



Workshop on the importance of Non-
Technical Measures for reductions in
emissions of air pollutants and how to
consider them in Integrated
Assessment Modelling

7-8 December 2005

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| <p>Title and subtitle of the report Workshop on the importance of Non technical measures for reduction in emissions of air pollutants and how to consider them in Integrated Assessment Modelling - 7-8 December 2005.</p> | |
| <p>Summary This report compiles the outcome of the workshop on the importance of Non technical measures for reduction in emissions of air pollutants and how to consider them in Integrated Assessment Modelling. The workshop was taking place in Göteborg in Sweden 7-8 December 2005.</p> | |
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Preface

This report compiles the outcome of the workshop on the importance of Non Technical Measures (NTM) for reduction in emissions of air pollutants and how to consider them in Integrated Assessment Modelling. The workshop took place in Göteborg in Sweden 7-8 December 2005. The workshop was organised by the Swedish ASTA research programme (International and national abatement strategies for transboundary air pollution) and in collaboration with the UN ECE Convention on Long-Range Transboundary Air Pollution.

The workshop included oral presentations and plenary discussions. This report includes both the conclusions and recommendations of the workshop as well as background paper and power point presentations. These documents can also be found at <http://asta.ivl.se/>.

An organising committee was established for the planning of the workshop and for the final preparation of the conclusions and recommendations. The committee consisted of:

Peringe Grennfelt, Swedish Environmental Research Institute
Catarina Sternhufvud, Swedish Environmental Research Institute
Lars Lindau, Swedish Environmental Agency
Rob Maas, Chairman of Task force on integrated assessment modelling.

Catarina Sternhufvud, Stefan Åström, and Jenny Arnell Swedish Environmental Research Institute handled the practical arrangements.

The workshop was supported by the ASTA programme and the Nordic Council of Ministers (NMR).

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1 Introduction

1.1 General

Air pollution strategies developed within the framework of CLRTAP and EU are mainly based on technical measures for which the potential and costs often can be estimated and used in Integrated Assessment Modelling (IAM). More recently Non-Technical Measures (NTM) have been put forward as a complement to technical measures in future air pollution strategies. Especially since such measures are assumed to play an important role in strategies to reduce emissions of greenhouse gases. These may become more important in the future when there will be parallel measures on both GHG and traditional air pollutants.

The potential and cost to implement NTM are in many cases difficult to estimate and they have only to a small extent been included in integrated assessment models. In the RAINS model NTM have not been considered for calculations on air pollution reduction, but an effort has been made to implement them in the greenhouse gases model GAINS. Since it is assumed that they will play a more important role in the future, there is a need to better understand the potentials and to discuss possible ways to include them in integrated assessment models and in air pollution strategies.

1.2 Aim and structure of the workshop

The aim of the workshop was to find out if Non-Technical Measures are of any importance to air pollution reductions and how to consider them in Integrated Assessment Modelling. The workshop was attended by 46 experts from 13 countries and representatives from different organisations as well as the UNECE secretariat.

The workshop was separated into four sessions. During session 1, measures and instruments in the transport sector were presented. Low emission zones in Berlin, highway speed limits in the Netherlands, fuel shifts and slow boating in the shipping sector as well as congestion charges in London were presented as examples of potential or existing measures that to this date are not used in integrated assessment models. In session 2 the attention was on the energy sector. Areas of interest covered were to what extent structural energy conservation measures are included in the extended version of RAINS (GAINS), the effect on abatement cost estimates from the inclusion of NTM into cost and effect calculations, the potential for energy savings in buildings as well as a case study on small combustion installations (SCI). Session 3 covered the agricultural emissions. Discussed measures were changes in diet, abatement measures adapted to minimise damages of existent pollutant levels (spatial measures, set-a-sides) as well as more pollutant-specific measures.

Finally, session 4 was a more theoretical session. The first part of the session discussed definitions and classification of measures from a NTM-viewpoint, a matter that can be of importance in the development of strategies and identification of successful measures. The second part discussed possibilities and constraints in including NTM in the integrated assessment models. Possible solutions discussed were inclusion of NTM into IAM or more attention to NTM scenario development or sensitivity analysis.

2 Conclusions and further studies

2.1 Conclusions

1. The workshop on NTM did not conclude on any specific definition on what type of measures that should ascribed as NTM. The workshop considered all types of non-end-of-pipe measures, such as behavioural changes, spatial measures, as well as structural changes such as input substitution and efficiency improvements as NTM.
2. Structural changes, behavioural changes, local and spatial measures can be partly taken into account in projections and IAM, but the costs can not always be estimated. Therefore, these measures cannot always be part of an optimization procedure, but such measures should be part of sensitivity analyses. Nevertheless although some measures such as monitoring, information and enforcement cannot be modelled at all, they are still important elements of policy strategies and should be given an adequate weight in the analysis.
3. National and regional policies aimed at improving the local environmental quality should be included in the national projections and be better communicated. It is also important to ensure the consistency with national reporting on climate policy.
4. A clearer view is needed on the possibilities of using energy, traffic and agricultural models to estimate costs and effects of NTM both at national and European levels. Specialized workshops should support this approach and to highlight ways to calculate welfare costs and to include sector specific models on shipping, aviation, and buildings.
5. An integrated view on agricultural projections (nitrogen losses) would be needed that takes into account both the obligations under the Gothenburg protocol and the NEC-directive of the EU as well as the obligations under the nitrate directive, the framework directive for water and the habitat directive. Other policies that need to be taken into account in nitrogen projections are the IPPC and the reform of the Common Agricultural Policy (CAP). Nitrogen projections should also include impacts on soil productivity changes as well as climate change.
6. The distinction between non-technical measures, technical measures and policy instruments was frequently discussed during the workshop. The relationship between these terms is visualised in Figure 1, and the participants concluded that it is important to use the terms correctly to avoid confusion.
7. The importance to classify abatement measures to facilitate a prioritization between the measures was also highlighted. A suggestion on classification is shown in Table 1. For each of the suggested measures it would be of great value to receive the following information; if they are already included in integrated assessment models, available cost estimates, significance, scale, useful instruments to implement the measure and what kind of policy type that might be successful.

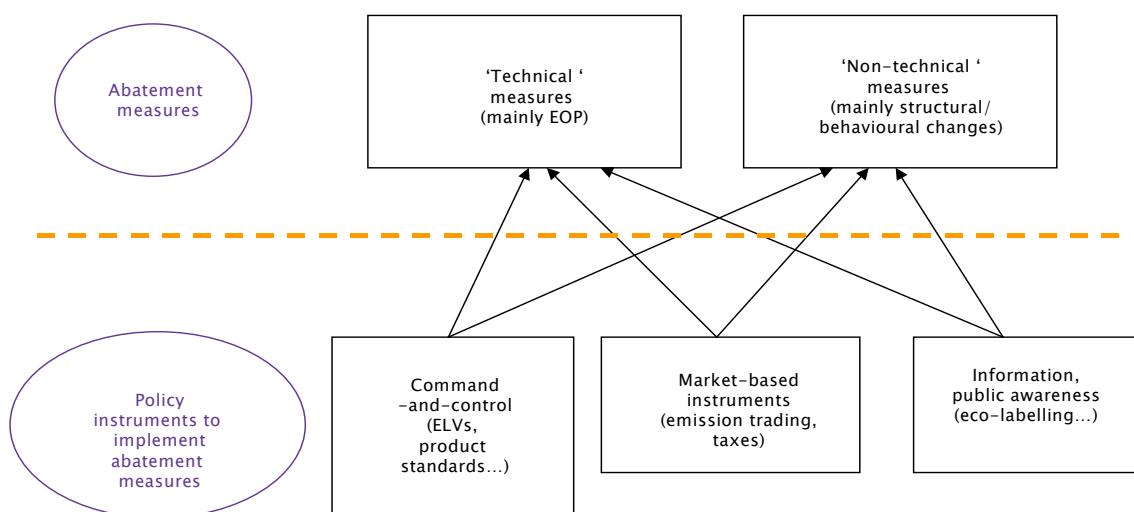


Figure 1 Distinction between abatement measures and policy instruments (Schucht, 2005).

8. The overall conclusion of the workshop is that NTM have such an importance in past as well as future strategies to reduce air pollution, that their potential need to be considered in future analysis and policy discussions.

