

Ports Energy and Carbon Savings

Deliverable 1.6.1

Energy savings in ports

Report about the D 1.5.2 tool experimentation by ports

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1. Introduction

Energy saving options can be sorted out into different aspects:

- Lighting
- Heating and cooling
- Fuels (including ship-to-shore power yard equipment – RTG, yard tractors, reach stackers, container forklifts)
- Specific equipment (cranes, container reefers, etc.)

A single tool can hardly handle all those aspects while remaining user-friendly and not time-consuming.

Cerema tried to propose a simple and user-friendly tool, keeping in mind that this approach means that the results should be regarded as tendencies that should lead ports to explore different solutions of energy savings.

This deliverable aims mainly to test the use of the tool (D1.5.2) and the accuracy of the methodology (D1.5.3) on energy savings.

Therefore, the ports of Oostende, Hellevoetsluis, IJmond and Portsmouth have employed the concept method.

This report is the synthesis of these feedbacks.

2. Hellevoetsluis

2.1. Results of the experimentation

What kind of energy savings are possible in your port ?				
Lightings				
Switching for LEDs	0 kWh	#DIV/0! of energy savings on electricity		
Using controls and sensors	85654 kWh	18% of energy savings on electricity		
De-lamping and daylight	13595 kWh	3% of energy savings on electricity		
Heating and cooling				
Insulation				
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks	
52295	37243	6250	8802	
19% of energy savings on the heating and cooling bill				
Heating system				
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks	
33935	24034	5500	4401	
12% of energy savings on the heating bill				
Cooling system				
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks	
640	640	0	0	
1% of energy savings on the heating and cooling bill				
Control devices				
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks	
26772	18621	3750	4401	
10% of energy savings on the heating and cooling bill				
Fuels				
Reducing time in port	NS savings on fuel used by shipping operation in port			
On shore power supply	0% savings on fuel used by ship at berth*			
Eco-driving	NS savings on fuel used by the company's vehicles			
* Other energy is then used as replacement but it is less emitting and produced with more efficiency and potentially with a share of renewable energy				
NS : non significant, Synthesis can't reflect a global tendencie				
Specific equipment				
From hydraulic to electric spreader	0% energy savings on energy used by spreaders			
From Diesel RTG to e-RTG	0% energy savings on energy used by RTG cranes			
From Diesel STS to e-STs	0% energy savings on energy used by STS cranes			
Installing a roof shade	0% energy savings on energy used by reefer conta			
Other considerations				
Potential for a district heating between industries:	no			
Potential for a district cooling between industries:	no			

TABLEAU 1: ENERGY SAVINGS FOR HELLEVOETSLUIS

2.2. Difficulties and remarks

Hellevoetsluis	
Way of using the tool	The tool was used 4 times. The port is divided in 4 areas and the tool was used in each area.
Strengths	easy to use
Weaknesses and difficulties	Problems to answer the questions on STS crane and RTG cranes. Overall energy consumption and not the consumption for lighting and heating separately is actually known.
Remarks	Some companies are also living in the harbour. How do we calculate this?

TABLEAU 2: HELLEVOETSLUIS, SYNTHESIS OF DIFFICULTIES AND REMARKS

2.3. Partial conclusion for this port

Even if this tool is simple to use, collecting the data is the major difficulty.

Dividing the ports in physical areas or administrative areas could be interesting, because some data are more easily available for some areas. Thus, the addition of energy savings of these areas show a more accurate picture of the energy savings for the global port. This method has a limit with the no numeric data entries (for example, “have your employees been trained to eco-driving?”) that should be analysed area by area: it is more accurate, but the global vision for the whole port is lost.

Met opmerkingen [MAP1]: Parce que manque de temps, pas de connaissance, pas de dialogue entre les compagnies qui sont hébergées dans le port ?

