”I don’t trust air I can’t see”

Woody Allen

”Look to Norway”

Some Norwegian experiences on the path towards clean emissions from ships

by

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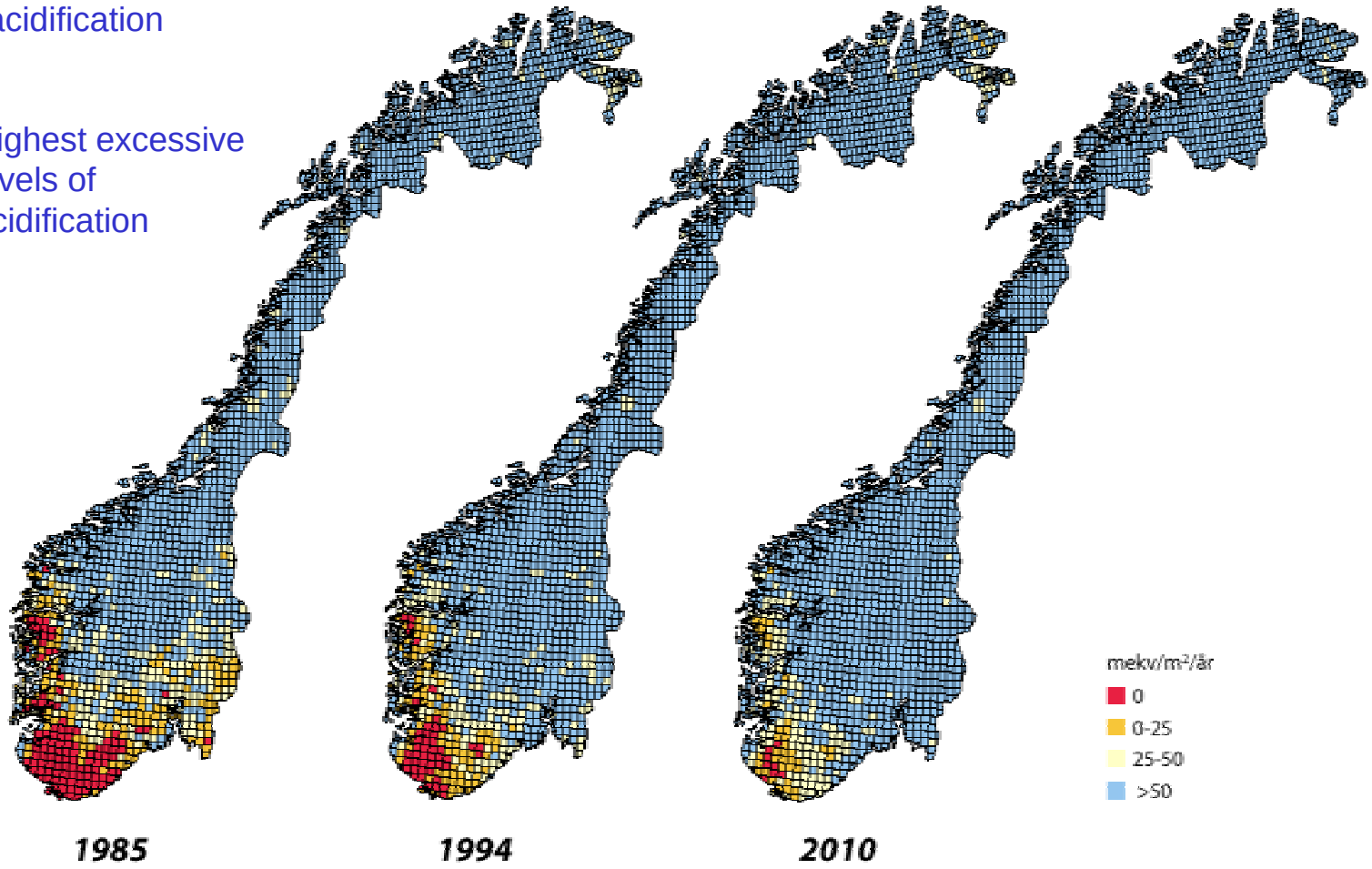
Washington DC January 30, 2002

Acidification in Norway

No excessive levels of acidification

Highest excessive levels of acidification



Creating a framework towards solution

- UNECE Convention on Long-Range Transboundary Air Pollution
  - Eight protocols
  - The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone
- MARPOL 73/78 Annex VI

MARPOL 73/78 ANNEX VI

- Norway ratified in 1998
- The five recognized organisations are authorised to issue intermediate statement of compliance on our behalf

The Gothenburg Requirements

- The Protocol sets emission ceilings for 2010 for four pollutants: sulphur, NOx, VOCs and ammonia.
- Negotiated on the basis of scientific assessments of pollution effects and abatement options. Parties whose emissions have a more severe environmental or health impact and whose emissions are relatively cheap to reduce will have to make the biggest cuts.
- Once the Protocol is fully implemented, Europe's sulphur emissions should be cut by at least 63%, its NOx emissions by 41%, its VOC emissions by 40% and its ammonia emissions by 17% compared to 1990.

