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Green and Effective Operations at Terminals and in Ports

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GLOSSARY

| | |
|---------------|---|
| Chassis | A wheeled platform that is used for cargo without wheels. |
| Forklift | A powered truck which is used to lift and transport materials. |
| Ramp | A type of drawbridge used in the operation of moving vehicles on and off a Ro-Ro vessel or ferry. |
| Reach stacker | A vehicle used for handling semi-trailers/containers. Reach stackers are also able to transport the cargo short distances. |
| Trailer | An unpowered vehicle pulled by a powered vehicle. Trailers are used to transport of goods and materials. |
| Tug master | Used to drive semi-trailers to/from the ship and also inside the waiting and interchange area if necessary. It is attached to trailers and semi-trailers like a front axle. |

Executive summary

A transparent picture of processes provides a common basis to foster discussions with the industry, administrations, policy makers and the public, most of them not being familiar with the processes on a RoRo terminal.

With regard to the main aim of the project “reduction and optimisation of energy consumption and carbon footprint” this deliverable provides content to the overall picture to be shown within the “Port and Terminal Knowledge Landscape (PTKL)”. It aims to map relevant RoRo terminal processes. The mapped processes are suitable to base management of operations, modelling and simulation on and to contribute to the aims of the PTKL.

Even if RoRo terminal processes are rather uniform all over the world, terminals are individually depending on layout, equipment and hinterland connections. Therefore a generic reference terminal is designed to allow for application of various solutions to reduce energy consumption and carbon footprint for comparison of results.

Additional contribution to the PTKL has been / will be provided e.g. within other deliverables in this work package aiming at mapping relevant container and inland waterway terminal processes and defining respective reference terminals.

1 Introduction

The main objective of work package 3 is to identify relevant terminal domains and processes by developing a terminal process map with regard to reduction and optimisation of energy consumption and carbon footprint applicable to container, RoRo and inland waterway terminals.

To achieve desired results a wide scope of scientific disciplines and practitioners must contribute, only a few being familiar with terminal processes. Therefore a “Port and Terminal Knowledge Landscape (PTKL)” will be generated to provide an unambiguous reference for multi-disciplinary research work and to support exchange of ideas with practitioners.

This Port and Terminal Knowledge Landscape technically in the first step is an industrial process map organized into domains (area of responsibility). Later it will serve to link all relevant information independent of the data types and format to a visualized terminal layout of reference terminals for container, RoRo and Inland Navigation at the same time allowing to identify and explain terminal-port links.

A process map is fundamental for the development and implementation of the simulation tool as defined in WP 5. However, it also serves as a basis for carbon footprint calculation and load shedding.

Business process modelling meanwhile is well established and there are various methodologies, conventions and tools available, however, in the port and terminal industry, the approach is currently not so common and usually not covering energy supply and consumption aspects even if some bigger terminal operation companies do apply process management tools for this purpose.

This deliverable aims to map relevant processes that are suitable to base management of operations, modelling and simulation upon allowing for a wide scope of measurements to reduce energy consumption.

The proposed solution aims at to:

- provide a transparent picture of processes and related organisation(s), responsibilities, equipment, scheduling, resources and other relevant facts
- allow for performance measurement by appropriate key performance indicators
- generate the Consortium-Coordination Platform (CCP) to base investigation, development, applications and training upon and to allow focussed work by maintaining the overall terminal and port coherence
- allow for selection of most appropriate methodologies and tools to implement and manage energy supply and consumption
- elucidate and visualize port and terminal processes to foster discussions with the industry, administrations, policy makers and the public (to support dissemination).

Process mapping is based on the process capturing and management methodology developed within the EU-funded project EFFORTS in the year 2009.

Even if RoRo terminal processes are rather uniform all over the world, terminals are individual depending on layout, equipment and hinterland connections. Therefore a

generic reference terminal is designed to allow for application of various solutions to reduce energy consumption and carbon footprint for comparison of results.

The main objective of this deliverable is to provide a common basis for all project partners, especially for the partners who are not familiar with RoRo terminal entities and processes. Therefore, chapter 2 discusses a model of a RoRo terminal based on the methodology developed in D 3.1. Chapter 3 develops data and layout of a generic reference terminal.

2 Model of a RoRo Terminal

2.1 Entities

2.1.1 Passengers and Cargo Units

In the following sections, passengers, vehicles and cargo units that are handled in a Ro-Ro terminal are explained briefly and some pictures are provided in order to get better understanding of different terms. The description follows a categorization that is useful to differentiate the processes concerning the respective cargo.

2.1.1.1 Passenger

Passenger is any person who travels in a vehicle and without vehicle.

2.1.1.2 Self-propelling cargo units

Self-propelling cargo units are driven by a driver that is not related to the terminal, they have an own engine and equipped with wheels. Examples are trucks, tourist cars, buses, campers and also conventional trains.

2.1.1.3 Self-propelling cargo units without driver

Self-propelling cargo units without driver are equipped with an engine and wheels, but without a driver accompanying it on the ship. Examples are trucks and caterpillars.

2.1.1.4 Rolling cargo units

Rolling cargo units are not equipped with an own engine, but they are moveable as they have own wheels. Examples are all kinds of trailers and caravans.



Picture 1 Trailer

Source: Port of Trelleborg

2.1.1.5 Non-rolling cargo units

Non-rolling cargo units has neither an own engine nor wheels. This usually includes cargo on combi trains as e.g. swap bodies or paper rolls that is lifted on chassis for (un)loading operations.

2.1.2 Equipment

The following sections introduce the main equipment that is used on a Ro-Ro terminal with some pictures to provide with a better understanding of terms.

2.1.2.1 Tug master

It is also known as Ro-Ro tractor. It is attached to trailers to drive them on and off the ship. Tug masters have high manoeuvrability.



Picture 2 Tug-master



Picture 3 Tug-master attached to a trailer

Source: Port of Trelleborg

2.1.2.2 Reach stacker

Reach stackers are vehicles that are used for handling trailers/containers. They are also able to transport the cargo short distances. The most common usage of a reach stacker in a combi terminal is to lift goods on/off a train.



