



# Port Links

## Index

1. Introduction .....	3
2. Port Links website .....	4
2.1. Description of the website .....	4
2.2. Building a route .....	5
2.2.1. Type of cargo .....	5
2.2.2. Hinterland .....	6
2.2.3. Foreland .....	7
2.2.4. Direction .....	8
2.2.5. Land mode .....	9
2.2.6. Passage through port .....	10
2.2.7. Maritime services .....	11
2.2.8. Results and costs .....	13
2.3. Results .....	17
3. Calculation model .....	18
3.1. Oceanic section .....	18
3.2. Overland section .....	19
3.2.1. Road .....	19
3.2.2. Rail .....	20
3.3. Externalities .....	21

## 1. Introduction

Port Links is a tool for building transport chains through the Port of Barcelona using its offer of maritime and land-based services. It provides a list of indicators associated with the transport chain that has been built (distance, transit time, emissions and externalities) and a representation of the route on a map.

Port Links is internet-accessible and provides up-to-date information on the Port of Barcelona's maritime and rail services. It also includes the emission calculation model developed by the Port of Barcelona under the ECOcalculator project and later expanded under the CLYMA project.

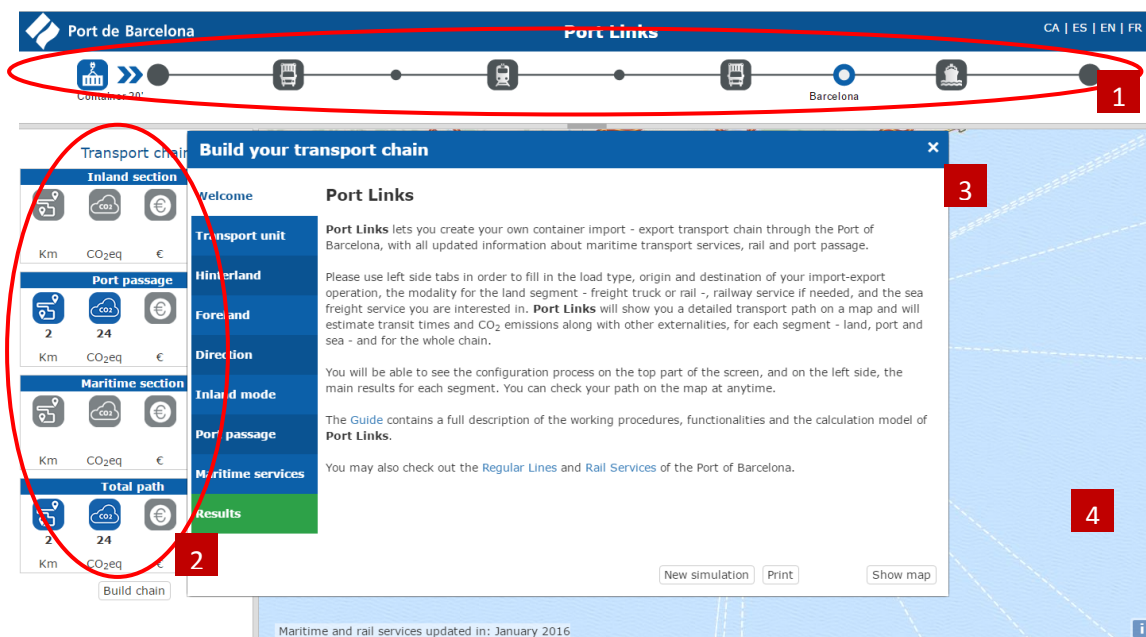
We expect to develop the tool further in the future to increase its potential and offer users greater functionality.

## 2. Port Links website

The web tool has been designed to build a complete logistics chain between any port foreland in the world and any European hinterland location. On this route there is always an oceanic section between the foreland port and the Port of Barcelona, and an overland section between the Port of Barcelona and the European hinterland location. This overland section may involve road or rail. In the latter case it will always consider a haulage route between the railway terminal and the hinterland location. There may also be an intermediate road haulage section in the vicinity of the port when the rail service leaves or arrives from a terminal outside the port precinct.

