Increasing Intermodal Transportation in Europe through Realizing the Value of Short Sea Shipping

by

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ABSTRACT

This thesis describes the role of short sea shipping within the transportation network in the European Union. It examines the existence of externalities relating to congestion, infrastructure, air pollution, noise, and accidents in the transportation sector. It evaluates the level of these externalities and also their effects on the Community. It then explains current attempts to internalize these factors, or incorporate them into the cost of transportation that the user pays. It concludes that current efforts are lacking and do not produce the most beneficial situation for the citizens of Europe. Consequently, the thesis investigates other possible methods of internalization that may produce more advantageous results and analyzes their possible effects on the transportation sector.

The value of short sea shipping is examined in regards to the previously mentioned externalities. It concludes that, with the exception of the emission of sulfur dioxide, maritime transportation outperforms other modes of transportation by producing relatively few external effects. The current status of the short sea shipping industry is then described, followed by a discussion of intermodal transportation and the initiative within the European Community to increase the use of intermodal transportation. Two case studies are then reviewed, which demonstrate the economy of intermodal transportation solutions compared to all-road alternatives.

The thesis concludes by summarizing the benefits of short sea shipping. Some of the obstacles which prevent the realization of the full potential of short sea shipping are discussed. Suggestions for improving the current situation are included as well as a description of some of the measures adopted by the European Commission to increase the use of short sea shipping as an alternative to road transportation.

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1. Introduction

An efficient transport system is essential to the economic growth and competitiveness of a society. It is necessary to ensure the movement of goods to market and to provide individuals with the freedom to participate in their required and voluntary activities. An inefficient transportation system can lead to economic losses, a reduction in overall competitiveness, and frustration for users. The increased mobility of its citizens and the growing demand for freight transportation resulting from the removal of barriers within the European Union has put strains on the current transportation network; increasing congestion, accidents, air pollution, and other externalities are becoming serious problems. Consequently, transportation policy within the EU is at a crossroads. Member States and citizens alike are calling for broad changes to reduce the negative affects of transportation across the Union (Kinnock i).

The problems with transportation in the European Union have become impossible to ignore. "Increasing transport delays have brought down travel speeds in a number of major European cities to levels which prevailed in the age of horse drawn carts," (Kinnock 1). Problems with air pollution in the summer due to surface ozone, especially in urban areas, are restricting the amount of outdoor activities that can be enjoyed by citizens across Europe. Tragically, thousands of people die each year in the European Union from particulate matter, another form of air pollution. The number of road accidents is increasing along with the increase in transportation demand; it is now the major cause of death for people under the age of 40 (Kinnock 1).

These adverse effects of transportation create not only social disturbances, but also economic losses. Over 4% of the GDP of the European Union is lost annually due to transportation related problems. Congestion is estimated to cost 2% of GDP resulting from losses in productivity and efficiency. The cost of accidents accounts for another 1.5% of GDP and air and noise pollution are responsible for another 0.6%; the total of these combined factors amounts to nearly 250 BECU annually. Road transportation is responsible for 90% of these costs. Therefore, the main strategy of the European Union is to affect a modal shift in transportation trends by creating a more fair and efficient pricing system for transportation (Kinnock i).

The current pricing system for transportation does not account for all of the costs associated with a user's transportation decision. This results in inefficiency in the market system because the user's choice is not based on true costs and is therefore skewed. It also creates an unfair situation because society is forced to absorb costs not paid by the user. Reconstructing the pricing system for transportation in a way that better associates the true costs of transportation with the user who generates them will result in an efficient and fair market system. Individuals will be forced to make decisions that take into account the good of society as a whole rather than just their own convenience.

Incorporating total costs into the price of transportation should result in a shift in transportation demand between modes. Certain modes of transportation, such as rail and maritime transportation, are considered 'green modes' because their effects are less detrimental to the environment. These modes produce less pollution, less noise, and account for fewer accidents. As a result, the European Union is eager to see these transportation modes used more extensively both for passenger and freight transportation. The intent is that with increased use of alternative, i.e. greener, modes, the problems with congestion in the Union will subside and society will reap the benefits of an improved environment.

In the hopes of encouraging intermodal shifts, the European Union has established a variety of programs to facilitate intermodal transportation. The TEN-T programs were created to complete the trans-European transportation network and to improve the transportation possibilities for alternatives to road transportation. One of the key projects within this program is the "motorways of the sea", which are shipping routes that are intended to replace commonly used road routes. Due to the nature of maritime transportation, its penetration into the continent is limited. It is therefore necessary that short sea shipping be combined with other modes to create door-to-door intermodal transportation options. Studies have shown this to be a cost-effective and environmentally friendly alternative to freight transportation on roads.

Short sea shipping is already a viable alternative, in many situations, to road transportation. The fact that the externalities associated with this mode are very small increases its attractiveness. As the European Union continues to make efforts to create a more fair and efficient pricing system for transportation, the use of short sea shipping will increase. The first step in this process is to identify and quantify the externalities of transportation in order to include them in the costs users pay for their transportation.

2. Externalities of Transportation

The existence of externalities in transportation is at the heart of the debate concerning transportation policy in Europe. They are directly linked with the concept of pricing because externalities create inefficient and unfair pricing situations in the transportation sector. The exclusion of some factors distorts the total price of transportation and can therefore make some modes appear to be more attractive than they really are, thus putting green modes of transportation at a disadvantage. Consequently, the European Union has developed several task forces to identify and quantify externalities of transportation and to determine how they affect society as a whole. There are many external costs associated with transportation, but the main factors include congestion, infrastructure, noise, air pollution, and accidents. The following sections will first provide a definition for externalities of transportation and then examine each of these factors in detail and discuss how these factors affect society in relation to various modes of transportation.

2.1 Definition of Externalities

"Transport externalities refer to a situation in which a transport user either does not pay for the full costs (e.g. including the environmental, congestion or accident costs) of his/her transport activity or does not receive the full benefits from it" (Kinnock 4). All transportation activities provide benefits as well as costs to society as a whole. The internal costs are costs that the user pays for directly such as fuel and tolls. The external costs are costs that the user does not pay directly, such as the damage their activity causes to the environment or costs associated with the infrastructure being used. The internal and the external costs combined are referred to as the social cost of the activity. When society is forced to pay for the ill effects caused by individual users, this is unfair and goes against the 'polluter-pays-principle' adopted by the European Union and recorded in the Treaty (Article 130 R2) (Kinnock 4). It is therefore implied that internalization of transportation costs as a principle should be upheld and enforced within the EU.

Removing externalities in transportation, or making the user pay for all the costs associated with his transport decision, is not only part of the EU's political agenda, but it is also necessary for an efficient economy. In a market economy, where prices are set by supply and demand, it is crucial that all possible costs are internalized otherwise consumers will base their decisions on incorrect information. This creates a system which does not provide the maximum benefit to society (Kinnock 5). As an example, in a market economy a manufacturer can choose between different modes of transportation to ship his product. The manufacturer will base his decision on a combination of factors including time to market and the direct costs incurred for the transportation, such as fuel and operator wages. Under the current pricing system which doesn't incorporate many factors into the overall cost, road transportation will likely appear to be the most economical choice. However, if costs for the pollution created by the truck during transport, the deterioration of the infrastructure due to the truck, and the added congestion were incorporated into the price of the road transportation, the overall cost of using road transportation would increase, causing the manufacturer to reevaluate his transport decision. It is evident from this example that without internalization of costs, the manufacturer will benefit from a lower price, but the negative effects on the infrastructure, environment, and added congestion will have to be absorbed by society.

Consequently, this is not efficient because it does not produce the greatest amount of good for society as a whole.

The internalization of external costs is not intended to increase transportation costs; instead it aims at making the appropriate person pay for all the costs associated with his transportation decisions. Although the direct costs for some modes of transportation may increase, this will be compensated by lower taxes for road maintenance and health care. These taxes have formerly been inflated due to the need to offset the lack of user fiscal responsibility for problems such as wear and tear of infrastructure and health problems related to air pollution. Congestion is another problem for which users are not presently held accountable.

2.2 Congestion

Congestion is currently an extensive problem across Europe, especially in regards to road transportation, and forecasts for the future look bleak. Traffic jams are huge problems in most urban areas and also on some key continental highways, causing enormous delays and loss of productivity. The estimated cost of congestion in the European Union is roughly equal to 2% of the GDP, or 120 Billion ECU (Kinnock 14). In the past, economic growth has corresponded directly to transportation growth. This implies that for the economy of the EU to grow, the demand for transportation will grow, resulting in increased congestion. The European Parliament has identified this as a threat to the Union's economic competitiveness and has consequently adopted several measures to tackle this problem.

In addition to economic growth, changes in logistic strategy have also contributed to the congestion problem. Opening the markets across Europe has enabled products to be manufactured in different regions than their final assembly location, which adds to the transportation needs for each product. The change over the last 20 years from a 'stock' to a 'flow' economy has increased transportation requirements as well. The emergence of the 'just-in-time' or 'revolving stock' logistics strategy has put additional strains on transportation networks (European Communities). This combination of factors has caused congestion to become the most important external factor for pricing.

Congestion is an external factor because the effects of a user's transportation decision can cause greater congestion problems than those experienced solely by the user. For example, a user who loses 10 minutes of their own time in traffic may cause others to suffer a loss in excess of 45 minutes in delays. This means that the user is underestimating the true costs of their decision (Kinnock 10). What makes the problem more severe is that the impact of each user is more than proportional, meaning that a small increase in vehicles can significantly reduce the overall traffic flow.

Congestion is the result of the fact that there is scarcity associated with the transportation network. This means that there is a limit to the amount of users who can employ the existing infrastructure at a given time. In the present situation there is no way to differentiate between the value of the time users associate with their use of the infrastructure. For instance, an executive who is trying to make it to an important business meeting would place a higher value on the time he spends in traffic delays than someone who is going to the grocery store and has no schedule to maintain. This leads to a market failure because there is no competitive way to deal with the scarcity of the resource. The result is that there is an inefficient use of resources and a negative effect on society as a whole (Kinnock 12-13).

Road transportation is not the only mode that suffers from congestion problems. Rail networks experience congestion for several reasons. Bottlenecks exist in several locations in Europe, specifically in the passes through the Pyrenees and the Alps. These bottlenecks create delays and problems with scheduling. The potential for delays increases as usage increases because there is a lack of recovery time in the system to absorb delays, therefore the delay experienced by one train will be passed on to additional trains throughout the system (Adler 11). With hub-and-spoke networks, such as air and water transportation, congestion can occur at the nodal points. The scarcity associated with air transportation occurs in runway capacity (number of take-offs and landings allowed per hour), terminal capacity (the number of people who can occupy the terminal), apron capacity (the number of planes that can be served at a given time), air traffic control capacity (the number or aircraft that can be monitored by the ATC), and gates (the number of planes that can access gates at a given time) (Adler 26). Water transportation experiences similar delays connected to port capacity (Adler 40).

2.3 Infrastructure

The problems associated with infrastructure are closely linked to congestion; as previously stated, it is the scarcity of infrastructure that causes congestion. There are two types of infrastructure costs that need to be internalized: capital costs and operating and maintenance costs.

Capital costs deal with the provision of transportation infrastructure and are thereby linked with congestion. Infrastructure is designed to operate at a specific capacity and when that capacity is exceeded, problems with congestion occur. The addition of infrastructure is usually regarded as the solution to congestion problems. However, there is a limit to the amount of infrastructure that can be supplied and it is therefore not a sustainable solution to congestion problems. Typical capital expenditures include port and airport installations as well as the construction of road, rail, and inland waterway networks. A contingent cost of the creation of infrastructure is the effects on the environment. It can create a disturbance of ecosystems and can also be unsightly and obtrusive to urban and residential neighborhoods (Kinnock 10, 11).

The second category is operation and maintenance costs. These expenses are the result of a combination of traffic and weather conditions. For example, heavy traffic flows can expedite the deterioration of pavement on roads, but so can excessive snow and ice, which require deicing measures such as salt that corrode the infrastructure. The maintenance costs associated with road transportation include repaving the roads and maintaining the proper signage. Inspecting and repairing rails are the expenses associated with rail transportation. Maintaining runways and aprons at airports are costs for air traffic and dredging rivers and harbors are operation costs for water transportation.

It is important to distinguish between the two categories of costs because the pricing for each is very different. One opinion states that "there is no reason to make users pay annually for the investment costs that were incurred in a particular year" (Kinnock 10). It is generally accepted that users should pay for the maintenance and operation costs of the infrastructure, therefore this cost category should be internalized (Kinnock 10).

2.4 Noise

Most European people, especially in urban and mountain areas, consider noise resulting from traffic and industrial activities to be their main environmental problem. With the increase in the number of vehicles, especially on the roads, the amount of noise has increased dramatically. Traffic noise is the worst kind of noise type among other noise sources such as industrial and recreational activities (Kinnock 34). Noise disturbances are increasing across Europe due to increases in traffic volumes. More and more Europeans are suffering such nuisances as sleep disturbance, loss of concentration, and even psychological disturbances and mental damages due to the noise problems associated with transportation (Rothengatter et al 8).

The problem with noise is very widespread. Recent studies in the European Union have indicated that 20% of citizens experience traffic noise above acceptable levels, which is defined as 65 dB (A). The World Health Organization states that noise levels in the range of 55-65 dB (A) can cause serious annoyance and another 170 million Europeans experience noise at these levels. The majority of the noise problems experienced are caused by road traffic. Surveys reveal that 19% of citizens in Europe are exposed to extreme noise caused by road traffic while 1.7% are exposed to rail related noise and 1% experience noise caused by air traffic. In the past couple of decades legislation has reduced the number of people affected by unacceptable noise levels, but the number of people experiencing noise in the 55-65 dB (A) range is increasing, due to the increase in traffic flows (Kinnock 34). Several abatement measures exist to combat the noise, such as noise walls and noise protection windows, however these do not produce ideal results. Noise walls create landscape obstructions and noise protection windows are only effective when closed, which can be a severe inconvenience (Rothengatter et al 8).