Picture 4 Reach stacker

Source: <http://www.trelleborgshamn.se>

2.1.2.3 Ramp

Ro-Ro vessels have their own ramps on the forward or stern of the ship to allow loading and discharging of vehicles. However, the ramp here refers to a type of drawbridge provided by the terminal to allow direct load/discharge on and from the upper deck of the vessel.



Picture 5 Ramp directly connected to ship's upper deck

Source: <http://www.trelleborgshamn.se>

2.1.2.4 Forklift

It is a powered truck which is used to lift and transport materials where and when necessary, e.g. for warehouse operations or for waste and material handling on a ship. There are different sizes of forklifts depending on operations.

2.1.2.5 Cars and shuttle bus

This equipment is used for transferring passengers to and from the ship and travelling within the terminal area to carry out operational issues. It is also used to bring drivers to the ship to unload self-propelling cargo units without driver (e.g. cars) or to (un)load e.g. caravans.

2.1.2.6 Chassis

Chassis are platforms that are used for cargo without wheels.

2.2 Processes on a RoRo Terminal

2.2.1 RoRo Terminal Domains

As described in Del 3.1, domains in a port should be defined to represent coherent application areas before considering the processes (Froese, 2009). Similar to container terminal domains which were explained in Del 3.2, Ro-Ro terminals are organised in domains as well. The relevant Ro-Ro terminal domains (Figure 1) are explained below.

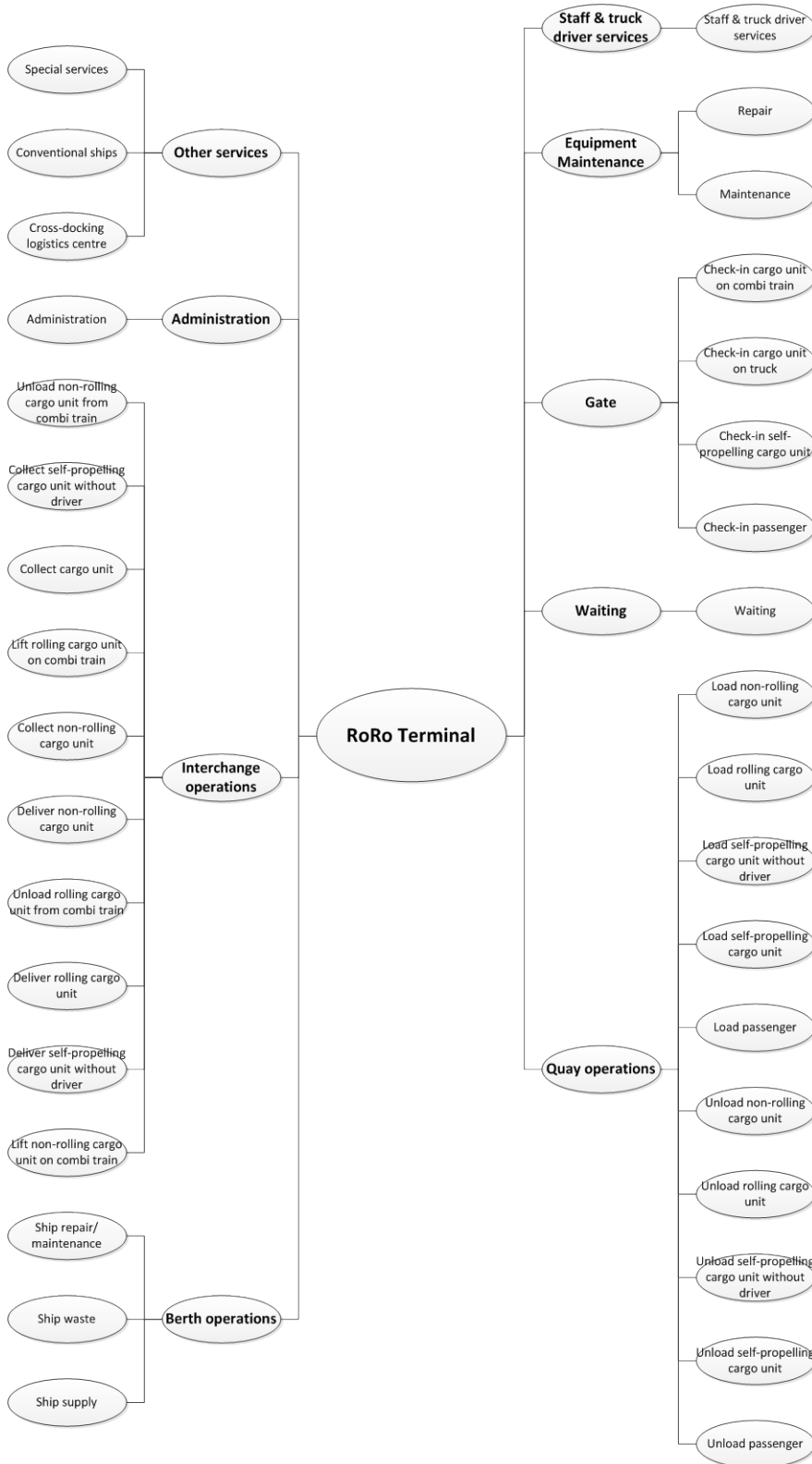


Figure 1 Ro-Ro Terminal Process Domains

1. Berth Operations

The berth domain consists of processes related to ships while they are berthed (water side).

2. Quay Operations

The quay domain associates to processes involving ships as well but related to the land side.

3. Waiting Area

The waiting area domain comprises processes which occur during the waiting time of trucks, cars, busses and passengers for loading (e.g. arranging the parking lanes and heating/cooling of trucks).

4. Interchange Operations

The interchange domain associates to processes in relation to handling of any kind of vehicle without driver, e.g. semi-trailers, trailers, cars as commodity, busses as commodity and goods delivered by train.

5. Gate

The gate domain includes processes to carry out check-in and check-out formalities for all kind of vehicles and passengers.

6. Equipment Maintenance

The equipment maintenance domain comprises processes related to the support of handling equipment functionality and availability.

7. Administration

The administration domain includes managing all the processes related to the whole terminal and all clients.

8. Staff & Truck Driver Services

The staff service domain links to all processes for staff and truck drivers.

