# TREMOVE - II

Ad-hoc Steering Group

8 September 2003

9h30 – 13h00

DG ENV meeting room C



# AGENDA

- Introduction & project objectives
- Model description & preliminary results
  - Structure of the model
  - Preliminary runs
- Work plan - issues
  - Artemis / Particulates
  - Eurostat data availability
  - Access to Entec data
  - Access to aviation data
  - Overall timing
  - Co-ordination with CAFE



# Project Team

- University of Leuven
- Transport and Mobility Leuven
- WSP (Marchial Echenique & Partners)
- Trasporti e Territorio
- INFRAS
- Transport Research Laboratories
- COWI
- AdpC
- GAMS



# Major project outputs (1/2)

1. **Transport and Emissions Baseline (2020)**
   - Transport Activity
   - Vehicle stock turnover
   - Emissions & Energy consumption

***Consistency with SCENES , PRIMES, TRENDS***

***Stakeholder consultation and agreement***



# Major project outputs (2/2)

2. **Simulation tool for policy evaluation**
   - Fiscal policies
   - Vehicle technology policies
   - Alternative fuels policies
   - Fuel quality policies
   - Traffic management policies

***Effects of policies on transport acitivity, vehicle stock, emissions, energy consumption and welfare***



# Scope of the model and baseline

**Time horizon** every year 1995 - 2020

**Geographical coverage** (countries)

- EU 15
- Switzerland, Norway
- Czech Rep, Hungary, Poland, Slovania
- [ North Sea, English Channel, Irish Sea, Baltic Sea, Black Sea, Mediterranean ]

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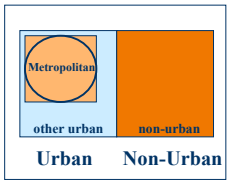
# Geographic coverage

Each country consists of 3 model regions



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# Modal coverage

Passenger transport

- Car
- Motorcycle
- Bus, Tram, Coach, Metro
- Train (interregional, international)
- Air
- Non-motorised
- Ferries

Freight transport

- Heavy duty truck
- Light duty truck
- Inland waterway
- Rail
- Truck – Rail
- Truck – Waterway
- Maritime



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# Trip categories

Passenger trip purposes

- Business
- Commuting to work
- Non-work

***Urban / Inter-regional / International***

Freight categories

- Bulk
- Unitised
- General Cargo

***Urban / Inter-regional / International***



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# Pollutants

- CO
- $NO_x$
- $SO_2$
- VOC
  - $CH_4$
  - $C_6H_6$
  - PAHs
- $H_2S$
- Particulate Matter (& size distribution)
- $NH_3$
- Pb
- Other heavy metals
- $CO_2$
- $N_2O$
- [ Additional GHG (HFC, $SF_6$, PFC, HCFC) ]



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# Scope of the model and baseline

**Welfare cost**

- Consumer Utility
- Industry Transport Costs
- External Costs (congestion, pollution, accidents, noise)
- Marginal Cost of Public Funds



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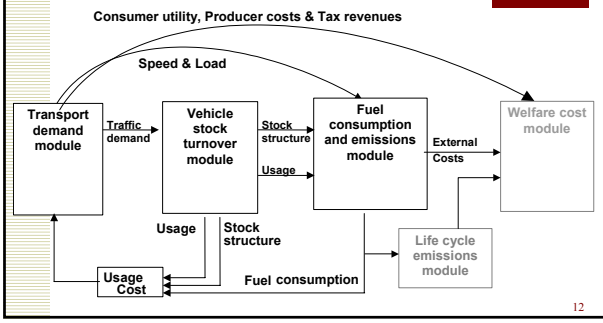
# Model specification : Modules



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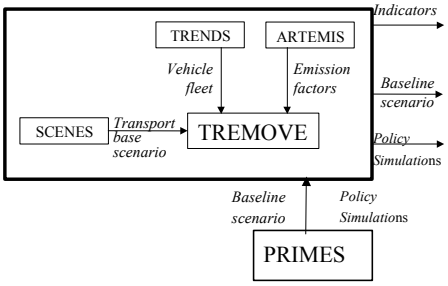
# Linkages