There are various factors that influence the amount of noise created by traffic and multiple methods for determining the extent of the noise. Factors that affect the level of noise for road transportation include the volume of traffic, the speed of traffic flow, the types of vehicles, the road surface, and the gradient or curvature. For rail, the factors include volume of trains, whether the cars are passenger or freight carriers, the types of breaks, the curvature, and the average speed. The level of noise for air traffic is mostly controlled by the volume of traffic, type of aircraft, and the altitude of the planes. Water transportation, both short sea shipping and inland waterways, is not identified as a source of noise. There is a linear relationship between the volume of traffic flow and the level of noise; if the traffic flow doubles, the increase in the noise is 3 dB (A). For road transportation, people note that truck or freight vehicles and motorcycles create the most noise disturbance. The affect of the number of heavy good vehicles (HGVs) is contradictory, however. An increase in the percentage of HGVs creates more noise because they are louder than passenger vehicles, but HGVs are also known to lower the flow rate of the traffic, which reduces the overall noise level (Rothengatter et al 10). Below is a chart that summarizes the main noise factors associated with road, rail, and air transportation.

Characteristic of noise source	Influencing parameters of the transport systems		
	Road	Railway	Air
Loudness and energy	- traffic volume - traffic mix - mean speed - road surface	- number of trains - share of freight trains - average speed	- operation phase (start, landing, flight) - altitude above ground
Frequency or sonority	- traffic mix - average speed	- share of freight trains - type of breaks - curvature (gradient)	- type of aircraft
Variability over time	- traffic volume - curvature (gradient)	- traffic volume	- traffic volume

Figure 2.1 Factors Influencing the Characteristics of Transport Noise (Rothengatter et al 9)

Noise disturbances correlate to financial losses and they are therefore an external factor that should be internalized into the total cost of transportation. One such cost is the reduction in property value near high traffic areas. This is a cost that must be unfairly absorbed by the property owner who is not at fault. Noise can also create medical costs for treating the psychological and mental damages that result from excessive exposure to noise. Sleep disturbance and loss of concentration can result in a loss of productivity, which influences the European economy. Costs are also associated with the abatement measures such as noise walls and noise protection windows (9). These costs combined account for .6% of the European Union's GDP (Kinnock i). According to the INFRAS/IWW (1995) study, the cost of noise was 12.7 ECU/1,000 tkm in road haulage and the cost for rail freight transport was 4.7 ECU / 1,000 tkm (Rothengatter et al 13). Figure 2.2 below shows the costs per person of noise in several locations within the European Union.

	Currency	Year	Noise Costs per capita and year				Share of Income			
			55-60	60-65	65-70	>70 dB(A)	55-60	60-65	65-70	>70 dB(A)
Sweden, NRA [1]										
WTP [2]	SEK	1993	150	600	1500	3000	0,09%	0,35%	0,88%	1,76%
CBA[3]	SEK	1985	270	1080	2700	5400	0,24%	0,96%	2,40%	4,79%
Finland	FM	1990	617	1000	2450	4900	0,62%	1,01%	2,48%	4,96%
ECOPLAN / Iten	SFR	1990		708	1500	2400		1,18%	2,50%	4,00%
IRER	SFR	1990		525	875	1225		1,23%	2,05%	2,87%
Hansson, Markham	ECU	1992	26	41	65	494	0,16%	0,26%	0,41%	3,09%
Weinberger, Willeke	DM	1990	300	432	564	828	0,86%	1,23%	1,61%	2,37%
MacKenzie (USA)[4]	US$	1992	85	170	255	340	-	-	-	-

Figure 2.2 Noise Costs per Exposed Person Used in Different European Studies (Rothengatter et al 12)

2.5 Air Pollution

Air pollution is a global problem and a major concern in the European Union, the focus being largely on transportation and energy production, which are the two largest burners of fossil fuels. The emission of air pollutants is an externality because it has a negative effect on the environment; if these emissions were harmless to the health of society, buildings, or vegetation there wouldn't be an externality. However, society's health is extremely affected from high-level concentrations of air pollutants. Estimates made by the OECD place the cost of air pollution due to transportation at .4% GNP. This number could be lower than the actual cost by orders of magnitude because the study failed to fully account for the effects on public health. The estimate also excludes the costs associated with greenhouse gases that contribute to global warming (Kinnock 28).

The effects of air pollution occur at three levels: local, regional, and global. Local pollution has major impacts on public health. The compounds associated with local pollution includes: nitrogen oxides (NOx), particles, carbon monoxide (CO), volatile organic compounds (VOC's), sulphur oxides (SOx), and ground level ozone. "In most

Member States of the European Union the major share of carbon monoxide (CO) and oxides of nitrogen (NOx) emissions come from transport (around 69% and 63%, respectively)" (Kinnock 27). Local air pollution can cause minor irritations, but some substances also exhibit carcinogenic qualities. The most obvious perceptible impacts of these pollutants consist in higher mortality and morbidity among the population affected, which result in higher material costs for health care (in the case of morbidity) and immaterial costs for human suffering, making air pollution an externality of transportation (Rothengatter 15).

Regional impacts of air pollution result from many of the same compounds as local air pollution, but specifically sulfur dioxide and nitrous oxides, which are the major causes of acid rain (http://www.epa.gov/docs/acidrain/#what). The impacts of these emissions are "material damages on buildings' surfaces and structures, cleaning costs, the loss of biodiversity and the destruction or deformation of genetic material in the case of impacts on flora and fauna" (Rothengatter et al 15). Across Europe, acid rain is responsible for the deterioration of many historical and culture structures, which is a loss to civilization and an external cost of transportation.

Global air pollution affects the overall world climate and occurs from the emission of "greenhouse gases". These greenhouse gases include CO_2, CH_4 (methane), N_2O (nitrous oxide), and O_3 (ozone). The main contributor being carbon dioxide, or CO_2, which accounts for over half of the total greenhouse gases (http://www.oecd.org/dataoecd/33/8/2055676.pdf). It is very difficult, however, to measure the effects of a single user's emissions on the overall global climate and then to determine its fiscal value. This is true because unlike the gases that cause local and regional air pollution, "CO_2-emissions have much wider consequences in terms of time and space. The chain of impacts from the actual emissions to the final impacts has been acknowledged to span over decades, as the emission is a flow variable, adding to the concentration of CO_2, a stock variable" (Rothengatter et al 18). This creates a problem that must be solved before the full effects of air pollution can be internalized.

Figure 2.3 shows the extent of air pollution due to road transportation in Member States and the corresponding financial losses. Figure 2.4 contains the cost of CO_2 emissions for rail transportation in various European countries.

	Road			
	m v-km	ECU/ 1000 v-km	m t-km	ECU/ 1000 t-km
Austria	5,200	22.0	13,100	8.73
Belgium	5,700	40.9	26,000	9.05
Denmark	6,300	23.0	10,400	13.94
Finland	5,400	10.4	23,800	2.35
France	105,000	15.7	148,000	11.13
Germany	44,600	38.2	203,000	8.40
Greece	3,400	65.1	12,300	17.88
Ireland (Rep.)	5,000	10.9	5,100	10.79
Italy	45,500	30.1	167,000	8.20
Luxembourg	400	22.1	800	11.63
Netherlands	12,900	24.9	23,300	13.83
Norway	3,100	20.3	7,690	8.29
Portugal	2,000	34.5	10,900	6.39
Spain	24,200	43.8	150,000	7.05
Sweden	5,100	16.1	25,400	3.24
Switzerland	4,900	16.9	12,800	6.48
UK	60,000	27.8	125,000	13.37
EUR 17 (weighted av.)		**23.2**		**10.25**

Figure 2.3 Air Pollution Damage Costs of Road Freight Transport (Rothengatter et al 17)

	Mill. t Carbon[1]	Cost (MECU)	Mill. train-km	ECU/train-km
Austria	0.187	34.3	130	0.25
Belgium	0.142	26.05	92.3	0.30
Denmark	0.171	31.35	54.7	0.55
Finland	0.074	13.55	40.1	0.35
France	0.461	84.50	478	0.20
Germany	1.608	294.80	847	0.35
Greece	0.038	6.95	16[2]	0.45[2]
Ireland (Rep.)	0.032	5.85	13.7	0.45
Italy	0.766	140.45	304	0.45
Luxembourg	0.009	1.65	5.3	0.30
Netherlands	0.226	41.45	118	0.35
Norway	0.025	4.60	32.4	0.15
Portugal	0.107	19.60	36.5	0.55
Spain	0.358	65.65	173	0.40
Sweden	0.035	6.40	95.9	0.05
Switzerland	0.012	2.20	131	0.00
UK	0.977	179.10	428	0.40
EUR 17 (weighted av.)	-			**0.32**

Figure 2.4 External Cost of CO_2-emissions, Rail Transport, per train-km (Rothengatter et al 19)

2.6 Accidents

Transportation accidents in the European Union result in not only economic losses, but human tragedy. The recorded number of citizens whose health is affected yearly by transportation accidents is 50,000. However, this number may be low due to a lack of accurate documentation. It is estimated that up to 3 million people in the EU suffer slight or severe injuries from transportation accidents, mainly road traffic accidents. Due to the human nature of the associated costs, it is difficult to provide an exact monetary value of these accidents, but some studies place the total as high as 2.5% of the GDP. The medical, administrative, and damage reparation costs come to 15 Billion ECU. If the future loss due to deaths and permanent injuries is added, that total comes to

15 Billion ECU. In addition, surveys have indicated that citizens are willing to pay 100 Billion ECU in order to prevent these accidents (Kinnock 21-23).

These numbers demonstrate the greatness of the accident problem in Europe in economic terms. The costs are great, but not all of them are external; some are already paid for by specific users and therefore do not need to internalized. The main cost categories associated with transportation accidents are damage of property, administrative costs, medical treatment, costs of recovery, production losses, and human suffering (Rothengatter et al 3). Of these factors, the damage to property, including the vehicles and public or private property, such as infrastructure, is usually covered by personal insurance, thereby classifying it as an internal expense. In addition, part of the medical expenses is normally covered by the user's insurance policy, but the rest must be absorbed by the public health system, making this factor partially an external and partially and internal cost. Altogether, the external costs account for 60% of the total expenses, or 1.5% of the European Union's GDP (Kinnock 23).

The fully externalities include administrative costs, costs of recovery, production losses, and human suffering. The administrative costs include the costs of policy and the administration of justice, as well as the administrative aspects of the insurance company, which are divided among all policy owners. Any expenses incurred after a victim leaves the hospital are classified as the costs of recovery. This could also include the cost for an employer of hiring a new employee in the case of a fatality. A fatality or injury also causes a reduction in the future productivity of an economy, which is an additional external cost. The value of this cost is calculated by multiplying the number of years lost by the average per capita income. Traffic fatalities are the number one cause of death for people under the age of 40 in the European Union. "A road accident fatality on average represents 40 lost years whereas death from cancer represents 10.5 lost years and death from cardio-vascular disease 9.7 years" (Kinnock 23). This shows that traffic accidents are very dear in terms of loss of production. The cost of human suffering is difficult to quantify, but the 'willingness to pay' or 'avoidance concept' can be used to approximate. As stated previously, citizens would be willing to pay 100 Billion ECU to avoid accidents.

In terms of modes of transportation, road transportation accounts for the largest componcnt of transportation accidents. The proportion of fatalities and casualties occurring in road transportation is nearly 99%. In 1993 the number of fatalities and casualties were 47,800 and 3,300,000 respectively. The average number for rail transportation was only 600 and 1300. The aviation sector witnessed only 18 fatalities and 6 casualties in 1994. The numbers for inland waterways and short sea shipping were negligible. Figure 2.5 shows the occurrences of fatalities and casualties per mode of transportation (Kinnock 22).

	Fatalities	Casualties	Fatalities per billion passenger kilometres		
			EU average	MS with lowest risk	MS with highest risk
Road (1993)	47,800	3,300,000[a]	13	6	118
Rail (average 88-92)	600[b]	1300	2	1	10
Aviation[c] (1994)	18	6	0.5	-	-
Inland waterway & maritime	na	na	0.5[d]	-	-

Source : Commission Services

a) adjusted for under reporting
b) no railway personnel, 50% of accidents at level crossings are included
c) only commercial aviation
d) based on UK statistics

Figure 2.5 Fatalities and Casualties in Transportation by Mode (Kinnock 22)

2.7 Summary

Externalities in the transportation sector are costs not paid directly by the user who generates them. The main identified externalities of transportation are congestion, infrastructure, noise, air pollution, and accidents. Road transportation accounts for the vast majority of these problems. Other than air pollution, specifically sulfur dioxide, there are very few externalities associated with short sea shipping. This implies that internalizing externalities of transportation will increase the attractiveness and competitiveness of short sea shipping.

3. Current Internalization Practices

Once the externalities associated with transportation have been identified and quantified, the next step is to develop a means of internalizing the costs and making the user responsible for them. Currently, users only pay a limited amount of the total costs of transportation.

Attempts to internalize costs are not uniform throughout the European Union, which creates unfair competition within the transportation sector. Internalization is also non-uniform across modes of transportation and for different externalities. The following sections discuss current measures intended to internalize costs for congestion, infrastructure, noise, air pollution, and accidents.

3.1 Congestion

In the past there has not been any explicit charging for congestion. However, on some toll roads the fares were increased during peak travel times. Since congestion is mainly a problem in urban areas, most of the measures to combat congestion occur in cities and are mostly regulatory in nature. Some means of deterring drivers from entering congested areas include parking restrictions, subsidies for public transport, and land use decisions intended to fight congestion (Kinnock 17). However, a breakthrough in congestion charging occurred on February 17, 2003.

Ken Livingstone, Mayor of London, announced on July 10th, 2001, that a new congestion charge of £5 per day would be imposed on motorists entering the identified congestion area of downtown London. He stated, "My transport strategy will radically improve and expand public transport, and take strong measures - including congestion charging in central London - to reduce the traffic congestion which blights the city," (http://www.businesseurope.com/cmn/viewdoc.jsp?cat=fn&docid=BEL1_News_0000002157). The goal of this congestion charge was to reduce the amount of road traffic by 10-15%, resulting in an even greater decrease in traffic delays. These traffic delays cost London businesses an estimated £4 million (€6 million) per week. The implementation of the plan included the installation of 203 enforcement cameras that monitor every lane of traffic on roads entering and exiting the congestion zone. The system is 85% effective in identifying and billing vehicles that enter the zone (http://cars.msn.co.uk/carnews/congestioncharging/Default.asp). This technology cost £200 million (€3 million) to set up and around £80 million (€120 million) per year to operate. However, it is expected that the fees collected will raise £130 million (€190 million) per year. This money is then to be invested in improvements to the public transportation system (Hoadley 2).