3. Ijmond

3.1. Results of the experimentation

What kind of energy savings are possible in your port ?			
Lightings			
Switching for LEDs	3391293 kWh	5% of energy savings on electricity	
Using controls and sensors	10348343 kWh	15% of energy savings on electricity	
De-lamping and daylight	1365938 kWh	2% of energy savings on electricity	
Heating and cooling			
Insulation			
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks
15533122	2174818	13358304	0
28% of energy savings on the heating and cooling bill			
Heating system			
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks
2249818	2174818	75000	0
4% of energy savings on the heating bill			
Cooling system			
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks
11100670	0	11100670	0
20% of energy savings on the heating and cooling bill			
Control devices			
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks
14430713	1087409	13343304	0
26% of energy savings on the heating and cooling bill			
Fuels			
Reducing time in port	0% savings on fuel used by shipping operation in port		
On shore power supply	95% savings on fuel used by ship at berth*		
Eco-driving	0% savings on fuel used by the company's vehicles		
* Other energy is then used as replacement but it is less emitting and produced with more efficiency and potentially with a share of renewable energy			
Specific equipment			
From hydraulic to electric spreader	#DIV/0!	energy savings on energy used by spreaders	
From Diesel RTG to e-RTG	0% energy savings on energy used by RTG cranes		
From Diesel STS to e-STs	0% energy savings on energy used by STS cranes		
Installing a roof shade	0% energy savings on energy used by reefer containers		
Other considerations			
Potential for a district heating between industries:	no		
Potential for a district cooling between industries:	no		

TABLEAU 3: ENERGY SAVINGS FOR IJMOND

3.2. Difficulties and remarks

Ijmond

Way of using the tool
Easy to use
Strengths
Quick results
Weaknesses and difficulties
Less accurate than the TNO tool (see further)
Remarks

TABLEAU 4: IJMOND, SYNTHESIS OF DIFFICULTIES AND REMARKS

3.3. To go further: energy savings at company level?

3.3.1. Determining the potential of energy savings at a company level: The TNO Tool

Ijmond has gone a step further in the determination of the energy savings options in their ports; by determining the potential of energy savings at the company level. For that, Ijmond used a tool developed by TNO, a Dutch knowledge institute.

The tool is a model that analyzes the potential for energy savings and local renewable energy production (solar PV) on a business park. Inputs for the model are publicly available data. Based on this data, and additional parameters formulated by TNO and ECN (another Dutch knowledge institute), the tool computes the results. TNO wrote a sort of script on Microsoft Access. All data is loaded into Access, and many queries have to be run, to calculate the outcome.

The so-called ‘potential scan’ from TNO is an energy audit tool that consists of multiple components. Firstly, TNO analyzed on a company level, then, TNO made an overview on a business park level. The results are split up into sustainable technology options and isolation techniques. TNO has delivered the results of the study in Dutch; therefore, the following example is a translation.

Company name XXXXXX

Current energy use

The estimated annual energy use of your property is:

- 308.000 kWh of electricity
- 30.000 m3 of gas

This is equal to 162 tons of CO2 emissions

Estimated annual energy use of your production process is:

- 2.239.000 kWh of electricity
- 175.000 m3 of gas

This is equal to 1106 tons of CO2

Your share of energy use compared to the business park is 8,5%

Sustainable technology options

LED

LED lamps are an energy efficient light source. In many cases this can be done in the existing fixture. The lifespan of LED lamps is longer than many other lamps, making the replacement less frequent.

Measure	Production/savings	Investment	Payback period	Environmental benefit (CO2)
LED	67.800 kWh	€10.500	1 years	24 tons

Solar PV

A solar panel or photovoltaic panel, shortly PV panel is a panel that converts solar energy into electricity. This means your roof is used for generating electricity.

Measure	Production/savings	Investment	Payback period	Environmental benefit (CO2)
PV	302.000 kWh	€371.000	9 years	107

Heat pump

A heat pump is a renewable heat source to replace a gas boiler. A heat pump uses heat from the soil, the outside air, ventilation air or groundwater for the heating of buildings.

Measure	Production/savings	Investment	Payback period	Environmental benefit (CO2)
Heat pump	8.900 m3	29.300	7 years	11 tons

Isolation options

Measure	Production/savings	Investment	Payback period	Environmental benefit (CO2)
Roof insulation	9.500 m3	€47.700	9 years	17 tons
Façade insulation	3.700 m3	€23.800	11 years	7 tons
Glazing	0 m3	€0	0 years	0 tons
Heat recovery installation	7.800 m3	€24.700	5 years	14 tons