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# TREMOVE - II

- Model Structure
  - Transport Demand and Costs
  - Vehicle Stock and Emissions
- Preliminary German Cases
  - Case 1: EURO V PM trap for Diesel Cars
  - Case 2: Tax on IWW High Sulfur Content Fuel



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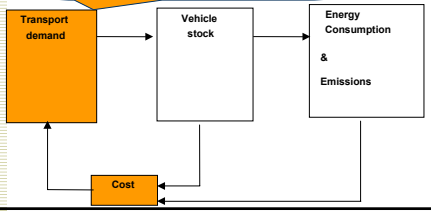
# Transport Demand and Costs

- Consumer / Industry Market
  - Consumer Demand (+example)
  - Industry Demand (+example)
  - Road Congestion connects Markets
- Base case Data provided by SCENES



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# Consumer and Industry Markets

- Consumer Transport
  - Budget spending
  - Generalized Prices
  - Competes non-transport
  - Leisure & Commuting
  - National & International
  - Cars/Motorcycles/Soft
  - Bus/Train/Metro/Plane
- Industry Transport
  - Cost Minimizing
  - Generalized Prices
  - Competes non-transport
  - Freight & Business Trips
  - National & International
  - Cargo/Bulk/Unitized Freight
  - Cars/Trucks (LDV/HDV)
  - Bus/Train/Plane/IWW

Congestion



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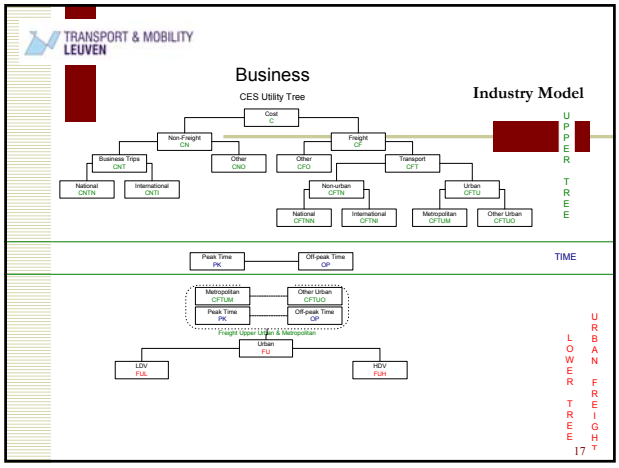




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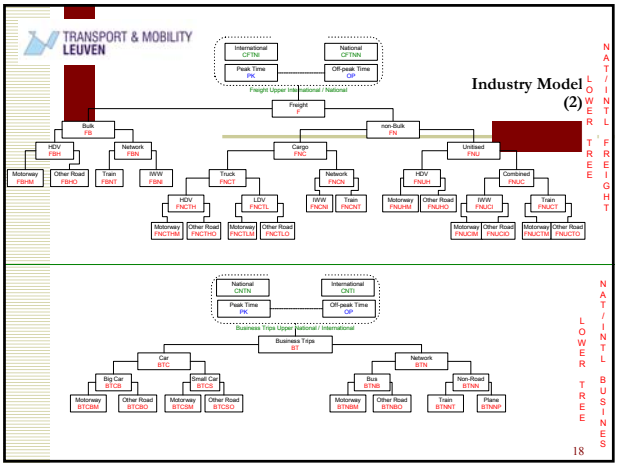
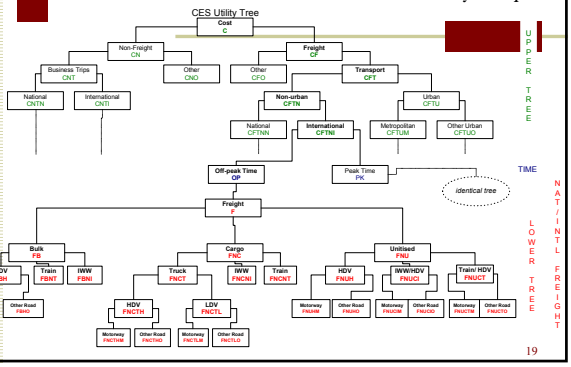