After one year of operation, the system appears to be highly successfully. The goal for the reduction in overall traffic was just surpassed with an average reduction of 16%. This resulted in a 30% decrease in traffic delays (Monaghan http://www.citymayors.com/report/congestion_charge.html). Although the results are restricted to one European city, the implications reach much further. Many cities were waiting to see the results of this "experiment" in London before committing to a congestion charging plan for their own high traffic zones. Deloitte Consulting recently completed a survey of cities within Europe to determine the overall position on congestion charging. Out of 47 survey responses, 72% of the municipalities were either interested or already pursuing the implementation of congestion charging schemes. The majority of responses indicated that congestion charging must first occur on a local level, but several comments were received about the eventual need of regional and national co-operation. Although some participants indicated that it was too early to judge by the London experiment, 32% indicated that looking at London increased the desire to pursue congestion charging (http://www.cwnewsroom.de/data/attachments/101062.pdf). This represents the impetus for a very significant change in current congestion charging policy.

3.2 Infrastructure

Within the European Union there is no standard method for the internalization of infrastructure costs. The two main vehicles for infrastructure charging are annual vehicle taxes and fuel excise duties. However, "Minimum levels of annual circulation taxes and maximum levels for road user charges are laid down, for commercial vehicles, in Community law. Minimum rates of fuel excise duties are also laid down," (Kinnock 17). Within these bounds, the actual rates still vary significantly between countries. For instance, the annual vehicle tax for a 38 ton HGV in Germany is 2676 ECU while the cost in Italy is only 711 ECU. This prohibits perfect competition because haulers from countries with higher taxes are at a disadvantage when seeking competitive contracts. Consequently, an effort needs to be made to reach conformity for minimum rates between countries (Kinnock 18).

Even after reaching conformity, these tax mechanisms will still fall short of charging the appropriate costs per user for transportation externalities. This is due to the fact that there is only a poor correlation between taxation and actual deterioration of infrastructure. The annual vehicle tax is independent of infrastructure usage and the fuel taxes do not correlate directly to distance traveled either. In road transportation, the evidence shows that these taxes and duties provide more than sufficient funds to cover the costs of infrastructure maintenance. The cost of maintenance for roads averages some 1.0% of GDP in the Union, while the total tax revenues from road users (tolls and vehicle and fuel taxes) equal 2.0% of GDP (Kinnock 18). Infrastructure is still considered an externality, however, because the costs are not paid fairly by the users. This is due to the 'fourth power rule', which states that "the damaging power of a vehicle axle on paved roads is approximately proportional to the fourth power of its axle weights," (Nash et al 6). The rule implies that heavy vehicles cause a drastically larger proportion of road damage than passenger vehicles, the damage of which is nearly insignificant. Consequently, passenger vehicles end up subsidizing the damage to infrastructure incurred by HGVs. These facts relate specifically to road transportation but similar distortions occur in other modes as well.

Because the rail networks are still largely publicly owned, government subsidies prevail. The result is that the users for the networks are not forced to pay the true costs of their transport; in fact, a recent study revealed that the average rate of infrastructure cost recovery in Europe was only 56%. Some of these costs are paid by Member States to ensure that certain public services are available (Kinnock 19). The extent of subsidization is dissimilar for all countries, though. For example, there is currently no charge for rail usage in the Netherlands. In Sweden there exists a form of short-run marginal cost pricing and in Germany and Britain there are commercially based (but regulated) charges. As deregulation and liberalization of the rail systems continue, it is predicted that the trend will move towards competitive pricing that incorporates more infrastructure prices (Nash et al 21).

In air transportation there is still a large degree of subsidization as well. Governments subsidize airport facilities and in some cases support national airlines. Although there are taxes and fees associated with landing and take-off, passenger charges, and charges for the various services offered, these generally have little bearing on the final user cost and therefore do not force consumers to base their transport decisions on all the internal and externalities. The infrastructure costs for short sea shipping, specifically port usage charges, are problematic as well. Current pricing practices have been largely based on "empirical intuition" and past trends, resulting in severe undercharging. For example, the berthing fee for a passenger ferry at the passenger port in Piraeus was only €16 per day in 1998, or roughly the same as that of parking a private car. The port authority authorized increases, which were protested by the ferry operators, but those costs need to be internalized and passed on directly to the users (Adler et al 41).

3.3 Noise

The noise externality of transportation is restricted mainly to road, air, and rail transportation. There are currently attempts to internalize the noise problem for road and air transportation, but none mentioned for rail transportation. The methods for internalizing noise for road transportation include a combination of fees, incentives, and regulations while the only apparent method of restricting noise in the air transportation sector is taxation.

Methods for restricting road transport noise are not well spread and vary greatly according to country within the European Union. The OECD published a report in 1991 which concluded by stating that "economic incentives for noise reduction have shown their effectiveness in relation to road vehicles in the few cases where they have been used," (Kinnock 35). In consequence of the lack of a Union-wide policy regarding noise, Member States have adopted various plans to reduce road transportation noise. In 1996 Austria implemented a program in which the annual vehicle tax included a portion that reflected the noise level of the vehicle. Germany and the Netherlands had programs with the same goal, but administrated differently. Purchasers of HGVs were given incentives to purchase low-noise vehicles. Specifically, the incentives consisted of a 7.5% grant for vehicles using "hush kits" that lowered the noise by 6 dB (A) and a 5% subsidy for a 3 dB (A) noise reduction. The operators themselves paid for the purchasing and installation of the hush kits. The result of these programs was a truck fleet in the Netherlands in which 60% of vehicles performed at 5 dB (A) below minimum noise level standards. Programs such as these should be implemented Union wide to internalize the noise costs, which will result in lower overall traffic noise (Kinnock 36).

In the air transportation sector, the mechanism for internalizing noise costs is a tax on aircraft noise emissions. These taxes are not uniformly applied throughout Europe. If it exists, the tax is normally added on top of landing charges paid by the airlines and correlates to the level of noise emissions produced by the aircraft. The revenue from the taxes is given to city, county or federal governments. These earnings are used to finance noise reduction programs to limit emissions from aircraft and also to complete and improve acoustic pollution monitoring systems. In some areas, the funds are also used to compensate residents living in the vicinity of the airport. Schiphol Amsterdam is one airport that already enforces this program, but some countries, such as Italy, have yet to legalize these measures (Adler et al 29). It is obvious that there is a long way to go before transportation noise pollution is fully internalized into transportation costs.

3.4 Air Pollution

In the past, the European Union has relied mostly on regulations to reduce the air pollution externality. Legislation was introduced in the early 1970's that limited values for tailpipe emissions from gasoline and diesel cars, as well as heavy and light duty vehicles. Other legislation provided incentives for consumers to purchase low emission vehicles. This was intended to increase the turnover rate for fleets, especially following the introduction of the catalytic converter. The goal was to reduce the consumption of leaded fuels. In addition, differential excise rates for leaded and unleaded fuel has resulted in a dramatic increase in the use of unleaded fuels, from only 1% in 1986 to 53% in 1993. Fuel standards that limit the amount of sulfur in diesel fuel, the maximum amounts of lead, and the maximum amounts of benzene have also been implemented (Kinnock 29).

Recently, the EU established the European Climate Change Program (ECCP) in June of 2000 to aid in reaching Europe's goal from the Kyoto Protocol. This target is an 8% reduction of the emissions of greenhouse gases from the 1990 level. This target should be reached by 2008-2012. To achieve this goal, the European Council adopted a strategy in 1996 to reduce CO_2 emissions, based on three pillars. The first pillar involved cooperation with the automobile industries. The EU established agreements with the

European (ACEA), the Japanese (JAMA) and Korean (KAMA) automobile manufacturers' associations about CO_2 emission reduction for new passenger cars. The second base was requiring fuel economy labeling for the purchase of vehicles. The purpose of this measure was to ensure that consumers would be aware of the fuel economy and emissions level of the cars they purchased. The third pillar was the use of fiscal measures to promote fuel efficiency (TERM 2002 02 EU).

In 1998 Directive 98/69/EC by the Council established the Auto-Oil Program, intended to significantly improve urban air quality. Incorporated in the program was legislation intended to make manufacturers responsible for the durability of their products. Provided that the vehicle is properly maintained, the manufacturer is responsible for the emissions levels for five years or 80,000 km, whichever comes sooner. Additional legislation was adopted concerning the installation of on-board diagnostic systems (OBD) to indicate when the emissions of the vehicle are too high and the vehicle needs repairs (http://europa.eu.int/comm/environment/air/transport.htm).

The previously cited legislation was intended to reduce the overall impact of air pollution, specifically regarding road transportation. Another piece of legislation was intended to internalize the externalities of air pollution. This legislation requires the periodic inspection of vehicles to ensure owners are maintaining their vehicles in a way that will reduce its emissions, which forces the owner to take responsibility for a portion of the air pollution they create (http://europa.eu.int/comm/environment/air/transport.htm).

In addition to road pollution, the EU has also established directives relating to the regulation of marine fuel to curb the level of ship emissions (http://europa.eu.int/comm/environment/air/background.htm#transport). The high sulfur content of the diesel fuel used by ships leads to high amounts of SO_2 emissions. "For example, emissions of NO_x and SO_2 from maritime transport in the North East Atlantic are of the same magnitude as total emissions in France," (Kinnock 28).

To summarize, the majority of attempts to internalize the costs of air pollution resulting from transportation have been regulative in nature. However, there is currently a trend in the legislation to make users more accountable for the emissions of their vehicle in fiscal terms.

3.5 Accidents

As indicated in the Accidents section of Chapter II, 99% of transportation accidents occur in road transportation and consequently this section will be limited to that mode. There currently exist two main forms of reducing the externalities resulting from accidents in transportation: improved road safety and well-devised insurance programs.

The European Union has recently implemented programs aimed at reducing the overall occurrence of traffic accidents by improving road safety. This has been realized through several different instruments. One instrument is the stricter enforcement of speed limits. Reducing speeds within safe limits has been very effective in reducing traffic accidents. Another measure that has been effective is the adoption and enforcement of laws reducing the allowable alcohol limit, which has not been well accepted by the public. Driving courses have had limited success and proven to be not very cost effective (Rothengatter et al 26). Other regulatory measures that have helped to reduce the risk of accidents include better road and traffic design and higher standards of safety for vehicles. "It is important that further measures are developed and applied if the current downward trends are not to reverse under the influence of traffic growth in the future," (Kinnock 23). Although this downward trend in the occurrence of accidents does not aid in the conversion of this from an external to an internal factor of transportation, it does lower the overall external costs.

Reform of the insurance industry has been successful in furthering compliance with the 'polluter pays principle'. The insurance industry has recently made some policy changes that increase differentiation between users in order to increase the correspondence of accident risk to insurance premiums. This means that the users who introduce more risk into the road network arc thc ones who are paying for that added risk. Insurance companies accomplish this by adopting either bonus systems or bonus/malus systems. These systems reward good drivers with clean records by granting them a reduction in premiums or combine this bonus system with a penalization for drivers who cause accidents (Kinnock 24). There is also a tendency towards cross-subsidization between categories of users within insurance companies, such as drivers of passenger vehicles subsidizing the costs for the freight transport sector (Rothengatter et al 3).

Large discrepancies exist between Member States regarding the extent of damage covered by insurance companies. For instance, in Sweden all health care costs associated with accidents are paid for by social security funds. Other countries such as Belgium, France, and Germany allow claims against the insurance provider for the driver. The limit of coverage varies greatly between countries too, but there has been a Directive within the EU to gradually bring uniformity to the insurance systems. Hopefully this Directive will also be effective in making sure that accident costs are fully internalized by the user (Kinnock 25).

3.6 Summary

Current internalization practices within the European Union are limited in scope and not uniformly applied across Member States. Congestion is not internalized in most cases, although congestion charging in urban areas is likely to become a trend. Infrastructure costs are somewhat internalized through taxation and usage fees. Some locations enforce noise regulation laws which limit the overall noise associated with road vehicle traffic and some airports charge fees for aircraft based on the noise they generate. Air pollution resulting from transportation is regulated by law and fuel taxes, but these measures have not been enough to achieve the target adopted at the Kyoto Protocol. The cost of accidents has been internalized to some extent by the insurance industry, but an improved insurance charging system could be more effective. Overall, more effective methods of internalization need to be introduced. They need to be broader in their scope and application. They should be provide a means of internalizing all external costs and be consistent across Member States within the European Union. This will facilitate fair competition and reduced environmental impacts throughout the European Community.

4. Proposed Pricing Scheme

The European Union has recognized the need for a common transport policy that is more effective at internalizing externalities of transportation. This fact has been signaled by the creation and adoption of the White Paper "European transport policy for 2010: time to decide" (European Communities) and the Green Paper: "Towards Fair and Efficient Pricing in Transport".(Kinnock). Surrounding these documents are various other studies and publication containing research and findings related to possible transportation policies. Much research has been specifically devoted to developing a more fair and efficient pricing system which internalizes externalities of transportation. The following sections take a look at some of the factors involved with selecting a pricing scheme, possible methods for internalizing factors, selects a possible method and reviews it in more detail, and then discusses how changing the current pricing system will impact the competitiveness within the transportation industry.

4.1 Factors Involved in Pricing Scheme Selection

The European Union has drawn from past experiences that one of the most substantial barriers to the implementation of a new pricing system for transport is acceptability; unless users are willing to accept the changes, the efforts will fail. In order to create a successful pricing policy, research was conducted by the EU to establish the factors involved in pricing that are most important to the public. The results indicated that fairness, transparency, practical issues, and personal freedoms, along with the obvious concern over financial impacts, were the chief concerns of citizens and businesses alike.

According to research conducted by task forces established by the European Commission, fairness depends to a great extent on consistency with former practices with which people are familiar (Sistemas 22,). Fairness is important to citizens of the European Union in many aspects. The first issue of fairness deals with determining a fair method of evaluating external costs. People are concerned that the pricing scheme should reflect the true value of the external costs, thus ensuring a fair distribution among users. The second aspect of fairness is social fairness. The concern here is that the measures will adversely affect the poorer social groups by placing costs on a good that historically was free. There is also a concern that internalization will be unfairly distributed geographically by placing greater demands on either urban or rural transportation networks. The last concern relates to the pricing policies for various modes. In order to avoid unfair competition, critics worry about the excessive focus on road transportation and request equal treatment of all modes, according to the same pricing principle (Sistemas 22, 23).

