



## Achieving more energy efficient and environmental friendly freight transport in cities

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# Urban freight transport



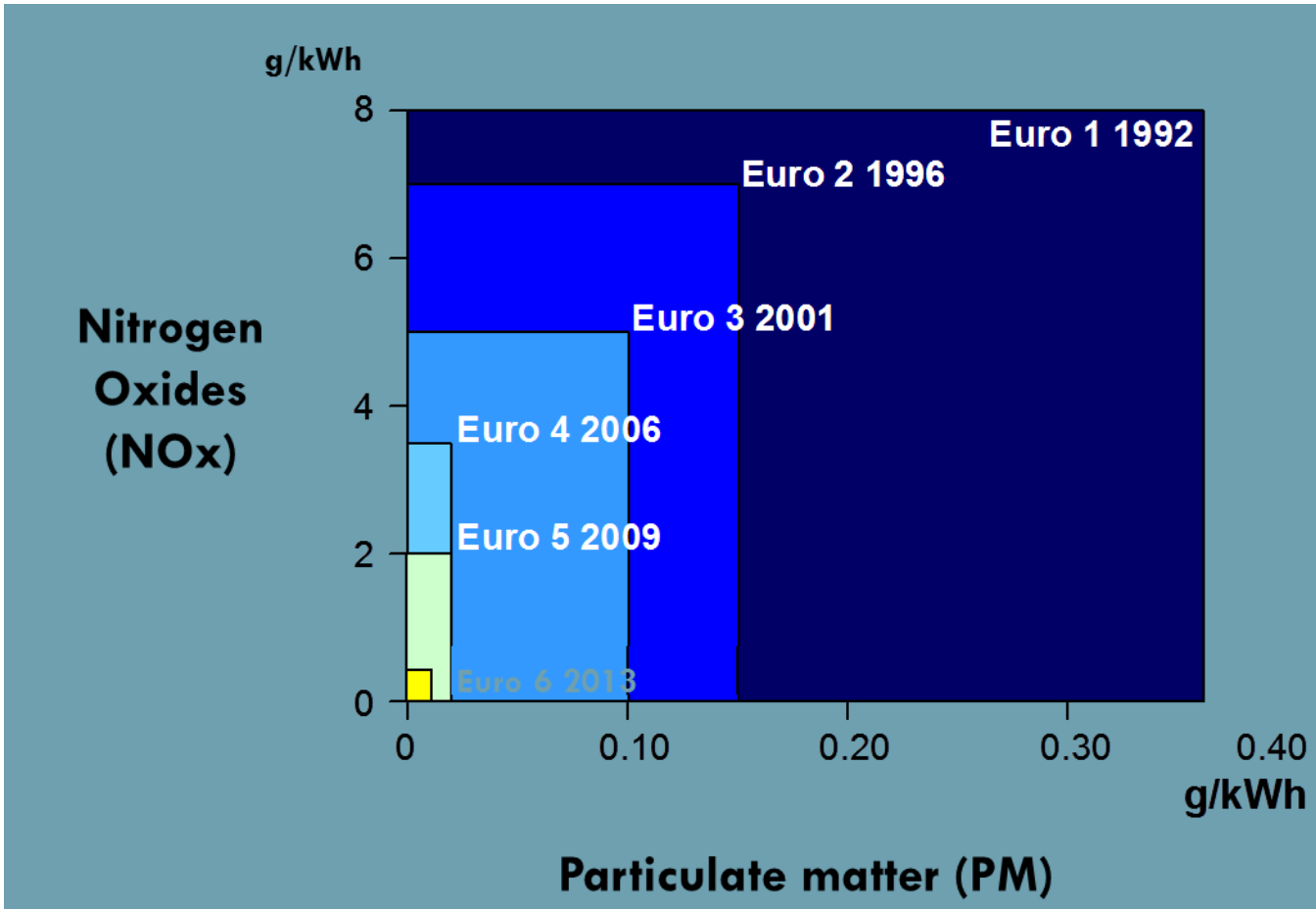
- Vital for cities to have a functioning freight transport system.
- Freight transport has negative consequences
  - Noise
  - Pollution (global and local effects)
  - Particulate matter
- Globally
  - CO<sub>2</sub> emissions and global warming
- Locally
  - NO<sub>x</sub>, more specifically NO<sub>2</sub>
- Atmospheric vehicle emissions are complex
  - Using grams/tonkilometer is an over-simplification