### 2.1. Description of the website

The Port Links website is divided into four distinct areas:



1. Route bar: shows the elements that define the selected route. As these are selected, they change from grey to blue and identification labels appear. Click on elements to change them.
2. Aggregated results: provides a compact view of the results in terms of distance, CO<sub>2</sub>-equivalent, cost and route time. The values will be filled in as the route elements are selected, with pictograms moving from grey to blue.

3. "Build your transport chain" element selection interface: allows you to select the various elements that will make up the route: cargo type, hinterland location, foreland port, direction of the chain, terrestrial mode, passage through the port, maritime services and getting results. They are organised into tabs for each item. The "New Simulation" button restarts the tool with all fields blank. The "Print" button generates a report with the simulation ready for printing to pdf or on paper (this utility is still under development and the report generated will be a trial version).
4. Map: shows the elements of the route on a navigable map. To navigate around the map, close the element selection interface by clicking the "Show Map" button. To return to the element selection interface, click on the "Build Chain" button in the aggregate results area.

## 2.2. Building a route

We recommend that you build routes sequentially. While there is no strict order for selecting elements, some selections do have to be made before you can choose certain elements.

### 2.2.1. Type of cargo

First select the type of cargo to be transported. The available options are 20, 40 and 45-foot containers. In future we will add the possibility to choose RO-RO and vehicles.

**Build your transport chain** ×

Welcome

**Select transport unit**

Transport unit

Select the type of container you want to transport: 20', 40' or 45'

Cargo:

Container 20' ▼

Hinterland

Foreland

Direction

Inland mode

Port passage

Maritime services

Results

New simulation

Print

Show map

The type of cargo chosen will determine the outcome by limiting maritime and rail services available to those used for that kind of cargo. Furthermore, the emissions and externalities selected will depend on the type of cargo.

### 2.2.2. Hinterland

The hinterland is the European location from which goods are exported or imported. Select this by typing the name of a location or a specific address, click "Search" and choose an item from the drop-down list.

The search is limited geographically to continental Europe. If you enter a location outside of this area, the system will warn you that the name is not found.

**Build your transport chain** ×

**Welcome**

**Transport unit**

**Hinterland**

**Foreland**

**Direction**

**Inland mode**

**Port passage**

**Maritime services**

**Results**

**Select a Hinterland location (city, address, ...)**  
Introduce the european city or adress of origin for your exportation, or your importation destination.  
Press 'Search' and select the desired result.  
Hinterland:

### 2.2.3. Foreland

The foreland is the port of origin or destination of the goods. Select it from the three drop-down menus offering the geographical area, country and port, respectively. The list will show the ports with which the Port of Barcelona has current or previous maritime connection services.

If the selected port currently has no maritime connection with the Port of Barcelona in the chosen direction, the system will warn that there is no connection and invite you to choose another port.

**Build your transport chain**
×

Welcome

Transport unit

Hinterland

Foreland

Direction

Inland mode

Port passage

Maritime services

Results

### Select a foreland port

Select the destination port of your export or the origin of your import, using the drop-down menu.  
First, select the region, then the country and finally the port

Region:

Select ▼

Country:

▼

Port:

▼

New simulation

Print

Show map

## 2.2.4. Direction

Choose the direction of flow: export or import, from the European point of view.

**Build your transport chain**
×

Welcome

Transport unit

Hinterland

Foreland

Direction

Inland mode

Port passage

Maritime services

Results

### Select transport direction:

Choose: import or export from/towards Europe.

Direction:

European export ▼

Hinterland

>>>>>

Foreland

New simulation

Print

Show map



Select **import** to show the foreland import port of origin. Select **destination** to show the location of the destination hinterland. Selecting **export** will show the foreland port as the destination and the hinterland location as the port of origin.

### 2.2.5. Land mode

Land mode makes it possible to join the hinterland location with the Port of Barcelona. The user can choose between Rail and Road.