Annual CO2 emissions after implementation of all measures: 1087 tons

TABLEAU 5 : EXAMPLE OF AN ANONYMIZED ANALYSIS ON COMPANY LEVEL

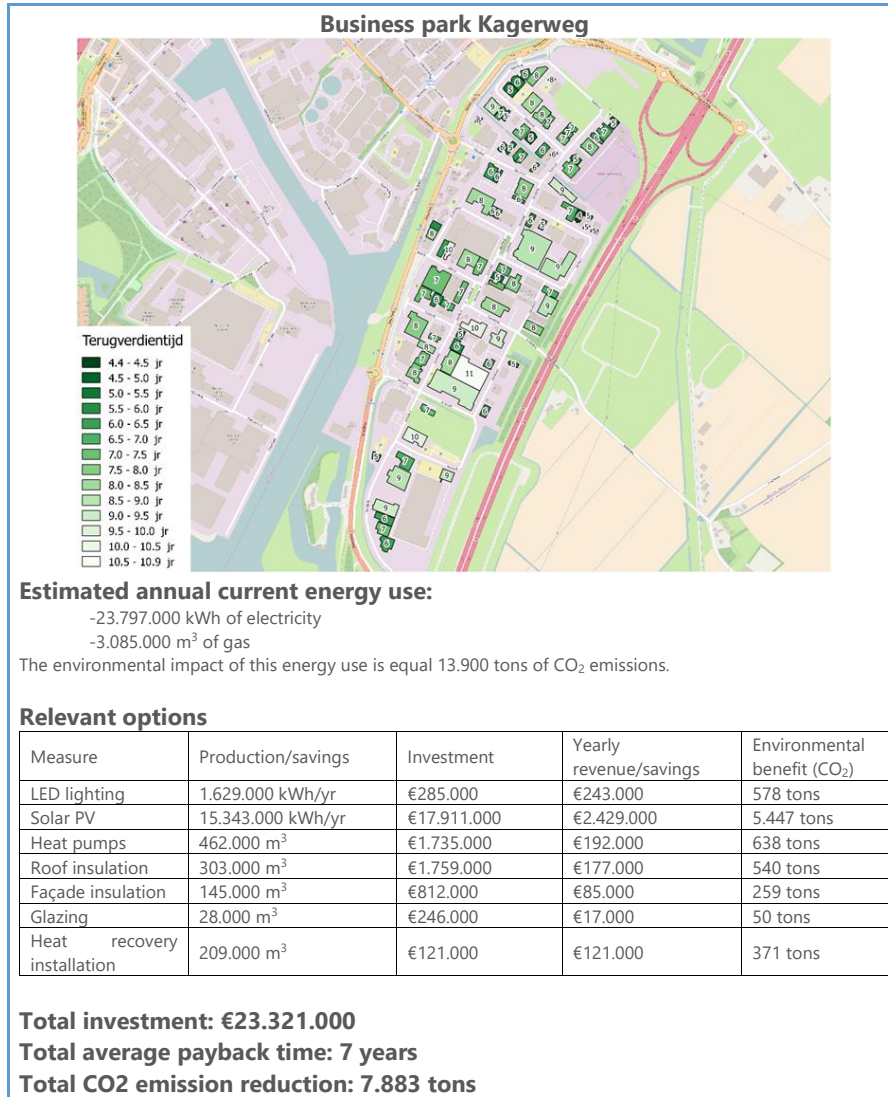


TABLEAU 6: EXAMPLE OF THE ANALYSIS ON BUSINESS PARK LEVEL

3.3.2. Main conclusion on the use of the TNO tool

The main conclusion we can draw about the TNO potential scan is as follows:

The tool is easy a cheap to use, because the entire model relies on publicly available data. The outcomes are straight forward and easily understood; therefore, this tool helps to make a rough estimate of the major energy saving options on the business park. In the Netherlands, the public data comes from the BAG (system that registers the

size and place of buildings), Chamber of Commerce (which identifies the type and location of the businesses), LISA (amount of employees), ECN (parameters to compute energy use). Thus, the accuracy of the model also depends on the data quality of these publicly available data sets. One of the weaknesses is therefore also accuracy. The model could be improved if the measured electricity use (from smart meter data) is implemented in the model. Also, a data source or tool that can estimate the dimensions of buildings better, would improve the outcome of the model.