## International Cargo Freigth - offpeak

**Industry example**

CES Utility Tree

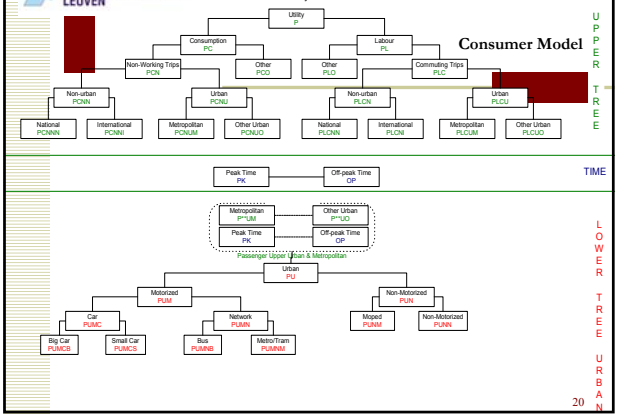





## Passengers

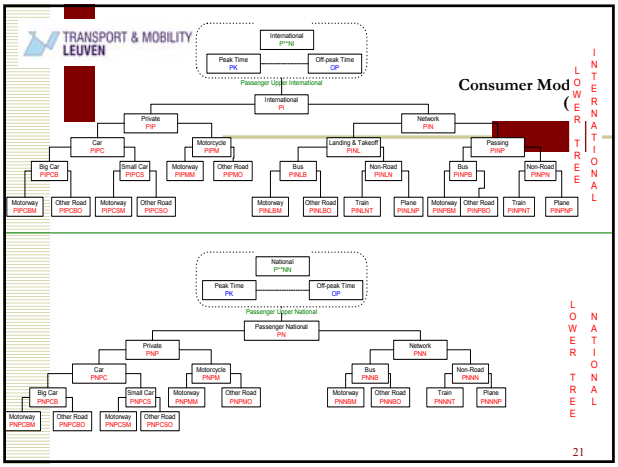
**Consumer Model**

CES Utility Tree





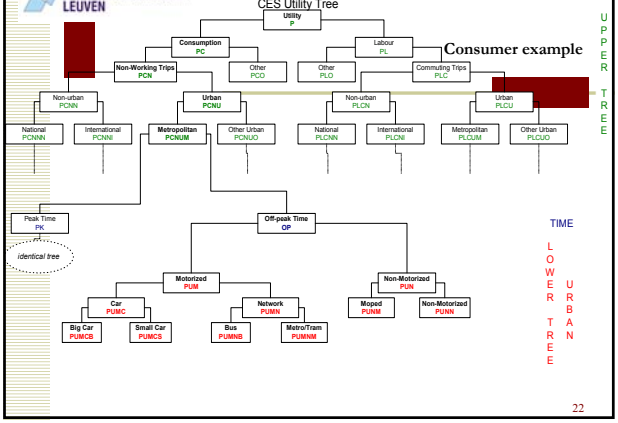

## Consumer Mod (





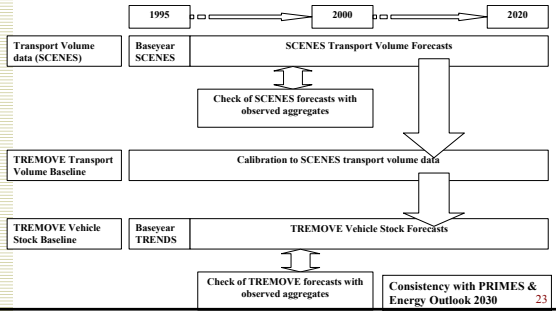

## Metropolitan Passengers
## Off-peak Non-working Trips
CES Utility Tree

**Consumer example**





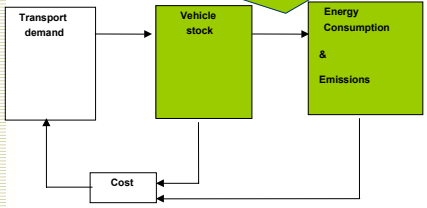

## Base Case Data: SCENES






## Vehicle Stock and Emissions

- Vehicle Stock Modeling
  - Road vehicles
  - Maritime & IWW vessels
  - Trains, Metro & Tram
  - Aircrafts
- Energy & Emission Modeling