Select Rail to show existing rail services, from closest to furthest from the hinterland location, and the origin or destination terminal of the rail service. When you choose one, the system will show it on the map and automatically calculate the necessary haulage services. All rail services require haulage between the hinterland location and the rail terminal, and another haulage service may appear when the second terminal is not within the port precinct. You must select the type of lorry used for haulage from the drop-down menu. Your choice will change the emissions results.

**Build your transport chain**
×

Welcome

Transport unit

Hinterland

Foreland

Direction

Inland mode

Port passage

Maritime services

Results

#### Select the type of land transport between the hinterland and the port

Choose between rail and road.

If you select rail, then you can choose between all rail available services in Barcelona Port, sorted from lowest to highest distance between the intermodal terminal and the selected hinterland. You may find [here](#) information on rail operators.

Truck type RT >28-32t Euro-VI

Rail
Road

	Origin terminal	Destination Tern	Service Descripti	Departures	Arriv
●	Abroñigal	Morrot	Renfe	DI DmDcDjDv-20:53	DmDcDjC
●	Azuqueca	Moll Prat (BEST)	Sicsa Rail Transport / Dj-17:00		Dv-10:00
●	Azuqueca	Moll Prat (BEST)	Alfil Logistics / HutchDI DmDj-18:00		DmDcDv-
●	Villafria	Moll Sud (TCB)	TCB Railway	DI DmDcDjDv-17:00	DmDcDjC
●	Zaragoza PLAZA	Moll Sud (TCB)	Sicsa Rail Transport / DcDv-06:00		DcDv-14:
●	Zaragoza PLAZA	Morrot	Renfe	DI DmDcDjDv-23:25	DmDcDjC

Page 1 of 1
60
View 1 - 30 of 30

New simulation
Print
Show map

If you select Road, the entire journey between the hinterland location and the port will be made by lorry. Select the desired type of lorry from the drop-down menu and press the "Calculate Route" button.

The system will calculate and indicate the distance of the journey.

Build your transport chain

Welcome

Transport unit

Hinterland

Foreland

Direction

Inland mode

Port passage

Maritime services

Results

Select the type of land transport between the hinterland and the port

Choose between rail and road.

If you select rail, then you can choose between all rail available services in Barcelona Port, sorted from lowest to highest distance between the intermodal terminal and the selected hinterland. You may find [here](#) information on rail operators.

Truck type

RT >28-32t Euro-VI

Rail

Road

Calculate route path

New simulation

Print

Show map

### 2.2.6. Passage through port

The calculated route always passes through the Port of Barcelona. This tab shows the features of this passage through the port, explains the Efficiency Network brand quality commitments and indicates the maximum applicable fees and charges.

10

**Build your transport chain**
×

<b>Welcome</b>	<b>Port passage time</b>
<b>Transport unit</b>	The average <b>time that a container remains in Barcelona Port is 1,5 working days</b> . It happens if all transport agents work efficiently, if any physical inspection is not required and if there isn't any contingency.
<b>Hinterland</b>	<b>Efficiency commitment</b>
<b>Foreland</b>	All companies that are certified with the quality brand of Barcelona Port Efficiency Network offer an efficiency commitment at the custom office and in the SIF's inspection process
<b>Direction</b>	<ul style="list-style-type: none"> <li>You may have automatic formality when any physical or documental inspection is not required.</li> <li>If you have a documental inspection, the formality would take less than 8 hours</li> <li>If you have a physical inspection, the time would be less than 17 hours</li> <li>If you have a SIF physical inspection, less than 25 hours</li> </ul>
<b>Inland mode</b>	
<b>Port passage</b>	Click here for more information about <a href="#">l'Efficiency Network</a>
<b>Maritime services</b>	Taxes and rates of Port passage
<b>Results</b>	<a href="#">Vessel's tax (T1)</a> , <a href="#">Good's tax (T3)</a> , <a href="#">Maximum rates for providing basic port services of handling and transport of goods in container trade</a>

New simulation
Print
Show map

### 2.2.7. Maritime services

To finish configuring the full route you must choose a maritime service. The list shows the services available, sorted from shortest to longest transit time between the Port of Barcelona and the foreland port, showing the direct services first, in comparison to which these involve a transshipment operation. When you select one, it will be coloured in on the map and the relevant calculations will be made.