# A quick technical introduction to emissions



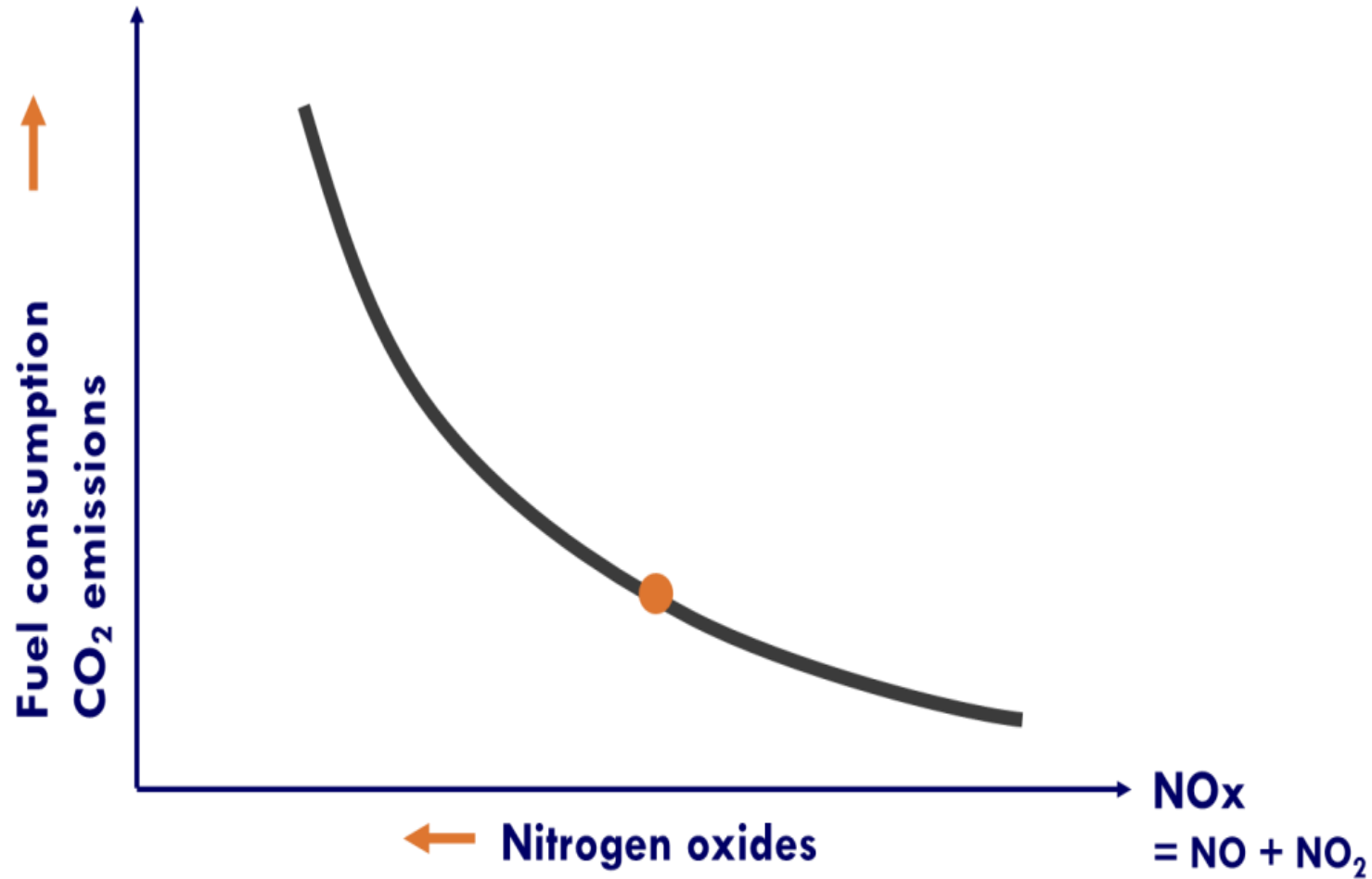
- Some useful background information

# The Euro emission standards

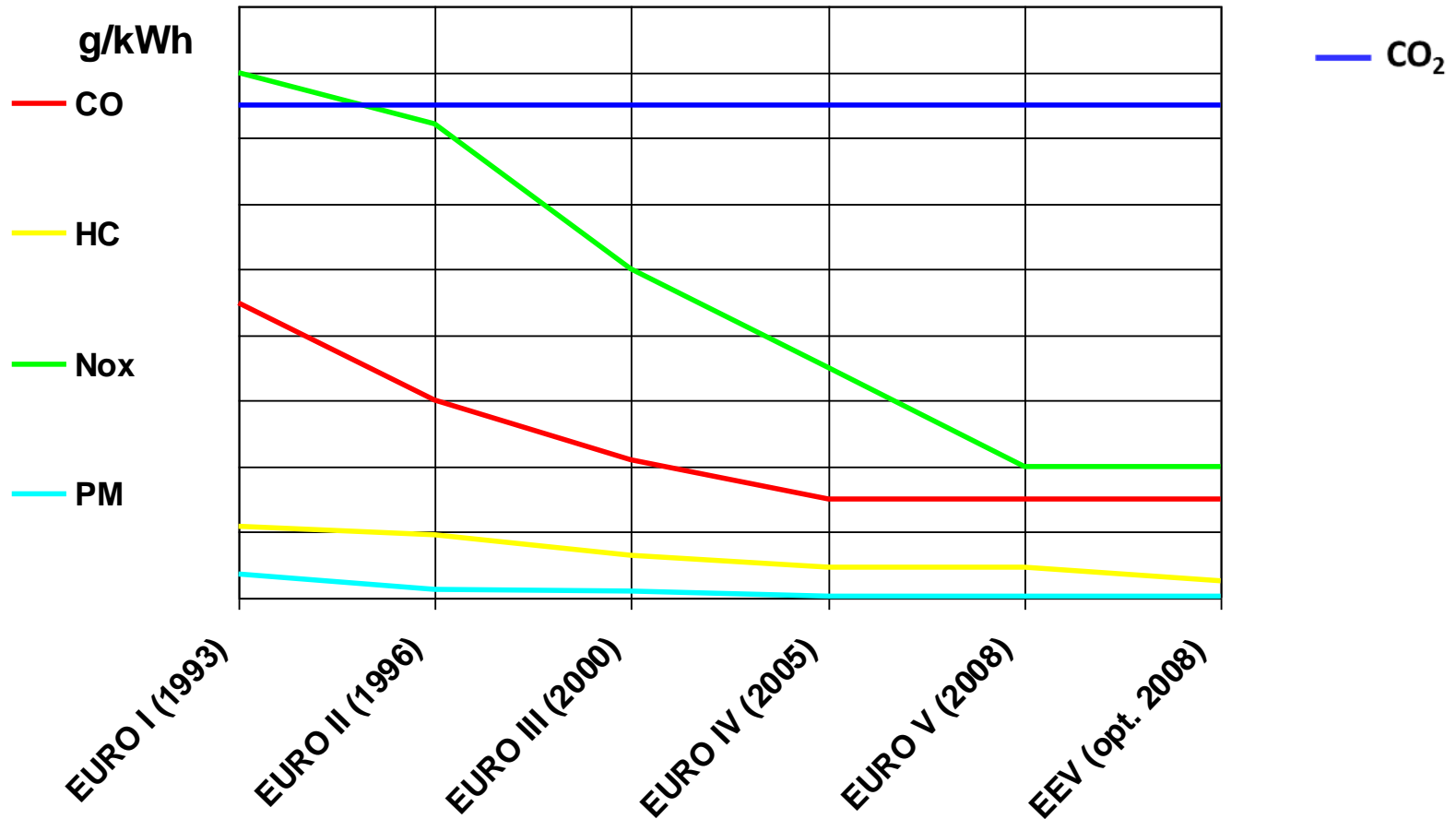


Note HDV Euro norm should be roman numerals

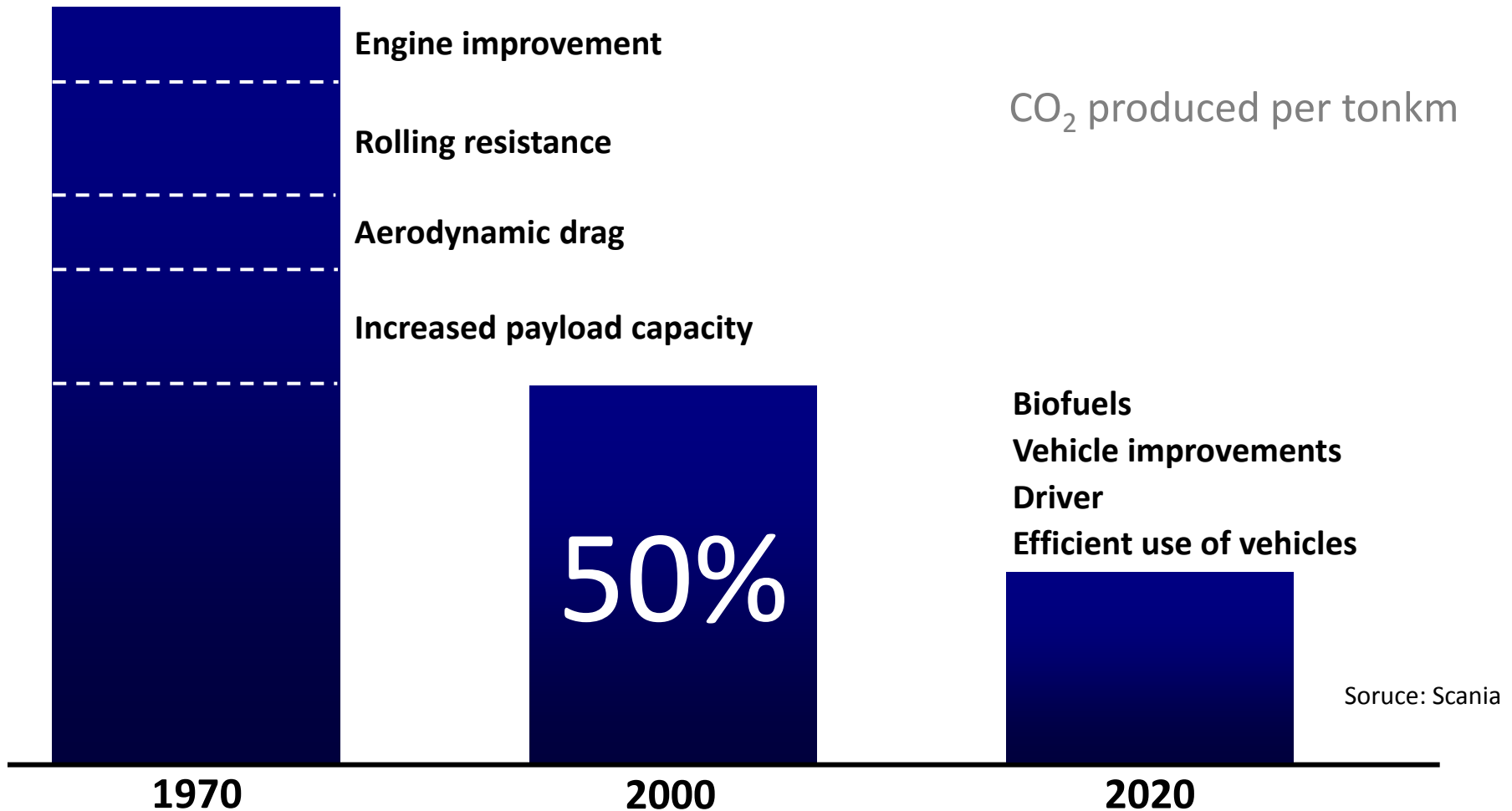
# NO<sub>x</sub> / Fuel consumption dilemma



# Engine emissions and energy



# Vehicle CO<sub>2</sub> efficiency



# Global / Local challenges



- Globally reduce CO<sub>2</sub> emissions to dampen global warming
  - Energy efficiency is the key here
  - NO<sub>x</sub> and energy efficiency are contradictory
- NOX – the new attention receiver
  - NO<sub>2</sub> concentrations are too high. (Health risk)
- EU Concentration regulation
  - Major Norwegian cities may shutdown the road network in case of severe pollution
- The politicians thought they had solved the problem with the EURO emission regulation
  - The answer has been and is Low Emission Zones based on the Euro Emission standard (LEZ)