Table 1 Suggested classification of measures

| Main type of measure | Classification | Example in the transport sector | Example in the energy sector | Example in the agriculture sector |
|----------------------|------------------------------|---------------------------------|-------------------------------|--|
| Technology | End of pipe | Particle filter | Selective Catalytic Reduction | Litter drying systems |
| | Fuel quality | Low sulphur oil | Low sulphur coke | Substitute industrial fertiliser with manure |
| | Conversion efficiency | Trimming | Good practice – flaring | Spreader maintenance |
| | Conversion technology | Efficient engines | Combustion modifications | Covered storage |
| Miscellaneous | Demand | Improved logistics | Improved insulation | Fertiliser free zone |
| | Land use planning | Infrastructure planning | Bio fuel plantations | Livestock density requirements |
| | Time of use planning | Road taxes | Timer ventilation | Immediate incorporation of manure |
| Behavioural | Demand/consumption reduction | Spatial planning | Lower indoor temperature | Precision farming |
| | Substitution | Modal shift | Change expenditure patterns | Livestock shift |
| | Technology of choice | Car size | Low energy refrigerator | Fertiliser equipment |
| | Technology use | Lower speed | Shorter showers | Fertiliser distribution |

2.2 Further studies

Further research is recommended on:

- the valuation of time, freedom and comfort in order to model personal preferences and behavioural changes. There is a need for consensus on how to estimate their costs and effects in IAM;
- the ways to make national policies more effective by including local measures should be investigated;
- the linkage between measures and instruments and the effects of subsidies and other economic instruments, eg. the reduction of subsidies on fuel types which are not environmentally friendly;
- the effects of climate policies, such as emission trading schemes for CO₂, that would shift emissions across Europe. Appropriate impact assessments on this issue would be needed, requiring global, local models and sector specific models and links between local and global models;
- development of alternative scenarios for reduction of air pollution including NTM at their full potential.

3 Background paper

By Rob Maas, MNP, The Netherlands

Background

Technical measures in RAINS have the advantage that they are relatively easy to implement, without a substantial change in the physical infrastructure, public institutions or in consumer behavior. Behavioral changes often seem less costly. Eating less meat, driving more slowly, using public transport, wear a pullover & use less heating, spend the holiday in the garden instead of in Patagonia or Mongolia, move cattle away from sensitive ecosystems, all are very cost-effective ways to reduce air pollution, but how can they be implemented? Sometimes we can use regulation (e.g. speed limits) although enforcement will be harder and more costly than with the simple add-on techniques, but often we need financial incentives and a change in the tax system, which could require a long period of debate with ministries of finance. Nevertheless it would be useful to have - as a result of the workshop - an inventory of possible additional measures that are not incorporated in RAINS, with their potential contribution, costs, implementation instrument and (political) feasibility.

Scope: 'non-technical measures, structural change and local policy options'

I would suggest adding 'structural changes' and 'local policy options' to the title of the workshop. Behavioral changes are often interlinked with technical solutions, e.g. buying products that use less energy. We are interested in all technical and non-technical measures, that are not in RAINS, such as shifts in the urban car-fleet, cleaner busses, use of residual industrial heat in households, clustering of animals in larger (and cleaner) stables at a larger distance from sensitive nature areas, etc.

Furthermore it would be useful to distinguish two types of structural and non-technical measures: specific local measures and generic (nation wide) measures.

Local measures

As hotspots are in the focus of the attention in any air pollution strategy, it is important to assess to what extent local measures are more cost-effective than EU-wide measures. EU-wide measures would also reduce emissions in areas where risks to health and environment are small, and where benefits thus are smaller than in hotspot areas. Hotspot areas are both the industrialized & urbanized areas with high densities of fossil energy use close to the population, and the rural areas with high densities of cattle close to sensitive ecosystems.

Outcome of the workshop could be a credible estimate for the potential of local measures to reduce the environmental pressure in hot spot areas, as well as their costs. Such estimates can be used as additional (exogenous) abatement measures in RAINS in certain grid cells.

Such measures should not be hypothetical, that is why it is good to see whether there is practical experience, information about costs, institutional limitations, and possibilities to implement the measures (e.g. with regulation, economic instruments, spatial planning instruments).

In urban areas measures that can be considered include speed limits, road user charges (depending on the type of car?), traffic circulation schemes, parking fees, car-free city centers, zero-emission busses and taxis, measures to reduce ship emissions in harbors, increase the use of industrial heat for heating of buildings, etc. Co-operation and information exchange between cities could reduce abatement costs, e.g. when all cities apply the same type of zero-emission bus it could lead to economies of scale and rapid learning in the production of such busses.

In rural areas shifting cattle away from sensitive nature areas could be considered, as well as additional regulation for farmers close to sensitive areas (e.g. cleaner stables, keeping cattle in stables).

Generic measures

The extension of RAINS with measures aimed at reducing greenhouse gasses increases the maximum technically feasible reduction potential for air pollutants considerably. Including these options would also significantly reduce the costs of the add-on abatement measures (this result was found in many countries, e.g. Italy, Netherlands, Sweden, China and the USA). First results of the extended RAINS-model (GAINS = Greenhouse Gas Interactions and Synergies model) could be presented during the workshop. GAINS mainly includes measures like fuel switch and reductions in fertilizer use, but it takes developments energy demand as given (output of the PRIMES - energy model). Also the vehicle mileage and meat demand are exogenous.

It is probably not easy to define a realistic potential of generic changes in behavior, such as eating less meat, driving less kilometers or using less energy. Technically it can be anywhere between 0 and almost 100%, depending on the policy instrument we use. If we tenfold the tax on meat or petrol the potential will be large, but the political feasibility is small. We would need more knowledge about the price-elasticity of the demand for meat, petrol, electricity, gas and coal. We should be aware of the environmental effects of the use of substitutes and the shifts in consumption patterns. For a coherent picture we would have to use models like PRIMES and TREMOVE. But then, is it possible to define a realistic tax increase on products like meat, petrol, electricity, gas and coal? Often the disadvantage is that such levies do hardly affect the richer part of the population. In order to reduce this inequity, a change in income tax structure could be considered, but then our discussions with the ministers of finance would become even more complex.

Perhaps we could make life easier when we limit our analysis to an arbitrary sensitivity-analysis for generic changes in behavior of consumers throughout Europe, e.g. assume that we consume (and produce) 10% less meat, that we decrease our car mileage by 10% or that we decrease the demand of electricity and heating by 10%, as compared to the baseline. These percentages are not completely unrealistic. E.g. RIVM has calculated that eating more healthy (less fat) could reduce ammonia-emissions by around 10%. Experiences with road user charges come up with an effect of around 10% less traffic. And 10% less demand for electricity and gas could be reached quite easy with a doubling of energy prices (which is not unrealistic if we look at the fluctuations in oil prices). The question is whether we could also assume some reduction in the transport of goods. 10% less transport, would also include 10% less 'world trade', and trade is seen as the driver of economic growth. Such a reduction seems hardly feasible from a political point of view. A 10% shift from road transport to rail or ship would imply roughly a doubling of rail and inland waterway capacity.

Cost estimates

Can the costs on non-technical measures be compared with the annualized costs of investments in technical measures? We clearly cannot simply compare increased taxes (for energy, parking, etc)

with investment costs in energy saving and abatement of air pollution. But may we add the GDP-loss due to less meat production to the cost-curve? And what about the GDP-loss due to less energy-production? How do we value the changes in traveling time due to speed limits or the use of public transport? My advice would be not to give these problems a high priority, but focus the workshop on the estimates for the potential contribution of 'non-technical' measures to the abatement strategy.

4 Power point presentations

4.1 Session 1: Estimates of the potential and cost of possible measures in the transport sector



4.1.1 Karl Heinz Zierock "The importance of non-technical measures in the transport sector for the UN-ECE emission reduction policies".