Each service has a particular route indicating length, stopovers and vessel type. All of these elements determine emissions and externalities. Bear in mind that services are not symmetrical, therefore the service changes according to import or export.

Build your transport chain

Welcome

Transport unit

Hinterland

Foreland

Direction

Inland mode

Port passage

Maritime services

Results

**Select a maritime service connecting the Port of Barcelona with the selected foreland port**

Services are sorted from lowest to highest transit time. Please click on service's name to see the complete path, click on Shipowner to see the next stops at Barcelona Port and click on Consignee to see the contact data.

	Name	TT	Type	Shipowner	Consignee
<input type="radio"/>	DRAGON / AE - 20	31	D	MAERSK LINE/A.P.MOLLER	MARITIMA DEL MEDITERRANEO
<input type="radio"/>	DRAGON / AE - 20	31	D	MEDITERRANEAN SHIPPING CO	MEDITERRANEAN SHIPPING
<input type="radio"/>	PM1 / MD1	33	D	CHINA SHIPPING CONTAINER LIN	CHINA SHIPPING SPAIN AGENCY
<input type="radio"/>	PM1 / MD1	33	D	CMA CGM	CMA CGM IBERICA S.A.U.
<input type="radio"/>	PM1 / MD1	33	D	COSCO CONTAINER LINES (COSCO)	COSCO IBERIA S.A.
<input type="radio"/>	PM1 / MD1	33	D	EVERGREEN MARINE CORPORATIO	EVERGREEN SHIPPING SPAIN S.L.
<input type="radio"/>	PM1 / MD1	33	D	HANJIN SHIPPING CO. LTD.	HANJIN SPAIN S A
<input type="radio"/>	PM1 / MD1	33	D	K LINE	K LINE ESP.SERVICIOS MARITIM
<input type="radio"/>	PM1 / MD1	33	D	UNITED ARAB SHIPPING, CO.	UASAC IBERIA S.L.

Page 1 of 1

40

View 1 - 23 of 23

New simulation

Print

Show map

The services table provides the following details:

- **Name:** trade name of the line by shipping company. Click on the name and a window appears with the rotation of the service, indicating ports of call, their LOCODE and the partial TT between each pair. Furthermore (T) indicates the port where any possible transshipment takes place.

LOCODE	PUERTO	TT
CNSHA	Shanghai	0
CNYTN	Yantian	3
CNCWN	Chiwan	4
MYTPP	Tanjung Pelepas	8
ESBCN	Port de Barcelona	23

- **TT:** Transit time, i.e. the time in days between origin and destination.
- **Type:** "D" means that the service is direct; "T" indicates the need for transshipment.
- **Shipowner:** displays the name of the owner of the vessel providing the route. Click on the name to see a list of the next stopovers.

> PRÓXIMAS ESCALAS		
Buque	Fecha Prevista Llegada	Fecha Prevista Salida
MSC BENEDETTA	20/07/2015 23:00	21/07/2015 18:00
MSC EMANUELA	22/07/2015 01:00	22/07/2015 16:00
SWAZILAND	22/07/2015 05:00	22/07/2015 14:00
MOZAMBIQUE	22/07/2015 11:00	22/07/2015 20:00
MSC CAPELLA	27/07/2015 06:00	27/07/2015 20:00
MSC KATRINA	27/07/2015 06:00	27/07/2015 20:00
MOZAMBIQUE	29/07/2015 05:00	29/07/2015 14:00
LESOTHO	29/07/2015 11:00	29/07/2015 20:00
MAERSK KINGSTON	29/07/2015 11:00	29/07/2015 20:00
MSC SAVONA	03/08/2015 06:00	03/08/2015 20:00
MSC IRENE	03/08/2015 06:00	03/08/2015 20:00
MAERSK KINGSTON	05/08/2015 05:00	05/08/2015 14:00
GEORG MAERSK	05/08/2015 05:30	06/08/2015 04:00
ZAMBIA	05/08/2015 11:00	05/08/2015 20:00
ZAMBIA	12/08/2015 05:00	12/08/2015 14:00

[Consultar detalles con el consignatario del buque](#)
[Cerrar](#)

- Shipping agent: indicates the name of the shipping agent of the service. Click on the name to view a window with contact information.