The results of the survey showed that many individuals linked fairness with the idea of transparency; in order for a pricing policy to be fair, it should be transparent. Transparency incorporates the concept that the process for internalization should be clearly related and defined for the public. It is important for the public to understand the purpose of the pricing measures and the details of the pricing scheme in order for them to accept its existence. There is also a need for transparency about how the pricing scheme will be implemented. Users need to know when and where to expect fees, as well as the amount of the fees. The use of the revenues resulting from the pricing scheme must be transparent as well; users need to know where their money is going. "The appropriate and transparent use of revenues raised by pricing measures is essential in terms of acceptability. The revenues have to be used in the transport sector for the paying users.

(...) cross-subsidization, for example, of public transport can enhance acceptability but has to be explored on a case to case basis," (Sistemas 3). In order to achieve this, cost assessment audits should be implemented wherever public money is used.

In addition to fairness and transparency, there are some practical issues that must be considered prior to the selection of a pricing scheme. For practicality purposes, as well as fairness, charges should be closely related to the amount of use and should vary according to different locations, different times of day, week or year, and different classes of vehicles. Payment in advance should be possible to prevent delays, although credit facilities may also be beneficial under certain conditions. Similarly, the method of payment should be easy to understand and applicable without difficulty, even for infrequent users. It is imperative that any equipment used should be very reliable to ensure efficiency. It would also be advantageous if the selected method could collect data indicating the strength of demand in various locations in order to give information both for monitoring and for planning purposes (Nash et al 31). Fulfilling all these requirements implies the use of highly developed technical equipment. Most of the technology is currently available and "by 2010 technological constraints are not seen as a barrier to implementation of more differentiated pricing systems," (Nash et al 35).

With the increased use of technology to monitor transportation, people begin to be concerned that their personal freedoms are being infringed upon. The United Nations Declaration of Human Rights of 1948 in its Article 13 recognized the right to mobility and the freedom to circulate as a basic right. This has become a part of the European collective conscience, and consequently, limiting mobility in any way decreases the acceptability of a pricing scheme. Results from the citizen surveys indicated a strong belief that roads are a basic public service and should be available to all (Sistemas 55). Privacy is another issue linked to technology and transportation. Citizens have stated concerns that electronically monitoring transportation could infringe on personal privacy. However, surveys suggest that if guarantees are made to keep the data protected and privacy ensured, there were no longer any complaints regarding electronic monitoring (Sistemas 34).

Financial impacts are at the heart of the transport pricing policy. The main focus of much of the European transport policy is economic efficiency. Reactions to the Commission Green and White Papers on transport pricing stemming from all types of entities such as HGV operators, the industrial organizations, vehicle manufacturers, shippers, governments, private entities, academics, and environmental organizations indicate that economic foundations of pricing have a certain relevance for the acceptability of transport pricing (Sistemas 21). In essence, users are concerned with how pricing schemes will affect their financial situation. Most people are not eager to pay for what was previously free unless they understand the reasoning behind the pricing schemes and can personally experience positive results. In many cases this is the overlying principle behind a lack of acceptance of pricing schemes (Sistemas 17).

4.2 Methods of Internalizing Transportation Costs

There are two main methods that can be used for the internalization of transportation costs which are market based instruments and direct regulation. Market based instruments are related directly to pricing while direct regulation is achieved by an act of the government (Kinnock 8). There are advantages and disadvantages associated with both methods.

Market based instruments can be very advantageous in certain situations. For instance, in a market economy, economic instruments fit nicely into the existing system and therefore require less red tape to implement than government regulations. In addition, if economic instruments can be closely linked to the problem at hand, "they are likely to be much more cost-effective than direct regulation because they allow citizens and businesses to rely on a variety of response channels to reduce the externality," (Kinnock 8). An example of this would be the change in behavior patterns after an emissions fee is instated such as the development of more environmentally friendly vehicles, a growth in carpool efforts, or increased use of public transportation. Market based instruments are also easier to implement across geographical and political boundaries, which tend to restrict government regulation.

There are some situations in which pricing mechanisms fail to be of use, however. If the market is not functioning efficiently, the price signals will fail to reach the end users and the effectiveness of economic instruments will be severely lessened. Market failures, high transaction and implementation costs, and difficulties in associating the externalities with the users can also cause pricing mechanisms to be inefficient (Kinnock 9). "Only if the prices of goods and services reflect all the costs of production and consumption, that means internal and external costs, a market failure (an overuse of the environment) can be avoided," (Rothengatter et al 25). High transaction costs can occur because advanced and expensive metering technology is needed to monitor the effects of each user. Even with such technology, classification problems make it difficult to associate charges directly with problems, and if these charges are not well associated, economic instruments are no longer attractive (Kinnock 9). In situations such as these, regulatory instruments may be more effective.

Regulatory instruments consist of technical standards, such as emissions standards or speed limits, laid down directly by the government (Rothengatter et al 25). One advantage of regulation is that it is independent of the market system and can therefore be effective even when the market is not. Although regulation may require more red tape, in the past it has been easier to implement because it is well-defined. Regulations are also very effective when a specific level of acceptability is involved. For instance, placing a maximum level of allowed vehicle emissions will ensure that the specified threshold is obtained (Kinnock 8). This can also be one of the disadvantages of regulation, however, because it fails to provide incentives to further reduce emissions. "Once a polluter has reached the emission standard, he or she has no longer any interest for further improvements. On the other hand, incentive charges give firms a financial incentive to invent ways to further reduce emission of pollutants even below the target level," (Rothengatter et al 25).

Because of the great complexity of the transportation network within the European Union, and the substantial differences between regions and modes of transportation, there is not one method of internalization that can be universally applied. In fact, internalization will most likely need to be accomplished on a case by case basis using a combination of market based instruments and government regulation (Kinnock 8). The following flow chart provides a summary for various policy instruments aimed at internalizing the external effects of transportation. It also provides specific examples for some of the various types of internalization instruments.

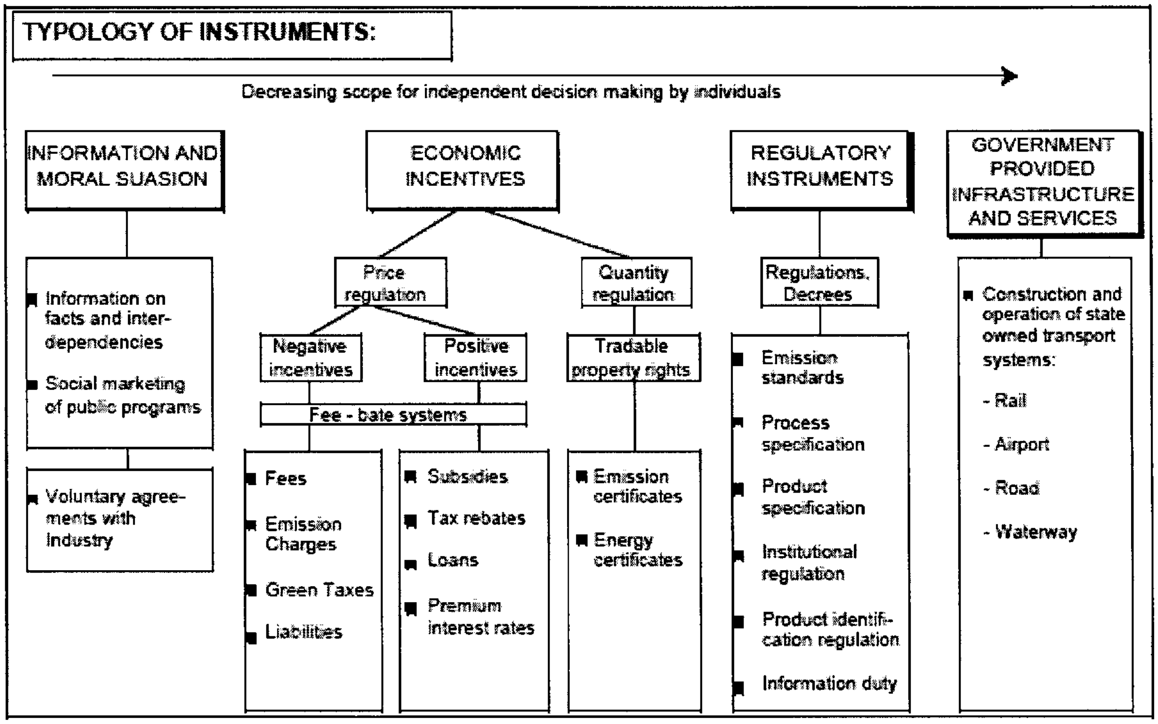


Figure 4.1 Typology of policy instruments for internalizing external effects (Rothengatter et al 24)

4.3 Selected Method

Among all the complexities regarding internalization, there is yet to emerge a single method agreed upon by all parties at stake. There still exist disagreements on methods to determine the cost of externalities, ways in which to pass these costs to the user, and the legislation required to pull everything together. The European Union has designated its transportation policy as a very important issue, however, and the Commission has therefore allocated a substantial amount of resources towards research designed to determine the best transportation policy. One such study, Pricing European

Transport Systems (PETS, ST 96 SC 172), was designated specifically for this task. The project was funded as a portion of the Transport RTD Program of the 4th Framework Program. As part of the research, the task force reviewed the current pricing situations for passenger and freight across all modes to determine whether the rates reflected the sum of all the internal and external costs of transportation. The next step was to forecast the consequences of adopting a more appropriate pricing scheme. In order to perform the forecasting scenarios, the task force first had to determine a method of internalization to apply to various case studies (Nash et al i). This section will review the method selected by the task force.

To determine the marginal cost of the transport externalities of one vehicle for a single trip, the study modeled the path from emissions to impacts and costs. The 'willingness to pay' principle was implemented to establish actual values. Three pricing scenarios were then applied to various transportation corridors to determine the true effects of the new pricing schemes. The pricing scenarios were as follows:

- "Scenario 1, the pricing scenario tested for all case studies, corresponds to equating all prices to the price-relevant marginal costs. This is the pricing scenario which maximizes the sum of producer's and consumer's surplus and internalizes external costs.
- Scenario 2 seeks to achieve the most efficient pricing system possible, subject to a budget constraint that the overall requirement for government funding should not be increased.

- A further scenario, scenario 3, was examined in some cases. This introduces a constraint that transport users should collectively pay the full economic and social costs of the transport system. This constraint was introduced because in some countries this was seen as an important political or equity requirement," (Nash et al 36).

The application of these scenarios to the selected corridors produced results that supported the objectives outlined by the "White Paper: European Transport Policy for 2010: time to decide". Perhaps the most important outcome of the PETS project was to prove that it is possible to determine actual values to be applied to users for transportation externalities; this had been a serious argument against internalization in the past. In order to determine the cost of externalities, it is important to estimate the marginal external cost instead of simply dividing the total cost by the number of users because it fails to take into account the important non-linearities that exist with problems such as congestion and accidents. The study also proved that market based pricing alone would not result in the desired redistribution between modes. Regarding road transportation, the findings reinforced the idea that inter-urban road transportation is under priced. The existing fuel taxes fail to appropriately account for the extra deterioration caused by heavier vehicles and the annual charge over-charges low mileage vehicles and under-charges high mileage vehicles. The findings of the PETS project should be highly valuable in establishing an acceptable Union-wide pricing strategy (Nash et al i, ii).

4.4 Effect of Internalization on Competition

It is difficult to predict the effect of internalization on the transportation industry and the competitiveness of the European Union as a whole, but with the information at hand some broad conclusions can be drawn. Transportation price increases can be caused by higher consumption, or usage, charges, and tighter technical standards. These increases may be offset by reductions in fixed charges and improved efficiencies in the transportation networks. The overall charge for transportation is likely to increase, however. It is forecasted that the cost of road transportation will increase by 18% for rural transportation and 30% in urban areas due to full internalization of costs. If the full cost of infrastructure is taken into account, the price of rail transportation could increase as much as 80%. This, however, would cause the demise of that particular mode and the increase is therefore likely to be restricted by the use of government intervention. The costs for inland waterways are expected to rise 25% while that of short sea shipping by 35% (Rothengatter et al 36, 37). Given the commitment to "green modes", however, it is likely that both waterborne transportation modes will receive some subsidies as well to increase their competitiveness. The trend here is a rise in overall costs for all modes. It is difficult to predict what the resulting modal split will be (Rothengatter et al 38).

There are a couple of factors that make these estimations highly speculative. The first factor is the fact that the exact method of internalization is as yet unknown, and therefore these numbers may not be representative of the adopted price scheme; different means of cost calculation and valuation of externalities can lead to results that vary significantly. Another reason that predictions may not be accurate is the fact that transportation markets have not experienced such drastic changes in prices and it is therefore not clearly understood how the markets will react to the changes. Obviously, the changes will need to be implemented gradually in order to give the markets time to adjust and to allow users to reestablish their behavior (Rothengatter et al 38).

In terms of Europe's overall competitiveness, the economy should benefit from the higher efficiency of the transportation network. For businesses, distribution costs should rise as a consequence of higher transport costs that result from higher user charges and stricter vehicle standards. These costs should be recuperated by lower fixed costs, such as a lowering of the 'green tax' that is currently collected from businesses through employers' portion of the social security contributions. Industries should also benefit from the increased productivity resulting from the decrease in congestion and accidents. In summary, the net effective of internalization of transportation costs can be expected to be positive (Rothengatter et al 36).

4.5 Summary

The European Union is aggressively pursuing a unified policy that will improve the transportation system through internalization of externalities. In order for this policy to be accepted by the public, it is crucial that it is perceived as being fair, transparent, and producing noticeable improvements to the existing system. The two means of internalizing external costs are regulation and market based instruments. Market based instruments require less red tape and result in incentives to reduce negative affects as much as possible. Regulations are useful when there is a threshold limit to be met. Due to the complexity of the transportation problem, the solution must be a combination of these two methods that fits the specific circumstances for each situation.

A method of internalization has not yet been adopted by the European Union. However, one study sanctioned by the Commission selected a method and performed cost projections based on the method. The results showed that internalizing costs could produce the desired shift in transportation modes. Another important aspect of the experiment was that it showed it was indeed possible to quantify environmental impacts of externalities and to place a monetary value on these elements. The effects of applying such a method across the transportation system are not completely predictable due to the complexity of the network. It can be inferred, however, that the direct costs of transportation will increase, but these increases will be offset by increases in productivity and a reduction in social security taxes. The economic competitiveness of the European Union as a whole should increase due to the reductions in congestion and the increased efficiency of the transportation network. The competitiveness of 'green modes', such as short sea shipping, should increase as well, due to the relatively small amount of externalities to be internalized compared to road transportation.