9. Other Services

The special service domain comprises all service processes which are not part of the terminal operation. These services can be offered by terminals as additional value-added services to their client, e.g. truck repair, maintenance, labelling, a warm warehouse, a cool store to freeze, label and pack goods for transport and IT services for customers.

2.2.2 Overview RoRo Terminal Processes

As mentioned in D 3.1, a process is understood as a workflow with specified begin and termination covering a phase of a production. Thereby, production can also imply providing a service.

The processes to import, export or tranship containers are discussed in this deliverable to provide a basis for further research in GREEN EFFORTS. As described in D 3.1, a process map will be developed, explaining

- Process objective(s)
- Main operations and its sequence
- Operational site(s)
- Time-dependency
- Resources
- Responsible parties.

The processes are structured according to domains which represent physical areas on the terminal. The Ro-Ro terminal domains are displayed in Figure 1. The following subsections discuss the details of the Ro-Ro terminal processes for each domain based on the process mapping approach developed in D 3.1. Each table represents one process within a certain domain. The processes are described as generic as possible to ensure comparability. If necessary, they will be described more detailed within the course of the project.

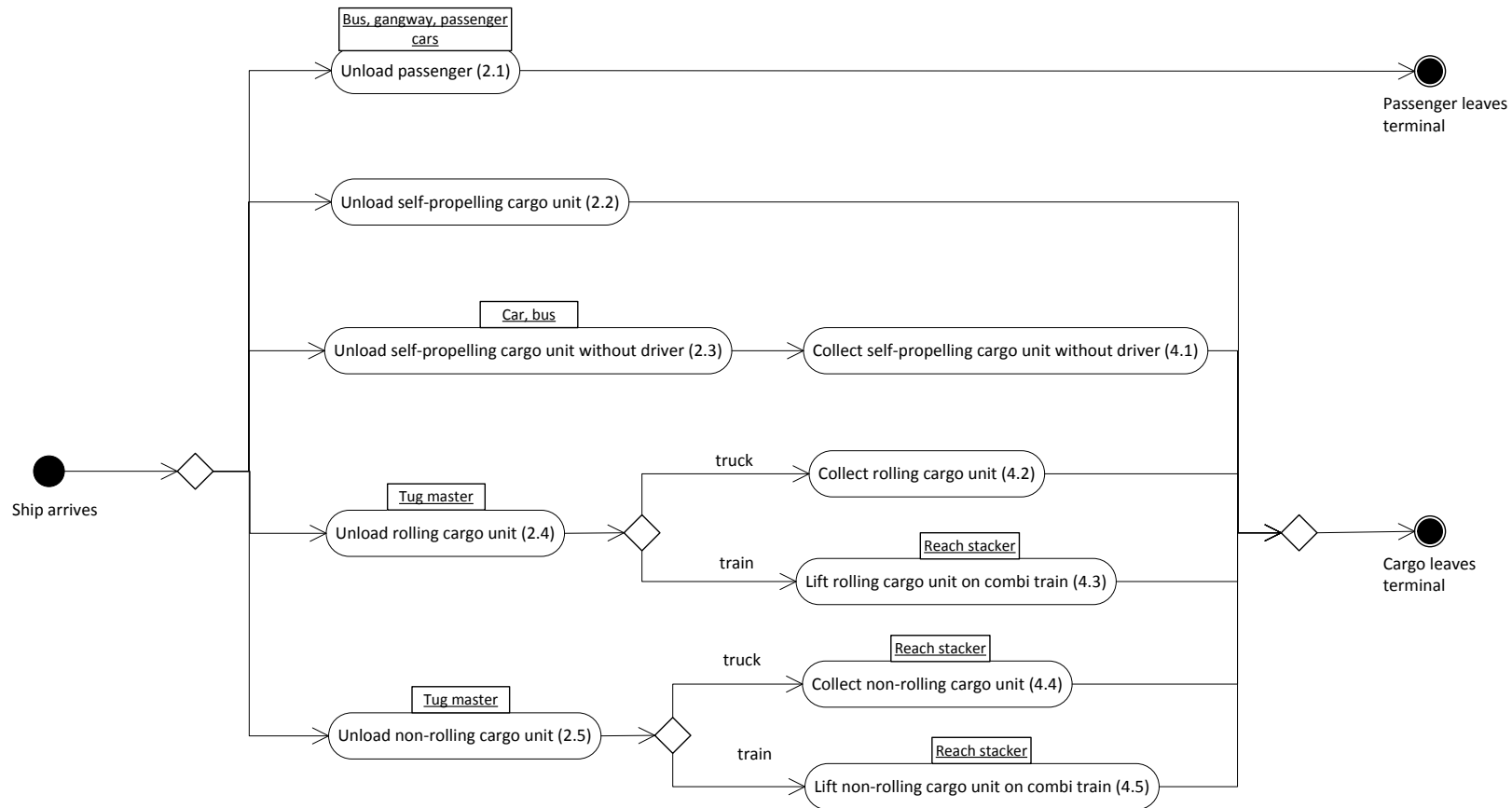


Figure 2 Ro-Ro Terminal Import Process

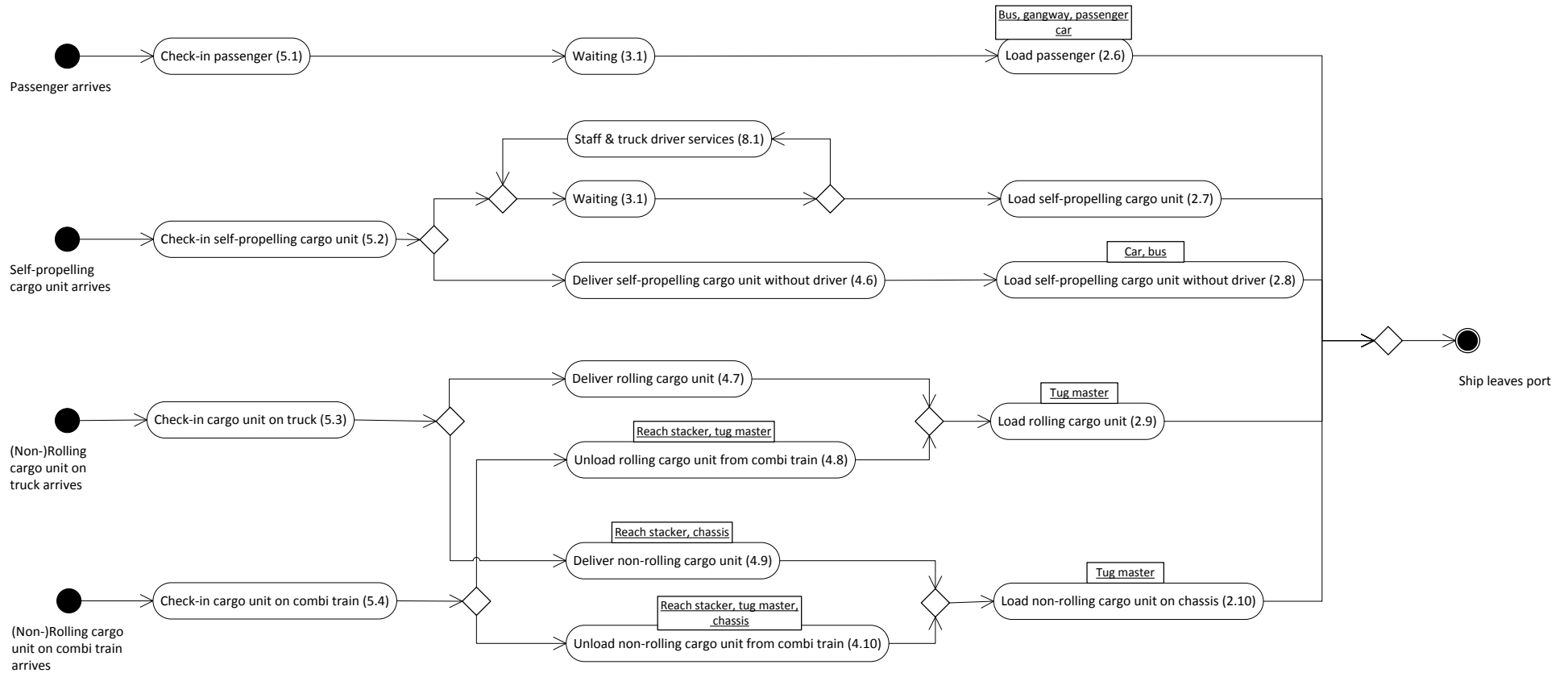


Figure 3 Ro-Ro terminal Export Process

2.2.3 Berth Operations

| | |
|----------------------------------|---|
| Process name | Ship supply |
| Process number | 1.1 |
| Process objective(s) | Deliver units of supply (fresh water, food, fuel, electricity...) to the ship |
| Main operations and its sequence | <ul style="list-style-type: none"> • Prepare equipment to be used • Take safety measures • Transport supply to ship • Communicate with supplier |
| Operational site(s) | Berth |
| Time dependency | While ship is berthed, between discharging and loading |
| Resources | Forklift |
| Responsible parties | Supplier, shipping company |

Ship supply is only delivered if required by the customer (shipping line). Fresh water is delivered with a tube, food and fuel by external companies with a truck.

| | |
|----------------------------------|---|
| Process name | Ship waste |
| Process number | 1.2 |
| Process objective(s) | Collect units of waste from the ship |
| Main operations and its sequence | <ul style="list-style-type: none"> • FL enters ship • FL collects waste • FL leaves ship |