# Current thinking in Norway and the alternative !



- The use of studded tires has an impact on the amount of PM<sub>10</sub> in the air.
  - The idea is to use the same scheme to reduce NO<sub>2</sub>
    - A challenge is the weak link between the EURO emission standard and the NO<sub>2</sub> emission reduction
- What is the alternative?
  - Effective policy require a correct understanding of the problem
    - Emissions
    - Correct assignment of costs in the freight industry
  - Motivation of the actors
  - Management functions for policy makers

# GAZ (Green Activity Zones)



- Green
  - Both the local environment and the global climate
- Activity
  - Behavior of the actors in the freight chain is crucial
- Zone
  - Different measures in different areas
- Optimal behavior is a key
  - Can we do what we do, but in a better way?
  - Use carrot and stick to induce optimal behaviour

# The GAZ project methodology



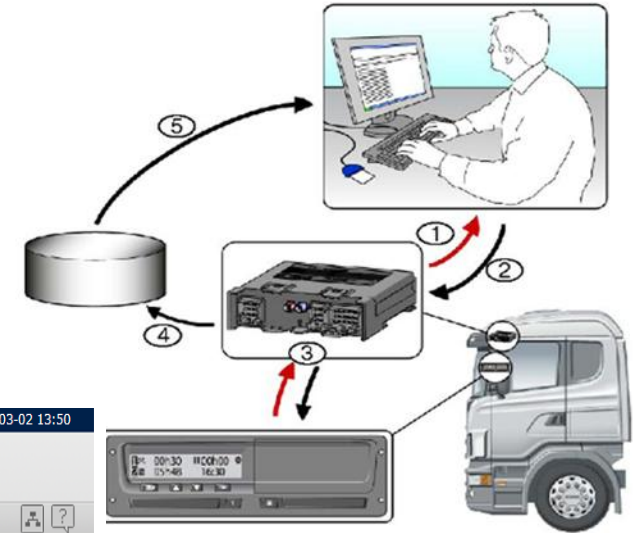
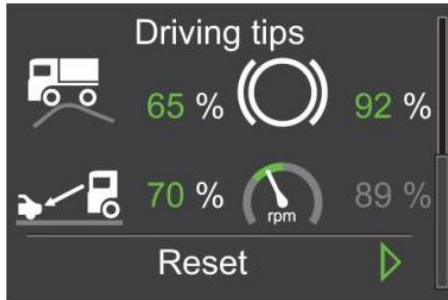
- Document availability of technology to measure emissions or trusted indicators for emissions and energy consumption
- Systematically find the actors in the freight transport industry that can change their behavior if correct incentives are given
- Developing a cost function to induce green behavior

# In-vehicle technology



- The ECU (Engine Control Unit)
  - Made emission manipulation possible
  - A unique way to access data from the engine
- Using engine-maps to calculate emissions
  - Foundation for state of the art emission tools – PHEM & VERSIT+
  - Created on the basis of measurements, possibly PEMS
  - Emissions as function of engine load and engine speed
- FMS (Fleet Management System) standard
  - Secure and standardised way to get data from the internal vehicle network
  - 7 HDV manufacturers
  - Monitoring performance in near real-time