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The importance of non-technical measures in the transport sector for the UN-ECE emission reduction policy

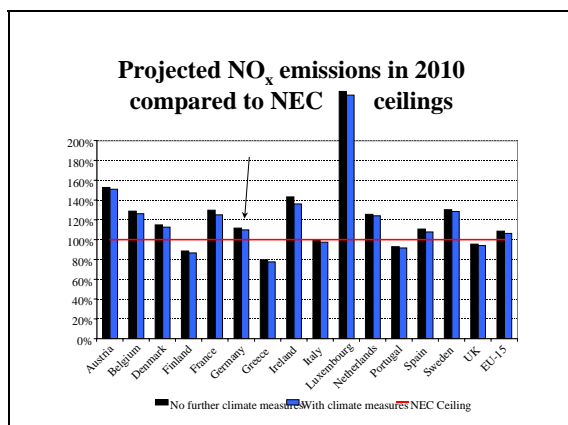
Dr. Karl-Heinz Zierock
Umweltbundesamt
Germany

UN/ECE Workshop Göteborg 7/8.12.2005

Umwelt Bundes Amt
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State-of-play

- Emissions of pollutants covered by UN-ECE protocols decrease but critical loads and ozone targets are still exceeded
- Transport is a key source for NOx and PM
- Currently protocols contain national emission ceilings/targets and BAT guidelines for stationary and mobile sources
- Non-technical measures are covered by the national ceilings/targets, but not explicitly addressed



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Technical measures considered to NEC emissions of the transport sector

| Source | Measure | Pollutant |
|---------------|---------------------------------------|------------|
| HDV/Bus | Euro 6 | NOx |
| Cars/LDV-Die. | Euro 5 | NOx |
| TW | Euro 4 | NMVOc |
| TW | Limit value for evaporative emissions | NMVOc |
| HDV/Bus | OBd & In-Use-Conformity-Testing | NOx |
| Cars/LDV-Die. | In-use NOx exhaust gas testing | NOx |
| Cars/LDV-gas. | Adaptation of test procedures | NOx, NMVOc |
| TW | In-use exhaust gas testing | NMVOc |

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Non-Technical measures considered to NEC emissions of the transport sector

| Source | Measure | Pollutant |
|----------------|---|------------|
| HDV/Bus | Extension of road toll for vehicles > 12 t and for secondary roads | NOx |
| Cars/LDV | Speed limit of 120 km/h on highways | NOx, NMVOc |
| Cars/LDV | Modification of the tax deduction for business-related road trips | NOx, NMVOc |
| Cars/LDV | Modification of car taxation | NOx, NMVOc |
| Cars/LDV | Modification of excise duties for diesel fuel | |
| All categories | Selective area- and street-related access restriction for certain types of vehicles | NOx |
| TW | Emission-related taxation | NMVOc |
| Cars/LDV | Road toll for highways and secondary roads related to EURO classes | NOx |
| All vehicles | Speed limits within cities | NOx |
| Cars/LDV | Incentives for their use of bicycles for short distance trips | NOx, NMVOc |
| HDV/Bus | EEV standards for public procurement | NOx |
| Cars | Fiscal incentives for retrofitting measures | NOx, NMVOc |
| All vehicles | Fiscal incentives for alternative fuels | NOx |

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Contribution of different sources to PM10 (including secondary particles) and NO2 emissions at monitoring sites

| Source | Total PM10/NO2 |
|------------------------------|---------------------|
| Transport | 5-50%/35-85% |
| Industry/power plants | 0-45%/0-15% |
| Domestic sources | 0-25%/5-10% |
| Others | 0-30%/0-30% |

Examples of measured/modelled local reduction potentials

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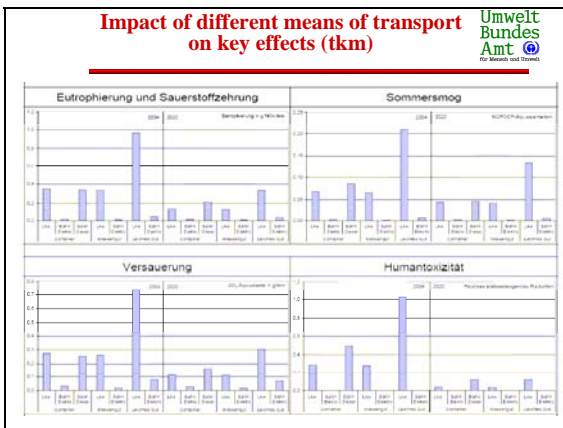
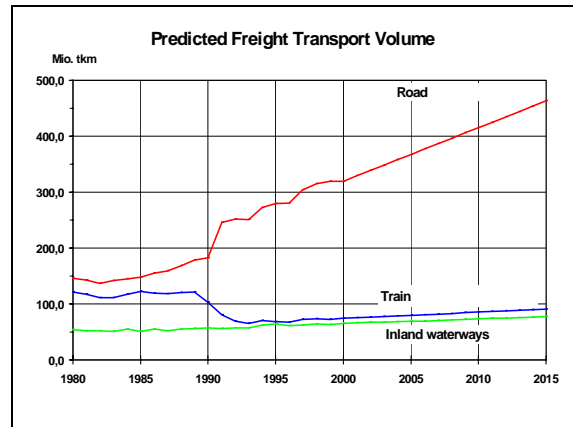
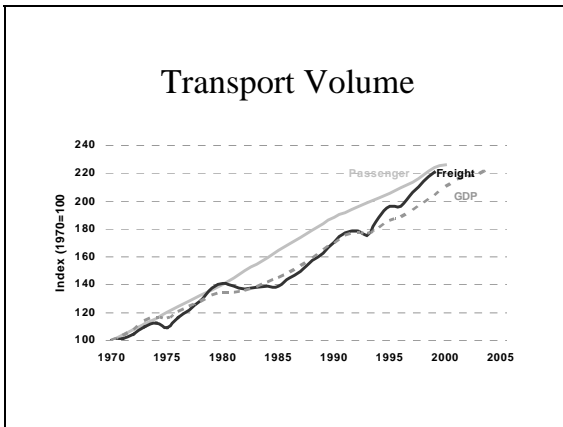
Measures to reduce PM- and NOx-emissions

| Type of measure | Potential to reduce emissions | Potential to reduce local PM- and NOx-concentrations |
|--|-------------------------------|--|
| 30 km/h speed restriction, where limit values are exceeded | | PM: 1.4% (Berlin) NOx: 1.5% (Berlin) |
| 100 km/h speed restriction on motorways | PM: ≈ 19% NOx: 10-15% | |
| Driving bans/access restrictions | PM: 25-40% | PM: 5-45% |
| Low Emission Zones | PM: up to 50% NOx: 1.5-25% | PM: 5-10% |
| Management of parking space | | PM: 1.5% |
| Optimisation of traffic flow "green wave" | PM: ≈ 24% NOx: ≈ 21% | PM: 5-25% |
| Shift of transport to alternate routes | | PM: 10-20% (Natten) |
| City logistics | PM: ≈ 5% NOx: 2.5% | |
| Promotion of alternative modes of transport | PM: ≈ 10% | PM: 2.5% |
| Dedicated lanes for urban buses | NOx: 0.5-12% | |
| City tolls | PM: 4.1-7.5% NOx: 3.4-9.8% | PM: 5-10% (London) NOx: ≈12% (London) |
| Scrappage schemes | NOx: 0.6-10% | |

Is there a need to integrate non-technical measures in the Protocols

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- There is still potential for further reduction taking technical and non-technical measures at international (EU), national and local level
- **The question is: What would be the added value if we incorporated non-technical measures in one or the other way into the Protocols?**




Non-technical measures potentially of interest for UN-ECE Protocols


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- To improve general policy settings in order to influence transport volumes
- To use the mode of transport with the highest unit efficiency

➤ **Join forces to give stronger signals**


To improve general policy settings in order to influence transport volumes 

- Transport Logistics: EU's MARCO POLO and GALILEO Programmes;
- Import/export restrictions for „dirty cars“
- Fuel taxation
- Strategic Impact Assessment
- Environmental Impact Assessment
- Better monitoring of transport impact

SEA for policy, plans and/or programmes, and EIA for transport projects in accession countries 


| | SEA | EIA |
|-----------------|-----|-----|
| Bulgaria | ✓ | UD |
| Cyprus | ? | ? |
| Czech Republic | ✓ | ✓ |
| Estonia | | UD |
| Hungary | | ✓ |
| Latvia | | ✓ |
| Lithuania | ? | ✓ |
| Malta | ? | ? |
| Poland | ✓ | ✓ |
| Romania | | ? |
| Slovak Republic | ✓ | ✓ |
| Slovenia | | ✓ |
| Turkey | ? | ✓ |

NB: ✓ = implemented
UD = under development
? = no information available


Monitoring of transport related measures 

| Member State | Transport included in general state-of-the-environment reporting | Transport and environment reporting | Indicator scope | | | | | |
|-----------------|--|-------------------------------------|----------------------------|---------------|------------------|------------------|---------------|------------|
| | | | Environmental consequences | Accessibility | Transport demand | Transport supply | Price signals | Efficiency |
| Bulgaria | | | ✓ | | | | | ✓ |
| Cyprus | ? | | | | | | | |
| Czech Republic | | | ✓ | | | | | |
| Estonia | | | ✓ | | ✓ | | | |
| Hungary | | | ✓ | | | | | |
| Latvia | | | ✓ | | | | | |
| Lithuania | | UD | ✓ | | ✓ | | | |
| Malta | ? | | | | | | | |
| Poland | ✓ | UD | UD | | | | | |
| Romania | | | | | | | | |
| Slovak Republic | ? | | | | | | | |
| Slovenia | | UD | UD | | UD | | | |
| Turkey | ? | | | | | | | |