5. The True Value of SSS

The use of short sea shipping in Europe should increase as a result of the internalization of externalities. Environmentally speaking, short sea shipping is a very favorable mode of transportation with limited negative impacts. In addition, the use of short sea shipping can alleviate some of the problems, such as congestion and noise in urban areas, which currently exist within the transportation system. The following sections examine the relative benefits of short sea shipping in the areas of fuel consumption, congestion, noise, and air pollution.

5.1 Fuel Consumption

The transportation sector is the largest consumer of non-renewable resources in the European Union. Because the transport sector as a whole is a major client of the oil industry, the demand for oil products by transport contributes substantially to the depletion of non-renewable resources, energy-related emissions, and environmental impacts arising from the oil industry (Kamp 13). In 1999, 32% of the oil used in Europe was in the transportation sector; this grew from 29.4% in 1990. The use of oil-based fuels is expected to increase through 2010, at which time the projected consumption of oil by the transportation sector will reach the equivalent of 300 million tons of oil (Mourelatou 37). Although passenger car fuel efficiencies should improve further in the next 10 years through the voluntary agreement between the European Union and car manufacturers, these technical developments alone are not sufficient to yield a decrease in overall fuel consumption. This is due to the fact that fuel consumption depends on additional factors such as driver behavior, congestion, types of trips, choice of vehicle, vehicle maintenance, and the age of the vehicle. As the European economy continues to grow, the demand for both passenger and freight transportation is expected to increase. One of the most important objectives of the revised Common Transport Policy is to decouple transport growth from economic growth, but until this goal is achieved, the demand for oil will continue to grow (Mourelatou 45).

Within the continental transportation sector, road transportation is responsible for the largest percentage of fuel consumption, which is 84.4%. The next largest sector was aviation at 11.1% followed by rail with 2.5% and inland navigation accounting for 2%. Maritime transportation was not included in the study (Kamp 13). The following figures provide comparisons of fuel consumption between transportation modes based on various measurements obtained through a variety of studies. Figure 5.1 shows the energy consumption for road, rail, maritime, and inland navigation in terms of MJ/ton-km. The results indicate that maritime transportation is the most fuel efficient; it uses only .1-.4 MJ/ton-km while road transportation can consume as much as 4.5 MJ/ton-km. Figure 5.2 shows a graphical representation of the numbers from Figure 5.1. Figure 5.3 gives values for fuel consumption in g/ton-km, which is the actual amount of fuel verses energy. Once again, the values for maritime transportation are the most efficient, if the minimum values are used. Road transportation is by far the largest consumer of fuel.

Mode of transport	Energy use in MJ/tonne-km			
	Source: EEB, Clean Air Seminar - 2002	Source: CSD, 2001	TU-Delft, 1998 Betuwe Line	CED-Delft, 2000. Data from CBD, 1999
Road	1,8 - 4,5	2,89	0,5	
Rail	0,4 - 1	0,677		0,52
Maritime transport	0,1 - 0,4	-		
Inland navigation	-	0,423		0,56

Figure 5.1 Energy Consumption per Transport Mode (Kamp 14)

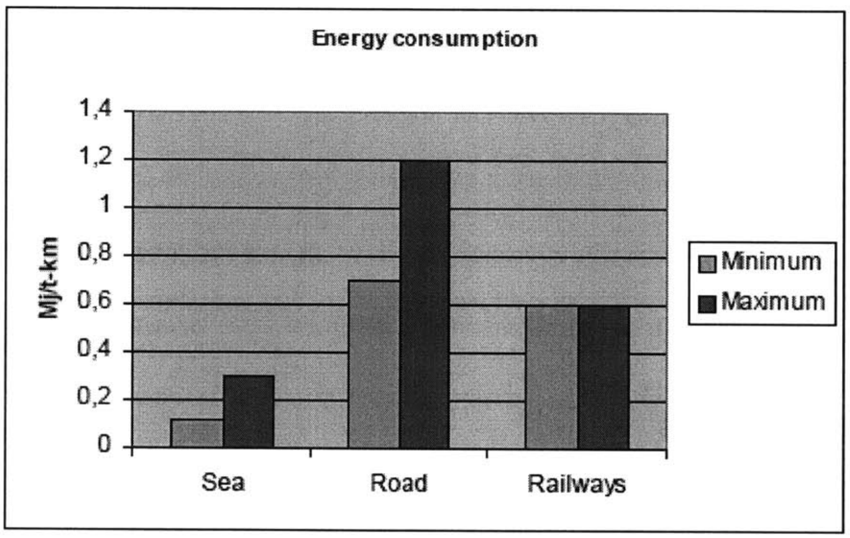


Figure 5.2 Energy Consumption per Transport Mode (Kamp 14)

Mode of transport	Fuel Consumption in g/tonne-km	
	Source: TECHNE / MEET-project and COPERT III	Source: COM317
Road	5.16 – 25.71	31.33
Rail	-	8.911
Maritime transport	2.5 – 8.33	-
Inland Waterways	7.97	4.828

Figure 5.3 Fuel consumption per transport mode
(Kamp 15)

5.2 Congestion

As previously stated, the European Union is currently experiencing extensive problems with congestion. The growth of traffic is distributed unevenly throughout Europe; in mountain areas such as the Pyrenees and the Eastern Alps, traffic is growing at a rate of 10% annually. This creates bottlenecks within the transportation network. According to information from Member States, 10% of the road network, or 7,500 km of roads are regarded as bottlenecks or subject to technical restrictions. Additionally, the road networks in many urban areas are already operating at levels beyond their designed capacity. Due to the structure of the rail system, i.e. the scarcity associated with linear tracks that cannot accommodate more than one train at a time, there is a limit to the additional capacity of rail transportation before congestion becomes a problem as well (European Commission 7). Approximately 20% of the rail network, or 16,000 km, are already viewed as bottlenecks. Air and maritime transportation are similar in that once the journey begins, congestion is rarely a problem. However, at the nodes, such as airports and sea ports, congestion can occur. In fact, congestion of airports is already seen as a problem in many large terminals; over a third of the flights within the EU experience over a 15 minute delay (European Commission 7). Congestion is also a problem at some ports, but the Commission has introduced plans to rectify this situation.

In a push to promote short sea shipping in the EU as a 'green alternative' to road transportation, the European Union has introduced a series of infrastructure improvements to the existing maritime and inland waterway system. These improvements are intended to make waterborne transportation a more viable solution to transportation needs. By increasing the use of the currently underused waterway network, the hope is to reduce the amount of freight being shipped by road transportation. In essence, short sea shipping is viewed as a means of alleviating congestion in other modes. "Sea-river shipping provides e.g. alternatives for traffic crossing sensitive zones such as the Alps and the Pyrenees," (INE 1). Some of the goals of the projects are to use short sea shipping as a way to avoid existing bottlenecks in road transportation and to reduce the amount of truck haulage by as much as 50% in some areas, such as the Maasroute (INE 1). In order to achieve these goals, the EU has begun to develop 'motorways of the sea' as part of the TEN-T projects.

The European Union has set aside certain transportation routes within Europe and labeled them as part of the trans-European transport network (TEN-T). These routes have been chosen based on their value to the transportation industry and are then given priority for EU funding. The intent is to channel EU financial support to projects with the greatest Community added value. The TEN-T network contains 75,200 km of roads, 78,000 km of railtracks, 330 airports, 270 international sea ports, and 210 inland ports. The combination of this infrastructure carries about half of all freight and passenger transportation. To maintain and improve this network, Community legislation has developed a list of priority projects. The original list was intended to be completed by 2010. A second list was developed to be completed by 2020. The third priority (out of 18) outlined in the 2020 list was the development of 'motorways of the sea'. Motorways of the sea are intended to provide relief for the congested road networks by creating standard short sea shipping routes connecting important logistic locations. The inclusion of this project in the list of priorities signals the important position that the Commission feels short sea shipping will play in solving the transportation issues within the European Union (Priority Projects 1-5).

Four motorways of the sea have been identified. They are the Baltic Sea motorway, the Western Europe motorway, the South-East Europe motorway, and the South-West Europe motorway. Infrastructure projects to create these motorways include updating ports and creating waterways or canals to link motorways. Additional service expenses include ice-breaking, dredging, and information systems. In the context of congestion, the value of short sea shipping lies in its ability to alleviate congestion on heavily used roads; the motorways will improve the trans-European transportation network by reducing volumes on road and providing opportunities to bypass existing bottlenecks (ESPO News 1). Figure 5.4 shows a map of Europe outlining the proposed motorways of the sea.

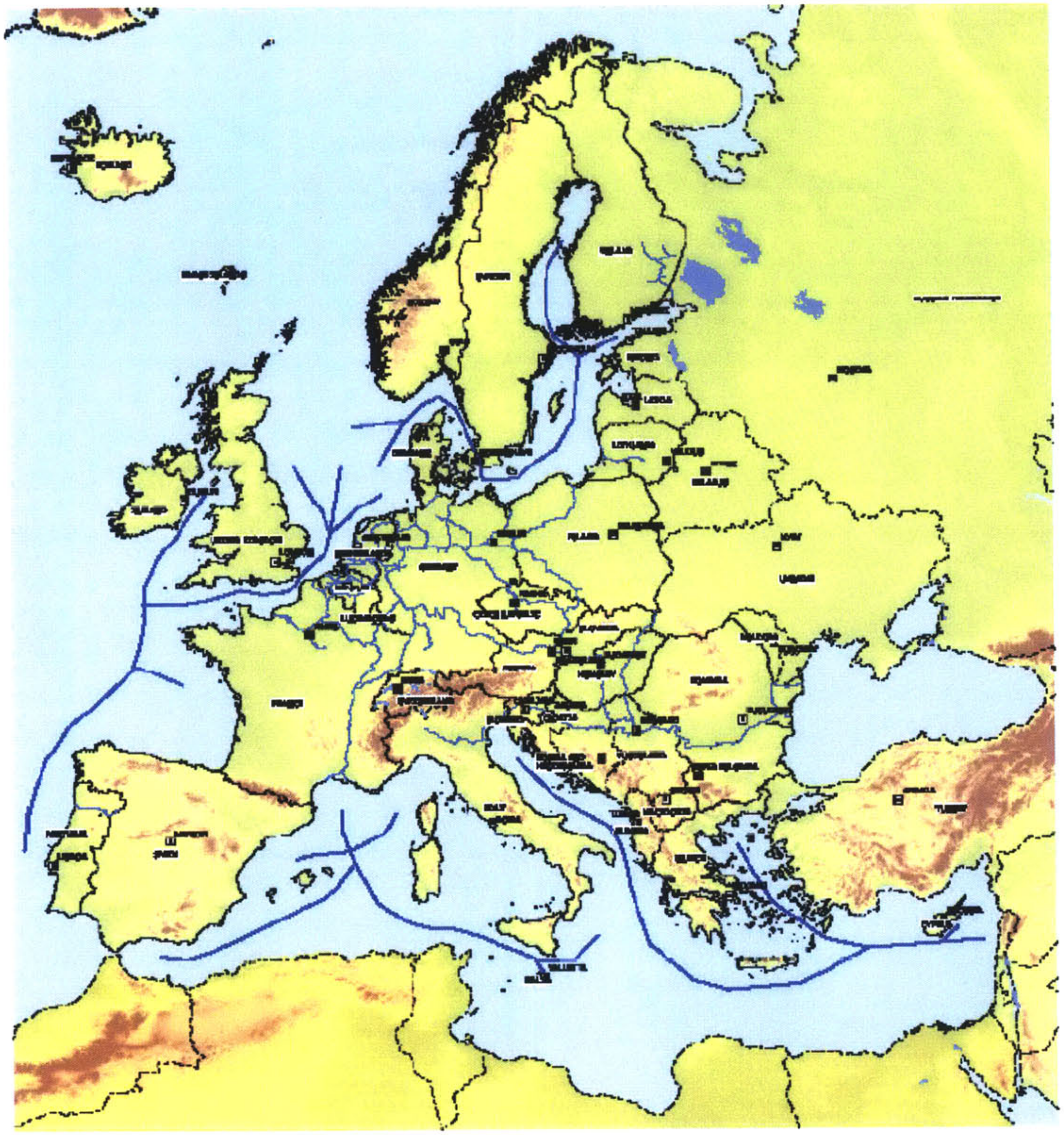


Figure 5.4 Motorways of the Sea

5.3 Noise

Noise problems in the European Union are mainly associated with road and rail transportation. It is estimated that 120 million people, about 32% of the total population, are exposed to excessive noise from roads while 37 million people, or 10%, experience noise as a result of rail transportation. A nine-ton truck traveling at a speed of 60 to 100 km/h creates 64 dB (A) per ton while a train, on overage, creates 63 dB (A) per ton. Although these figures are roughly the same, the types of noise are different. Noise resulting from road transportation is normally constant while noise from a train is intermittent. Noise from rail is generally considered to be less of a nuisance than that of trucks. Air traffic also creates a noise problem at airports. Noise produced by ships is not considered to be relevant to people. However, some studies indicate that it can be disturbing to marine life, especially free ranging marine mammals because it creates interference in their communication. The full impact of noise on marine life is not known (Kamp 24, 25).

Because noise due to maritime transportation is not relevant to humans, it is not considered an external factor of transportation. It does not result in the same medical costs associated with noise from road transportation and neither does it require noise abatement measures which are also external costs of transportation related noise. Therefore, short sea shipping is a value in the context of noise as well.

5.4 Air Pollution

The transportation sector is responsible for the emission of many hazardous substances into the air. Among the most detrimental are CO, CO_2, NO_X, SO_2, CH_4, nm-VOC, and PM_{10}. These emissions are broken down according to the grams per ton-kilometer by each mode of transportation in Figure 5.5.