| Operational site(s) | Berth |
| Time dependency | While ship is berthed |
| Resources | Forklift |
| Responsible parties | Waste disposal contractor, shipping company, or port |

Waste on the ships is usually collected separately. Waste water (grey and black water) is either treated and disposed to the open sea, or it is pumped out and collected by a truck, or it is pumped out via pipe to the local community's sewage treatment plant. Sludge is collected by a truck.

| | |
|----------------------------------|---|
| Process name | Ship repair/maintenance |
| Process number | 1.3 |
| Process objective(s) | Conduct ship maintenance, repair broken parts |
| Main operations and its sequence | <ul style="list-style-type: none"> • Depends on type of ship, maintenance plan and defects • Usually only minor repairs that don't require a stay in a shipyard |
| Operational site(s) | Berth |
| Time dependency | While ship is berthed |
| Resources | Truck, barge |
| Responsible parties | Repair & maintenance contractor |

2.2.4 Quay Operations

Loading operations are carried out in the following order: first, all cargo without drivers is loaded (e.g. trailers), second passengers and cargo with drivers is directed to the ship. Unloading operations follow the reverse order.

| | |
|----------------------------------|--|
| Process name | Unload passenger |
| Process number | 2.1 |
| Process objective(s) | Move passenger from ship to gate |
| Main operations and its sequence | <ul style="list-style-type: none"> • Passenger walks on a gangway off the ship to the gate and leaves the terminal <p>Alternatively:</p> <ul style="list-style-type: none"> • Passenger is transported to the gate area by a bus <p>Alternatively:</p> <ul style="list-style-type: none"> • Passenger drives on a specified lane off the ship to the gate and leaves the terminal |
| Operational site(s) | Quay, gate |
| Time dependency | While ship is berthed, depending on the situation, usually leaving first |
| Resources | Bus, gangway, passenger cars |
| Responsible parties | Passenger, port and ship crew |

| | |
|----------------------------------|---|
| Process name | Unload self-propelling cargo unit |
| Process number | 2.2 |
| Process objective(s) | Move self-propelling cargo units from ship to gate |
| Main operations and its sequence | <ul style="list-style-type: none"> • Cargo units drive on a specified lane off the ship to the gate and leave the terminal |
| Operational site(s) | Quay, gate |
| Time dependency | While ship is berthed, depending on the situation, usually after passengers |
| Resources | |
| Responsible parties | Driver of cargo units, ship crew |