#### > DETALLE EMPRESA

▣ Nombre de la Empresa:	MARITIMA DEL MEDITERRANEO S.A.
▣ Nombre Comercial:	MARITIMA DEL MEDITERRANEO S.A.
▣ Dirección de la Empresa:	ATLANTIC
▣ Extensión de la Dirección:	EDIF. NORAI- ZAL
▣ Población:	BARCELONA
▣ Código Postal:	08040
▣ País:	ES
▣ Teléfono:	932987777
▣ Fax:	932683359
▣ E-mail:	ccdoc@marmedsa.com;mmdoc@marmedsa.com
▣ Web:	http://www.marmedsa.com

- Stevedore: the name of the stevedoring service, linked to the terminal at which the ship will berth.
- Frequency: the frequency of service. The number indicates how many days the stopover will last. For example, 7 indicates a weekly service.
- Unit: indicates the unit of capacity of the vessel (TEU - containers, MLI - linear metres for RORO, VEH - number of vehicles).
- Capacity: indicates the ship size measured in the units indicated in the Unit field.
- SSS: indicates whether the service is considered as Short Sea Shipping.
- FEEDER: indicates whether it is a public feeder service

## 2.2.8. Results and costs

The results tab shows detailed results of the simulation divided by sections and organised into 3 tables.

**Build your transport chain**
✕

Welcome

Transport unit

Hinterland

Foreland

Direction

Inland mode

Port passage

Maritime services

### Results and costs

The following tables show the detailed results for each section of the route and mode (time and distance) CO<sub>2</sub> and pollutant emissions and negative externalities generated by transport. Costs table allows entering the costs associated with each section of the transport chain.

Path
Emissions
Externalities
Costs

	O-D	Service name	Dist.(km)	Time (d)
Road section	Madrid - Abroñigal		4,67	0
Rail service	Abroñigal - Morrot	Renfe	746	0,78
Road section	Morrot - Barcelona		8,28	0
Port passage	Barcelona		2	1,5
Maritime service	Barcelona - Shanghai	DRAGON / AE - 20	18.256	31
<b>Total path</b>			<b>19.016,95</b>	<b>33,28</b>

Blank cells indicate that concept does not apply

New simulation
Print
Show map

- **Route:** shows the origin and destination of each section of the transport chain, the name of the selected rail and maritime service and the distance and transit time of each section.
- **Emissions:** shows the emissions of the route you have built, measured in kg of pollutants.
  - CO<sub>2</sub>eq: is an expression in equivalent CO<sub>2</sub> weight of the global warming potential of the gases emitted by the transport modes. Includes CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>. Measures the impact on climate change.
  - NO<sub>x</sub>: expresses the amount of nitric oxide and nitrogen dioxide emitted by burning fossil fuels. Accumulation of these gases in the atmosphere damages health.
  - PM<sub>2.5</sub>: suspended particles smaller than 2.5 microns produced during combustion of fossil fuels. Inhaling these causes lung and cardiovascular diseases.
  - CO: the carbon monoxide produced in the partial combustion of fossil fuels. It is toxic in high concentrations.
  - NMVOC: non-methane volatile organic compounds, which include a long list of substances present in the fossil fuels and released in combustion gases. These produce a variety of adverse health effects and interact with other compounds such as NO<sub>x</sub> to generate an even greater impact.