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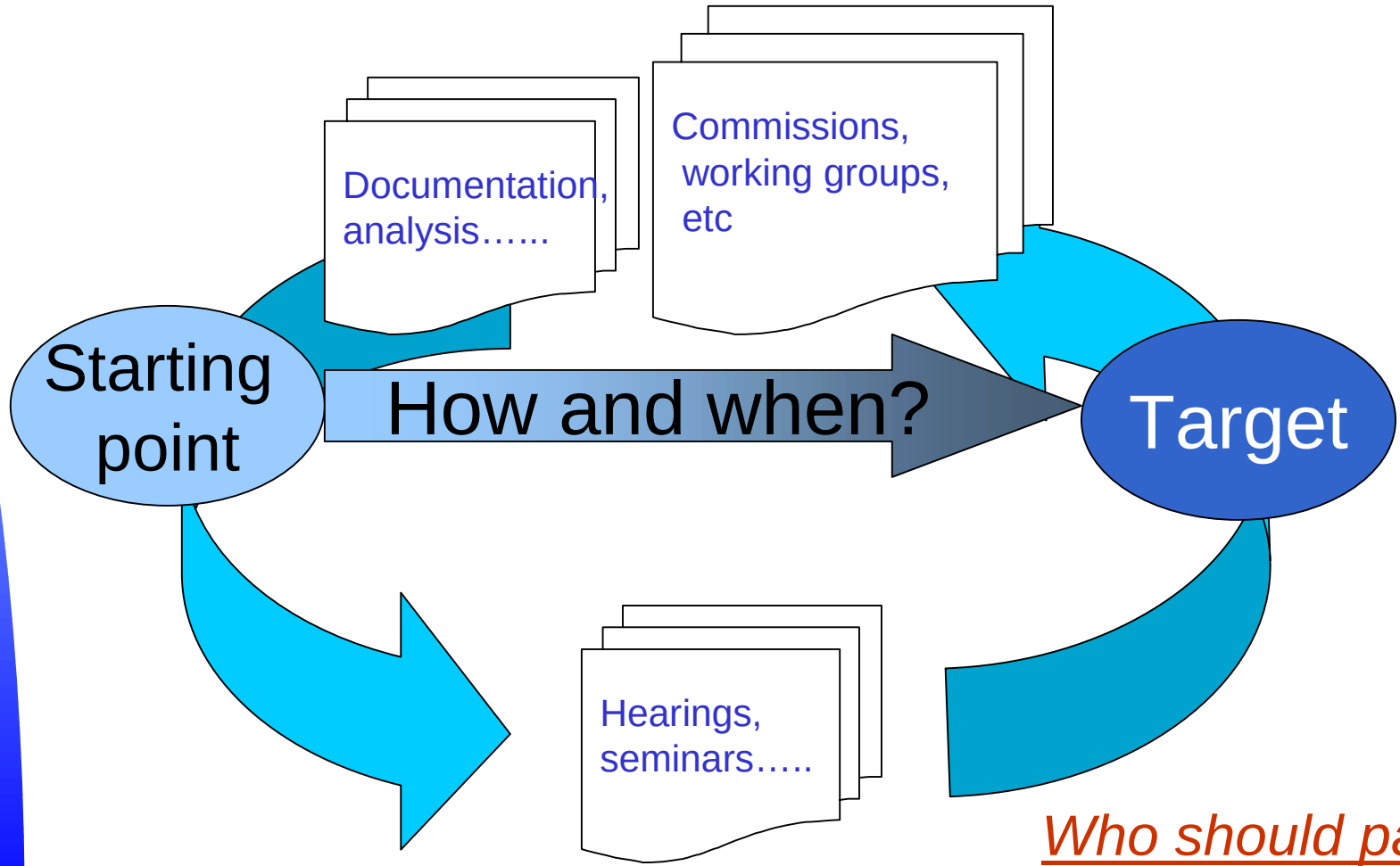
Process to towards action

Where are we? Where to go? How and when to get there?



Who should pay?

Norwegian Gothenburg commitments

	1990	1999	2010 Commitment	Reduction 1990 – 2010
SO2	**53.000**	**29.000**	**22.000**	**58%**
NOx	**219.000**	**228.000**	**156.000**	**29%**
NH3	**23.000**	**27.000**	**23.000**	**0%**
NMVOC	**300.000**	**343.000**	**195.000**	**35%**

From 2001 to 2010 - policy instruments

- 2001-2002: analyses and recommendations
- 2002-2003: political decisions
- 2002-2006: implementation
- 2008: evaluation
- 2009: adjustments
- 2010: no emissions beyond the emission ceilings !!!!!!

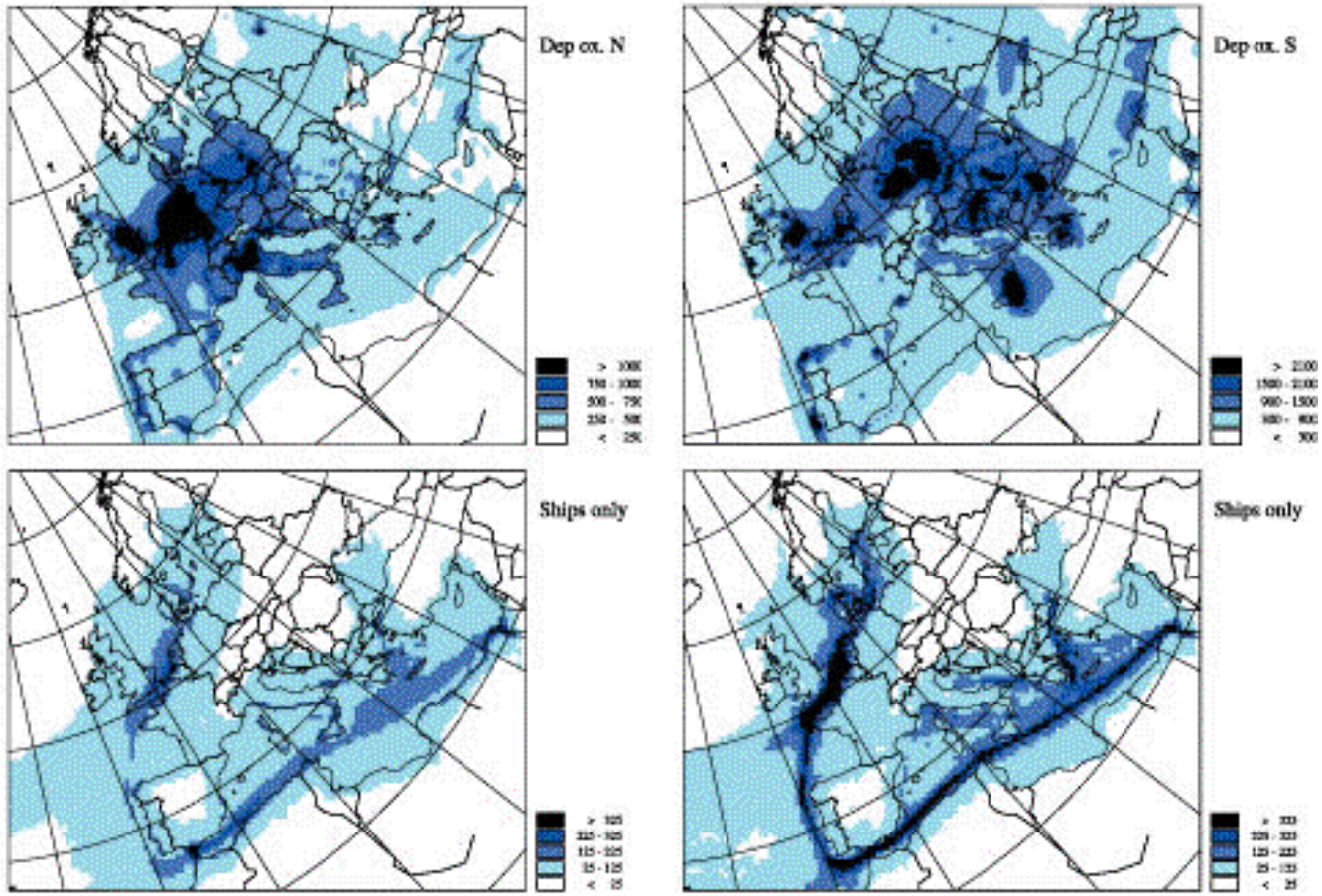
Towards the Gothenburg target -NMD analysis

