ITEC – Carbon footprint calculator for intermodal terminals

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ITEC – Partners and their roles

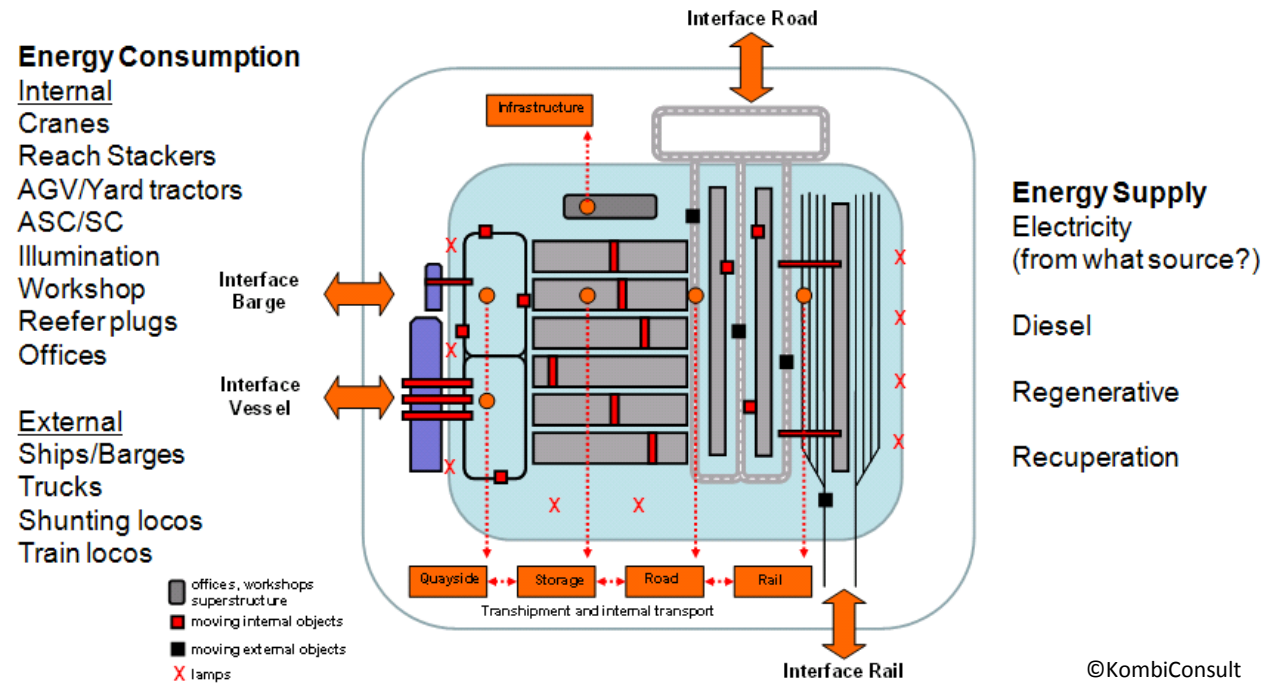
Partner		Particular knowledge in				
		Terminal processes	Terminal technologies	Information modelling	Software development	Environm. issues
HCN	**Core team:** ITEC development and ownership	✓	✓	✓	✓	
KC		✓	✓	✓		
PE				✓	✓	✓
IBI	**Application team:** Data collection Validation Demonstration	✓	✓			
JER		✓	✓			
ADRIA		✓	✓			
IFB		✓	✓			
UIRR		✓	✓			✓

Main idea: **I**ntermodal **T**erminal **E**co-Efficiency **C**alculator (ITEC)

- To enable terminal operators to accurately calculate their current GHG performance;
- To identify where terminal “hot spots” are with regard to energy consumption and GHG emission
- To determine what impacts different measures in the context of a terminal have, either in an ex ante (scenario) or ex post (monitoring) perspective.