# Manufacturers efforts



SCANIA

Aktiviteter Analys Administration

HEM > ANALYS > MILJÖRAPPORT

Vecka Månad Kvartal År Eget

Startdatum 2011-02-23 00:00 Slutdatum 2011-03-02 00:00

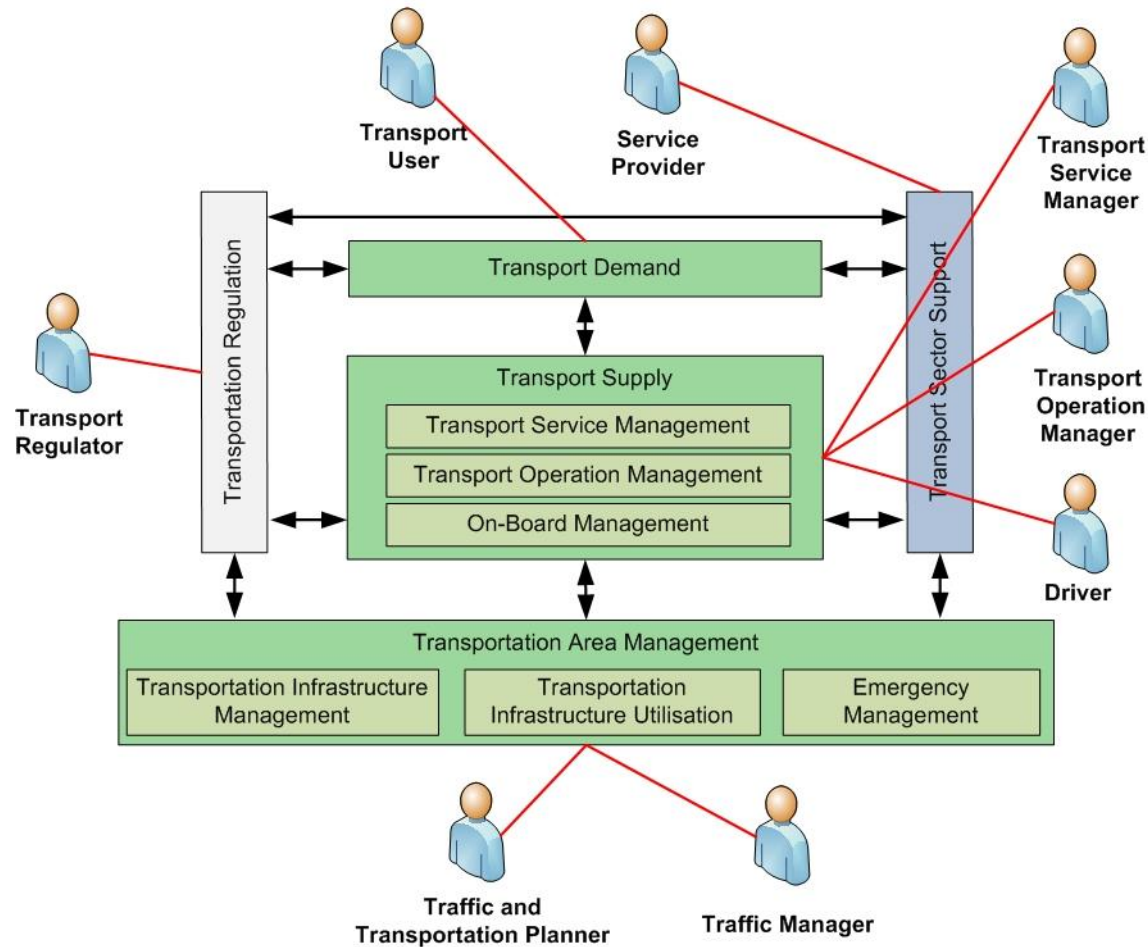
Fordonsgrupp Stavanger Visa

Fordon	Start	Stopp	Sträcka (km)	Bränsle (liter)	NO <sub>x</sub> (kg)	PM (kg)	HC (kg)	CO (kg)	CO <sub>2</sub> (kg)	Motor typ
RJ 82290	2011-02-23 05:01:00	2011-03-02 06:33:00	2535	1255	15,1	0,06	0,28	1,2	3389	Euro 4, SC, DC16 05
RJ 82291	2011-02-23 14:56:00	2011-03-02 00:04:00	1368	684	8,2	0,03	0,15	0,6	1847	Euro 4, SC, DC16 05
RJ 82292	2011-02-23 00:03:00	2011-03-01 03:25:00	1793	868	5,8	0,05	0,07	1,2	2344	Euro 5, SC, DC16 09
<b>Totalt</b>			<b>5696</b>	<b>2807</b>	<b>29,1</b>	<b>0,15</b>	<b>0,50</b>	<b>3,0</b>	<b>7579</b>	
<b>Flotta</b>			<b>5844</b>	<b>2882</b>	<b>30,5</b>	<b>0,18</b>	<b>0,59</b>	<b>3,2</b>	<b>7781</b>	

Exportera data



# The actors



## ARKTRANS:

Software engineering methodology to identify actors and their roles.