- Technical analysis is undertaken
- Cost/benefit is calculated
- Preliminary results:
  - Measures on 279 ships
  - Costs: app, 62 mill US$
  - Reduction: 38 500 ton NOx/year
  - Selective Catalytic Reduction (SCR) contributes most to the calculated reduction

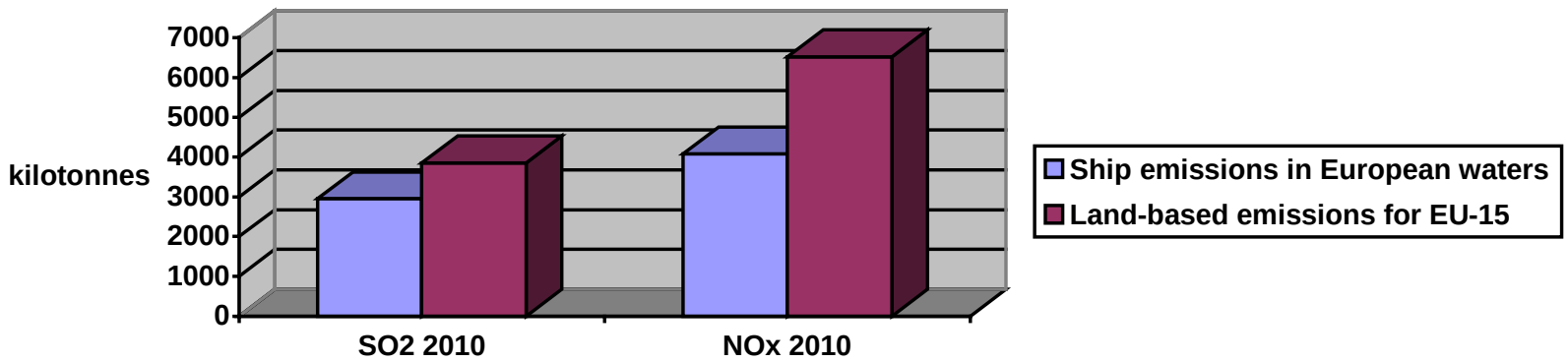
The Contribution from shipping to acidification in Europe