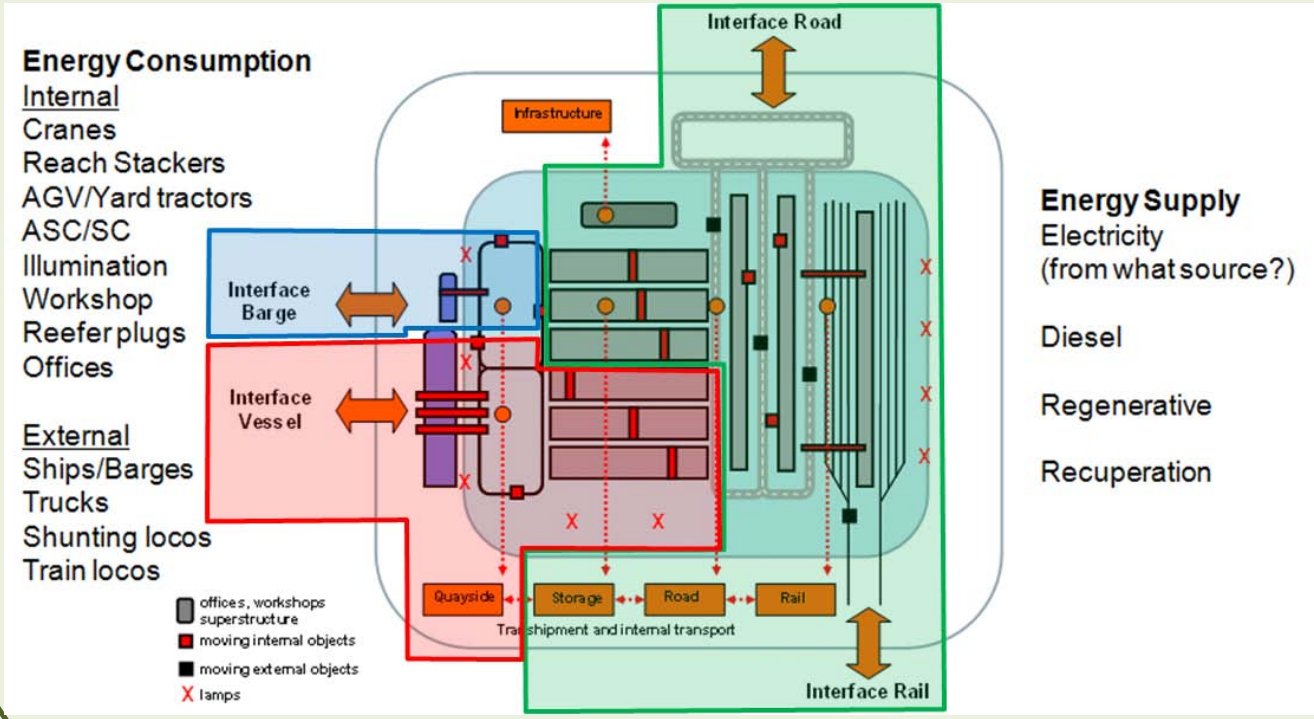
ITEC – Functional specification

- ITEC refers to the terminal as <u>functional entity</u>
  - considering all energy/GHG relevant processes and facilities,
  - regardless the recipients of the energy bills.



ITEC – Development phases

Model/tool development focusses on rail-road transhipment and associated terminal components/services (→demonstration cases)



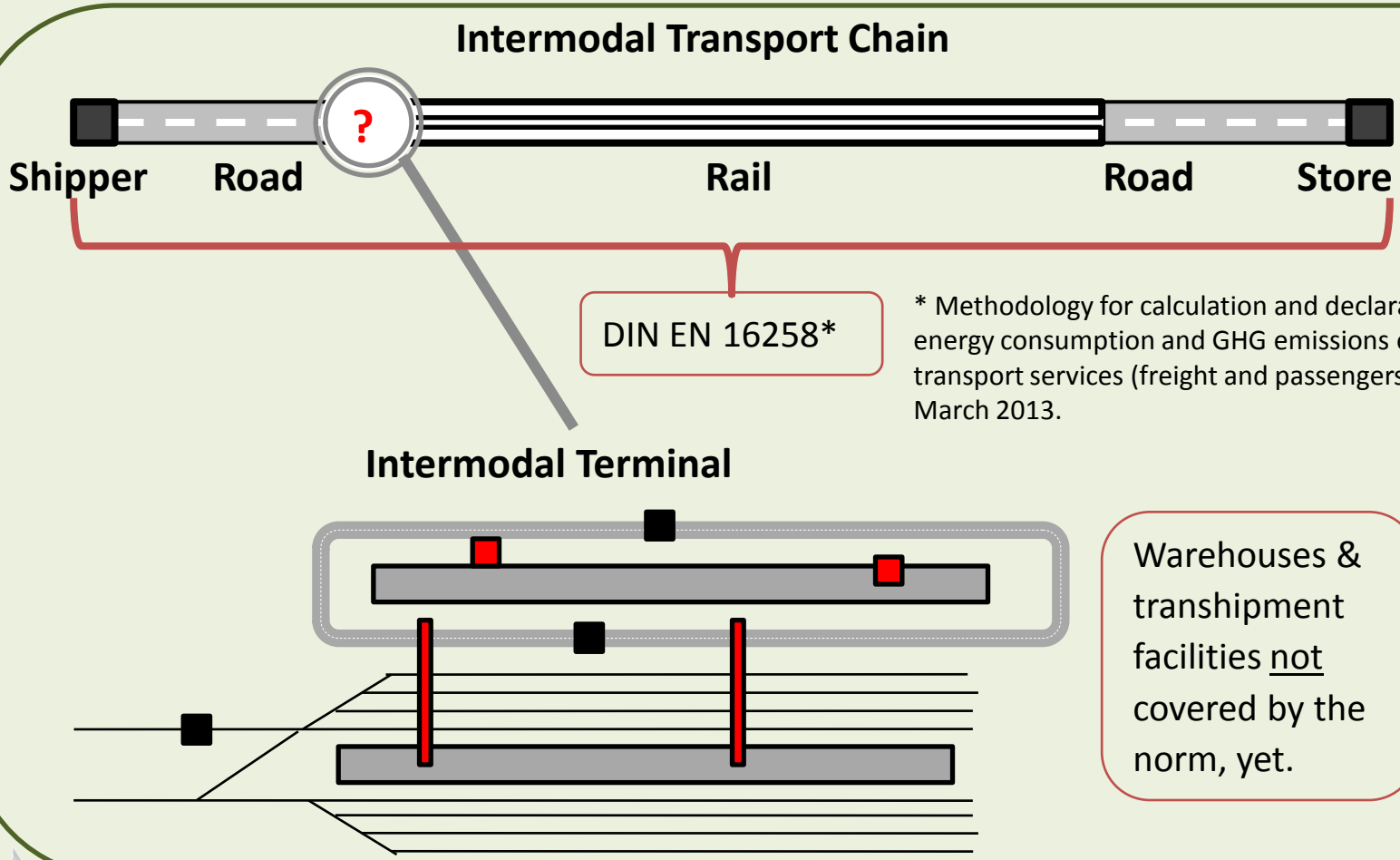
1st development phase (demonstration)

2nd development phase (optional)

3rd development phase (new project)