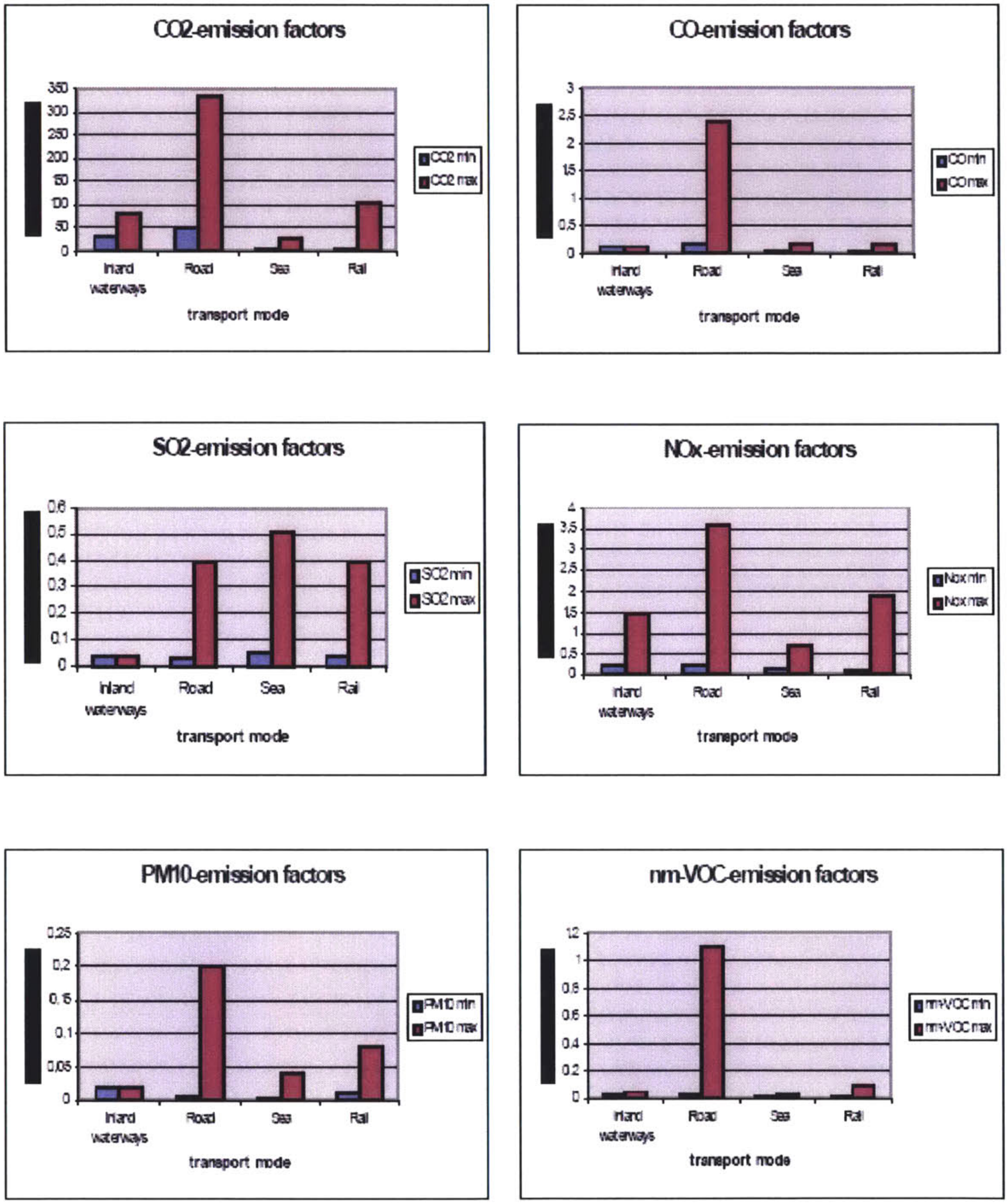


Figure 5.5 Emission to Air of Pollutants in gram per ton-km in Function of Transport Mode (Kamp 19)

These charts show that road transportation is responsible for a vast majority of emissions within the transportation sector. In all categories except SO_2, short sea shipping outperforms the other modes. The high level of SO_2 emitted in sea shipping is a result of the high level of sulfur content in the fuel that vessels consume. On average, marine fuel oil contains 2.6% to 3% or 26,000 – 30,000 parts per million (ppm) sulfur while fuel consumed by trucks on average only contains 350 ppm sulfur (Kamp 19, 20).

Arguably the most detrimental emission is CO_2, which is the primary greenhouse gas associated with transportation. "In 2000, CO_2 emissions from the transport sector constituted 25% of total EU CO_2 emissions and 20% of the total EU greenhouse gas emissions," (Kamp 16). In the European Union, 300 million tons of CO_2 are emitted yearly, 90% of which is a result of road transportation. Short sea shipping is responsible for only 7.7%. Figure 5.6 contains the total yearly emissions of air pollutants broken down by mode.

EU-15	Year	Bn Tkm[7]	Mio Tonnes CO_2	Mio Tonnes CO	Mio Tonnes NO_x	Mio Tonnes PM	Mio Tonnes VOC	Mio Tonnes SO2
Road (freight transport)	1998	1265	271.1 [(footnote 15)] (272.9 [(fn 16)])	3.116 [(fn 16)]	2.056 [(fn 15)]	0.205 [(fn 16)]	0.659 [(fn 16)]	
	2000	1348	282.3 [(fn 8)]	2.777 [(fn 16)]	1.878 [(fn 15)]	0.180 [(fn 16)]	0.616 [(fn 16)]	0.075 [(fn 9)]
Railway	1998	240	1.9 [(fn 15)]	-	-	-	0.3	-
	2000	249	-	0.545 [(fn 17)]	0.1 [(fn 17)]	-	-	-
Inland waterways	1998	121	3.6 [(fn 15)]	-	-	-	0.1	-
	2000	125	-	0.18 [(fn 17)]	0.35 [(fn 17)]	-	-	0.19 [(fn 17)]
Pipelines	1998	85	1.0 [(fn 15)]	-	-	-	-	-
	2000	85	-	-	-	-	-	-
Short Sea Shipping	1998	1166	23.3 [(fn 15)]	-	-	-	-	-
	2000	1270	48.2 [(fn 10)]	-	1.100 [(fn 18)]	-	0.043 [(fn 18)]	0.802 [(fn 18)]

Figure 5.6 Data on ton-km and Total Transport Related Emissions in Europe (Kamp 21)

This chart indicates that short sea shipping is much more environmentally friendly than road transportation. Although the actual volume of Tkm is similar between the two modes, SSS results in less than one fifth the amount of CO_2 emitted. Short sea shipping was also responsible for only a fraction of the amount of NOx and VOC emitted by road transportation. The amount of CO and PM resulting from SSS is negligible. However, the amount of sulfur dioxide emitted in maritime transportation is substantially greater than that of road transportation. Taking everything into account, short sea shipping must be recognized as a green alternative to road transportation.

5.5 Summary

Short sea shipping is an environmentally friendly mode of transportation. It consumes less fuel and emits less air pollutants, other than SO_2, than other modes. Additionally, maritime transportation does not produce any noticeable noise pollution, unlike road, rail, and air transportation.

Not only is SSS safe for the environment, but it is also safe for cargo and passengers. The occurrence of casualties or fatalities involved with maritime transportation is much less than that of road transportation. For every billion passenger kilometers, there are 13 fatalities resulting from road transportation while only .5 fatalities occur in maritime transportation (Kinnock 22). Short sea shipping is also a very secure form of transportation for the owner of the cargo. Access is limited, so vessels are easily monitored and controlled and less susceptible to hijacking. Maritime transportation also provides a safe way to transport hazardous freight; shipping hazardous material on the sea avoids the potential exposure to public that can occur when road freight is carried through urban areas.

Short sea shipping is also a very reliable service. There are no missing links in the system, such as a missing bridge for road and rail transportation, which can restrict access and cause excessive delays. Outside the port, delays due to congestion are not associated with maritime transportation. Ships very rarely experience bottlenecks, and indeed, are very effective at bypassing existing bottlenecks within the road and rail networks. The independent nature of vessels means that the delay of one ship will not be passed on to other vessels, unlikc thc domino effect experienced in rail and road transportation. In short, the nature of maritime transportation makes it less susceptible to delays caused by externalities. Therefore there is a higher expectation for goods to arrive on time.

Since the market is driven by economic factors, all these advantages of short sea shipping might be irrelevant if it was not a financially viable option. However, short sea shipping can be very inexpensive and cost effective. The size of the transportation vehicles allows for economies of scale in the shipping industry. The lack of detrimental externalities in maritime transportation will make it even more competitive once these factors are internalized for all modes because other transportation prices will increase. The fact that the European Union has earmarked short sea shipping as a 'green mode' and subsequently decided to provide subsidies to compensate for additional externalities that may be difficult to internalize, makes it an even more financially viable option.

To summarize, short sea shipping is an environmentally friendly, safe, reliable, and cost effective mode of transportation. Due to all these factors, the increased use of short sea shipping will increase the overall economic competitiveness of the European

Union. It will make the transportation system more sustainable and more reliable, increase productivity by reducing congestion losses, and reduce health care costs by improving air quality and reducing accidents.

6. Short Sea Shipping and Intermodal Transportation

6.1 Current Status of SSS

The short sea shipping industry in Europe has experienced some changes recently with the liberalization which began in January 1999 to put it in accordance with the competition legislation of the European Union. Previously there existed cabotage laws that placed restrictions on the flag of carriers between national ports. Additionally, some national carriers, especially in the Western Mediterranean, were heavily subsidized by the government, to the point of becoming monopolistic in nature. The liberalization, which was scheduled for completion in 2003, will benefit the short sea shipping segment of intermodal transportation in many important ways. Removing barriers to entry will lead to more perfect competition and greater efficiency. Smaller firms will be able to increase their market shares and there will be increased opportunities for innovative services and more choices for transport users (Baccelli et al 18).

As of January 2004, all Member States were required to fully comply with the new cabotage regulations. The European Community Shipowners' Associations (ECSA) published an article stating the view of the shipping industry on the liberalization of the maritime transportation industry. The organization feels that regulations have achieved a well balanced legal framework for shipping. The regulations require Member States to open international routes to third-state flag ships but intra-European routes can remain open only to EU flag ships. Furthermore, the article stated that, "the global effect of the whole process, of liberalizations in general, has been a benefit to the European trading system, increasing efficiency and contributing to economic growth. Liberalization has, other things being equal, also increased the competition in the market and thereby contributed to a tightening of the competitiveness of the shipping companies involved. All in all, it seems to be a sound process," (http://www.ecsa.be/publications/021.asp).

Although the market for short sea shipping is increasing, the European Union has identified a few problems that hinder its emergence as a primary shipping mode. The first obstacle is the public image. Potential customers sometimes view maritime shipping as an outdated mode of transportation. Their perception is that it is slow and inefficient. To overcome this prejudice, the EU has established short sea shipping promotion centers in nearly all member states which contain a coastline, and also in some candidate countries. The purpose of these centers is to educate people about the true benefits of short sea shipping in order to increase its use. Establishing a positive public image will be strategic in the growth of short sea shipping (http://europa.eu.int/comm/transport/maritime/sss/index_en.htm).

Another current shortcoming of maritime transportation is a deficiency in customer service. Short sea shipping must be a convenient freight option in order for people to use it. Intermodal transportation is essential to correcting this problem. Due to the fact that by nature short sea shipping can only reach the outer borders of countries, it must be well connected to the interior through other modes. However, customers should not be burdened with arranging for themselves several modes of transportation and the details of the transitions between them. Therefore, it is essential that door-to-door third-party-logistic companies emerge to coordinate intermodal transportation that provides the user with a worry-free, economical, and environmentally-friendly shipping solution. Some such companies already exist, but the EU has allocated funding as part of the

Marco Polo program to increase the number of companies and their influence in the market.

The extensive documentation necessary for short sea shipping transactions is another drawback associated with this mode. However, efforts are being made to streamline the process in order to reduce the amount of downtime spent in ports, waiting for the transition to the next transportation mode. In addition to the documentation, the technology and infrastructure of ports needs to be updated in order to reduce the transition times.

6.2 The Push for Intermodal Transportation

Intermodal transportation can be defined as "the movement of goods in one loading unit, which uses successively several modes of transport without handling of the goods themselves in transshipment between the modes," (Black et al 12). There are at least three general conditions under which this definition applies. In intermodal transportation, two or more transportation modes are used. At the same time, the freight remains in the same transportation loading unit (LU) throughout the entire journey. In most cases rail or water replaces road transportation for the long-distance portions of the trip, but trucks are used for local distribution.

The European Union is currently aggressively supporting the concept of intermodal transportation through a variety of programs, the most important of which is Marco Polo. The Marco Polo program was incorporated in the Commission White Paper "European transport policy for 2010: time to decide" from September 2001. Its purpose is to "reduce road congestion and improve the environmental performance of the whole transport system by shifting freight from road transport to short sea, rail and inland waterway transport," (http://europa.eu.int/comm/transport/marcopolo/summary_en.htm). Marco Polo is meant to target transportation within the European Community, which is still mostly accomplished through road transportation. Funding from the program is intended for commercial actions within the freight transport, logistics, and other relevant markets. Estimates for the program predict that for every €1 in grants to Marco Polo, at least €6 in social and environmental benefits will be generated. Areas in which money will be recuperated are decreases in congestion and the delays, thereby increasing productivity; improvements in the health of citizens due to increased air quality; and reductions in repair costs resulting from acid rain. There are threc main action types: modal shift actions, catalyst actions, common learning actions.

Funding for modal shift actions is intended to give start-up aid for new services in freight markets that provide alternatives to road transportation. The program provides co-funding for up to 30% of the costs for setting up a new service. This is equivalent to €1 per 500 tkm shifted. The minimum total of shifted transportation per contract granted is 250 million tkm (http://europa.eu.int/comm/transport/marcopolo/highlights/doc/intermodality_logistics_2004_04.pdf). The funding can last for up to three years, after which the service should be financially viable on its own. As part of the Marco Polo program, quantified and verifiable modal shift objectives were set. The goal for the annual rate of modal shift is 12 billion ton-kilometers per year, which is approximately equal to the projected increase in international road freight. In essence, the program intends to maintain or decrease the current level of road freight by shifting any additional demand to short sea shipping, rail, and inland waterways. The purpose of the modal shift actions is to maximize the traffic shift in order to reach the 12 billion objective that was set for the program (http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/02/193&format=HTML&aged=1&language=EN&guiLanguage=fr).

Catalyst actions are very similar to modal shift actions, except they are more ambitious in nature. The focus of these actions is on the removal of existing structural market barriers which prohibit the further development of alternatives to road transportation. These actions should help in changing the way transportation is conducted in Europe by providing user-friendly intermodal or non-road freight transportation options. An example would be establishing motorways of the sea or a high-quality international rail freight service managed as a door-to-door enterprise (http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/02/193&format=HTML&aged=1&language=EN&guiLanguage=fr). Additional examples include high quality, well integrated inland waterway services, pools for tri-modally-compatible intermodal loading units, and reliable transportation and logistics information systems. The amount of aid available for this category of action is 35% for a duration of 4 years (http://europa.eu.int/comm/transport/marcopolo/highlights/doc/intermodality_logistics_2004_04.pdf).