All sources

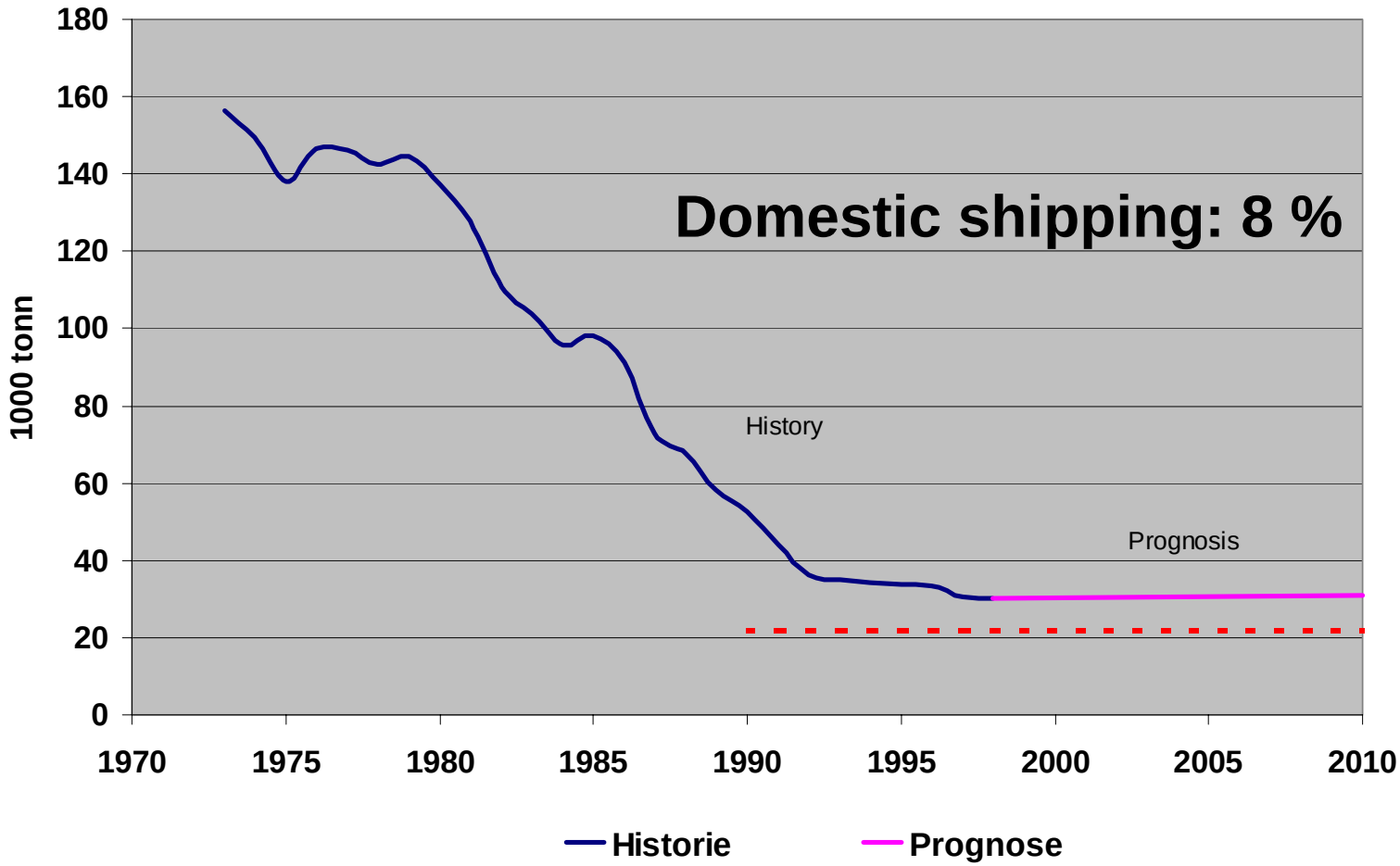
Shipping only



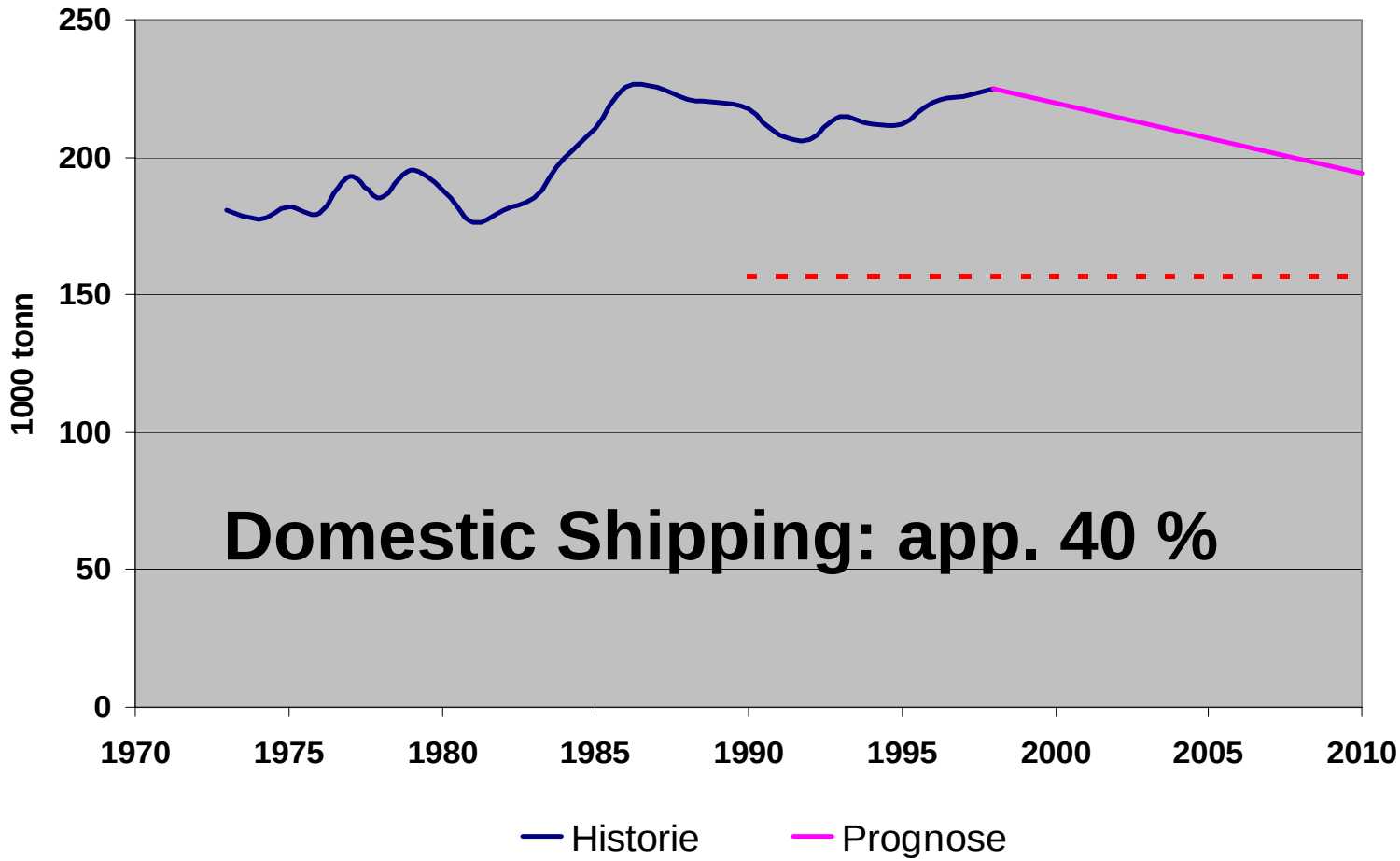
Ship emissions in European waters



SO2 Emissions in Norway



NOX Emissions in Norway



Mechanisms introduced in Norway to curb air pollution from shipping

	Mechanism	**International**	**Domestic**
Administrative	Regulations	(NOx)	(NOx), S, VOC
	Voluntary agreement		~~VOC~~
	Functional requirements		NOx, S, (CO2)
Economic	Taxes		S, CO2
	Environmental Differentiation	NOx, S, ++	NOx, S, ++
	Grant schemes		NOx
	Third Party Solution		NOx
Information	Clean ship tool box	Several	Several