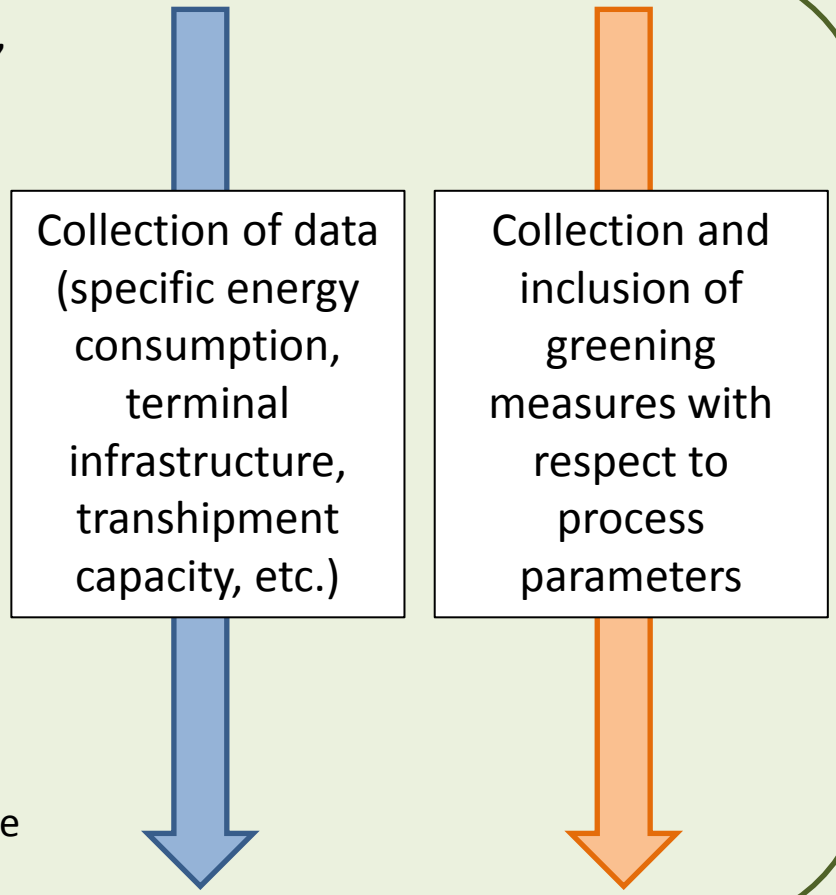
→ Modular program structure required!

ITEC – Position within the intermodal transport chain



ITEC – Methodical approach

1. Capture of actual terminal processes, as far as relevant for energy/GHG calculation
2. "Translation" into model processes
   - Considering interdependencies between infrastructure, operation and technique
   - Defining main parameters of energy consumption/GHG emission
3. Transfer of model processes into a calculation tool
   - Basis: GaBi software of PE (adapting existing, proven software)
   - Including relevant standards, life-cycle approach, comparison of scenarios



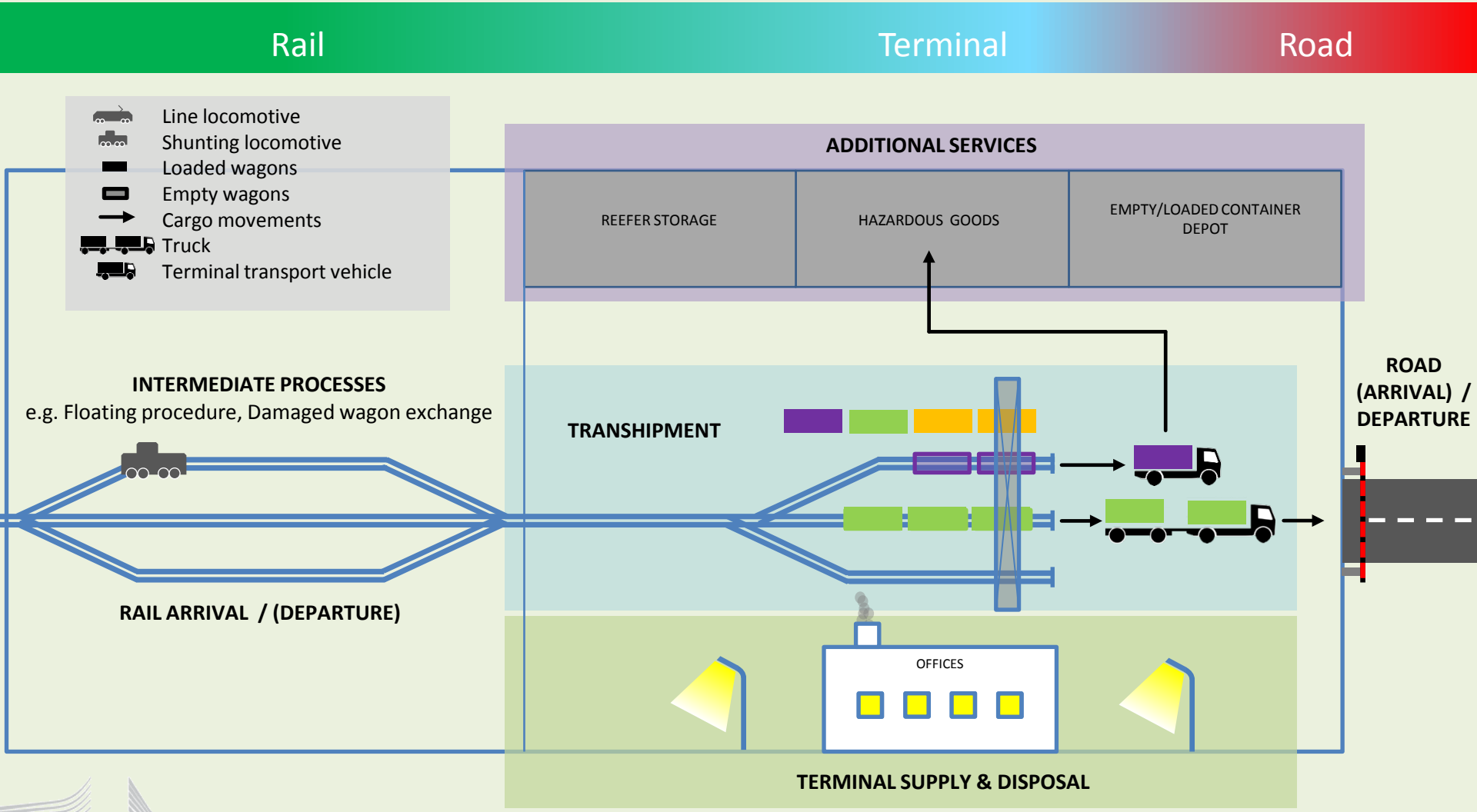
ITEC – Main Process Groups (MPG)