- SO<sub>x</sub>: includes a wide variety of sulphur-oxygen compounds. It is associated with respiratory disease and is the cause of acid rain.
- Externalities: shows the externalities associated with each mode of transport measured in EUR.
  - Congestion: a measure of time lost through traffic concentration at certain times of day and certain infrastructure sections.
  - Accidents: more traffic means more accidents, with or without casualties, but in any case with an economic cost.
  - Noise: all modes of transport generate noise that causes discomfort to people.
  - Pollution: fossil fuels used in transport generate a range of substances that cause health problems.
  - Climate change: greenhouse gases (CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>) from burning fossil fuels used in transport have a long-term effect on global warming and climate change.
  - Other environmental impacts: certain pre- and post transport processes directly related to this have an environmental impact. These processes include sending the necessary energy to vehicles (fuel/electricity) known as "well-to-tank emissions" and the manufacturing, maintenance and disposal of the vehicles and infrastructures used in transport.
  - Infrastructure: the marginal cost of infrastructure corresponds to increased maintenance and repairs caused by increased traffic



It also includes a cost tab in which the user can enter transport prices for each section, if available, so that the system can display them along with the other results. To do this, click the pencil icon in each box, enter them and select the "Apply costs" button.

Build your transport chain

Welcome

Transport unit

Hinterland

Foreland

Direction

Inland mode

Port passage

Maritime services

Results

Results and costs

The following tables show the detailed results for each section of the route and mode (time and distance) CO<sub>2</sub> and pollutant emissions and negative externalities generated by transport.

Costs table allows entering the costs associated with each section of the transport chain.

Path

Emissions

Externalities

Costs

Euros (€)	Cost	
Road section	0	
Rail service	0	
Road section	0	
Port passage	0	
Maritime service	0	

Blank cells indicate that concept does not apply

Apply costs

New simulation

Print

Show map

You may print out the results by clicking on "Print".

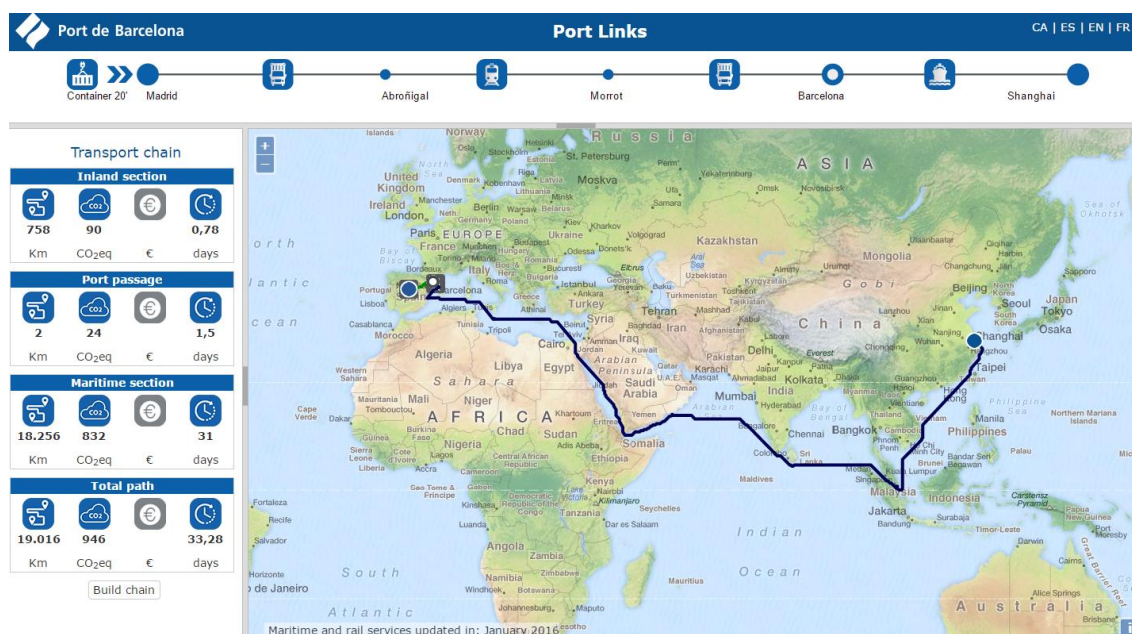
You can use this Results section, and any of the others used to build the transport chain, to start a new chain in which the choices made so far will be cleared. To do this, click on "New simulation".



