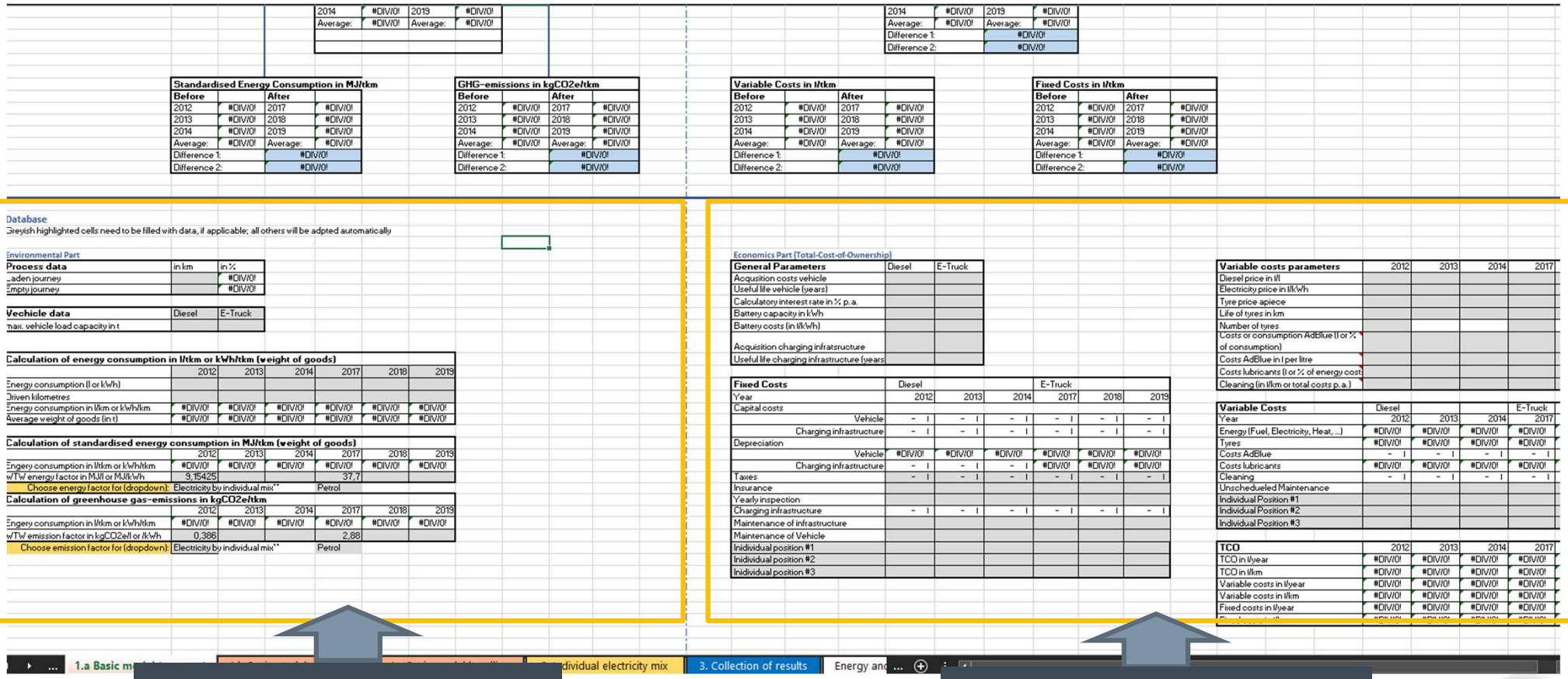
Variable costs parameters	2012	2013	2014	2017
Diesel price in l/l				
Electricity price in l/kWh				
Tyre price apiece				
Life of tyres in km				
Number of tyres				
Costs or consumption AdBlue (l or % of consumption)				
Costs AdBlue in l per litre				
Costs lubricants (l or % of energy cost				
Cleaning (in l/km or total costs p. a.)				

Variable Costs	Diesel			E-Truck
Year	2012	2013	2014	2017
Energy (Fuel, Electricity, Heat, ...)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Tyres	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Costs AdBlue	- l	- l	- l	- l
Costs lubricants	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Cleaning	- l	- l	- l	- l
Unschedueled Maintenance				
Individual Position #1				
Individual Position #2				
Individual Position #3				

TCO	2012	2013	2014	2017
TCO in l/year	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
TCO in l/km	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Variable costs in l/year	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Variable costs in l/km	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Fixed costs in l/year	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Fixed costs in l/km	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

... | 1.a Basic model transport | 1.b Basic model warehouse | 1.c Basic model handling | 2. Individual electricity mix | 3. Collection of results | Energy and ...

THE SCOREBOARD



2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!

2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!
Difference 1:		#DIV/0!	
Difference 2:		#DIV/0!	

Standardised Energy Consumption in MJ/tkm

Before		After	
2012	#DIV/0!	2017	#DIV/0!
2013	#DIV/0!	2018	#DIV/0!
2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!
Difference 1:		#DIV/0!	
Difference 2:		#DIV/0!	

GHG-emissions in kgCO2e/tkm

Before		After	
2012	#DIV/0!	2017	#DIV/0!
2013	#DIV/0!	2018	#DIV/0!
2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!
Difference 1:		#DIV/0!	
Difference 2:		#DIV/0!	

Variable Costs in l/tkm

Before		After	
2012	#DIV/0!	2017	#DIV/0!
2013	#DIV/0!	2018	#DIV/0!
2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!
Difference 1:		#DIV/0!	
Difference 2:		#DIV/0!	