Main process group		Terminal processes included	Basic terminal activities	Advanced terminal services	Total terminal operation
1	Arrival	Movements rail/road/barge from terminal boundary → transhipment area			
2	Transhipment	Transhipment of loading units, incl. intermediate storage			
3	Intermediate operation	Rail: - Change of transhipment track occupation (standing/floating procedure), - Damaged wagon exchange, - Wagon group transition			
4	Departure	Movements rail/road/barge from transhipment area → terminal boundary			
5	Additional services	Empty/loaded container depot, reefer storage, hazardous LU storage, internal truck transfer			
6	Terminal supply/ disposal	Offices, suprastructure (other than transhipment facilities), illumination etc.			

Break down into single process steps and assign

- Energy consumers with specific consumption
- Operational effort, process step duration
- Relevant volume, process frequency

ITEC – Captured processes



ITEC - Model implementation in GaBi

GaBi is the most widely used product sustainability solution on the planet

- Helps businesses achieve **optimal product sustainabilty performance:**
  - Environmental
  - Social
  - Economic
- GaBi is a modelling, reporting & diagnostic software tool that drives product sustainability performance during design, planning and production.
- Powerful LCA tools and databases for product and process sustainability

GaBi Software — Product Sustainability Performance

ITEC – Application (1)
Status: November 2014

- April 2014: Roll-out of ITEC prototype ready to use.
- May 2014: First application of ITEC prototype (use case: Stockholm Arsta)
- 26.05.2014: Presentation of results on the occasion of official opening of the new Stockholm Arsta terminal and to AGORA group
- September 2014: Neuss application finalised,
- October 2014: Bologna application finalised
- November 2014: Antwerp Combinant application finalised, Ljubljana and Antwerp Zomerweg ongoing

ITEC – Application (2)
Input mask (example: rail arrival parameters)