Marco Polo intends to inform the key players in the transportation and logistics industry about intermodal and non-road freight solutions through the funding of common learning actions. These are not intended to provide immediate changes in the market, but to improve cooperation and sharing of knowledge and experience. This goal is becoming more and more important as the transportation and logistics industries grow increasingly complex. Common learning actions will be funded up to 50%

(http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/02/193&format=HTML&aged=1&language=EN&guiLanguage=fr). There are many proposed common learning actions that will increase the awareness and effectiveness of intermodal shipping. These include improving procedures and methods in sea and inland ports; new co-operation and capacity management models in rail; adapting procedures and methods in transport systems to meet today's logistics requirements; European training centers; improving pricing, procedures and methods in the terminal; and action aiming to improve shippers' understanding of intermodal freight transport (http://europa.eu.int/comm/transport/marcopolo/highlights/doc/intermodality_logistics_2004_04.pdf).

The Marco Polo program was adopted by the European Commission on July 22, 2003. The program was intended to run from 2003 to 2006 with a budget of €100 million. On July 15, 2004, the Commission presented a proposal to expand the current Marco Polo program from 2007 onwards. Within the proposal are actions to facilitate the creation of motorways of the sea and also traffic avoidance measures. For 2007-2013, the budget will be €740 million and has been extended to include countries that border the Union. The final form of Marco Polo II has yet to be determined and will depend on the outcome of negotiations within the European Parliament and Council (http://europa.eu.int/comm/transport/marcopolo/index_en.htm). At the onset of the first Marco Polo program, Vice-President Loyola de Palacio, in charge of energy and transport policy, commented, "The Commission is determined to help turn the notion of "intermodality" from a buzz-word into a real alternative to road-only transport solutions... We are proposing a very concrete and practical instrument for the transport and logistics industry to take on the remaining market challenges and shift more freight from congested road corridors to other, less congested modes," (http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/02/193&format=HTML&aged=1&language=EN&guiLanguage=fr). This statement confirms the EU's commitment to intermodal transportation and increasing the use of short sea shipping, as well as rail and inland waterways, to create a sustainable transportation system. Due to the fact the majority of the Marco Polo projects are long-term in nature, it is too early yet to determine the success of the program.

6.3 Short Sea Shipping in Intermodal Transportation

The use of intermodal transportation in Europe has been increasing over the last decade. Between 1990 and 1996, intermodal transportation experienced growth rates of 9.3%. Lately the use of rail/road intermodal transportation has decreased, but short sea shipping has continued to experience rapid growth (Baccelli et al 13). The following is a definition of short sea shipping in terms of intermodal transportation:

> "Short-sea-shipping offering an alternative for road transport (therefore excluding all the flows that are captive), including SSS for feedering containers between intercontinental hub ports and secondary European continental ports and SSS with both the origin and destination in Europe." (Baccelli et al 17)

By this definition, intermodal short sea shipping accounted for 5.3% of transport within the European Union in 1996. It also represented 13% of international SSS freight traffic in terms of tkm. The breakdown of short sea shipping in Europe varies in each Member

State. However, the majority of cargo carried was bulk. In Europe as a whole, 60% of the goods unloaded was liquid bulk, the majority of which was crude oil or some other form of oil. Dry bulk accounted for the next largest portion of cargo. Containers and other cargo accounted for around 25% of the total cargo (Xenellis 5).

There are currently two main submarkets for short sea shipping in intermodal transportation. Load on-load off (LO-LO) consists of the feeder transport of containers and intra-European container transport. The transport of units on wheels, such as road vehicles, unaccompanied semi trailers, and swap bodies or containers is termed roll on-roll off (RO-RO). The first type of SSS is mainly used for the transfer of intercontinental cargo from deep-sea ports to port terminals that cannot be accessed by deep-sea vessels. It is more cost-effective to transfer cargo from larger vessels than to make additional port calls or reduce the size of the intercontinental vessels. The RO-RO type of short sea shipping is already serving many portions of Europe. This service is important in locations where there are no viable land options, such as shipping on the Baltic Sea between Scandinavia and Northern Europe or from England to the Continent. For example, in Denmark 34% of short sea shipping cargo consisted of RO-RO units. Sweden and the United Kingdom also had a significant percentage of cargo in the form of RO-RO units (Xenellis 5). These services are also important between islands and the mainland in Italy and Greece. In the past few years routes have been established as alternatives to land transportation, such as the route between Genova and Barcelona (Baccelli et al 19).

Short sea shipping is a very effective link in the intermodal chain. It is very beneficial for avoiding bottlenecks that occur on land in both road and rail transportation.

In other cases, such as between islands and the mainland, there are no viable land options. SSS is also beneficial when dealing in bulk because economies of scale can be reached in this mode. Consequently, the use of short sea shipping in intermodal transportation is increasing. The next section contains two cases comparing intermodal transportation incorporating the use of short sea shipping with all-road alternatives.

6.4 Methodology for Case Studies

In order to determine the competitiveness of intermodal transportation, case studies have been conducted by several agencies in which intermodal transportation solutions were compared with all-road routes. This section contains a summary of case studies developed as part of REALISE. REALISE is an organization established by the European Union to research the benefits of short sea shipping and to promote its use as an alternative to road transportation.

In the REALISE study, four transportation corridors were selected for analysis based on a combination of factors. They were intended to be as representative as possible of real solutions, being composed of a combination of real route segments. The corridors were also intended to reflect trade routes that are likely to be developed in the future. Together, they cover a vast geographical area within Europe. The objective was to include the most important industrial and geographical markets in the routes because they are important factors determining the modal split of freight transportation. The segments that were analyzed are among the most crucial arteries of goods flow within Europe. The north-south axis consists of Austria, Germany, and Denmark; while Belgium and Germany are crucial countries for east-west flow. This trend should increase with the addition of the accession countries (Vassallo et al 16). Two of the four corridors are presented in this paper.

The classification and allocation of costs was another integral concept in the REALISE study. The team built on the information developed in former studies, especially those conducted as part of RECORDIT (REal COst Reduction of Door-to-door Transport). Based on these studies, the cases were broken down into eight cost categories, which are common among all parts of the transportation chain. REALISE obtained the costs through contacting existing transportation providers for each segment in order to ensure the most realistic final quotes. The eight cost catcgories are: depreciation, maintenance, personnel, consumption, insurance, tolls and charges, terminal costs, and third party services. These costs and the formula used for calculating them are listed in Figure 6.1 below (Vassallo et al 17).

Cost category	Formula (meas. unit)
Depreciation	*[(€/year) / (km or h/year)] * (km or h/LU) / loading factor = €/LU*
Personnel	*[(€/year) / (h/year)] * (h/LU) / loading factor = €/LU*
Consumption	*[(€/litre or kWh) * (litre or kWh/km)] * (km/LU) / loading factor = €/LU*
Maintenance	*[(€/year) / (km or h/year)] * (km or h/LU) / loading factor = €/LU*
Insurance	*[(€/year) / (km/year)] * (km/LU) / loading factor = €/LU*
Tolls and charges	*€/LU / loading factor = €/LU*
Depreciation, Personnel, Maintenance in terminals	*[(€/year) / (LU/year)] * # required = €/LU*
Third party services	*€/LU* or *€/LU / loading factor = €/LU*

Figure 6.1 Cost Categories and Formulas
(Vassallo et al 17)

Depreciation and maintenance costs include the depreciation and interest as well as the maintenance of the containers, means of transport (i.e. vessel or vehicle), technical assets, and building/property/infrastructure. Salary of drivers and workers, expenses incurred by the driver, social security, overhead, administration, advertising or PR, and advocating/consulting are all included in personnel costs. Consumption refers to the use of goods such as fuel, electricity, and tires. Insurance is required for the cargo, the risk of the freight operations, and for the vehicle and loading unit. Tolls and charges include taxes, duties, tolls, fixed road charges, vehicle taxes, rail track user charges, lock charges, and port charges; wherever they are applicable. Third party costs are those associated with loading and unloading, transshipment, shunting, marshalling and rearranging, as well as storage of goods. The appropriate costs in these categories were calculated and applied to each segment of the journey for both corridors (Vassallo et al 17, 18).

Other important factors, such as the value of time, were not incorporated in the study. This is because the value of time changes considerably for various goods, i.e. the value of time for high-valued goods can be much higher than that of low-valued goods. Other criteria not included in the study are: flexibility, reliability, and risk of damage (Vassallo et al 20).

6.5 Case Study #1 Gioia Tauro-Manchester Corridor

The first case study reviews the transportation options between Gioia Tauro and Manchester. An intermodal solution was compared to the all road route. The following is a list of the types of modes used for the various segments of the trip:

Gioia Tauro – Genova (sss)

Genova – Basel (rail)

Basel – Rotterdam (inland waterway)

Rotterdam – Felixtowe (sss)

Felixtowe – Manchester (rail)

The route is illustrated in the map below. The decisions concerning which mode of transportation was to be used, i.e. inland waterway vs. rail, were based on preliminary pricing calculations (Vassallo et al 21).

Figure 6.2 Map of Corridor 1

(Vassallo et al 21)

The cost of a 20' and 40' container for multimodal and all road situations are represented in the chart below.

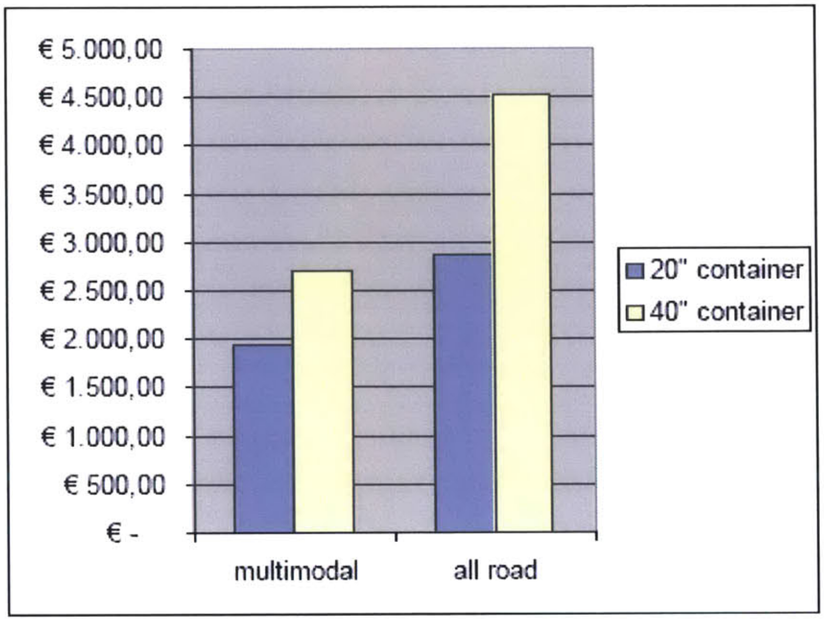


Figure 6.3 Total Cost of Transportation for Multimodal and All Road Routes

(Vassallo et al 22)

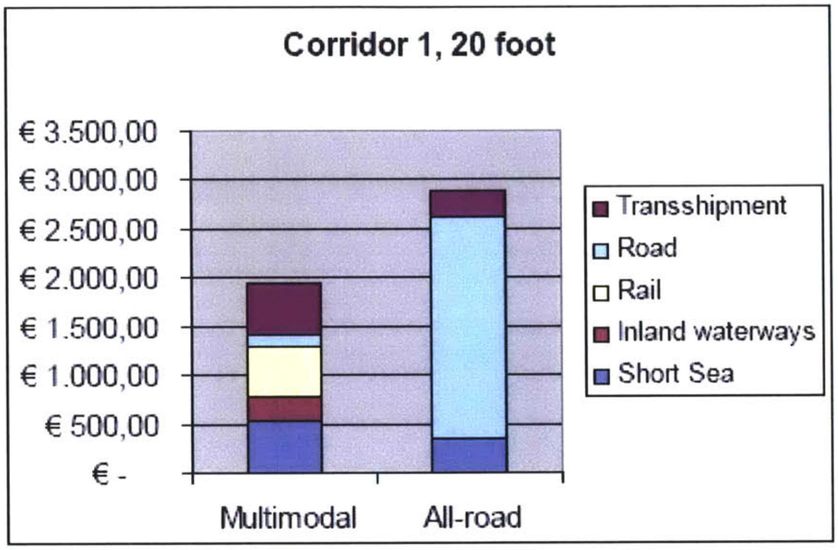
The table below shows the share of door-to-door costs for each component for the alternatives on the corridor between Gioia Tauro and Manchester.

corridor 1	20 foot		40 foot	
	Multimodal	All-road	Multimodal	All-road
transshipment	27,1%	8,8%	19,5%	5,6%
road	7,0%	79,1%	7,4%	84,5%
rail	26,3%	0,0%	29,4%	0,0%
inland waterways	11,8%	0,0%	13,0%	0,0%
Short Sea	27,8%	12,2%	30,7%	9,9%
	100,0%	100,0%	100,0%	100,0%

Figure 6.4 Breakdown of Costs for Both Routes

(Vassallo et al 23)

The following is a graphical representation of the costs. From the graph, it can be seen that the transshipment costs are greater for the intermodal routes, although the overall cost is less (Vassallo et al 22, 23).



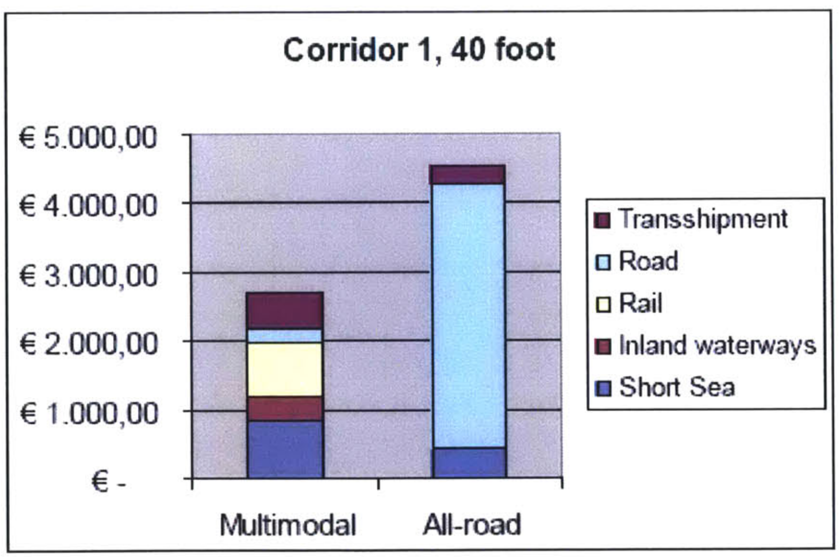


Figure 6.5 Graphical Representations of Cost Breakdown

(Vassallo et al 22, 23)

The total cost for the all road solution for a 40' container was € 4532.55 while for intermodal solution it was only € 2712.92. For the 20' container, the total for the all road solution was € 2879.71 and € 1949.54 for intermodal. Intermodal transportation resulted in a 40% discount compared to the all road solution for the 40' and a 33% discount for the 20' container. This demonstrates that intermodal transportation utilizing short sea shipping can be very cost effective.