NB: ✓ = implemented
UD = under development
? = no information available

To use the mode of transport with the highest unit efficiency 

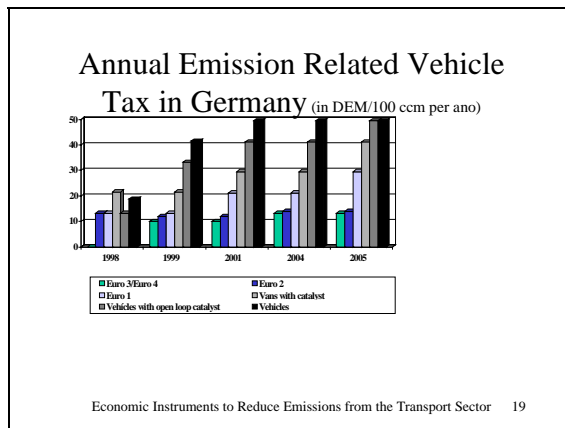
- Fair pricing, e.g. charges on infrastructure and external costs (Eurovignette Directive)
- Fuel quality and Clean fuels
- Vehicle taxation
- Regional measures: sea motorways & inland waterways programme

Impact of different means of transport on key effects (Pkm) 


The charts show the impact of different transport modes (air, sea, road, rail) on four key environmental effects: Eutrophierung und Sauerstoffzehrung, Sommersmog, Versauerung, and Humantoxizität. The x-axis represents different transport modes and years (2000, 2005, 2010, 2015, 2020). The y-axis represents the impact level. The charts show that air transport generally has the highest impact, followed by road transport, while sea and rail transport have significantly lower impacts. The impact of air transport is expected to decrease over time, while the impact of road transport is expected to increase.

Road charges in Europe 

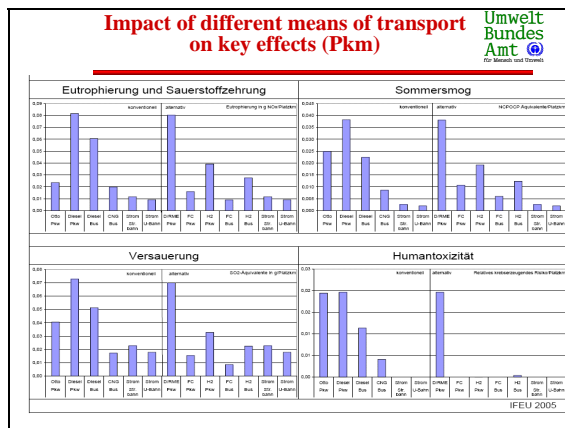
| Country | Charge type | Rate |
|-------------|-----------------|---------------|
| Austria | Distance charge | € 0.10 per km |
| Belgium | Distance charge | € 0.10 per km |
| Denmark | Distance charge | € 0.10 per km |
| France | Distance charge | € 0.10 per km |
| Germany | Distance charge | € 0.10 per km |
| Italy | Distance charge | € 0.10 per km |
| Netherlands | Distance charge | € 0.10 per km |
| Poland | Distance charge | € 0.10 per km |
| Spain | Distance charge | € 0.10 per km |
| Sweden | Distance charge | € 0.10 per km |
| Switzerland | Distance charge | € 0.10 per km |
| UK | Distance charge | € 0.10 per km |




Alternative Technologies in the German Fleet 2004:



- **Electric Cars:** ca. 5,000
- **Fuel Cell (H2):** ca. 100 prototypes
- **CNG:** ca. 14,500 PC + 4,000 HDV




How could non-technical measures be integrated into protocols?



- Annexes/separate UN-ECE papers with guidelines
- Mandatory application of certain non-technical measures
- Joint action in well-defined areas
- Joint action in certain policy fields
- Exchange of information

Examples of non-technical measures worth to be considered for integration into protocols



- Annexes = exchange of information = ongoing (The PEP)?
- Mandatory = procedural measures, fuel quality, monitoring
- Area measures = alternative fuels, logistics + regional infrastructure
- Policy field measures = charges on infrastructure

Thank You for Your Attention !

Karl-Heinz Zierock


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<http://www.umweltbundesamt.de/>

4.1.2 Corjan Brink "Speed limits for Dutch motorways"

Speed limits for Dutch motorways


Corjan Brink



Implementation: A13 motorway Rotterdam

About A13:

- high level of traffic movements (~150,000 vehicles/day)
- one of most congested motorways
- right across the Overschie district of Rotterdam
- within 50m of densely populated residential area
- noise and air quality levels well above national and EU standards




Speed limit on A13 Rotterdam

- speed limit of 80 km/h (was 120 km/h)
- strict enforcement: automatic speed monitoring on 3 km stretch

Cost

- technology and infrastructure for enforcement
- investments €1.2 million; operating costs €0.8 million
- average increase in traveling time ~20 sec./vehicle (~ 300,000 hrs/yr ~ €3 mln/yr)
- but: freer circulation of traffic in peak hours
- other welfare effects?




Effects

- slower speed and more steady flow of traffic (less stop-go traffic)


| | NO ₂ | PM10 |
|---|---------------------------|--------------------------|
| emission reduction (%) | 15-25% (NO _x) | 25-35% |
| air quality improvement | | |
| 50m from roadside | 5 µg/m ³ (7%) | 4 µg/m ³ (4%) |
| 200m from roadside | 3 µg/m ³ (3%) | 1 µg/m ³ (1%) |
| reduction in contribution A13 to total air quality (up to 200m) | 25% | 34% |

- other benefits:
 - CO₂ emissions (15%)
 - noise impacts (50%)
 - road accidents and victims




Applicability to other locations

- effects cannot simply be transferred to other locations
- dependent on local circumstances
 - ratio passenger vs. freight traffic (A13 10% heavy duty trucks)
 - position of road w.r.t. residential area
 - traffic volumes
 - intensity of traffic jams
 - contribution traffic emissions vs. background
- calculations for 10 other stretches in the Netherlands
 - reduction NO₂ concentrations 1-5%
 - reduction in noise impacts
 - less road accidents (35%) and victims (47%)