Start calculation manually

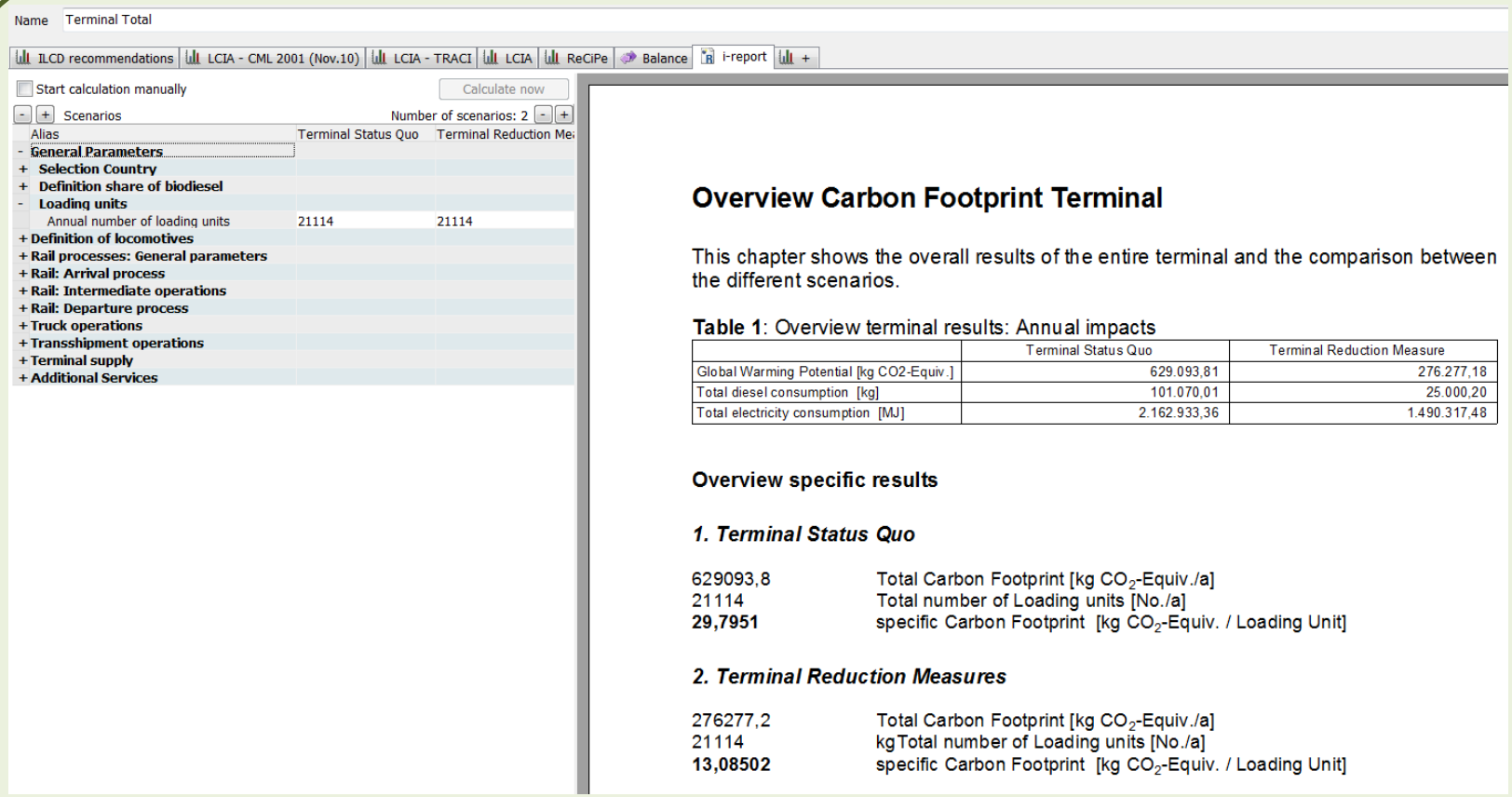
Scenarios

Alias	Terminal Status Quo	Terminal Reduction Me	Comment, units, defaults
+ **General Parameters**			
+ **Definition of locomotives**			
+ **Rail processes: General parameters**			
- **Rail: Arrival process**			
- **Operating schedule 1**			
- **Line engine movement operation schedule 1**			
Distance to parking position 1	0,49	0,49	[km] distance of line loc from transshipment track to parking position
Idle time line engine 1	0,25	0,25	[h] time line engine is running in idle mode
- **Selection of engine types for line engine operating**			
Select line engine type 1	2	2	1 = diesel-locomotive; 2 = E-Locomotive
If type = 1: Annual number of diesel locomotives type 1	0	0	Number of movements with diesel line engine 1 for operation schedule 1
If type = 2: Annual number of electric locomotives type	572	572	Number of movements with electric line engine 1 for operation schedule 1
Select line engine type 2	2	2	1 = diesel-locomotive; 2 = E-Locomotive
If type = 1: Annual number of diesel locomotives type 2	0	0	Number of movements with diesel line engine 2 for operation schedule 1
If type = 2: Annual number of electric locomotives type	0	0	Number of movements with electric line engine 2 for operation schedule 1
Select line engine type 3	2	2	1 = diesel-locomotive; 2 = E-Locomotive
If type = 1: Annual number of diesel locomotives type 3	0	0	Number of movements with diesel line engine 3 for operation schedule 1
If type = 2: Annual number of electric locomotives type	0	0	Number of movements with electric line engine 3 for operation schedule 1
- **Shunting operation schedule 1**			
Distance of shunting engine approaching 1	1	1	[km] Distance for shunting engine between parking position and entrance tracks
Total idle time during shunting operation 1	0,333	0,333	[h] Average idle time during shunting operation
Total shunting distance 1	2	2	[km] Total shunting distance (i.e. between entrance track & transshipment track)
- **Selection of engine types for operating schedule**			
Select engine type 1	1	1	1 = diesel-locomotive; 2 = E-Locomotive
If type = 1: Annual number of diesel locomotives type	572	572	Number of shunting proccesses with diesel engine type 1 for operation schedule 1
If type = 2: Annual number of electric locomotives type	0	0	Number of shunting proccesses with electric type 1 engine for operation schedule 1
Select engine type 2	1	1	1 = diesel-locomotive; 2 = E-Locomotive
If type = 1: Annual number of diesel locomotives type	0	0	Number of shunting proccesses with diesel engine type 2 for operation schedule 1
If type = 2: Annual number of electric locomotives type	0	0	Number of shunting proccesses with electric type 2 engine for operation schedule 1
Select engine type 3	1	1	1 = diesel-locomotive; 2 = E-Locomotive
If type = 1: Annual number of diesel locomotives type	0	0	Number of shunting proccesses with diesel engine type 3 for operation schedule 1
If type = 2: Annual number of electric locomotives type	0	0	Number of shunting proccesses with electric type 3 engine for operation schedule 1
+ **Operating schedule 2**			
+ **Operating schedule 3**			
+ **Operating schedule 4**			
+ **Rail: Intermediate operations**			
+ **Rail: Departure process**			
+ **Truck operations**			
+ **Transshipment operations**			
+ **Terminal supply**			
+ **Additional Services**			

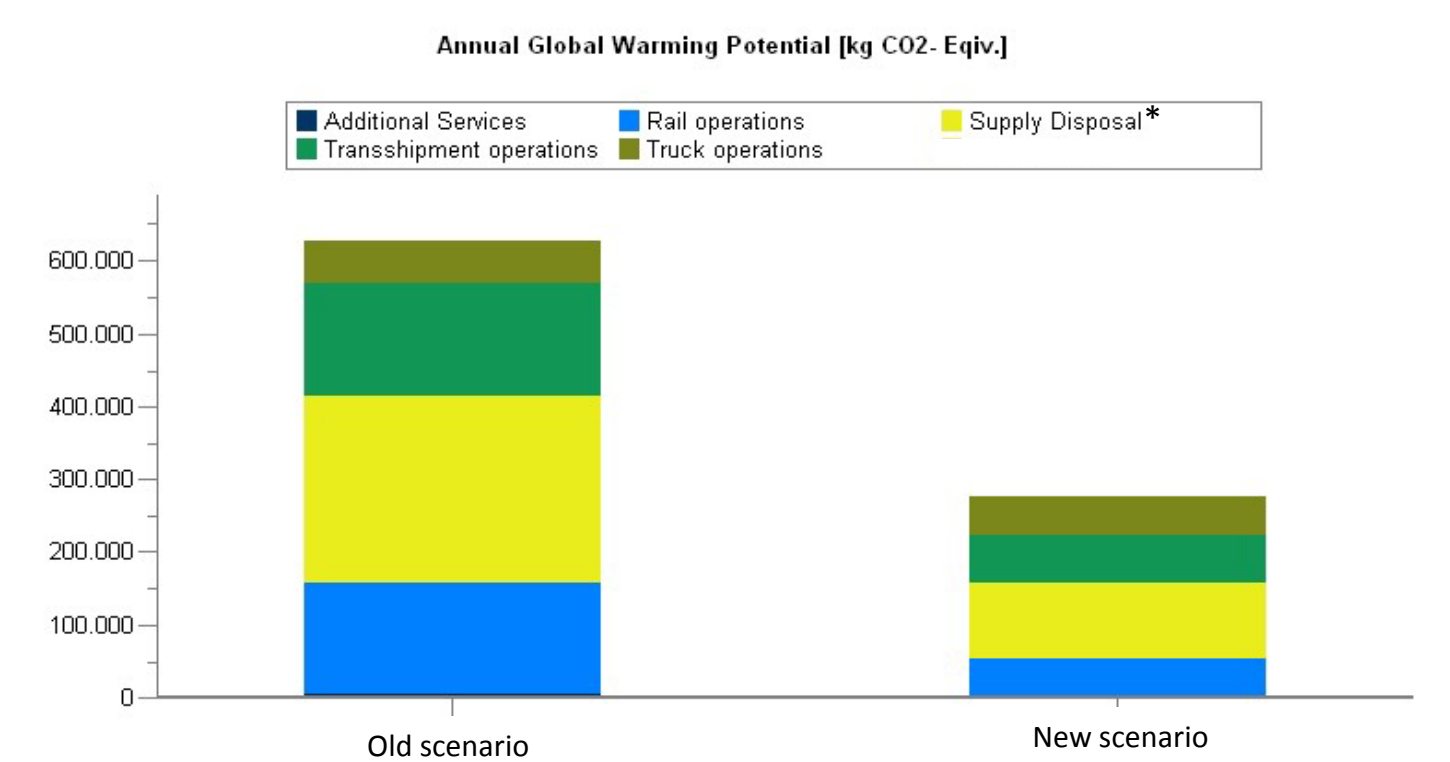
ITEC – Application (3)
Results – The i-report