## 2.3.Results

Once the full route has been built, the user can navigate freely to explore the results. The left column of the screen displays the aggregate results of distance, CO<sub>2</sub>eq, emissions, cost and transit time. The map provides a graphical representation of the route it has built and the results tab of the "Build Chain" wizard shows the detailed results.

Clicking on any element of the upper schema launches the Build Chain window to change the selected item.



### 3. Calculation model

Below is a description of how the various parameters are calculated for each mode of transport (distance, transit time, emissions and externalities) and, if applicable, the simulation model used.

#### 3.1.Oceanic section

Port Links considers the Port of Barcelona's updated offer of regular services, which is also available through the Port's website (<http://www.portdebarcelona.cat/en/web/Port-dels-Negocis/lineas-regulares>).

They take into account the specific characteristics of the selected maritime service, obtained as follows:

- Vessel size in TEU: obtained from the Port of Barcelona's databases based on Lloyd's lists, this information makes it possible to determine the fuel consumption per distance unit and TEU.
- Distance: approximate theoretical value obtained using a maritime simulation graph developed by the Port of Barcelona.
- Stopovers: obtained from the Port's range of regular lines.
- Transit time: obtained from the Port's range of regular lines.

The emission calculation uses a formula involving two variables: vessel speed and size. This formula comes from the Notteboom & Cariou analysis (IAME 2009) and requires information on the vessel's maximum design speed.

Since this data is not available, we have added a statistical regression to determine the maximum design speed depending on the size of the vessel, measured in TEU.

The result is a double entry formula showing the fuel consumption for a given speed and vessel size. A third parameter converts fuel consumption into the various pollutants.

Final consumption per unit transported is increased to simulate the fact that ships are loaded to 80% capacity on average, indicating that there are empty containers or free space remaining on the ship.

While no exact sailing speed is available, the transit time between each pair of ports is known and can provide an approximate value. This transit time includes the hours of the stopover, therefore the sailing speed can be obtained by subtracting stopover time, taken to be 18 hours for all ports. On certain short journeys this may mean that the

calculated speed is abnormally high or abnormally low, therefore two limitations are applied:

- When the calculated speed is under 15 knots, a speed of 15 knots is applied for calculating consumption.
- This maximum rate applies when the calculated speed is higher than the theoretical maximum ship speed design (which depends on the number of TEU that the ship can carry).
- When the speed is over 15 knots and under the maximum design speed, the deduced transit time is applied, subtracting 18 hours for the stopover.

Unit emissions are multiplied by the distance to obtain the total emission volume. This distance is obtained from a maritime graph created by the APB to find the optimal route between two ports.

## 3.2. Overland section

The overland journey takes into account the road and rail sections.

### 3.2.1. Road

Road journeys are calculated using the [www.yournavigation.org](http://www.yournavigation.org) router on Openstreetmap (Open Source software), which obtains the optimal route between two points on the current road network in Europe. It assumes an average speed of 80 kph and adds resting time in accordance with EU legislation, adding 14 hours rest time for every 10 hours of driving.

The COPERT IV formulation model (the base for the CORINAIR methodology) is implemented for road transport. This formula relates fuel consumption to speed, type of technology, size of the lorry and level of load and makes it possible to use up to 84 different types of vehicle. The user can choose the desired lorry from a drop-down list.

This is how emissions are calculated according to the fuel consumption of the chosen vehicle, which is then multiplied by 3.14 (average carbon content of diesel fuel for lorries, according to CORINAIR data).

Other pollutants are obtained directly with the formulas provided by the COPERT IV model.

Consumption is increased to simulate the fact that the lorries are loaded to 75% capacity on average, indicating that empty runs are made.

The emission factors are multiplied by the distance to obtain the total emission volume.

This methodology is applied both to haulage and long-distance trucking.

### 3.2.2. Rail

Port Links considers the Port of Barcelona's updated offer of regular services, which is also available on the Port's website <http://www.portdebarcelona.cat/en/web/port-dels-negocis/lineas-ferroviarias>.