The following graphs represent typical costs associated with SSS, and can be applied to both case studies. The first graph represents the cost of SSS, road, and SSS with transshipment fees. It demonstrates the fact that transshipment fees are a significant portion of the total costs of short sea shipping. The second graph shows a breakdown of all the cost elements of a typical short sea shipping segment. It can be noted that port charges like berthing, pilotage, towing might represent around 25-30% of the total cost of SSS. Another interesting observation is that gross profit accounts for 5% of the total cost (Vassallo et al 24).

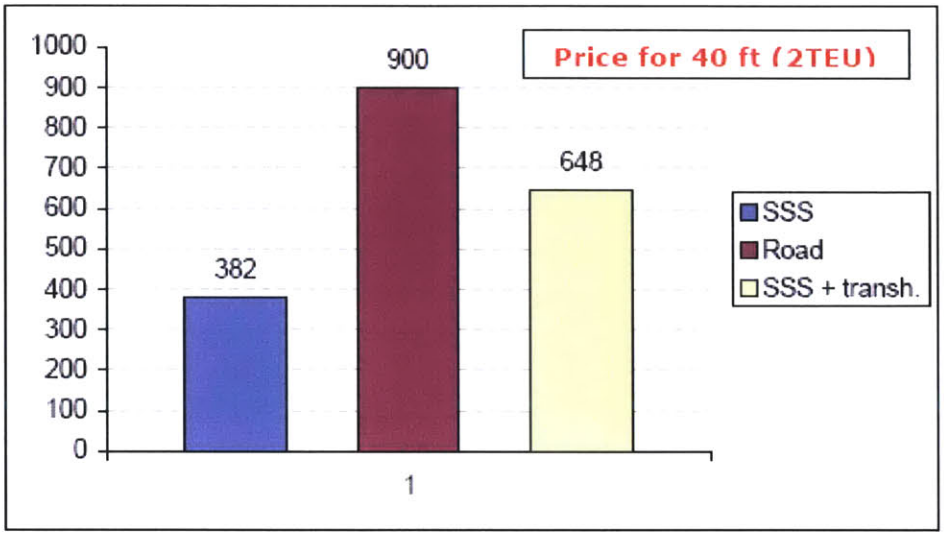


Figure 6.6 Typical Costs for SSS Segments Compared to Road

(Vassallo et al 24)

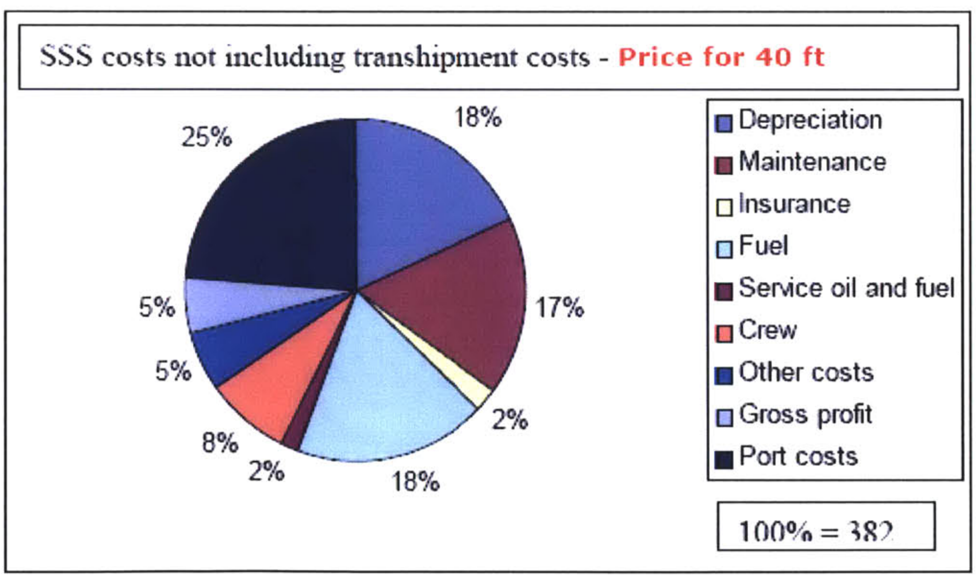


Figure 6.7 Breakdown of SSS Costs

(Vassallo et al 25)

6.6 Case Study #2 Lisbon – Rostock Corridor

The next case study was of the corridor between Lisbon and Rostock. This is an important corridor because the intermodal solution, specifically the short sea shipping segments, allows the bottlenecks in the Pyrenees and the Alps to be circumvented. The breakdown of the intermodal route is as follows:

Lisbon – Bilbao (rail)

Bilbao – Antwerp (sss)

Antwerp – Hamburg (sss)

Hamburg – Rostock (rail)

The following map shows the route (Vassallo et al 29).

Figure 6.8 Map of Corridor 2

(Vassallo et al 29)

The following chart shows the overall costs for the multimodal and all road solutions for both the 20’ and 40’ containers. It can be seen that the difference between the intermodal and all road solutions is significantly greater than in the first case study. For the 40’ container, the cost of the multimodal solution is _ 1491.02 while it is _ 4009.30 for the all road case; the multimodal solution is only 37% of the cost for the road route. The cost for the intermodal solution for a 20’ container is _ 1069.51 and _ 2015 for the all road solution, which means the multimodal solution results in a discount of 47%. The difference between the cost for the 40’ and the 20’ containers is very large for the road solution, but not that significant for the multimodal solution.

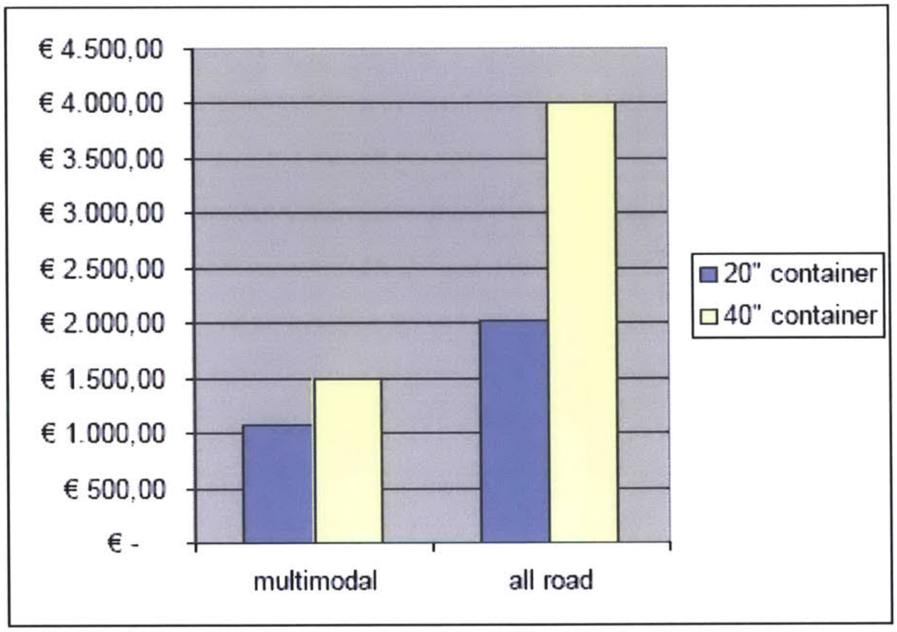


Figure 6.9 Total Cost of Transportation for Multimodal and All Road Routes (Vassallo et al 30)

The table below shows the share of costs for each component for the alternatives on the Lisbon - Rostock corridor (Vassallo et al 30, 31).

corridor 2	20 foot		40 foot	
	Multimodal	All-road	Multimodal	All-road
transshipment	7,3%	0,0%	5,6%	0,0%
road	0,0%	100,0%	0,0%	100,0%
rail	73,1%	0,0%	69,1%	0,0%
inland waterways	0,0%	0,0%	0,0%	0,0%
Short Sea	19,6%	0,0%	25,3%	0,0%
	100,0%	100,0%	100,0%	100,0%

Figure 6.10 Breakdown of Costs for Both Routes (Vassallo et al 31)

6.7 Summary of Case Studies

In both cases studies, the intermodal transportation solution was less expensive for both container sizes. Below are charts that summarize the costs for the various corridors and container sizes (Vassallo et al 39).

Corridor 1		Corridor 2	
Inter-modal	All road	Inter-modal	All road
2712,92	4532,55	1491,02	4009,3

Figure 6.11 Comparison of Multi-modal vs. All Road Solution in Terms of Quoted Prices for 40 ft containers (expressed in €) (Vassallo et al 39)

Corridor 1		Corridor 2	
Inter-modal	All road	Inter-modal	All road
1949,54	2879,71	1069,51	2015

Figure 6.12 Comparison of Multi-modal vs. All Road Solution in Terms of Quoted Prices for 20 ft cContainers (expressed in €) (Vassallo et al 39)

Although the cost in these cases is less, there are other factors that sometimes dissuade customers from using intermodal transportation. The duration of the multimodal trips is in many cases significantly longer than for road routes. Waiting time can greatly increase the overall duration of a trip. Some customers who were interviewed stated that, "to maintain a reasonable overall transit time, a frequency of at least three sailings a week on a specific destination is needed," (Vassallo et al 41). This frequency cannot always be maintained at a profitable level for some routes at this time. The problem with overall transit time, however, may not always be a problem if there is a sufficient amount of planning. For instance, the concept of "floating stock" can save on warehousing costs. Another current disadvantage of intermodal transportation is the lack of flexibility. Routes are set without the opportunity for much deviation. The problems of time and lack of flexibility will decrease as the demand for intermodal transportation increases and new routes can be established to satisfy the demand. These case studies demonstrate that even now, on selected routes, intermodal transportation is a very economical alternative to all road transportation (Vassallo et al 42).

7. Conclusion

Short sea shipping is currently an underused transportation mode with the potential to significantly improve the European transportation system. Increasing the use of short sea shipping by transferring traffic from the congested road system to motorways of the sea will result in many benefits to European society as a whole. It will decrease transportation delays, reduce the need for additional infrastructure on land, decrease the loss of productivity and medical expenses due to accidents, and help to control and reduce the amount of noise pollution as well as air pollution. Internalizing these external costs associated with transportation will increase the costs of transportation for some modes, such as road transportation, while making other, greener modes more competitive.

Once internalization of external costs is complete, the market mechanisms should result in shifts to environmentally friendly modes like maritime transportation and rail. However, government regulations may still be necessary in some instances to achieve the goals outlined in the Marco Polo program for modal shifts and a reduction in the reliance on road transportation. The European Union should establish a system of taxation and subsidies that will create the most good for society by causing shifts towards the greener transportation modes. Possible examples of such subsidies are fuel taxes that reflect the environmental effects of the corresponding mode and a favorable amortization rate for maritime vessels. This will be beneficial in several ways. It will help increase the number of ships available for short sea shipping, thereby increasing the number and frequency of shipping routes. It will also help to ensure that fleets are as modern as possible, which will aid in making maritime transportation faster and more environmentally friendly.

In addition to pricing, there are several other issues with short sea shipping which restrain it from realizing its true potential. A major setback is the current administrative situation in the maritime transportation sector. The customs and declaration of cargo documentation requirements are complicated, confusing, and inconsistent between countries. The EU has adopted several directives to help simplify these procedures. The first is a directive that requires all Member States to accept the International Maritime Organization (IMO) FAL forms. This will create consistency within the European port system. Additionally, the Commission published a Guide to Customs Procedures for Short Sea Shipping with the intention of explaining Customs rules and identifying needs for further simplifications. Another important development is the 'eCustoms' initiative. This program includes the implementation of the New Computerised Transit System (NCTS) to replace the paperwork currently required by the Single Administrative Document (SAD) procedure. It will hopefully speed up and simplify the process for declaring cargo. These administrative changes will be very beneficial in increasing the attractiveness of short sea shipping by reducing the amount of time spent in ports awaiting transfers to other modes of transportation (http://europa.eu.int/scadplus/leg/en/lvb/l24258.htm).

In addition to administrative restraints, deficiencies in infrastructure also result in delays in transition times in ports. There is currently a lack of interconnectivity between modes of transportation. To rectify this situation, the EU has made it a priority to enlarge and upgrade ports by making them better connected to the current road and railway systems. Cooperation between Member States and also Accession Countries will be integral for the effective creation of a connected intermodal network. There must be a high degree of communication between the decision makers across national boundaries and also between modes to ensure that Community funds are spent in ways that will bring the most benefit to all citizens and transportation network users.

Intermodality should be further simplified by the standardization and harmonization of loading units. It is important for efficient transfers between modes that the shipping containers transition easily from ship to rail or road. This will aid in decreasing the time spent in ports and the overall shipping time. Since time is the second most important factor in shipping after cost, it is essential that intermodal transportation using short sea shipping can compete on the temporal platform (http://europa.eu.int/scadplus/leg/en/lvb/l24258.htm).

Establishing motorways of the sea that bypass land bottlenecks in Europe is also necessary to create comprehensive door-to-door logistic chains that fully take advantage of the benefits of short sea shipping. Motorways of the sea should offer efficient, regular, and frequent services between key logistic locations within Europe in order to compete effectively with road transportation. A wide short sea shipping network that fully connects Europe is essential to the increased use of short sea shipping. Efforts should be made to include neighboring countries in this network to further increase its effectiveness. New Member States and also candidate countries should be encouraged to develop their short sea shipping capabilities so that they can become fully connected within the European Community.

To summarize, short sea shipping offers a variety of benefits to the transportation industry. Its speed, reliability, flexibility, regularity, and high degree of cargo safety make it a mode of transportation with great potential. Short Sea Shipping Promotion

Centers will increase consumers' awareness of maritime transportation as an effective transportation solution. The internalization of externalities will increase the use of short sea shipping as well by making it an economical alternative to road transportation.

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