- The report is generated automatically,
- Changes of results corresponding to modified data input is displayed ad hoc (desktop version),
- The report consists of tables, graphic presentations and connecting text. Thus, it can be provided to the customer without any further processing. It is a real standard product itself.
- The report is available in pdf and in Word (rtf) format. The latter allows for e.g. integrating the i-report into an overall document, if required,
- Results are displayed on different aggregation levels. This enables detailed identification of “hot spots” and of contributions of single greening measures.

ITEC – Application (4)
Results – Example: Overall carbon footprint



ITEC – Application (5)
Results – Example: Carbon footprint overview



→Reduction of carbon footprint for the entire terminal is 56%

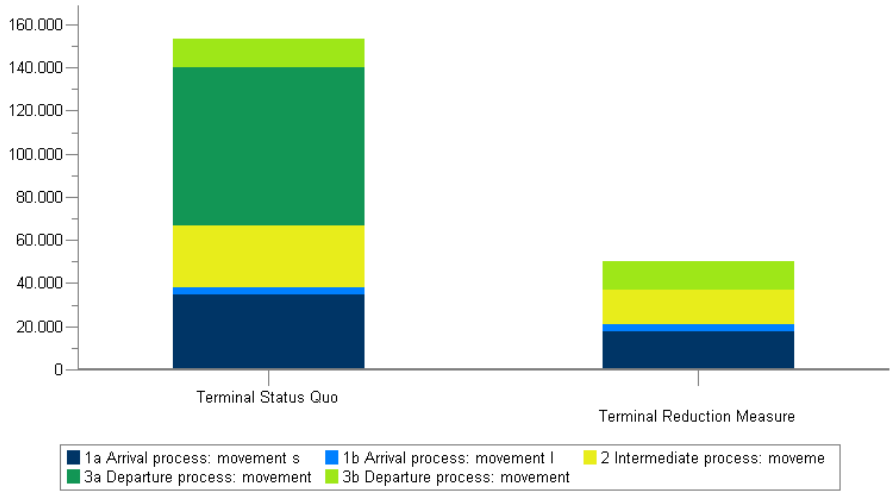
* Illumination, office electricity, heating of the office building and switch heating

ITEC – Application (6)
Results – Example: Rail operation

Table 3: Global Warming Potential [kg CO2eq] of the different rail process groups