Policy instruments SO_2 - regulations

- Individual regulations of emissions from large stationary sources
- Regulation of the content of sulphur in mineral oils
  - Auto diesel: max 0,035 % (350 mg/kg) from 2000, max 0,005% (50 mg/kg) from 2005 (like the EU)
  - **Marine gas oils and light fuel oils: max 0,2 %, max 0,1% from 2008 (like the EU)**
  - **Heavy fuel oils: max 1%**

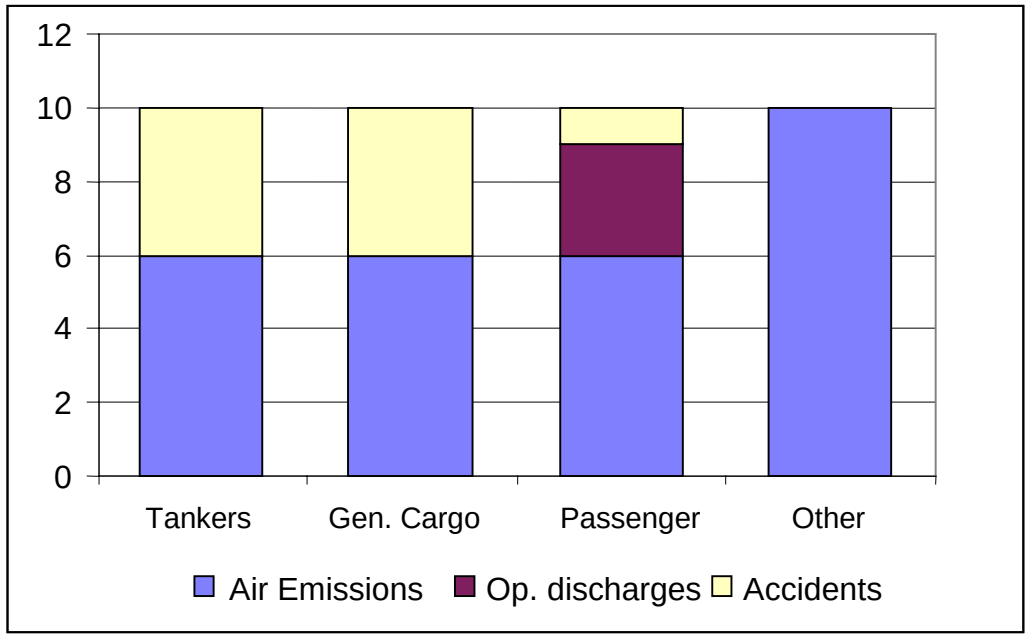
Policy instruments SO_2 - taxes

- Sulphur tax on mineral oils since 1970
  - 2001: 0,07 NOK/l for every 0,25% of sulphur (equalling 17 NOK/kg SO_2)
- An additional tax on auto diesel containing more than 0,005% (50 mg/kg) of sulphur (to reduce emissions of particles)
  - 2001: 0,32 NOK/l
- Sulphur tax on coal/coke (industrial processes) from 1999
  - 2001: 3 NOK/kg SO_2