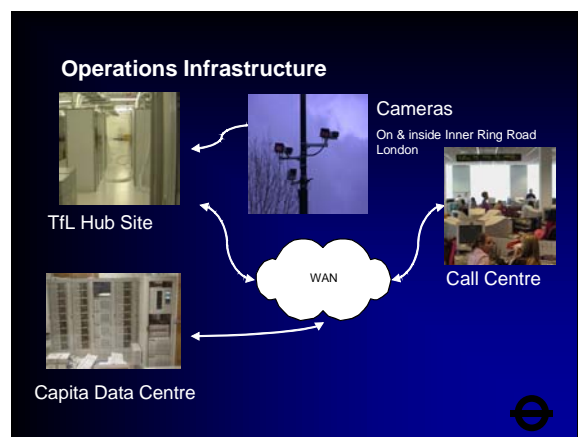
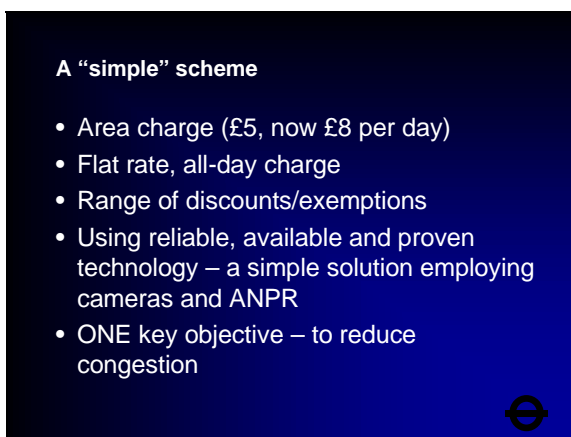
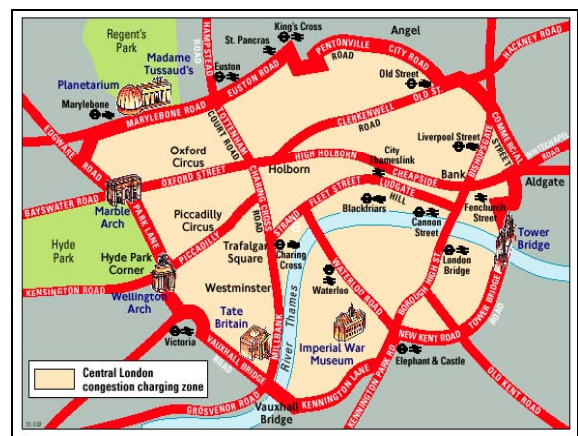
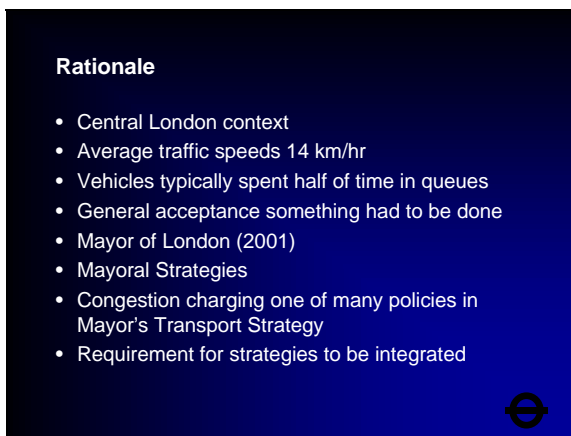
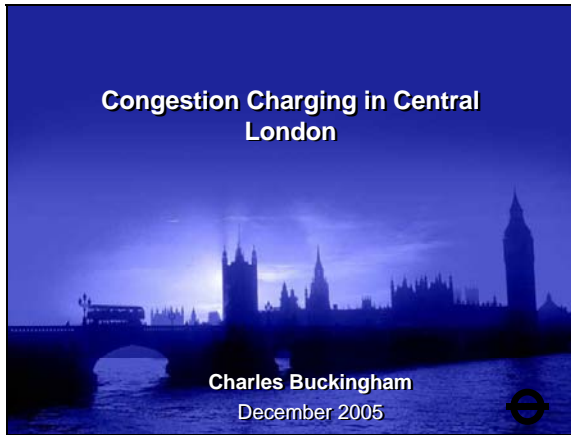


Conclusions

- speed limits may reduce environmental impact of road traffic at pollution hot spots
- useful short term bridging solution to improve local air quality until more source-oriented measures are available
- (cost-)effectiveness dependent on local circumstances
- air quality improvements only on roads with congestion



4.1.3 Charles Buckingham "London's congestion charge"

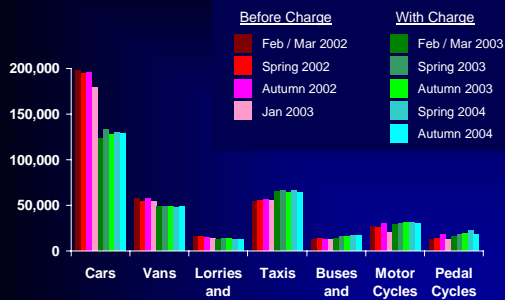


Key Impacts

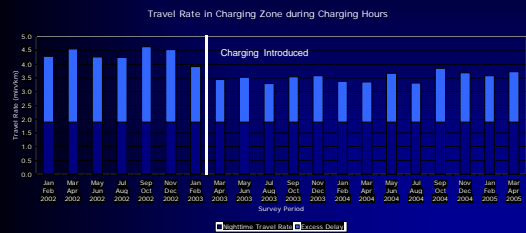
Key Benefits From Scheme

- Total traffic down 15-18%
- Congestion down 30%
- Dramatic bus network improvements
- 'Excess' accidents savings
- 12% reduction in emissions (PM₁₀ and NO_x)
- Revenues for re-investment in transport
- Benefits have been sustained
- Few traffic or other 'side effects' noted
- But continuing debate over retail impacts

Total traffic entering the charging zone During charging hours



Reduction in congestion – Averages 30%

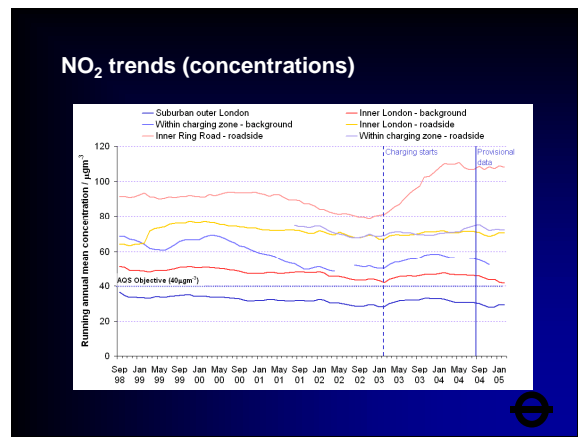
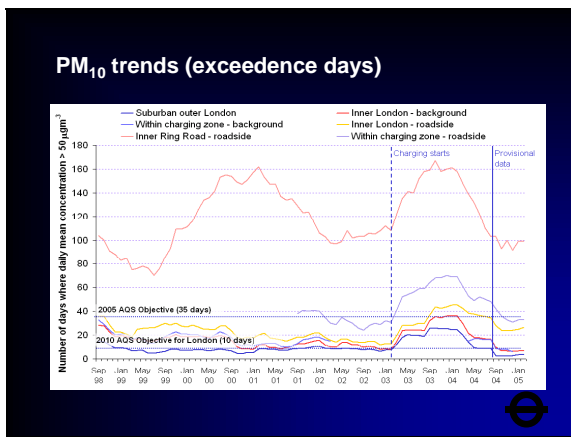


Social and economic impacts

- Overall, people tended to over-estimate impacts
- Most people/businesses substantially unaffected
- Overall continued support for scheme
- Financial implications small in CL context
- Some evidence of more intense sector-specific effects (e.g. retail)
- BUT 'background' difficulties also play significant role
- Lesson – extremely difficult to disentangle effects

Emissions gains from scheme

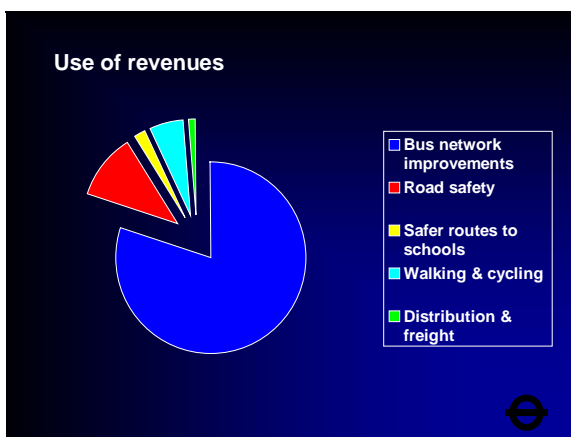
| Percentage change in relation to pre-charging base (100%) | Charging zone NO _x | Charging zone PM ₁₀ | Inner Ring Road NO _x | Inner Ring Road PM ₁₀ |
|---|-------------------------------|--------------------------------|---------------------------------|----------------------------------|
| Volume change - motorcycles | 0 | +1 | 0 | +1 |
| Volume change - taxis | +1 | +3 | 0 | 0 |
| Volume change - car | -6 | -4 | +1 | +1 |
| Volume change - bus and coach | +4 | 0 | +3 | 0 |
| Volume change - light goods | -1 | -2 | +1 | +2 |
| Volume change - rigid goods | -2 | -1 | +1 | 0 |
| Volume change - articulated heavy goods | 0 | 0 | 0 | 0 |
| Speed changes (all vehicles) | -8 | -9 | -4 | -5 |
| Percentage change due to traffic and speed changes | -12 | -12 | +2 | -1 |
| Emissions factors (fleet turnover and technology mix) | -4 | -4 | -6 | -5 |
| Overall traffic emissions change | -16 | -16 | -4 | -7 |



Costs and Revenues

Scheme revenues and costs 2004-2005 (£m)

- Revenues:
 - Standard charges (at £5) 98
 - Fleet charges (£5, £5.50) 17
 - Residents' charges (£2.50/week) 2
 - Enforcement income 72
 - (Total revenues) 190
- Costs: 92
- NET REVENUES 97



4.1.4 Karl Heinz Zierock / Martin Lutz "The case of Berlin"

Berlin's Air Quality Strategy: measures and expected effects

Martin Lutz
Senate Department for Urban Development, Berlin
Directorate IX, Environment Policy

- > brief recap: problems, origin, sources
- > expected benefit of a trend scenario
- > additional measures and their impact

Senate department of urban development 1 Unit IX D: air pollution and noise control, M. Lutz

assessment of the air quality in Berlin summary

- on sulfur dioxide: ☺ no problem
- on lead: ☺ no problem
- on carbon monoxide ☺ no problem
- on benzene ☺ diminishing problem
- on nitrogen dioxide ☹ serious problem
- on PM₁₀ ☹ severe problem, to be tackled on local and European level
- on ozone ☹ serious problem, to be tackled mainly on a European level

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Source analysis Simplified schematic of the PM pollution

The diagram shows a vertical cross-section of PM concentration in $\mu\text{g}/\text{m}^3$ on the y-axis (ranging from 10 to 40) and distance on the x-axis (Urban areas vs. countryside). The layers from bottom to top are: hemispheric/natural background (green, ~10-15), regional background (cyan, ~15-25), urban background (blue, ~25-35), and traffic, local sources (orange/red peaks, ~35-40) in urban areas.