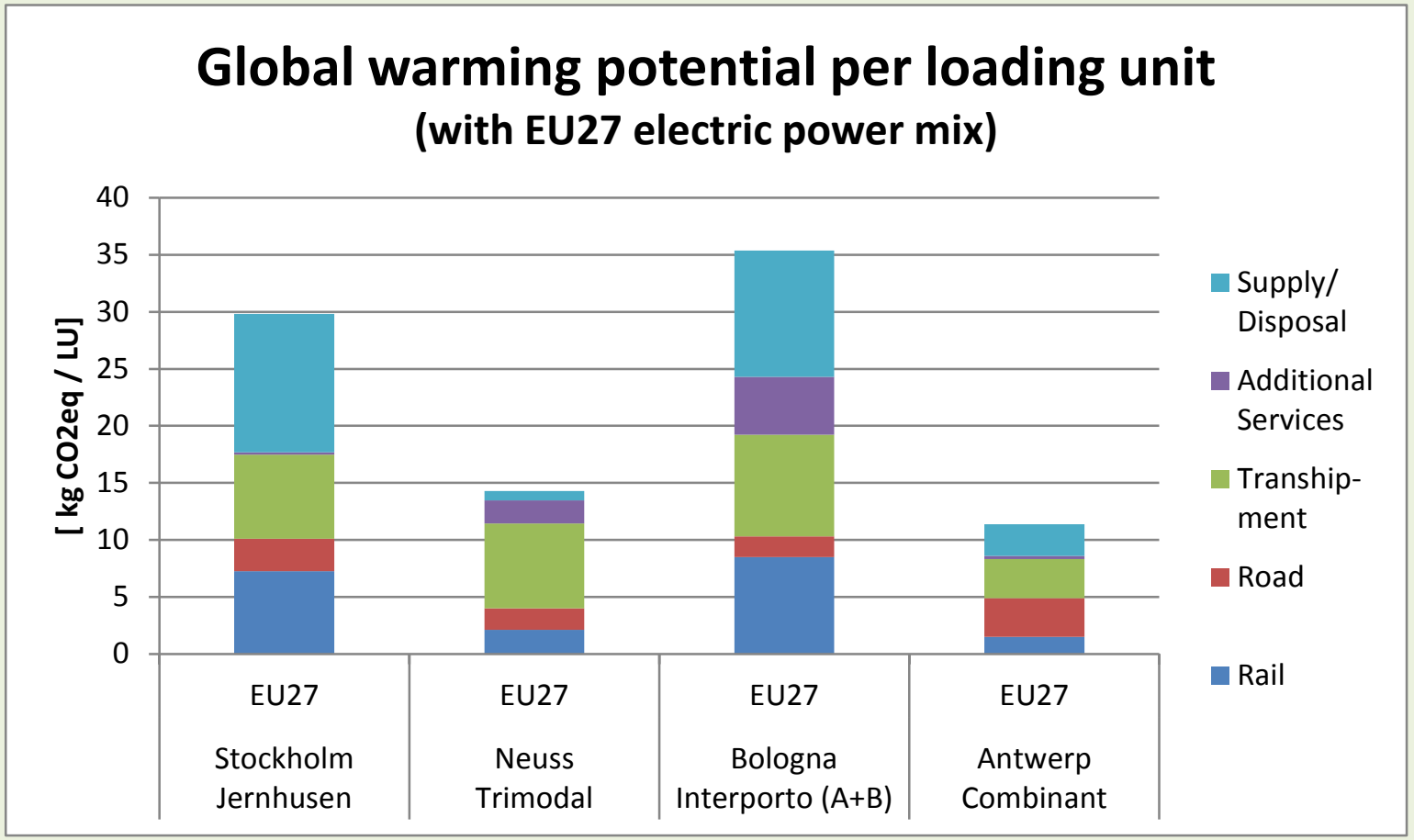
	Terminal Status Quo	Terminal Reduction Measure
1 Arrival: Movement of line locomotive: operating schedule 1	2.188,34	2.188,34
1 Arrival: Movement of line locomotive: operating schedule 2	994,70	994,70
1 Arrival: Shunting of operating schedule 1	21.890,32	12.180,76
1 Arrival: Shunting of operating schedule 2	12.974,81	5.536,71
2 Intermediate operation schedule 1	6.203,52	3.101,76
2 Intermediate operation schedule 2	22.332,68	12.919,26
3 Departure: Movement of line locomotive: operating schedule 1	8.976,67	8.976,67
3 Departure: Movement of line locomotive: operating schedule 2	4.080,31	4.080,31
3 Departure: Shunting of operating schedule 1	47.220,09	
3 Departure: Shunting of operating schedule 2	26.428,54	

Figure 1: Global Warming Potential [kg CO_{2eq}]: Contribution analysis rail processes



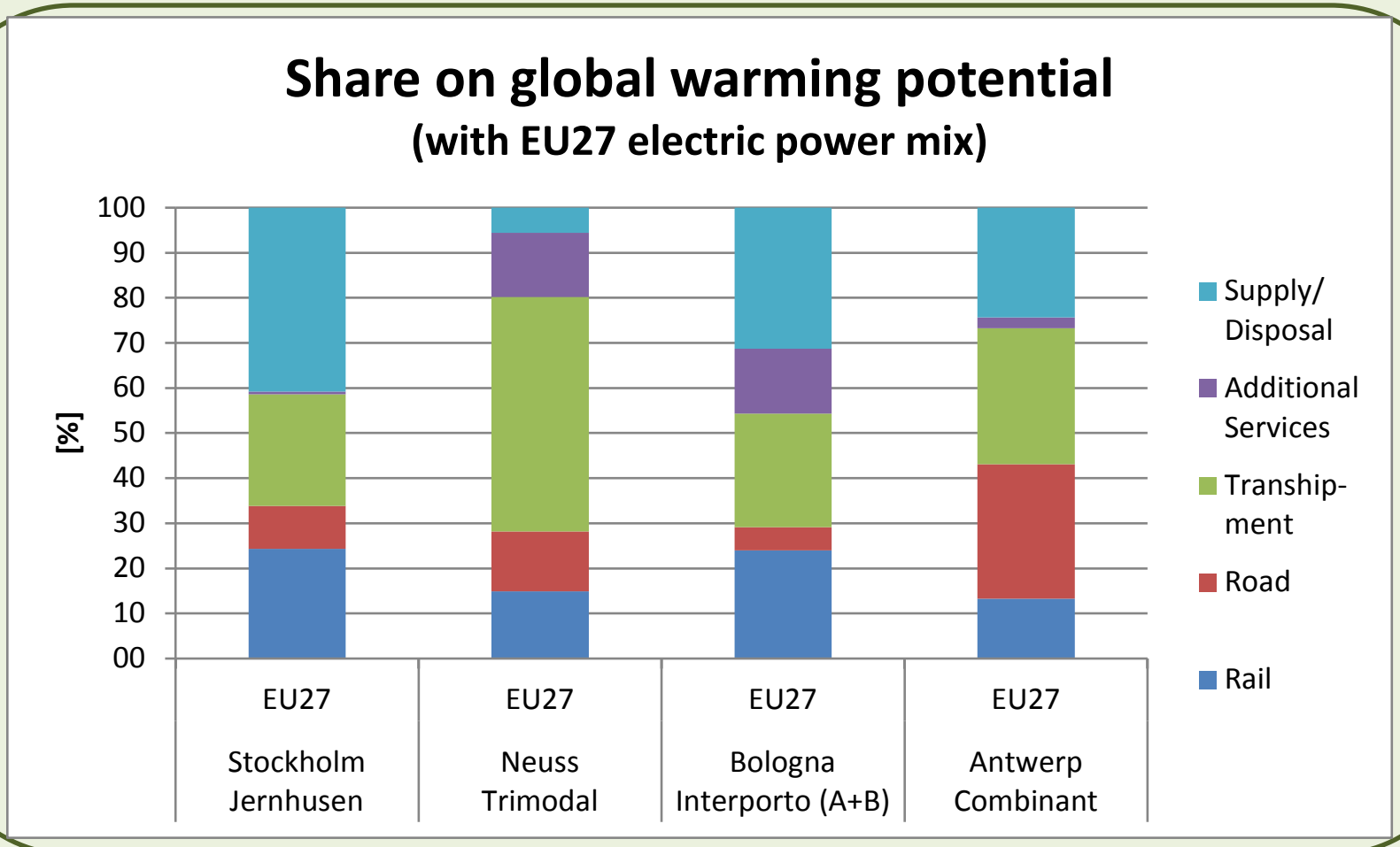
ITEC – Application (7)