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# Technology, Energy & Emissions

- **VEHICLE STOCK & USAGE MODELLING**
  - **Road vehicles**
  - **Inland waterway vessels**
  - **Maritime vessels**
  - **Trains, Metro & Tram**
  - **Aircrafts**
- **ENERGY CONSUMPTION AND EMISSION CALCULATION**
  - **Road vehicles & Non-road vehicles**



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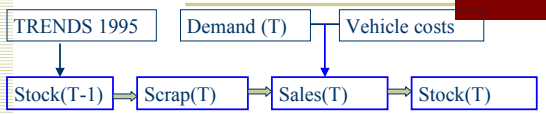
# Road Vehicles




- Logit choice model for car technology

NEW

  - Types : gasolines, diesels, hybrids, fuel cells, electric, ...
  - Parameters : fuel cost, purchase cost, performance, range, fuel availability ...
  - Data : Flemish inquiry , Literature (US,...)



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# Road Vehicles (2)

- Heavy duty trucks :

NEW

  - different fleet composition on urban, motorway, rural roads : ~traffic count data (GE,IT)
- Mopeds vs Motorcycles

NEW

  - different fleet composition on urban, motorway, rural roads
- Vintages up to 1965

NEW



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# Inland Waterway: usage

NEW

**Tonne-kms BULK , UNITISED , CARGO domestic & international**

Vessel trip data (NL)

Vessel stock (FR,GE,NL,..)

| | Tanker vessel | Pusher craft | Cargo vessel |
|---|---|---|---|
| < 450 T | | | |
| 450 – 650 T | •Vehicle kilometres by vessel type<br>•Load factors by vessel type | | |
| 650 –1000 T | | | |
| 1000- 1500 T | | | |
| 1500- 3000 T | | | |
| > 3000 T | | | |



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# Inland Waterway: technology

NEW

Select fuel type, engine type & aftertreatment equipment in order to minimise average cost per vessel-kilometre

Subject to :

- Cost of the fuel, engine & equipment
- Availability of the fuel, engine & equipment
- Endogenous rate of engine replacement
- ...
- Policy environment (fuel tax, emission tax, tech. standard, fuel quality standard, ...)



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NEW

# Maritime

## *Demand, usage & technology*

- Separate Maritime Demand Forecast
  - 1995 activity by vessel type from ENTEC/Lloyds,
  - 1996 - 2020 growth rate from SCENES
- Technology choice simulation by model cfr. inland waterway vessels (cost-minimisation)

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NEW

# Rail: Usage

Tonne-kms and Passenger-kms

TRENDS vkm by train type

Occupancy rates / Load factors

| | Diesel | Electric | H.S.T. |
|---|---|---|---|
| Railcar | Vehicle - kilometres by train type | | |
| Locomotive | | | |

UIC vehicle stock

UIC age distribution

Vehicle-kilometres per train by train type and age



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# Rail :Vehicle stock

UIC 1995/2000

Demand (T)

Vehicle costs

Stock(T-1) ⇒ Scrap(T) ⇒ Sales(T) ⇒ Stock(T)

NEW

*Metro & Tram*

- No explicit vehicle fleet modelling
- Energy consumption factors : kWh/vkm



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NEW

# Air

- Single EU + A.C. aircraft fleet (not by country)
- 1995 trip data by aircraft type and size from TRENDS/EUROCONTROL
  - Update requested @ EUROCONTROL
- Technology choice simulation by category cfr. inland waterway vessels (cost-minimisation)



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# Energy/Emission modelling

- Road vehicles

  1° COPERT III + fuel specification + EURO III, IV factors + ACEA agreement (Similar to TREMOVE - I)

  2° ARTEMIS / PARTICULATES

NEW Increase in emission factors expected (off-cycle emissions)

- Non-road vehicles : prel. ARTEMIS results

NEW



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# Preliminary Results - Germany