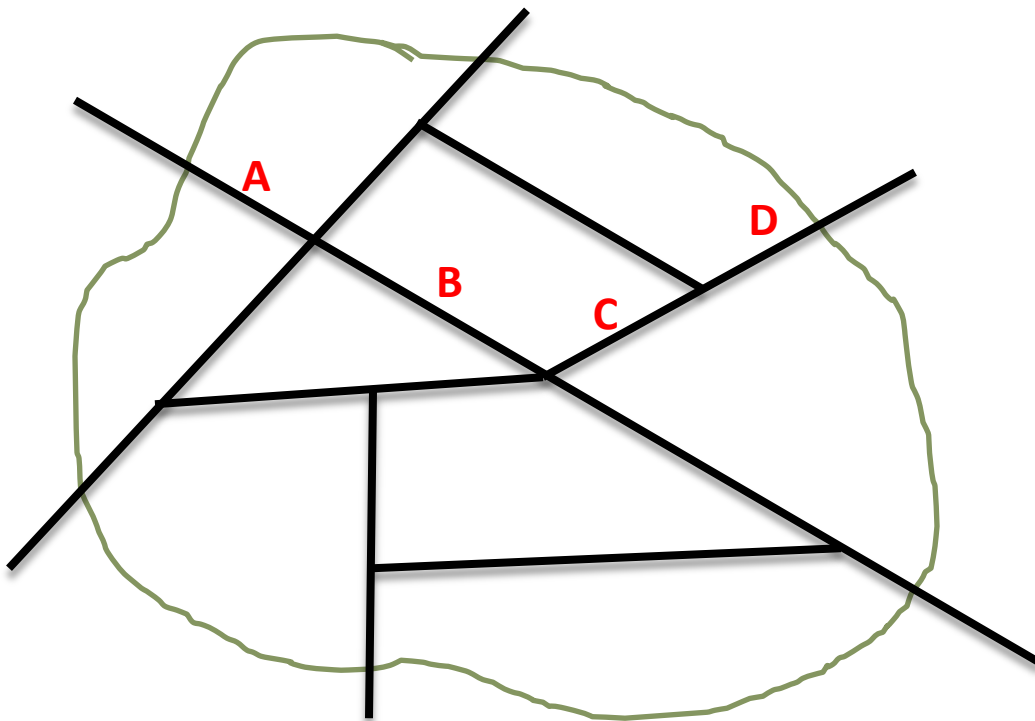
Abstract the complex nature of urban freight transport and the actors involved to help create a reasonable cost function