Rail services are allocated on a railway graph created by the APB, based on the European Commission's TRANSTOOLS Geographic Information System, to obtain the distance travelled. This simulated journey is an approximation of the actual journey, since the rail freight operation does not always follow the logic of the shortest route and depends on the availability of slots that is often marked by passenger traffic and road maintenance operations.

The travelling speed for the simulation is 60 kph, although actual speeds will be included as rail service schedules are confirmed.

To calculate the emissions, it is hypothesised that rail-generated emissions come from indirect sources. This means that all transport is performed using electrical-powered trains, but part of the electricity comes from renewable sources.

First, we obtain the data of 0.028 kWh/tonne-km, using LIPASTO (an emission calculation methodology developed and applied in Finland ([http://lipasto.vtt.fi/yksikkopaastot/tavaraliikenne/raideliikenne/junat\\_konttie.htm](http://lipasto.vtt.fi/yksikkopaastot/tavaraliikenne/raideliikenne/junat_konttie.htm))). This value applies to a full container freight train and the model assumes that the trains are always full. This information is obtained on the basis of trains running in Finland, but is the only data available therefore it is assumed that container trains have characteristics that can be extrapolated to the rest of Europe.

As regards CO<sub>2</sub>, we apply a value of 0.3622 kgCO<sub>2</sub>/KWh (2007 data) obtained from the European Environment Agency (average emissions per kilowatt-hour of electricity generated in EU27, sourced from (<http://www.eea.europa.eu/data-and-maps/indicators/ener002-co2-intensity-of-heat/assessment>)).

Unit emissions are multiplied by the distance to obtain the total emission volume.

Because the consumption is obtained from kWh per tonne transported, containers must be converted to tonnes. It is assumed that containers (TEU) transport 10 tonnes on average, a value obtained from freight statistics at the Port of Barcelona.

### 3.3.Externalities

Transport generates environmental impacts, accidents, congestion and infrastructure wear and tear. In contrast to the benefits of transport, the costs of these negative effects are not borne by the user.

Users do not therefore take these negative factors into account when making decisions about transport externalities.

To ensure that externalities are internalised, the European Commission has developed a methodology to assess their impact economically.

This methodology, which is updated regularly (last update 2014), includes the following externalities:

- Congestion: traffic concentration at certain times of day and certain infrastructure sections causes significant losses in passenger and freight time.
- Accidents: more traffic means more accidents, with or without casualties, but in any case with an economic cost.
- Noise: all modes of transport generate noise that cause discomfort to people.
- Pollution: fossil fuels used in transportation generate a range of substances that cause health problems.
- Climate change: greenhouse gases (CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>) from burning fossil fuels used in transport have a long-term effect on global warming and climate change.
- Other environmental impacts: certain pre- and post transport processes directly related to this have an environmental impact. These processes include sending the necessary energy to vehicles (fuel/electricity) known as "well-to-tank emissions" and the manufacturing, maintenance and disposal of the vehicles and infrastructures used in transport.

- Infrastructure: the marginal cost of infrastructure corresponds to increased maintenance and repairs caused by increased traffic

The methodology used to calculate these externalities is the same for all modes of transport and involves applying the unit values provided by the Commission's Marco Polo calculator to provide an economic assessment of the transport externalities per tonne transported and kilometre travelled. The latest version of the guide can be found at <http://ec.europa.eu/transport/themes/sustainable/studies/doc/2014-handbook-external-costs-transport.pdf>.

The values applied in Port Links are averages extracted from the guide and are summarised in the following table by mode of transport. They are measured in EUR cents per TEU and kilometre:

Externality	Road	Rail	Maritime
Congestion	11.3	0.2	0
Accidents	0.6	0.4	0
Pollution	1.25	0.8	0.0004
Noise	28	0.9	0
Climate change	4.15	0.415	0.0004
Other environmental impacts	1.8	3.62	0.0001
Infrastructure	2.4	0.9	0
<b>Total</b>	<b>49.5</b>	<b>6.82</b>	<b>0.0009</b>

Table 1: Cost of externalities in EUR cent/TEUkm