1. EURO-V PM Trap
   - Technology Standard
   - All New Diesel Cars
   - From 2009 onwards
   - 1000 € / Vehicle
   - 80% PM Emission Reduction compared to EURO IV
2. IWW Sulphur Fuel tax
   - ½ Sulphur fuel: +3€/liter
   - Increasing vkm tax if high sulphur fuel
   - Increasing production capacity for low sulphur fuel
   - Endogeneous engine choice



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# Case 1. EURO-V PM Trap

(4) Modal shift

(5) Demand Reduction

(1) Shift to gasoline cars

(2) Shift to emission controlled cars

Demand → Vehicle Stock → Emissions

(6) PM Emission Reduction

Cost

(3) Increase in Price of car transport

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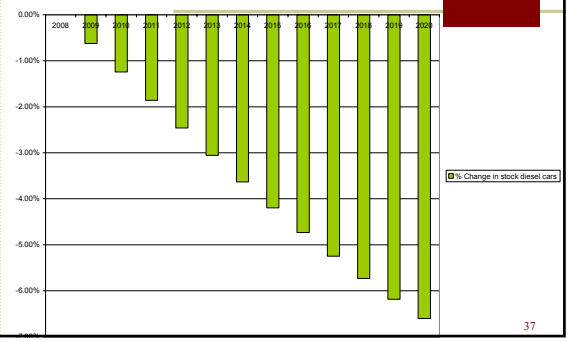
# (1) Shift to Gasoline Cars



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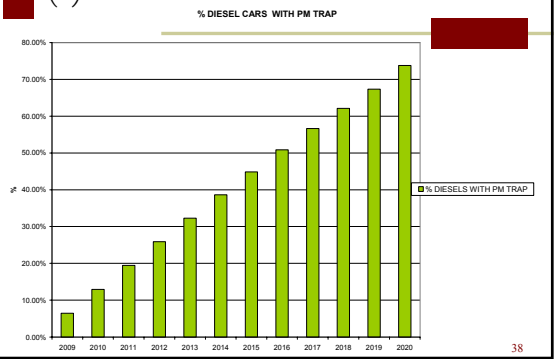
# (2) Shift to emission controlled cars



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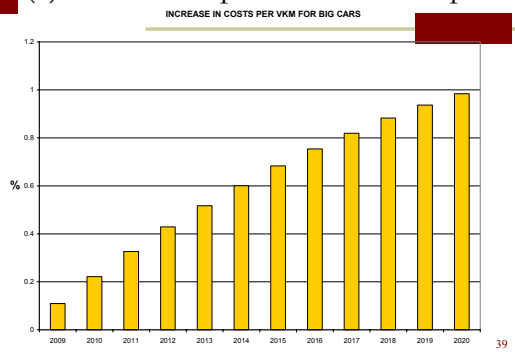
# (3) Increase in price of Car transport



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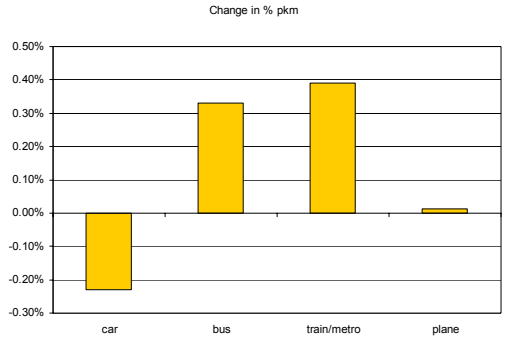
# (4) Modal Shift

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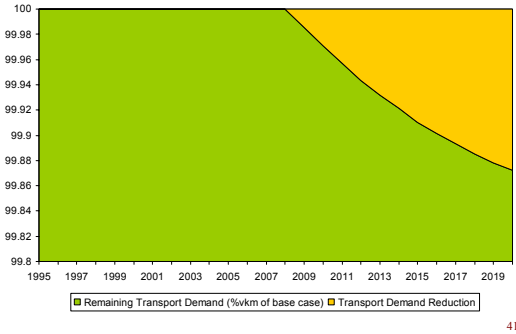
# (5) Demand Reduction