	Positive	Negative
Internal	<p>Strengths</p> <ul style="list-style-type: none"> -Quick scan, so it is easy to execute -Cheap -Gives a clear overview of larger and smaller energy consumers -Provides insight in the costs and rate of return of different energy saving measures -Provides insight in possible solutions 	<p>Weaknesses</p> <ul style="list-style-type: none"> -Constructed at a distance (desk research) -Energy demand is a estimation, which means it could differentiate from the actual/real energy demand -Based only on averages/key figures
External	<p>Opportunities</p> <ul style="list-style-type: none"> - Easily scalable 	<p>Threats</p> <ul style="list-style-type: none"> - Entrepreneurs do not understand why the outcome of the scan differs from reality - Based on data that might only be available in the Netherlands

TABLEAU 7: IJMOND, SWOT OF THE POTENTIAL OF ENERGY SAVINGS AT A COMPANY LEVEL

Another drawback is the amount of time it takes to run the model. It is quite an intensive process now. This is because the model runs mainly in Microsoft Access, the process could be accelerated by making the EPS a little less intensive to run, for example by transforming it into a python based model.

3.4. Partial conclusion for this port

The tool is easy to use. The example of this port is quite relevant because it shows the main difference between the simplified tool and a more complex one. On the other hand, special attention must be paid to the quality and the availability of the data, both for the Netherlands and should the tool be used in other countries.

4. Oostende

4.1. Results of the experimentation

What kind of energy savings are possible in your port ?			
Lightings			
Switching for LEDs	58283 kWh	2% of energy savings on electricity	
Using controls and sensors	8537 kWh	0% of energy savings on electricity	
De-lamping and daylight	23475 kWh	1% of energy savings on electricity	
Heating and cooling			
Insulation			
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks
113358	10246	96950	6161
11% of energy savings on the heating and cooling bill			
Heating system			
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks
156352	8874	145425	2054
15% of energy savings on the heating bill			
Cooling system			
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks
686	686	0	0
0% of energy savings on the heating and cooling bill			
Control devices			
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks
66374	5123	58170	3081
6% of energy savings on the heating and cooling bill			
Fuels			
Reducing time in port	2% savings on fuel used by shipping operation in port		
On shore power supply	0% savings on fuel used by ship at berth*		
Eco-driving	10% savings on fuel used by the company's vehicles		
* Other energy is then used as replacement but it is less emitting and produced with more efficiency and potentially with a share of renewable energy			
Specific equipment			
From hydraulic to electric spreader	#DIV/0!	energy savings on energy used by spreaders	
From Diesel RTG to e-RTG	0% energy savings on energy used by RTG cranes		
From Diesel STS to e-STs	0% energy savings on energy used by STS cranes		
Installing a roof shade	0% energy savings on energy used by reefer containers		
Other considerations			
Potential for a district heating between industries:	no		
Potential for a district cooling between industries:	no		

TABLEAU 8: ENERGY SAVINGS FOR OOSTENDE

4.1. Difficulties and remarks

Oostende

Way of using the tool

Easy to use, the experimentation is on an 1 year period (2018) and the area is limited (blue area on the map below).

Strengths

Easy to use, results are clear

Weaknesses and difficulties

The port of Oostende has about 5 significant office buildings, 9 different warehouse buildings and multiple sanitary blocks. Some were built more than 50 years ago, some are brand new. Same for the heating installations inside. It is impossible to fill only one table for all that kind of building, and making a new document for every building seems like a lot of work and will scatter the results. Maybe different tabs for office, warehouse and sanitary blocks, with in each tab the provision for e.g. 10 buildings could be an improvement of the tool.