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source attribution Sectors contributing to total PM₁₀ at a busy traffic spot in Berlin....

The pie chart breaks down PM₁₀ sources into regional background (22%), urban background (15%), and local traffic (31%). Local traffic is further divided into: road traffic exhaust (11%), traffic non-exhaust (15%), and other (3%). Road traffic exhaust is further divided into: cars (7%), HDV & LDV (4%), and non-exhaust (0%). Other sources include: industry & power plants (22%), domestic heating & solvents (9%), agriculture (4%), other (2%), industry & power plants (3%), domestic heating & solvents (3%), and traffic exhaust (9%).

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source analysis interim conclusion

- regional PM₁₀ background is around half of kerbside levels
- motor traffic is the predominant source of PM pollution
- 20% of regional PM₁₀ background can be attributed to traffic exhaust emissions, but the bulk is secondary PM from industry & power plants
- more than half of traffic related PM₁₀ stems from road&tire abrasion and resuspension of road dust
- HDV & LDV emissions of particular importance
- NO₂ regional background usually less than 10 %

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trend scenario 2010 interim conclusion

- envisaged improvement through "business as usual" measures not sufficient to meet NO₂ limit values by 2010
- annual PM₁₀ limit value can be attained
- 24h-limit value for PM₁₀ won't be met by "business as usual" even in 2010
- ☹ additional measures necessary to curb PM₁₀ und NO₂ – emissions!
- ☹ city-wide non-attainment needs city-wide action

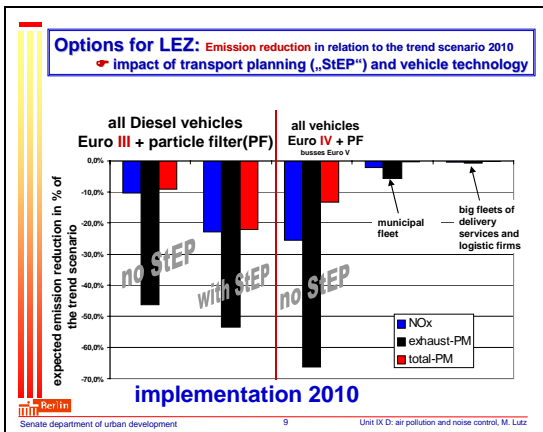
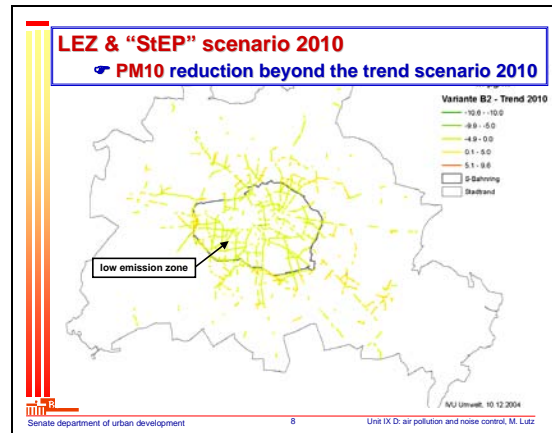
Senate department of urban development 6 Unit IX D: air pollution and noise control, M. Lutz

Air pollution control planning

☛ additional measures planned

- stationary sources
 - BAT and more
- transport:
 - cleaner vehicles and fuels
 - municipal car fleet (CRT retrofit & CNG)
 - LEZ (low emission zone)
 - less traffic through sustainable transport- and city planning (master plan transport, "StEP"), *inter alia*....
 - re-routing through traffic on tangential roads
 - extension of zones with parking fees
 - expected effect: ~ 10% traffic reduction in Berlin's centre
 - Optimized traffic management at hot spots (☛ HEAVEN)
 - linked with noise abatement
 - Speed limits
 - big effect on noise and road safety
 - little effect on air quality

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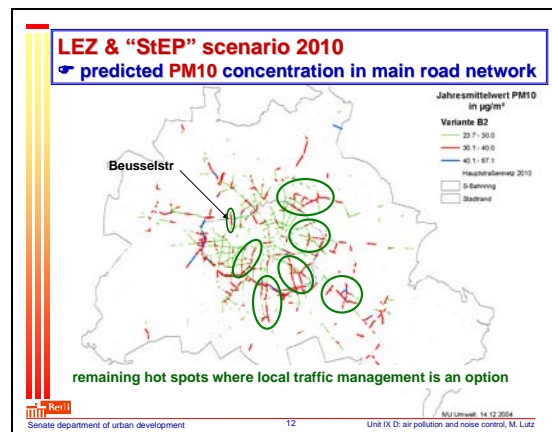
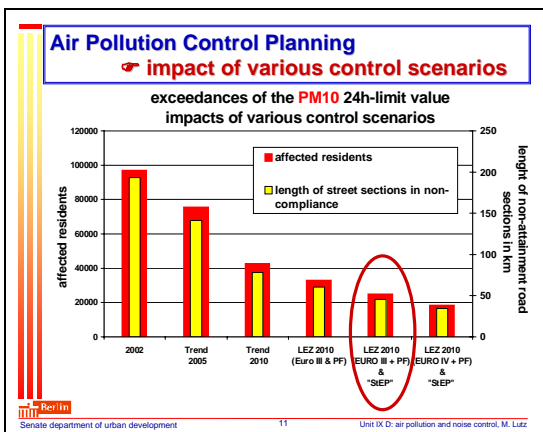
Air Pollution Control Planning

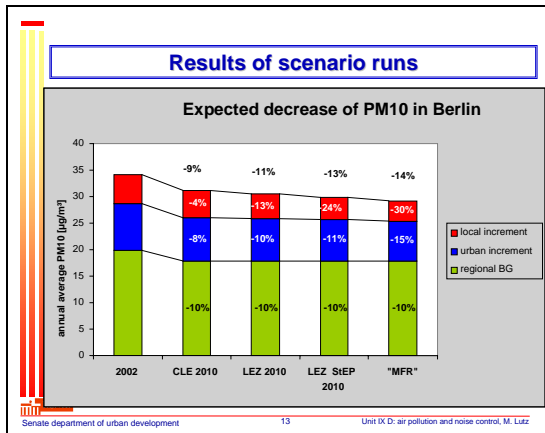
☛ Core measure: low emission zone

traffic restriction for high emitting Diesel vehicles in the central city area

- stage I: 2008, minimum criteria EURO II
- stage II: 2010, minimum criteria EURO III & particle filter
- scrutiny in 2006, whether retrofit with particle trap could be required already in stage I
- under preparation...
 - national labelling scheme for clean vehicles
 - Federal Government
 - tax incentives, in particular for clean (or retrofitted) vans and lorries
 - Federal Government

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Air Pollution Control Planning

☛ supplementary action

- Optimised traffic management at hot spots**
 - ☛ **HEAVEN**: potential for improvement up to 20% (NOx) and 7% (PM10) by truck ban
 - ☛ limited scope for implementation
 - ☛ needs thorough investigation to avoid disbenefits elsewhere
 - ☛ **successive scrutiny of remaining hot spots**
- Speed limits**
 - ☛ concept for imposing **30 km/h limits on main roads** where **noise & road safety & air pollution warrants**

Sensite department of urban development 14 Unit IX D: air pollution and noise control, M. Lutz

4.1.5 Jürgen Isensee "The effect of better fuel and low sailing speed on ship emissions"

The effect of better fuel and low sailing speed to reduce ship emissions

1. STATEMENT: Residual fuel is the key reason for bad environmental performance of shipping
2. FACT: Better fuel is clean and more expensive
3. STATEMENT: High bunker prices are an incentive to reduce emissions