| | |
|----------------------------------|---|
| Process name | Unload self-propelling cargo unit without driver |
| Process number | 2.3 |
| Process objective(s) | Move self-propelling cargo units without driver from ship to interchange operations area |
| Main operations and its sequence | <ul style="list-style-type: none"> • Driver (from the terminal) is shuttled to the ship and enters the ship • Driver drives self-propelling cargo unit off the ship to the interchange operations area • Driver leaves the self-propelling cargo unit in a specified place within the interchange operations area • Shuttle collects driver |
| Operational site(s) | Quay, interchange operations area |
| Time dependency | While ship is berthed, depending on the situation, usually after passengers |
| Resources | Car, bus |
| Responsible parties | Driver, ship crew, or port |

| | |
|----------------------------------|---|
| Process name | Unload rolling cargo unit |
| Process number | 2.4 |
| Process objective(s) | Move cargo on wheels without own engine from ship to interchange operations area |
| Main operations and its sequence | <ul style="list-style-type: none"> • Tug master drives on the ship • Tug master attaches to cargo unit • Tug master drives off the ship to the interchange operations area • Tug master leaves the cargo unit in a specified lane within the interchange operations area (if the cargo is transported afterwards by truck: closest area to berth; if the cargo is transported by train: combi terminal) |
| Operational site(s) | Quay, interchange operations area |
| Time dependency | While ship is berthed, depending on the situation, usually after passengers and traffic being unloaded |
| Resources | Tug master |
| Responsible parties | Tug master driver, ship crew |

| | |
|----------------------------------|--|
| Process name | Unload non-rolling cargo unit |
| Process number | 2.5 |
| Process objective(s) | Move non-rolling cargo units on chassis from ship to interchange operations area |
| Main operations and its sequence | <ul style="list-style-type: none"> • Tug master drives on the ship • Tug master attaches to cargo unit • Tug master drives off the ship to the interchange operations area (combi terminal) • Tug master leaves the cargo unit in a specified lane |
| Operational site(s) | Quay, interchange operations area |
| Time dependency | While ship is berthed, depending on the situation, usually after passengers and traffic being unloaded |
| Resources | Tug master |
| Responsible parties | Tug master driver, ship crew |

| | |
|----------------------------------|--|
| Process name | Load passenger |
| Process number | 2.6 |
| Process objective(s) | Move passenger from waiting area to ship |
| Main operations and its sequence | <ul style="list-style-type: none"> • Passenger walks on a specified path from the waiting area to the ship <p>Alternatively:</p> <ul style="list-style-type: none"> • Passenger is transported to the ship by a bus <p>Alternatively:</p> <ul style="list-style-type: none"> • Passenger drives on a specified lane on the ship |
| Operational site(s) | Waiting area, quay |
| Time dependency | While ship is berthed, depending on the situation, usually leaving first after unloading |
| Resources | Bus, gangway, passenger car |
| Responsible parties | Passenger, port or ship crew |

| | |
|----------------------------------|---|
| Process name | Load self-propelling cargo unit |
| Process number | 2.7 |
| Process objective(s) | Move self-propelling cargo units from waiting area to ship |
| Main operations and its sequence | <ul style="list-style-type: none"> • Cargo units drive on a specified lane from the waiting area to the ship • Cargo units park on the ship |
| Operational site(s) | Waiting area, quay |
| Time dependency | While ship is berthed, depending on the loading plan |
| Resources | |
| Responsible parties | Drivers, ship crew |

| | |
|----------------------------------|--|
| Process name | Load self-propelling cargo unit without driver |
| Process number | 2.8 |
| Process objective(s) | Move self-propelling cargo units without driver from interchange operations area to ship |
| Main operations and its sequence | <ul style="list-style-type: none"> • Driver is shuttled to interchange operations area • Driver enters cargo unit • Driver drives cargo unit from interchange operations area to ship • Driver leaves cargo unit in a place on the ship specified by the crew • Driver is picked up the shuttle |
| Operational site(s) | Quay, gate |
| Time dependency | While ship is berthed, depending on the situation, usually after passengers |
| Resources | Car, bus |
| Responsible parties | Driver, ship crew |

| | |
|----------------------------------|--|
| Process name | Load rolling cargo unit |
| Process number | 2.9 |
| Process objective(s) | Move any kind of cargo on wheels without own engine from interchange operations area to the ship |
| Main operations and its sequence | <ul style="list-style-type: none"> • Tug master drives to the interchange operations area • Tug master attaches to cargo • Tug master drives from the interchange operations area to the ship • Tug master leaves the cargo in a place on the ship specified by the crew |
| Operational site(s) | Interchange operations area, quay |
| Time dependency | While ship is berthed, depending on the loading plan |
| Resources | Tug master |
| Responsible parties | Tug master driver, ship crew |

| | |
|----------------------------------|--|
| Process name | Load non-rolling cargo unit |
| Process number | 2.10 |
| Process objective(s) | Move non-rolling cargo units on chassis from interchange operations area to the ship |
| Main operations and its sequence | <ul style="list-style-type: none"> • Tug master drives to the interchange operations area • Tug master attaches to cargo • Tug master drives from the interchange operations area to the ship • Tug master leaves the cargo in a place on the ship specified by the crew |
| Operational site(s) | Interchange operations area, quay |
| Time dependency | While ship is berthed, depending on the loading plan |
| Resources | Tug master |
| Responsible parties | Tug master driver, ship crew |

2.2.5 Waiting area

| | |
|----------------------------------|---|
| Process name | Waiting |
| Process number | 3.1 |
| Process objective(s) | |
| Main operations and its sequence | <ul style="list-style-type: none"> • Self-drivers wait in the car etc. separated by lanes (load plan) • ... |
| Operational site(s) | Waiting area |
| Time dependency | After check-in and before loading |
| Resources | Passengers cars, trucks |
| Responsible parties | Drivers |