Remarks

TABLEAU 9: OOSTENDE, SYNTHESIS OF DIFFICULTIES AND REMARKS

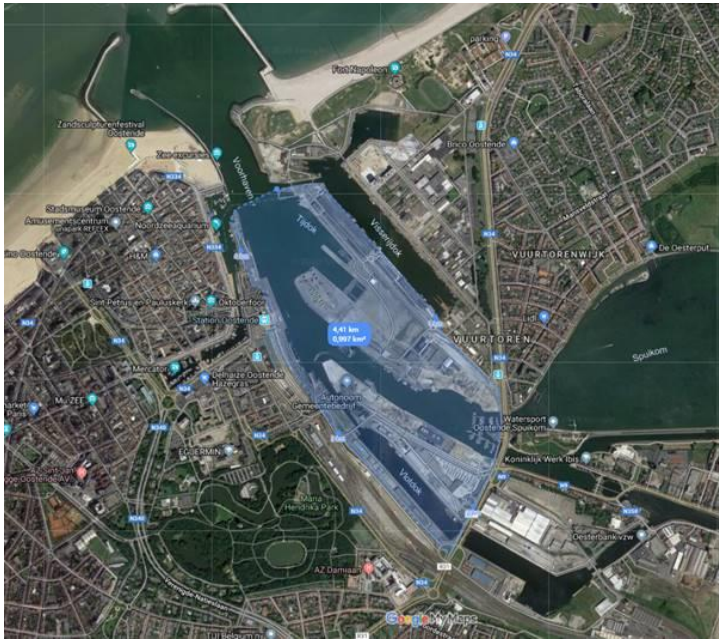


FIGURE 1: PORT OF OOSTENDE: AREA OF THE TOOL EXPERIMENTATION

4.1, Partial conclusion for this port

The main difficulty for Oostende was to use the tool that is deliberately simple with different kind of buildings, warehouses, built in different years, with different kind of installations without making a new document for each buildings. The potential way of improving the tools is to split some entry tables of the tool, which seems to be a point that increase the complexity of the tool.

Portsmouth

4.2. Results of the experimentation

What kind of energy savings are possible in your port ?				
Lightings				
Switching for LEDs	0 kWh	0% of energy savings on electricity		
Using controls and sensors	220686 kWh	8% of energy savings on electricity		
De-lamping and daylight	33402 kWh	1% of energy savings on electricity		
Heating and cooling				
Insulation				
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks	
2044561	334031	1674120	36410	
28% of energy savings on the heating and cooling bill				
Heating system				
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks	
0	0	0	0	
0% of energy savings on the heating bill				
Cooling system				
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks	
1407472	12372	1395100	0	
19% of energy savings on the heating and cooling bill				
Control devices				
TOTAL (kWh/yr)	Offices	warehouses	sanitary blocks	
1692325	0	1674120	18205	
23% of energy savings on the heating and cooling bill				
Fuels				
Reducing time in port	8% savings on fuel used by shipping operation in port			
On shore power supply	95% savings on fuel used by ship at berth*			
Eco-driving	10% savings on fuel used by the company's vehicles			
* Other energy is then used as replacement but it is less emitting and produced with more efficiency and potentially with a share of renewable energy				
Specific equipment				
From hydraulic to electric spreader	0% energy savings on energy used by spreaders			
From Diesel RTG to e-RTG	0% energy savings on energy used by RTG cranes			
From Diesel STS to e-STs	0% energy savings on energy used by STS cranes			
Installing a roof shade	12% energy savings on energy used by reefer containers			
Other considerations				
Potential for a district heating between industries:	no			
Potential for a district cooling between industries:	no			

TABLEAU 10: ENERGY SAVINGS FOR PORTSMOUTH

4.3. Difficulties and remarks

Portsmouth

Way of using the tool

No major difficulties to use the tool
Strengths
Weaknesses and difficulties
Remarks

TABLEAU 11: PORTSMOUTH: SYNTHESIS OF DIFFICULTIES AND REMARKS

4.1. Partial conclusion for this port

No particular comment were received concerning the use of the tool.

Met opmerkingen [MAP2]: Parce qu'ils ont un port tout simple ?

Met opmerkingen [MSD3R2]: Ask about Further explanation about "no remarks"

5. Energy savings

The table 12 below summarizes the potential of energy savings in each of the four ports:

Energy savings	Hellevoet.	Ijmond	Oostende	Porthmouth	
Lightings					
Switching for LEDs	0%	5%	2%	0%	of energy savings on electricity
Using controls and sensors	18%	15%	0%	8%	of energy savings on electricity
De-lamping and daylight	3%	2%	1%	1%	of energy savings on electricity
Heating and cooling					
Insulation	19%	28%	11%	28%	of energy savings on the heating and cooling bill
Heating system	12%	4%	15%	0%	of energy savings on the heating bill
Cooling system	1%	20%	0%	19%	of energy savings on the heating and cooling bill
Control devices	10%	26%	6%	23%	of energy savings on the heating and cooling bill
Fuels					
Reducing time in port	0-2%	0%	2%	8%	savings on fuel used by shipping operation in port
On shore power supply	0%	95%	0%	95%	savings on fuel used by ship at berth
Eco-driving	0-10%	0%	10%	10%	savings on fuel used by the company's vehicles
Specific equipment					
From hydraulic to electric sprea	0%	0%	0%	0%	energy savings on energy used by spreaders
From Diesel RTG to e-RTG	0%	0%	0%	0%	energy savings on energy used by RTG cranes
From Diesel STS to e-STs	0%	0%	0%	0%	energy savings on energy used by STS cranes
Installing a roof shade	0%	0%	0%	12%	energy savings on energy used by reefer containers
Other considerations					
Potential for a district heating :	no	no	no	no	
Potential for a district cooling :	no	no	no	no	