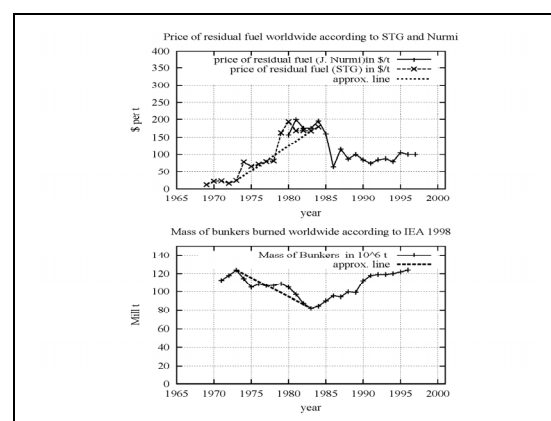
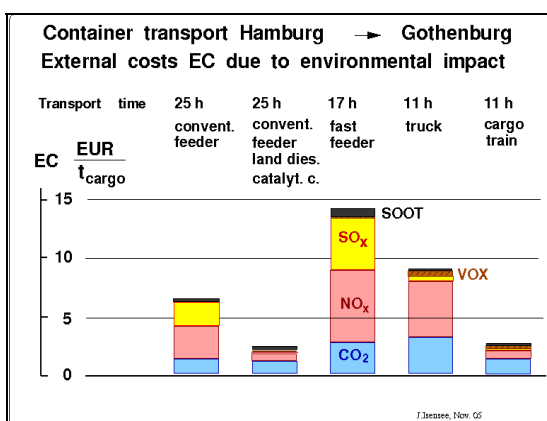
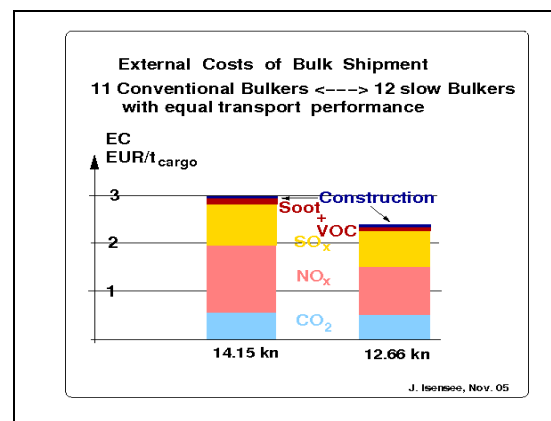
Prerequisites and assumptions

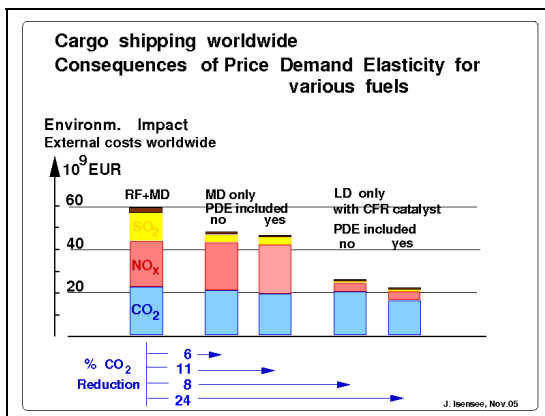
| | Residual fuel RMH35 | Marine Diesel DMB | Land Diesel trucks |
|---|---------------------|-------------------|--------------------|
| Price (2002) tax-free \$/t | 165 | 242 | 440 |
| Spec. density kg/l | 0.991 | 0.900 | 0.85 |
| Typical S content % mass | 2.7 | 1.0 | 0.035 |
| CO ₂ emiss. per ton fuel [t/t] | 3.180 | 3.109 | 3.112 |
| Spec. energy [kJ/g] | 39.8 | 42.2 | 43.0 |

Monetary value of environmental impact in €t emission

| | CO ₂ | NO _x | SO _x | VOC | soot |
|--|-----------------|-----------------|-----------------|------|-------|
| Acc. EC MT | 50 | 4000 | 800 | 4000 | - |
| Acc. EC emitted in ports | | 4200 | 8200 | | 29000 |
| Acc. EC emitted on sea (Baltic, North Sea, Channel) | | 4200 | 4000 | | 9000 |
| Acc. EC emitted on sea (East Atlantic, northern Mediterr.) | | 4200 | 4600 | | 9000 |
| Own estimation: emitted in World sea born trade | | 2100 | 2000 | | 4500 |

ECMT = Europ. Conference of Minist. of Transport "Efficient Transport for Europe"
EC: 1999/32/EG Sulphur in bunker
VOC = volatile organic compounds





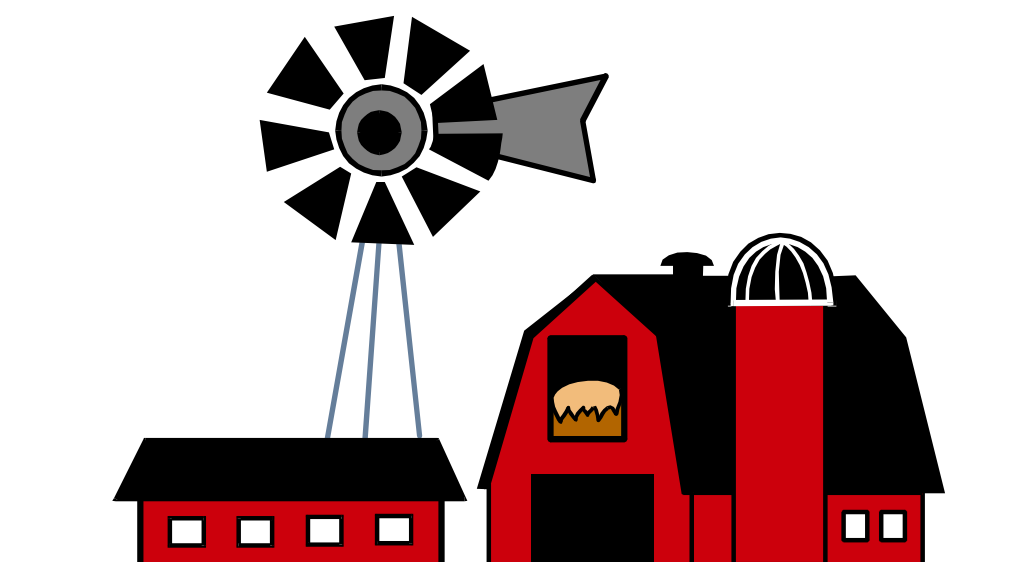
Additional Costs due to better fuel

| | For shipping companies: Additional costs/ voyage | For consumer: Additional cost/product or service |
|---|--|--|
| Tanker 90000 tdw, 15.0 kn Kuweit-Rotterd: 1890 t RF RF >>> MDO RF >>> LD | 126.000 € 457.000 € | 0.0013 €/1 l Petrol 0.0050 €/1 l Petrol |
| Cont. 4120 TEU, 25.4 kn Taiwan-Hamburg: 3735 t RF RF >>> MDO RF >>> LD | 236.000 € 905.000 € | 0.01€/ 1 pair shoes 0.04€/ 1 pair shoes |
| Cruise, 2592 Pax. 23.0 kn 11,5 d. cruise: 1734 t RF RF >>> MDO RF >>> LD | 110.000 € 420.000 € | 42.3 €/passeng/trip 162.1 €/pass./trip |
| Ferry, 1900 Pax. 25.0 kn 1.0h trip: 7.7 t RF RF >>> MDO RF >>> LD | 484 € 1.856 € | .25 €/pass/trip .98 €/pass/trip |

Better fuel and low speed – a promising NTM ?


| NTM in use or on agenda | NTM in discussion | Own proposal |
|-----------------------------------|---|---|
| Swedish fairway dues | Per Kageson: “En-route-charge ...in Baltic” | “Better fuel quality for shipping..IMO” |
| IMO: SECA at Baltic + North S. | GACCC: Charge on glob. Comm. | |
| EU: Harbour + Pass.: S - limit | | |

4.2 Session 2: Estimates of the potential and cost of different measures in the energy sector




4.2.1 Markus Amann "GAINS"

Markus Amann
International Institute for Applied Systems Analysis




“Non-technical measures offer cost-effective potentials for further emission reductions”