2.2.6 Interchange Operations Area

| | |
|----------------------------------|--|
| Process name | Collect self-propelling cargo unit without driver |
| Process number | 4.1 |
| Process objective(s) | Collect self-propelling cargo unit from the interchange operations area and move it to the gate |
| Main operations and its sequence | <ul style="list-style-type: none"> Collecting truck / driver enters terminal through gate Collecting truck / driver moves to specified place in the interchange operations area Cargo unit is loaded on collecting truck / driver enters cargo unit Truck / cargo unit moves to gate |
| Operational site(s) | Interchange operations area, gate |
| Time dependency | After unloading |
| Resources | |
| Responsible parties | Truck driver |

| | |
|----------------------------------|---|
| Process name | Collect rolling cargo unit |
| Process number | 4.2 |
| Process objective(s) | Collect rolling cargo unit by tractor from the interchange operations area and move it to the gate |
| Main operations and its sequence | <ul style="list-style-type: none"> Tractor unit enters terminal through gate Tractor unit drives to specified place in the interchange operations area Tractor unit attaches to cargo unit Truck drives to gate with cargo unit |
| Operational site(s) | Interchange operations area, gate |
| Time dependency | After unloading |
| Resources | |
| Responsible parties | Truck driver |

| | |
|----------------------------------|--|
| Process name | Lift rolling cargo unit on combi train |
| Process number | 4.3 |
| Process objective(s) | Lift rolling cargo unit on a combi train in the interchange operations area |
| Main operations and its sequence | <ul style="list-style-type: none"> • Reach stacker drives to specified rolling cargo unit • Reach stacker lifts rolling cargo unit • Reach stacker moves rolling cargo on a specified position on a train |
| Operational site(s) | Interchange operations area |
| Time dependency | After unloading |
| Resources | Reach stacker |
| Responsible parties | Equipment operator |

| | |
|----------------------------------|---|
| Process name | Collect non-rolling cargo unit |
| Process number | 4.4 |
| Process objective(s) | Collect non-rolling cargo unit by truck from the interchange operations area and move it to the gate |
| Main operations and its sequence | <ul style="list-style-type: none"> • Truck enters terminal through gate • Truck drives to specified place in the interchange operations area • Reach stacker lifts cargo unit on truck • Truck drives to gate with cargo unit |
| Operational site(s) | Interchange operations area, gate |
| Time dependency | After unloading |
| Resources | Reach stacker |
| Responsible parties | Truck driver, equipment operator |

| | |
|----------------------------------|---|
| Process name | Lift non-rolling cargo unit on combi train |
| Process number | 4.5 |
| Process objective(s) | Lift non-rolling cargo unit on a combi train in the interchange operations area |
| Main operations and its sequence | <ul style="list-style-type: none"> • Reach stacker drives to specified non-rolling cargo unit on chassis • Reach stacker lifts non-rolling cargo unit off chassis • Reach stacker moves non-rolling cargo on a specified position on a train |
| Operational site(s) | Interchange operations area |
| Time dependency | After unloading |
| Resources | Reach stacker |
| Responsible parties | Equipment operator |

| | |
|----------------------------------|---|
| Process name | Deliver self-propelling cargo unit without driver |
| Process number | 4.6 |
| Process objective(s) | Deliver any kind of cargo on wheels with own engine from the gate to the interchange operations area |
| Main operations and its sequence | <ul style="list-style-type: none"> • Truck enters gate • Truck drives to specified place in the interchange operations area • Truck unloads cargo unit • Tractor unit drives back to gate empty |
| Operational site(s) | Gate, interchange operations area |
| Time dependency | After check-in |
| Resources | |
| Responsible parties | Truck driver |

| | |
|----------------------------------|---|
| Process name | Deliver rolling cargo unit |
| Process number | 4.7 |
| Process objective(s) | Deliver any kind of cargo on wheels without own engine by truck from the gate to the interchange operations area |
| Main operations and its sequence | <ul style="list-style-type: none"> • Truck enters gate • Truck drives to specified place in the interchange operations area • Truck detaches trailer • Tractor unit drives back to gate empty |
| Operational site(s) | Gate, interchange operations area |
| Time dependency | After check-in |
| Resources | |
| Responsible parties | Truck driver |

| | |
|----------------------------------|--|
| Process name | Unload rolling cargo unit from combi train |
| Process number | 4.8 |
| Process objective(s) | Move rolling cargo unit from train to interchange operations area |
| Main operations and its sequence | <ul style="list-style-type: none"> • Reach stacker drives to specified cargo unit in the train area • Reach stacker lifts cargo unit off the train • Reach stacker moves cargo unit to a specified place in the interchange operations area • Reach stacker places cargo unit in the interchange operations area <p>Alternatively:</p> <ul style="list-style-type: none"> • Reach stacker drives to specified cargo unit in the train area • Reach stacker lifts cargo unit off the train and places it in the train area • Tug master attaches to cargo unit and moves it to a specified place in the interchange operations area • Tug master detaches from cargo unit |
| Operational site(s) | Train area, interchange operations area |
| Time dependency | After train arrival |
| Resources | Reach stacker, tug master |
| Responsible parties | Equipment operator |

| | |
|----------------------------------|---|
| Process name | Deliver non-rolling cargo unit |
| Process number | 4.9 |
| Process objective(s) | Deliver any kind of cargo without wheels by truck from the gate to the interchange operations area |
| Main operations and its sequence | <ul style="list-style-type: none"> • Truck enters gate • Truck drives to specified place in the interchange operations area • Truck unloads cargo unit • Truck drives back to gate or collects a cargo unit for import • Reach stacker lifts cargo unit on chassis <p>Alternatively:</p> <ul style="list-style-type: none"> • Reach stacker unloads cargo unit directly from truck and places it on chassis |
| Operational site(s) | Gate, interchange operations area |
| Time dependency | After check-in |
| Resources | Reach stacker, chassis |
| Responsible parties | Truck driver, equipment operator |

| | |
|----------------------------------|---|
| Process name | Unload non-rolling cargo unit from combi train |
| Process number | 4.10 |
| Process objective(s) | Move non-rolling cargo unit from train to interchange operations area |
| Main operations and its sequence | <ul style="list-style-type: none"> • Reach stacker drives to specified cargo unit in the train area • Reach stacker lifts cargo unit off the train • Reach stacker moves cargo unit to a specified chassis in the interchange operations area • Reach stacker places cargo unit on the chassis <p>Alternatively:</p> <ul style="list-style-type: none"> • Reach stacker drives to specified cargo unit in the train area • Reach stacker lifts cargo unit off the train and places it on a chassis in the train area • Tug master attaches to chassis and moves it to a specified place in the interchange operations area • Tug master detaches from chassis |
| Operational site(s) | Train area, interchange operations area |
| Time dependency | After train arrival |
| Resources | Reach stacker, tug master, chassis |
| Responsible parties | Equipment operator |