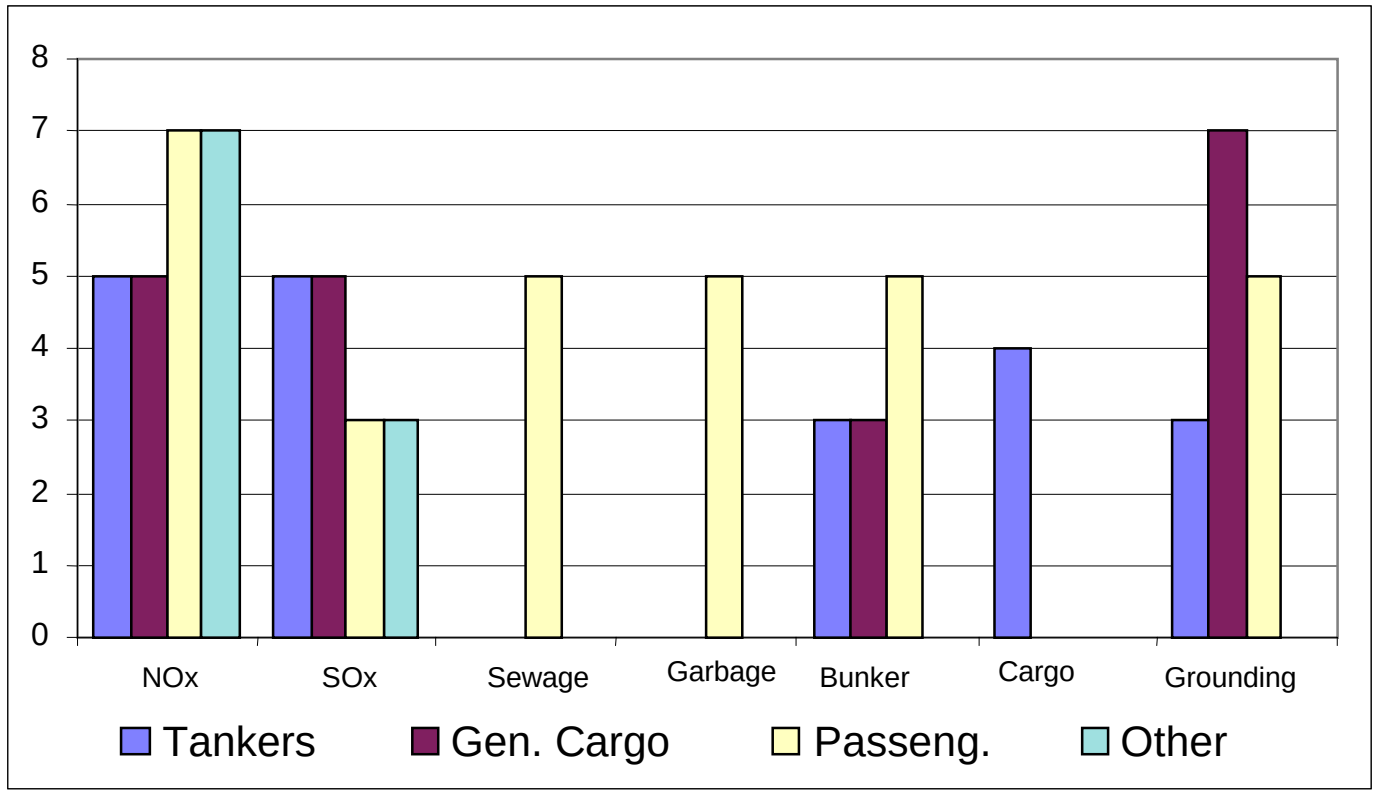
Environmental differentiation of ships

- Can be used on several taxes, charges and other terms which applies to shipping
- Environmental differentiation of the tonnage tax:
  - Introduced for the year 2000
  - Total revenue app. 20 mill US$
  - Max 25 % reduction
  - A voluntary system
  - The environmental declaration will be registered and can be subject to control

Environmental differentiation of ships - Weighting



Weighting of different criteria in the system



Environmental rating for Cargo ships

Criterion	Requirements	Score	Ships score
NOx	NOx > IMO NOx IMO NOx > NOx > 0,85 IMO NOx 0,85 IMO NOx > NOx > 0,6 IMO NOx 0,6 IMO NOx > NOx > 0,2 IMO NOx 0,2 IMO NOx ≥ NOx	0 0,75 1,5 3 10	
SOx	2,5% < S 1,5% < S ≤ 2,5% 0,6% < S ≤ 1,5% 0,2% < S ≤ 0,6% S ≤ 0,2%	0 0,75 1,5 2,25 3	
Fuel	No special requirements The ship uses MDO only Double hull around the bunker tanks Double hull around the bunker tanks and MDO	0 0,3 0,6 1,2	
Reduced risk of running aground	Neither take-me-home device nor redundant machinery Take-me-home device Redundant machinery	0 1,4 2,8	

Environmental rating for passenger ships

Criterion	Requirements	Score	Ships score
NOx	NOx > IMO NOx	0	
	IMO NOx > NOx > 0,85 IMO NOx	1,05	
	0,85 IMO NOx > NOx > 0,6 IMO NOx	2,1	
	0,6 IMO NOx > NOx > 0,2 IMO NOx	4,2	
	0,2 IMO NOx ≥ NOx	10	
SOx	2,5% < S	0	
	1,5% < S ≤ 2,5%	0,45	
	0,6% < S ≤ 1,5%	0,9	
	0,2% < S ≤ 0,6%	1,35	
	S ≤ 0,2%	1,8	
Sewage	No special requirements	0	
	Use of sewage-treatment plant	1,5	
Garbage	No special requirements	0	
	Incinerator on board	0,75	
	Sorting / compacting and 100% delivery to land	1,5	
Fuel	No special requirements	0	
	The ship uses MDO only	0,125	
	Double hull around the bunker tanks	0,25	
	Double hull around the bunker tanks and MDO	0,5	
Reduced risk of running aground	Neither take-me-home device nor redundant machinery	0	
	Take-me-home device	0,25	
	Redundant machinery	0,5	

Environmental Declaration

»	Total declarations	Mean value
• Mobile offshore units	3	8,83
• Cargo ships	96	2,8
• Barges	3	10
• Oil tankers	76	2,94
• Gas tankers	57	1,76
• Combination carriers	27	1,56
• Chemical tankers	41	1,57