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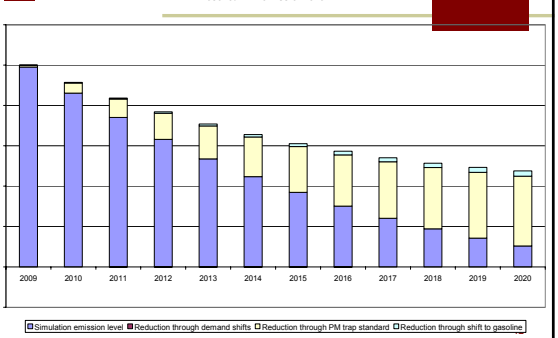
# (6) PM Emission Reduction



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# Case 2. IWW Sulphur Fuel Tax

**Policy Scenario : Introduction of a low sulphur fuel**

Sulphur content = 50% of normal fuel

Resource cost per litre 3 EURO's more than normal fuel

There is a km-tax which is equal over all ship types, but depends on the type of fuel used

| | using normal fuel | using low sulphur fuel |
|---|---|---|
| 1995-2004 | 0 | ********** |
| 2005-2008 | 5.0 euro per vkm | 2.5 euro per vkm |
| 2009-2015 | 10.0 euro per vkm | 5.0 euro per vkm |
| 2016-2020 | ********** | Compulsory |



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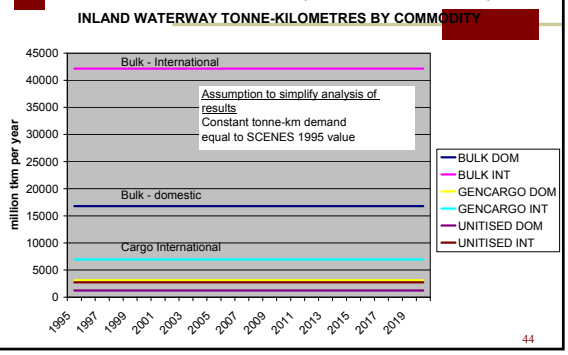
# IWW Market by Commodity



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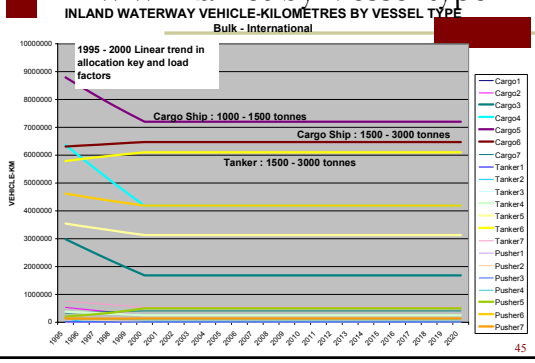
# IWW Market by Vessel type



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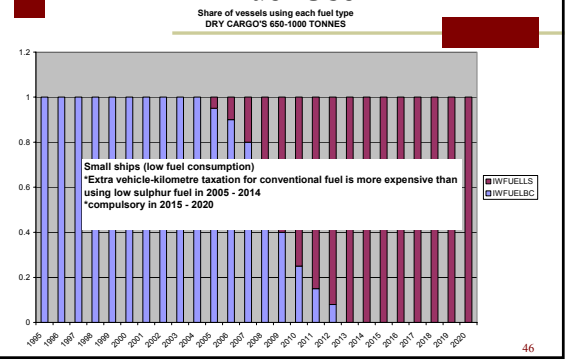
# Fuel Use



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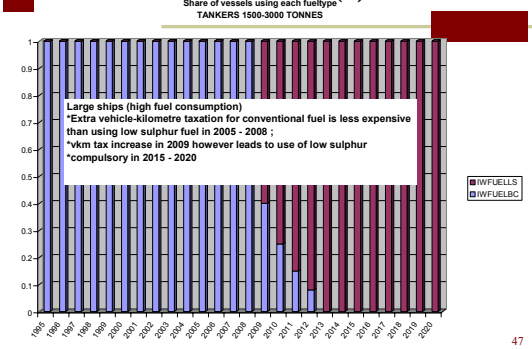
# Fuel Use (2)