TABEAU 12 : POTENTIAL OF ENERGY SAVINGS IN PARTNER'S PORTS

The results of table 12 allow drawing the following conclusions:

- Ports are very diverse, also regarding their potential of energy savings.
- Insulation and control devices on heating and cooling seems to be a levy common to all ports to induce energy savings, even if the efficiency of this measure is not the same for all ports.

6. Avenues of improvement for the tool

6.1. Avenues to improve the tool

6.1.1. Cranes

Based on the expertise of Blue Power synergy, the use of electric cranes could lead to maintenance difficulties. Ports that do not explore this way of energy savings should not be regarded as the odd man!

Spreaders are largely used in loading and unloading somewhat everywhere in the ports and industry. Many types exist not just electric-grid or hydraulic-diesel but also hydraulic-electrical and electric-diesel.

Depending of the application and location different type of actuation is used. For fixed cranes with an own electricity supply mostly electric-grid connected spreaders are chosen to a certain extend. For mobile container forklifts, a hydraulic power take-off will be used. Often manufacturers use the same spreader structure equipped with an adapted type of actuator, going from manual for small size, hydraulic for mobile units or where electoral

cables are not applicable or for applications demanding high actuation forces, electrical or pneumatic.

To realise energy savings there is a need for modernisation and improvement of those tools, especially the choice of high-performance steel instead of simple construction steel is important to save weight and so to save energy. More and more manufacturers of spreaders propose high performance spreaders in modern materials for any which powering. For each powering improvements on structure, materials and design can grant valuable energy savings.

6.1.2. Lighting

In addition to the method, lighting computations (lumen), which are currently based on area, we could also include the number of lights per unit area. For instance, maybe only 2 lights would be sufficient on small offices but ports could be using 3 or 4.

6.1.3. Boilers

Boilers have efficiency ratings (<https://www.britishgas.co.uk/smarter-living/save-energy/green-deal/products-included-in-green-deal/a-rated-boilers.html>) and that information from ports could improve potential heat savings estimates.

6.2. Is it relevant to improve the tool?

The best way to use those remarks seems to be only by having a second look at the potential of energy savings of the ports after the use of the tool. Due to the evidence that, even if the tool is very user friendly and need no specific knowledge in energy savings, the access to the data is a major obstacle to fill the tool.

7. Conclusion

Experimentation of this tool has been done in four different ports of the project, allowing to estimate the possibility and the kind of energy savings.

In addition, the main feedback of this experimentation is the difficulty to have data or the difficulties to use the tool with different kind of data available in different areas of the ports.

This tool should be considered as a guide to determine which global type of energy savings is possible in a port and need further investigations. Indeed, increasing the accuracy of this tool should be approached with care because of the correlated rise of data collection that is the major barrier to a large diffusion of the tool.

The Current complexity level of the tool seems to be a rather good compromise between its ease of use and its accuracy.

Met opmerkingen [MAP4]: Proposer d'améliorer l'outil en intégrant ce paramètre éventuellement ?

Met opmerkingen [MAP5]: A-t-on des solutions / manières de contourner ce problème ?

Met opmerkingen [MSD6R5]: Which improvement should be done without too many problems about collecting data ?

Met opmerkingen [MAP7]: Peut-être donner quelques exemples pour étoffer ?
Exemple, IJmond et Portsmouth peuvent essayer de diminuer la consommation des bateaux à quai, Hellevoetsluis en installant des contrôles sur l'éclairage, Oostende en changeant son système de chauffage et tous en isolant les bâtiments ?

Egalement s'interroger sur qui est capable / autorisé à faire tous ses changements (le port, les compagnies qui louent (j'imagine) les bâtiments)

Met opmerkingen [MAP8]: Nuancer en expliquant que si on demande moins de données, alors l'outil sera de moindre qualité