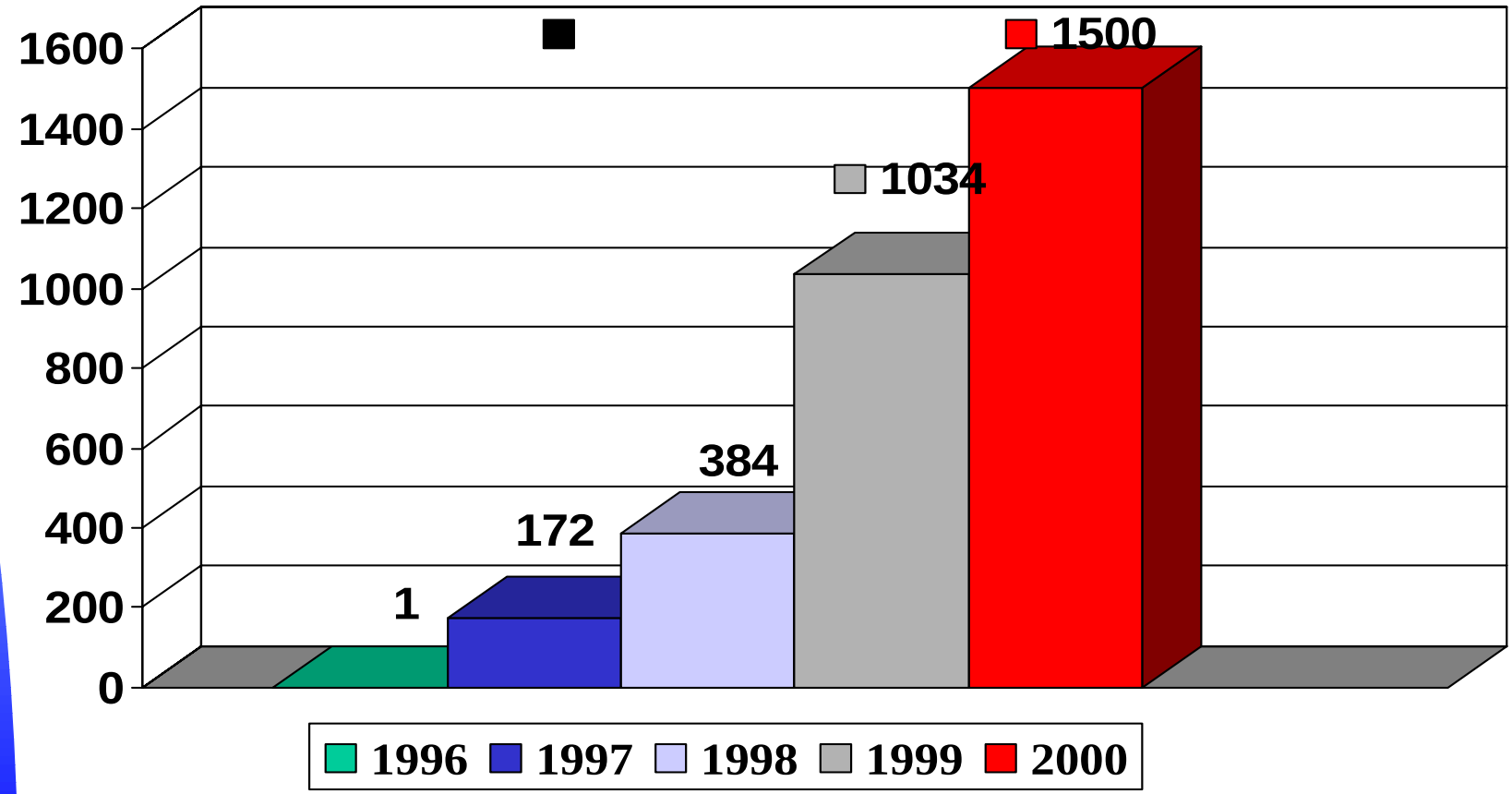
NOxRED-Programme

- National scheme for the implementation of NOx-reducing measures
- Initiated and financed by the Norwegian Government
- Administrated by the NMD
- Program duration: 1.1.1996 - 31.12.2000
- Budget: App. 4 million US$
- Base: Available applicable technology

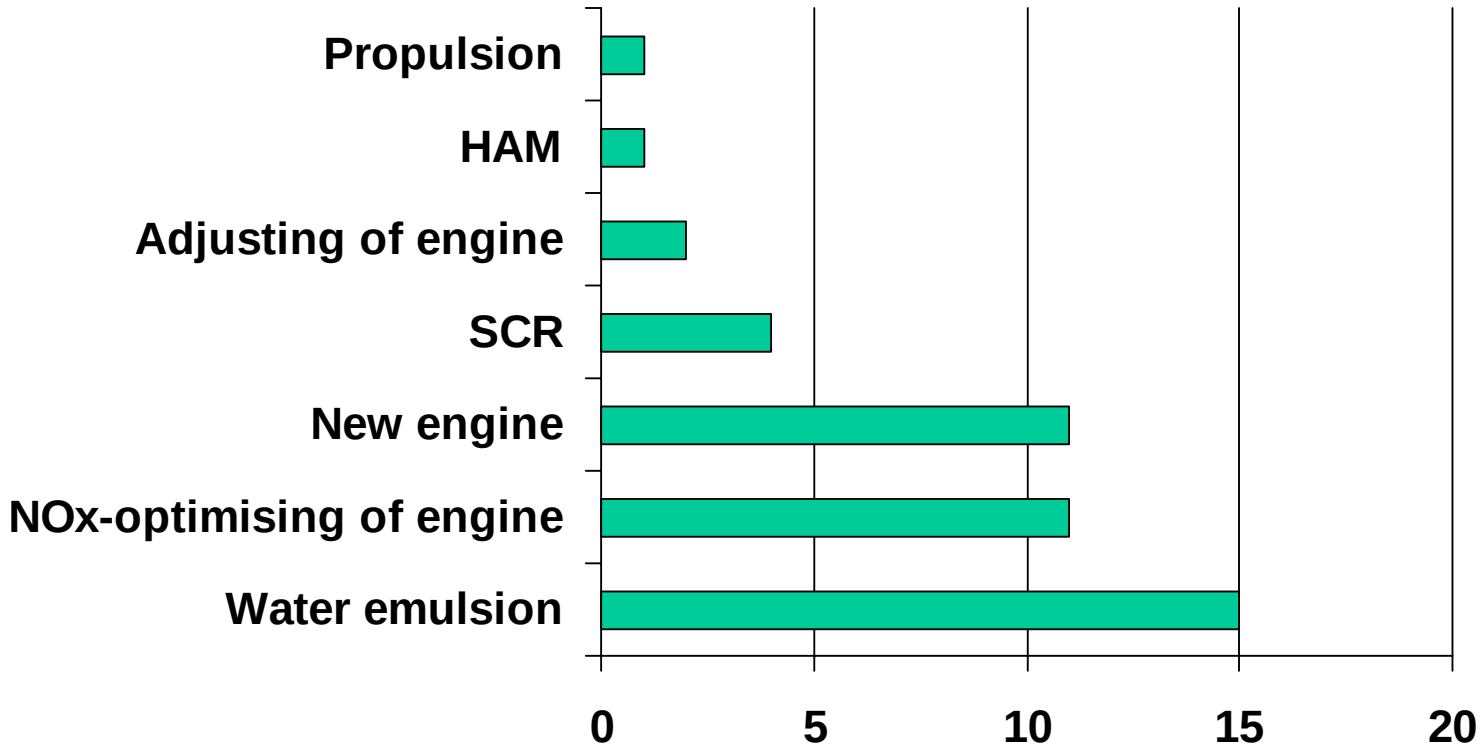
Types of ships in the scheme

- Norwegian ships in domestic trade
  - Bulk carriers and general cargo ships
  - Tankers
  - Passenger ships
  - Catamarans
  - Ferries
  - Other passenger ships

Accumulated NOx reduction (ton reduced/year)



NOxRED: 45 Projects



NOxRED: Experienced NOx-reduction

- Water emulsion: 5% - 20%
- NOx-optimising of engine: 30% - 50%
  - Including fuel reduction: 2% - 7%
- New engine: 20% - 50%
  - Including fuel reduction: 9% - 28%
- SCR: 88% - 92%
- Adjusment of engine: 21%
- HAM: 67%
- Propulsion: 11%
  - Including fuel reduction: 11%