Fixed Costs in l/tkm

Before		After	
2012	#DIV/0!	2017	#DIV/0!
2013	#DIV/0!	2018	#DIV/0!
2014	#DIV/0!	2019	#DIV/0!
Average:	#DIV/0!	Average:	#DIV/0!
Difference 1:		#DIV/0!	
Difference 2:		#DIV/0!	

Database

Greyish highlighted cells need to be filled with data, if applicable; all others will be adpted automatically

Environmental Part

Process data	in km	in %
Laden journey		#DIV/0!
Empty journey		#DIV/0!

Vechicle data	Diesel	E-Truck
max. vehicle load capacity in t		

Calculation of energy consumption in l/tkm or kWh/tkm (weight of goods)

	2012	2013	2014	2017	2018	2019
Energy consumption (l or kWh)						
Driven kilometres						
Energy consumption in l/tkm or kWh/tkm	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Average weight of goods (in t)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Calculation of standardised energy consumption in MJ/tkm (weight of goods)

	2012	2013	2014	2017	2018	2019
Engery consumption in l/tkm or kWh/tkm	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
wTW energy factor in MJ/l or MJ/kWh	9,15425			37,7		
Choose energy factor for (dropdown):	Electricity by individual mix**			Petrol		

Calculation of greenhouse gas-emissions in kgCO2e/tkm

	2012	2013	2014	2017	2018	2019
Engery consumption in l/tkm or kWh/tkm	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
wTW emission factor in kgCO2e/l or /kWh	0,386			2,88		
Choose emission factor for (dropdown):	Electricity by individual mix**			Petrol		

Economics Part (Total-Cost-of-Ownership)

General Parameters	Diesel	E-Truck
Acqusition costs vehicle		
Useful life vehicle (years)		
Calculatory interest rate in % p.a.		
Battery capacity in kWh		
Battery costs (in l/kWh)		
Acquisition charging infratsructure		
Useful life charging infrastructure (years		

Fixed Costs	Diesel			E-Truck		
Year	2012	2013	2014	2017	2018	2019
Capital costs						
Vehicle	- l	- l	- l	- l	- l	- l
Charging infrastructure	- l	- l	- l	- l	- l	- l
Depreciation						
Vehicle	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Charging infrastructure	- l	- l	- l	#DIV/0!	#DIV/0!	#DIV/0!
Taxes	- l	- l	- l	- l	- l	- l
Insurance						
Yearly inspection						
Charging infrastructure	- l	- l	- l	- l	- l	- l
Maintenance of infrastructure						
Maintenance of Vehicle						
Inidividual position #1						
Inidividual position #2						
Inidividual position #3						

Variable costs parameters	2012	2013	2014	2017
Diesel price in l/l				
Electricity price in l/kWh				
Tyre price apiece				
Life of tyres in km				
Number of tyres				
Costs or consumption AdBlue (l or % of consumption)				
Costs AdBlue in l per litre				
Costs lubricants (l or % of energy cost				
Cleaning (in l/km or total costs p.a.)				

Variable Costs	Diesel			E-Truck
Year	2012	2013	2014	2017
Energy (Fuel, Electricity, Heat, ...)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Tyres	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Costs AdBlue	- l	- l	- l	- l
Costs lubricants	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Cleaning	- l	- l	- l	- l
Unschedueled Maintenance				
Individual Position #1				
Individual Position #2				
Individual Position #3				

TCO	2012	2013	2014	2017
TCO in l/year	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
TCO in l/km	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Variable costs in l/year	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Variable costs in l/km	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Fixed costs in l/year	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

1.a Basic m... | ...dividual electricity mix | 3. Collection of results | Energy and ...

Calculate ecological impact by filling out grey fields

Calculate Economical impact by filling out grey fields

THE SCOREBOARD

Please insert values in greyish highlighted cells:

	Proportion of energy source on electricity mix in %		
Nuclear power	0,9%		
Coal	22,6%		
Natural gas	22,1%		
Renewables	52,9%		
Oil and other fossil fuels	1,5%	Sum:	100,0%
Individual energy factor	9,154 MJ/kWh		
Individual emission factor	0,386 kgCO2e/kWh		

Calculation with:

	Energy factor WTW (MJ/kWh)	Emission factor WTW (gCO2e/kWh)
Nuclear power	11,7	28
Coal	9,95	1070
Natural gas	7,8	454
Renewables	9,3	55,57
Oil and other fossil fuels	10,45	976,5

Source: BMVI 2014 - Berechnung des Energieverbrauchs und der Treibhausgasemissionen des ÖPNV; p. 30ff.

... | 1.a Basic model transport | 1.b Basic model warehouse | 1.c Basic model handling | 2. Individual electricity mix | 3. Colle

Adjust energy mix in order to adjust emission factor

THE SCOREBOARD

Possible Decision Criteria:

"The solution with the biggest reduction of GHG-emissions compared to the current technology in absolute numbers will be chosen." --> Consult the green column

"The solution with the biggest reduction of GHG-emissions compared to the current technology in percent will be chosen." --> Consult the yellow column

"The cheapest solution that is still providing at least a minimal reduction of GHG-emissions will be chosen." --> Consult the blue column and check the other two to see if there is a reduction

Solution	Absolute reduction of GHG-emissions (GHG-emissions;Difference 1)	Relative reduction of GHG-emissions (GHG-emissions;Difference 2)	TCO/reference unit
Solution 1			
Solution 2			
Solution 3			
Solution 4			
Solution 5			
Solution 6			
Solution 7			
Solution 8			
Solution 9			
Solution 10			

... 1.a Basic model transport | 1.b Basic model warehouse | 1.c Basic model handling | 2. Individual electricity mix | 3. Collection of results | Energy and ...

Collect results here and sort by preferred decision factor