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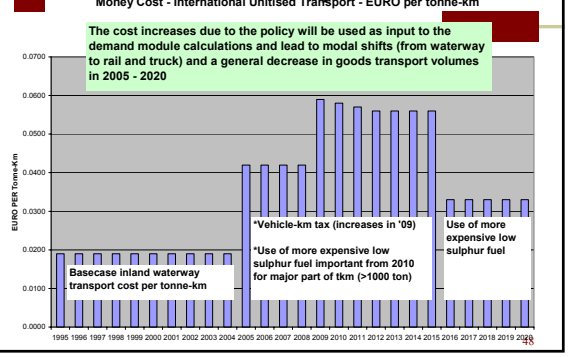
# Cost Impact



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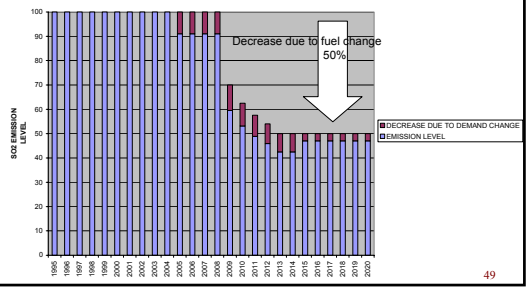
# Emission Reduction

**SO2 EMISSIONS - TANKER 1000-1500 TONNES**

Direct effect of introduction of low sulphur fuel is enlarged by indirect effect on inland waterway demand due to cost increase



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# Overall work plan

- 1. TRANSPORT DEMAND MODULE
- 2. VEHICLE STOCK MODULE
  - Final draft model: Feb 04 *(LOT 1)*
  - Final model including new technologies: Nov 04 *(LOT 2)*
- 3. EMISSIONS MODULE
  - Final draft model: Feb 04 *(LOT 1)*
  - Final model: Nov 04 *(LOT 2)*
- OTHER ISSUES (life cycle emissions, welfare)
  - Nov 04: final model *(LOT 2)*
- POLICY RUNS
  - Nov 04 – Nov 06 *(LOT 3)*



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# WORK PLAN & ISSUES
## 1. TRANSPORT DEMAND MODULE

- Modelling in GAMS: quasi finished – some issues left
- Input data for 21 countries: Sep 03 – input data link with SCENES still to be fine-tuned (timing is very ambitious)
- Some preliminary stakeholder consultations (5 countries) on transport demand baseline: Oct – Dec 03 *(LOT 2)*
  (including co-ordination with CAFE)
- Consistency check of input data (SCENES) and TREMOVE baseline with PRIMES: Oct – Dec 03
- Final draft module: Feb 04
- Mar – Oct 04: Stakeholder consultations on TREMOVE baseline, including accession country peer review *(LOT 2)*
- Nov 04: final model *(LOT2)*



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# WORK PLAN & ISSUES
## 2. VEHICLE STOCK MODULE

- Modelling in GAMS: road and inland waterways quasi okay
- Still to go:
  - Rail: data and methodology okay – Gams implementation required
  - Maritime: Entec/Lloyds data needed
  - Aviation: data okay – methodology to be fine-tuned
  - Road data: HDV limitations – adaptations of TRENDS needed
  - Need for vehicle specific cost data (purchase price, vehicle taxes, ...) for all modes, except car, LDV, motocycles
- Final draft module: Feb 04
- Mar – Oct 04: Stakeholder consultations on TREMOVE baseline, including accession country peer review
- Nov 04: final model



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# WORK PLAN & ISSUES
## 3. EMISSIONS MODULE

- Issues to be resolved before end 2003:
  - Road, : Artemis/Particulates versus Copert issue
  - Martime: need for Entec report
  - Air: Artemis and TRENDS data – okay
  - Rail, metro, tram: Artemis – okay
  - Inland waterways: okay
- Final draft module: Feb 04
- Mar – Oct 04: Stakeholder consultations on TREMOVE baseline, including accession country peer review
- Nov 04: final model



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# TREMOVE

**www.tremove.org**