Could also be used to locate barriers

# The GAZ algorithm

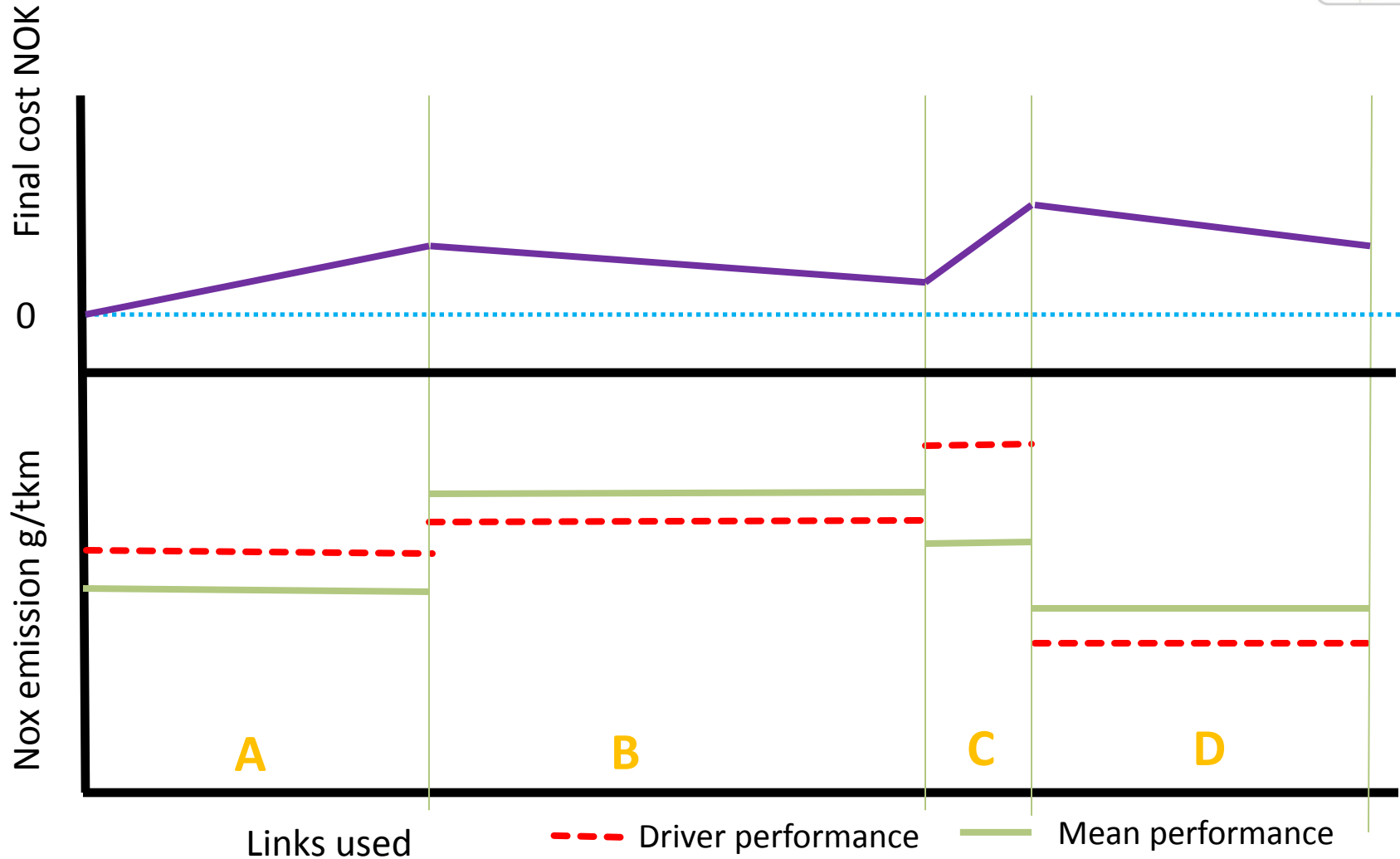


- Use fiscal measures to induce wanted behaviour



- A set of links inside a cordon
- Compete against the mean g/tkm factors
- Hourly means as reference, stored centrally for each link
- Reference link data, mean speed and mean number of stops
- Weighting of links, manage flow. Primarily distance, but also for consolidating flow

# A trip within the cordon





# Formulation of the GAZ fee



$$GAZ_{Fee} = \sum_{Link} \left[ \left( \sum_{Pollutant} (E_{Vehicle} - E_{Average}) \times Cost_{Pollutant} \right) \times Cost_{Link} \times Distance_{Link} \right]$$

- P = Pollutant (CO<sub>2</sub>, NO<sub>x</sub>, PM, HC, CO)
- L = Link (road segment between two intersections)
- E = Emitted amount in grams/tkm
- An average driver pays nothing

# A more accurate and fair charging concept



1. The fee is calculated using different vehicle related parameters where data are provided by the internal ICT system of the HGV, e.g. engine characteristics, speed, total weight, distance travelled, fuel used and emissions.
2. The fee is calculated in a dynamic way that is reflecting the actual use of the HGV and the driver behavior, e.g. acceleration and deceleration.
3. The fee is calculated using a differentiated pricing of the pollutants (CO<sub>2</sub>, NO<sub>x</sub>, PM, HC, and CO).
4. The fee calculated can be related to specific transport services provided by the Transport Service Providers in a transparent way enabling the Transport Service Provider to charge the Transport User for extra costs due to specific delivery requirements, e.g. deliveries in rush hours

# Expected improvements



- A more effective alternative to the expected LEZ
- Activity based costing, not an indulgence
- Improved local control (more fine grained)
- Harvesting of digital freight transportation (Digital information recycling)
- Transport regulators get access to real data
- Better transparency for Transport Service providers, pushing costs up the chain
- More effective emission control when needed (High concentrations)



Thank you for your attention