2.2.7 Gate

| | |
|----------------------------------|---|
| Process name | Check-in passenger |
| Process number | 5.1 |
| Process objective(s) | Register and check passenger at the gate |
| Main operations and its sequence | <ul style="list-style-type: none"> • Checking passenger information and ticket • Show passenger way to waiting area |
| Operational site(s) | Gate |
| Time dependency | Before passenger enters terminal |
| Resources | |
| Responsible parties | Gate operator |

| | |
|----------------------------------|---|
| Process name | Check-in self-propelling cargo unit |
| Process number | 5.2 |
| Process objective(s) | Register and check self-propelling cargo units at the gate |
| Main operations and its sequence | <ul style="list-style-type: none"> • Checking cargo information and tickets • (Security checks by coast guards on cargo securing in the trucks) • Show traffic way to waiting area |
| Operational site(s) | Gate |
| Time dependency | Before self-propelling cargo unit enters terminal |
| Resources | |
| Responsible parties | Gate operator |

| | |
|----------------------------------|---|
| Process name | Check-in cargo unit on truck |
| Process number | 5.3 |
| Process objective(s) | Register and check (non-)rolling cargo unit on truck at the gate |
| Main operations and its sequence | <ul style="list-style-type: none"> • Checking cargo and delivering truck information against information in the system • Take pictures of the cargo • Inform truck driver about area where to deliver the cargo unit |
| Operational site(s) | Train area |
| Time dependency | Before cargo enters terminal |
| Resources | |
| Responsible parties | Gate operator |

| | |
|----------------------------------|---|
| Process name | Check-in cargo unit on combi train |
| Process number | 5.4 |
| Process objective(s) | Register and check (non-)rolling cargo unit on combi at the gate |
| Main operations and its sequence | <ul style="list-style-type: none"> • Checking cargo and train information • Security checks |
| Operational site(s) | Train area |
| Time dependency | Just after train enters terminal |
| Resources | |
| Responsible parties | Gate operator |

2.2.8 Equipment Maintenance

| | |
|----------------------------------|---|
| Process name | Maintenance |
| Process number | 6.1 |
| Process objective(s) | Keep equipment in good condition |
| Main operations and its sequence | <ul style="list-style-type: none"> • Maintaining equipment • Tank • Cleaning |
| Operational site(s) | Workshop |
| Time dependency | In regular intervals |
| Resources | Fuel, spare parts, workshop |
| Responsible parties | Equipment manager, driver/equipment operator (fuelling) |

| | |
|----------------------------------|--|
| Process name | Repair |
| Process number | 6.2 |
| Process objective(s) | Bring equipment in good condition |
| Main operations and its sequence | <ul style="list-style-type: none"> • Fix broken equipment |
| Operational site(s) | Workshop |
| Time dependency | As soon as necessary |
| Resources | Spare parts |
| Responsible parties | Equipment manager |

2.2.9 Administration

| | |
|----------------------------------|---|
| Process name | Administration |
| Process number | 7.1 |
| Process objective(s) | Organise RoRo cargo handling |
| Main operations and its sequence | <ul style="list-style-type: none"> • Operations planning • Finance • IT • Security • Personnel • Utility (cleaning etc.) • ... |
| Operational site(s) | Buildings |
| Time dependency | Depending on the process step |
| Resources | Computers |
| Responsible parties | Respective department |

2.2.10 Staff & Truck Driver Services

| | |
|----------------------------------|---|
| Process name | Staff and truck driver services |
| Process number | 8.1 |
| Process objective(s) | Support staff and truck drivers |
| Main operations and its sequence | <ul style="list-style-type: none"> • (Provide food in a canteen / self-service kitchen) • Provide shower facilities (separately for staff and truck drivers) • Provide break rooms for rest (separately for staff and truck drivers) |
| Operational site(s) | Buildings |
| Time dependency | Depending on shifts |
| Resources | Kitchen, sanitary facilities |
| Responsible parties | Respective department |

2.2.11 Other Services

| | |
|----------------------------------|---|
| Process name | Cross-docking logistics centre |
| Process number | 10.1 |
| Process objective(s) | Loading, discharging and storing of cargo units |
| Main operations and its sequence | <ul style="list-style-type: none"> • Loading cargo units in a "container" • Unloading and stripping cargo units from a "container" • Storing cargo units |
| Operational site(s) | Cross-docking logistics center |
| Time dependency | |
| Resources | Forklift |
| Responsible parties | Respective personnel |

| | |
|----------------------------------|--|
| Process name | Conventional ships |
| Process number | 10.2 |
| Process objective(s) | Loading, discharging on/off conventional ships and storing other cargo units as e.g. grains, oil |
| Main operations and its sequence | <ul style="list-style-type: none"> • Loading other cargo on a conventional ship • Discharging other cargo off a conventional ship • Storing other cargo |
| Operational site(s) | Separate quay, storage area |
| Time dependency | |
| Resources | Equipment |
| Responsible parties | Respective personnel |

| | |
|----------------------------------|---|
| Process name | Special services |
| Process number | 10.3 |
| Process objective(s) | Providing value-added services |
| Main operations and its sequence | <ul style="list-style-type: none"> • warm warehouse • label and pack goods for transport • IT services for customers • Help reload goods in case of damages |
| Operational site(s) | Respective buildings |
| Time dependency | Depending on customer requests |
| Resources | Equipment |
| Responsible parties | Equipment operator |

3 Reference Terminal

The reference terminal serves as an exemplary case for all carbon footprint calculations and simulations which will be conducted within GREEN EFFORTS. Figure 4 shows a generic view of a RoRo terminal and the main logistics processes. The capacities and dimensions of the particular areas are specified in the following.