Carbon footprint of demonstration terminals
Status Quo scenario (without greening measures)



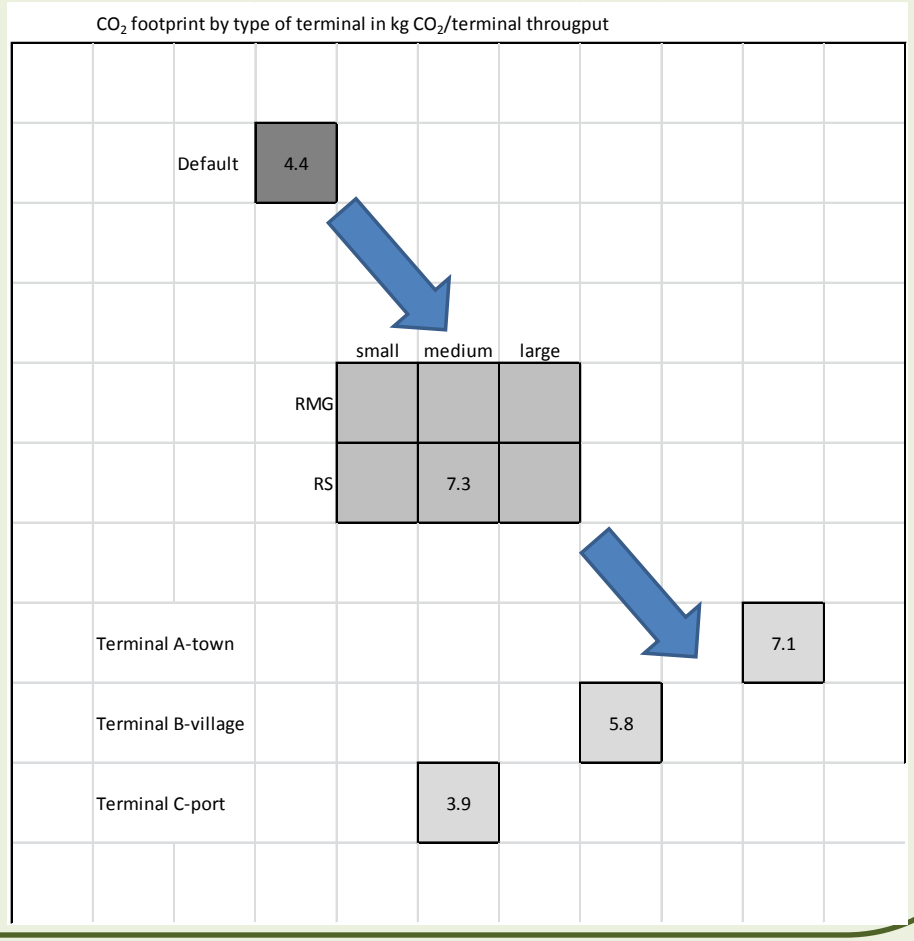
ITEC – Application (8)

Carbon footprint of demonstration terminals
Status Quo scenario (without greening measures)



ITEC – Providing of results

- Procedure to achieve results within EcoHubs lifetime:
- 2 x 3 basic matrix of “virtual”, typical rail/road terminals, calculated with ITEC
- Provide this basic matrix as input to other EcoHubs work packages and for free use (e.g. for EcoTransIt).
- Successive expansion of the basic matrix calculation of additional “real” terminals.



ITEC – Main advantages for users (1)

- Very detailed capturing of all energy relevant processes possible (800 ITEC parameters might be modified on demand);
- Single “greening” measures can be implemented (e.g. replacement of transhipment facilities, modified rail/road infrastructure, new road check-in or wagon repair procedure);
- Not only total carbon footprint/”greening” effect, but detailed results:
  - → Identification of “hot spots” (e.g. by processes or mode);
  - → Explanation of different specific energy consumptions of terminals;
  - → Valuation of greening impact of (single) measures or measure bundles;

  allowing
  - Adequate allocation of investments in greening measures,
  - Conclusions on optimisation on rail/road operation in the terminal.

ITEC – Main advantages for users (2)

- In case of missing terminal specific parameters, experience figures and model calculations are available → Missing terminal specific data does not prevent ITEC applicability;
- ITEC can be used ad hoc (no data interfaces needed, no requirements concerning dedicated IT terminal systems or data exchange formats);
- Standardised template for data gathering (energy consumers and their specific consumption);
- Operational procedures can be clarified with terminal operator via video/telephone conference, using standardised check-list (ca. 2 h);
- Desktop and web application available;
- Consideration of (country/terminal) specific energy mix;

ITEC – Main advantages for users (3)

- Result documentation (Word/PDF) automatically generated;
- Visualisation of parameter modifications (scenarios) on the spot;
- Functional terminal approach closes the knowledge gap to line oriented CO_2 calculators and standards (e.g. CEN 16258);
- Use of proven GaBi software in line with standards (e.g. CEN 16258) and respective methodical basics
  - 1st priority: use of exact, measured data,
  - next priority: use of average data or analogy methods