Mechanism to reduce VOC emissions in Norway

- Geneva Protocol commitment
- VOC from Offshore crude oil loading is to be reduced
- Negotiations on a voluntary agreement with the oil companies stranded
- The following requirement apply to oil companies operating on Norwegian shelf:
  - Install technology which reduces VOC emissions when loading by 78%.
  - By the end of 2003, 40% of the crude loaded has to be loaded with such technology
  - By the end of 2004, 70% of the crude loaded has to be loaded with such technology
  - By the end of 2005, 95% of the crude loaded has to be loaded with such technology

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Pilot project - Two LNG powered supply vessels

New mechanisms - third party solutions

- Credit trading:
  Verified reductions on to supply vessels are credited as reductions on two onshore plants
- Political agreement between the government and STATOIL
- First time this mechanism is used

Two LNG Powered supply vessels - Basic facts

- To be delivered in 2002 and 2003
- Estimated reduction of emissions (each ship):
  NOx: 195 - 210 t/year ~ 82-84%
  CO2: 2720 t/year ~ 20%
- Emission reductions are to be verified by the Norwegian Pollution Control Authority
- Extra investments:
  5.6-6.7 mill US$ pr. vessel
- National safety regulation is under development

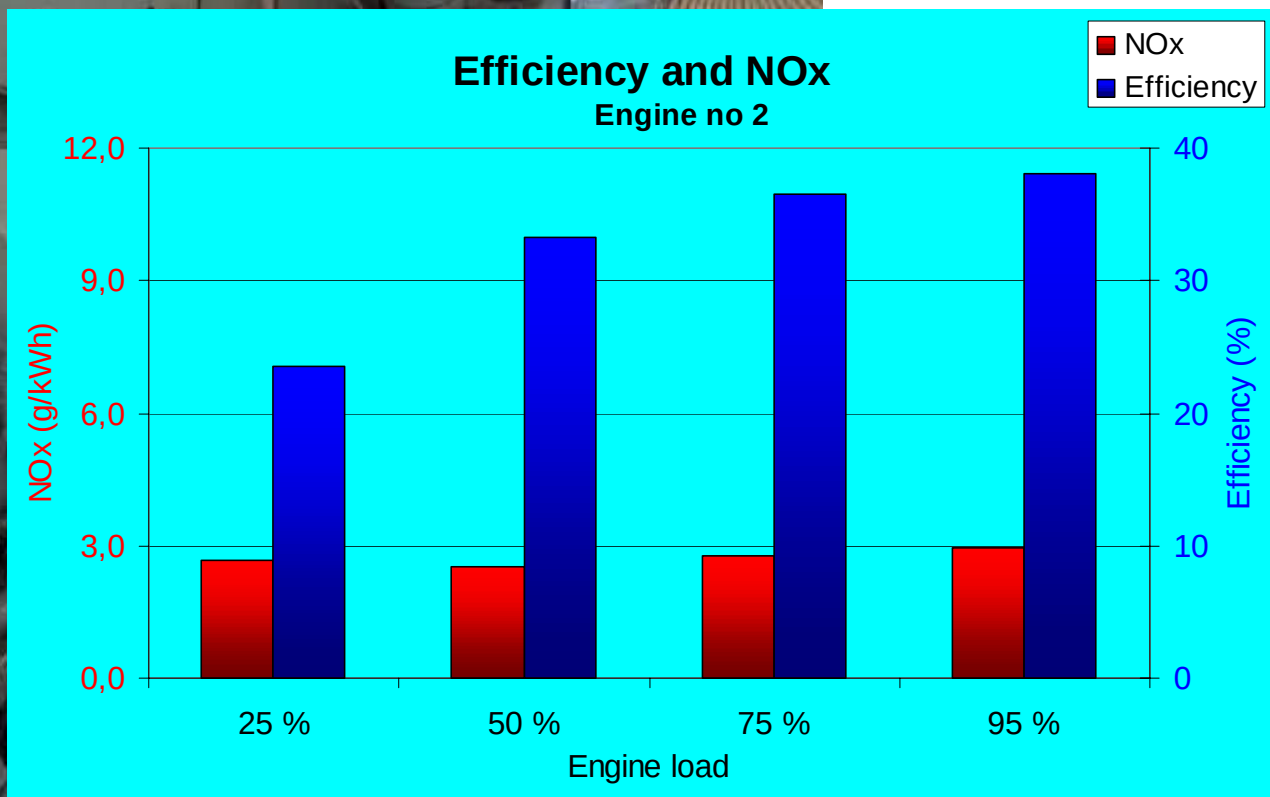
Domestic ferries

- 150 ferries serves the public roads
- Yearly distance travelled: ”250 round the world voyages”
- App. 3% of Norwegian NOx emissions

- **NMD:**
  - Safety and environmental regulations

- **Public Road Administration:**
  - Give licence to operate
  - Economic terms
    (decide tariffs and buy services – 230 mill US$ yearly)
  - Functional requirements

Mitsubishi 12 cylinder V Lean Burn Pre-chamber spark plug gas engine, Power output - 675 kW



Costs

- Investments - 30% higher than a similar diesel powered ferry
- Operation - same as for diesel fuel, depending of the oil price

Domestic ferries – measures on existing vessels

- Adjusting engine
  - •Point of time for ignition, new nozzles
  - •Preheating of air and fuel
  - •NOx optimising engine
  - •Water emulsion
  - •SCR
- Adjusting systems for propulsion
  - •Larger Diameter and reduced rotation speed for propeller
  - •Highly scewed propeller
  - •Contra rotating propeller/twin propeller
- Fuel additives
- Material technology (lighter vessels)
- Optimised hull design

Clean Ship tool box

- Project to establish a tool box as supporting ship owners who wants to build ”Clean ships” (BAT-solution)
- A systematic approach + examples
- Cradle to grave
- The aim is to establish this information as a service from NMD from 2003

Summing up

- Further reduction of air pollution from ships is needed
- A combination of regulations and incentives seems realistic
- Split the bill? (political decision)
- Pilot projects is needed to progress further

”Look to Norway?”

It’s not where you look which give results,

but the willingness to look, learn, and move towards the target…..

…….. in time.