3.1 Generic view

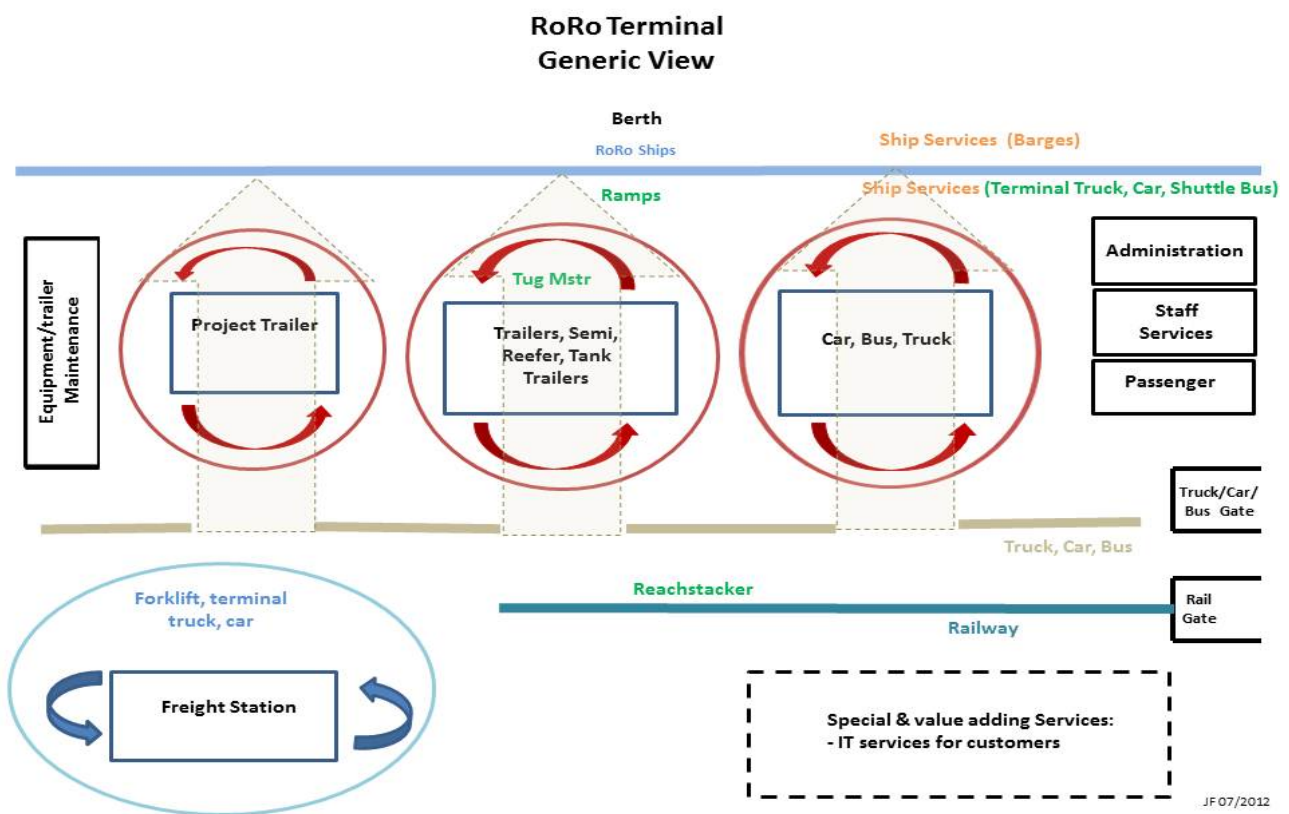


Figure 4 Ro-Ro Terminal Generic View

Figure above shows an exemplary depiction of Ro-Ro terminal as generic view showing its logistics processes and Ro-Ro energy-related entities. Main operation processes and some supporting processes and related process entities (e.g. equipment and infrastructure) will be investigated to find out processes having impacts on energy consumption and sourcing and estimate potential impacts of results.

3.2 Data of Reference Terminal

3.2.1 Terminal/port volumes

The following table shows the volumes of handled goods for the reference terminal.

Table 1: Terminal volumes

| | |
|--|---|
| Passengers | |
| 1,563,586 | Passengers |
| Self-propelling cargo units with driver | |
| 276,590 | Cars |
| 487,628 | Trucks |
| 4,247 | Buses |
| Rolling cargo units | |
| 121,143 | Trailers (without drivers) |
| 1364 | Imp and Exp Caravans and cars (without drivers) |
| 10,905 | Caravans (with drivers in PKW) |
| Non-rolling cargo units | |
| 1,256,031 | Volumes of railway |
| 36,118 | Railway wagons |
| Total volume | |
| 9,394,980 | Volumes trucks and trailers good in tons |

3.2.2 Number of Equipment, Equipment Productivity and Terminal Data

The following table summarises the core data of the reference terminal.

Table 2: Data sheet reference terminal

| | | |
|--------------------------|------|------------------------------|
| Length quay side | 1830 | m |
| Number of berths | 6 | RoRo without rail-connection |
| | 3 | RoRo with rail-connection |
| | 2 | Bulk cargo |
| Number of reach-stackers | 2 | |
| Number of tug masters | 16 | |
| Number of forklifts | 8 | (logistic centre) |

| | | |
|-------------------------------|---|----------------|
| Number of cars | 16 | |
| Productivity reach-stackers | 12-25 | Moves/hour |
| Productivity tug masters | 5-7 | Moves/hour |
| Area of buildings | 40,000 | m ² |
| Area | 70 | ha |
| Number of train tracks | 4 tracks (each 400m) | |
| Number of truck lanes at gate | 7 gates, appr. 50 lines 4 diff areas | |
| Number of light posts | 490 | light sources |

4 Conclusions and Outlook

This deliverable provides a common basis for all partners of the GREEN EFFORTS project for analysing energy consumption, energy supply, energy management and carbon emissions. The described model of a RoRo terminal reflects all relevant entities and processes on the terminal focusing on cargo handling. Within the course of the project the RoRo terminal model will be used to determine systematically energy consumption and to calculate carbon emissions. It also serves as input for load shifting and energy management considerations.

Based on the entities and processes identified, a reference RoRo terminal is developed for future research and simulations. The reference terminal reflects a specific terminal in order to ensure that future research bases on realistic assumptions and operations. It is therefore supposed to ensure a close link between research and reality and to ensure applicability of future results.