“Non-technical measures” ? “end-of-pipe” measures

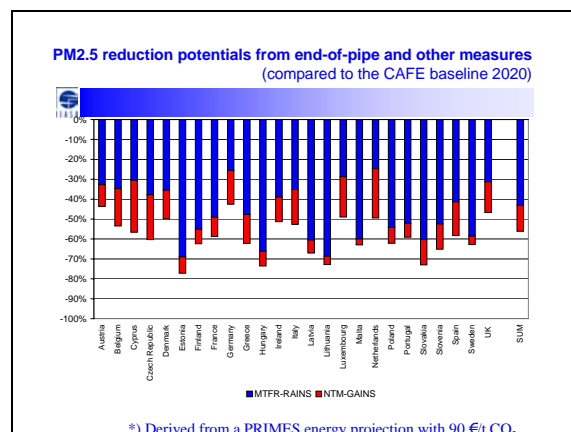
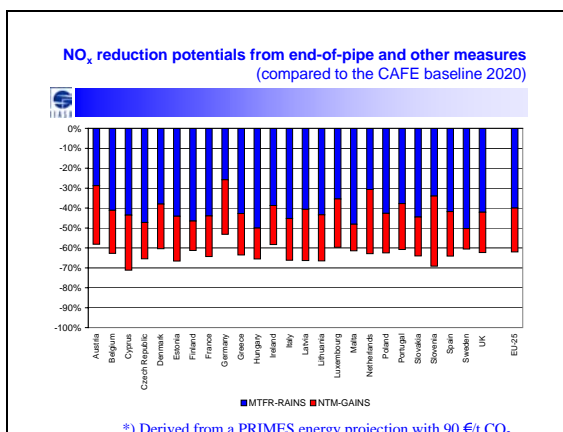
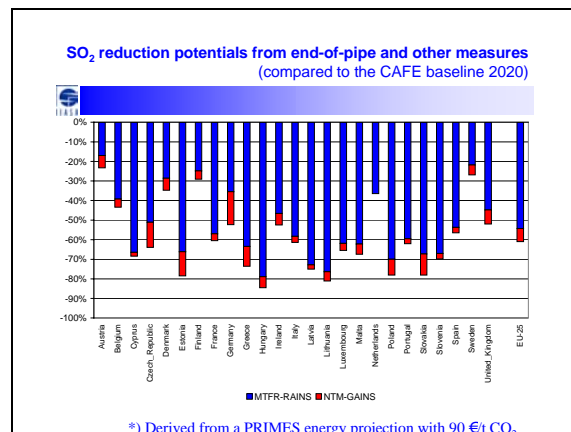


- They include measures that do not change energy services to consumers:
 - technical changes in energy supply structures (e.g., fuel switching),
 - technical measures to reduce final energy demand (increased combustion efficiency, reduced losses),
- and measures that reduce level of (energy) services to consumers:
 - Other (non-technical) measures that change demand for “useful” energy (e.g., space heated, miles driven, meat eaten, etc.)


NTM offer potential for further emission reductions



- Potential depends on assumptions
 - on costs/prices and other policy objectives: for measures that do not change consumer’s utility (e.g., fuel switching, energy savings, fertilizer substitution)
 - on political/societal acceptability: for measures that change consumer’s utility/behavior (e.g., less use of cars, more vegetarian food, etc.)
- Difficult to establish consensus on these assumptions as a basis for policy analysis, also because some of them are policy objectives (e.g., consumption levels).
- In principle, one can model these potentials. However, they are linked to other policy areas and/or private consumption, which are outside the traditional system boundaries of IAM. Modelling is possible, e.g., through linkages with disciplinary models (done, e.g., with GAINS).




Cost-effectiveness of NTM




- Cost-effective measures identified by models are often not implemented in reality, because of
 - Market imperfections:
 - Lack of (technical and economic) knowledge
 - Implementation barriers (e.g., ownership of buildings).
 - Different consumer's preferences:
 - E.g., choice of transport modes.
 - Conceptual reasons:
 - The cost-optimality concept used in IAM models is different from the cost concept of individual actors.

Cost effectiveness as seen by models and individual actors




- "Cost-effectiveness" is related to a specific costing concept.
- E.g., for RAINS/GAINS, to decide about the optimal use of resources for a society:
 - Minimize resource costs to the society
 - Excluding taxes, profits, transfer payments
 - Full life cycle costs
 - 4% interest rates for capital
 - Perfect foresight.
- Individual actors apply different cost concepts and thus do not behave according to the modeled cost-effectiveness.
 - Profit maximization based on prices, taxes, etc.
 - Short pay-back times, high private interest rates, accepted risk
 - Costs are not the only criterion (e.g., alternative use of money, consumer's preference for certain transport modes, time, etc.)

Mainstream economic analysis: Negative cost options do not exist




| Energy technology approach/ Bottom-up analysis/ Engineering cost analysis | Mainstream economic analysis |
|---|--|
| There exists an energy efficiency gap. | The market is exploiting such opportunities at reasonably efficient rates. |
| There are market barriers. | Market barriers are benign characteristics of functioning markets; they reflect costs of market adjustments. |
| Households apply too high discount rates. | Market discount rates reflect efficient investment decisions and willingness to pay. |

Cost-effective baseline projections



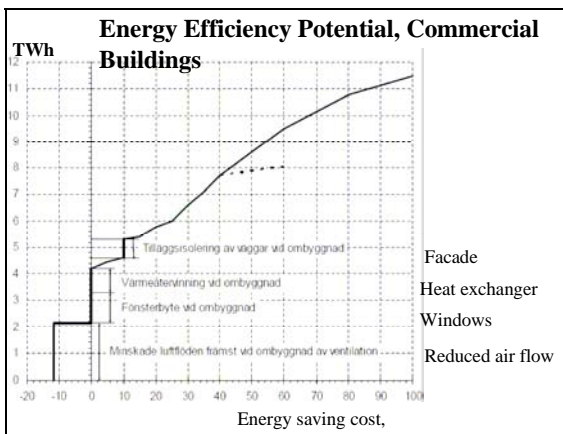
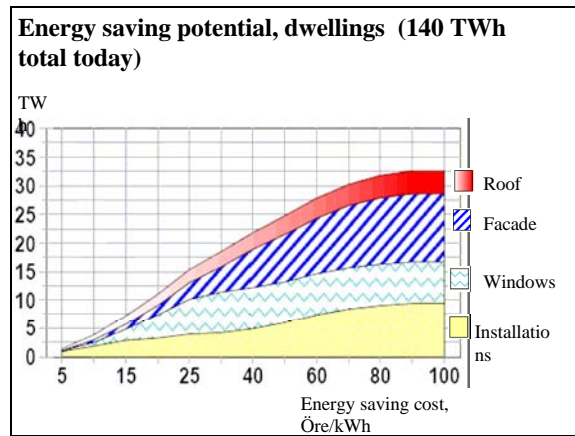
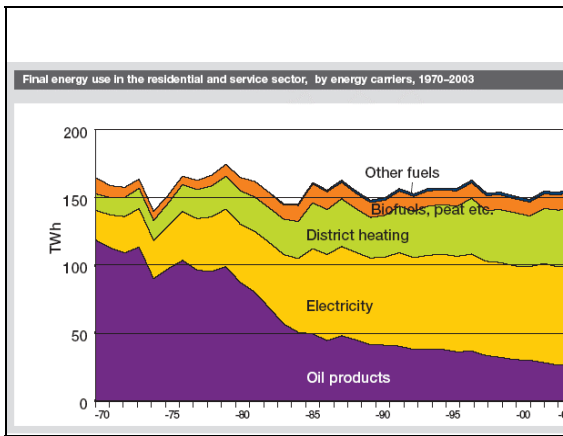
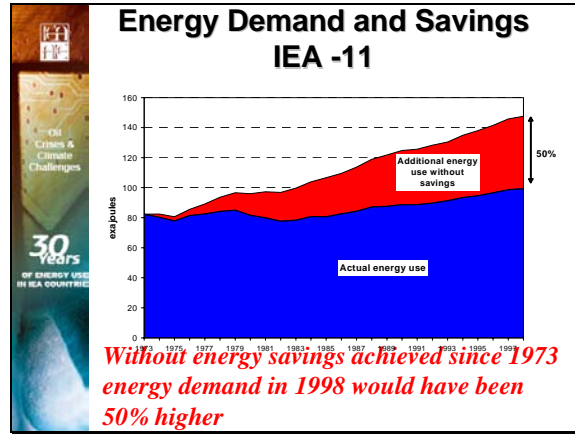
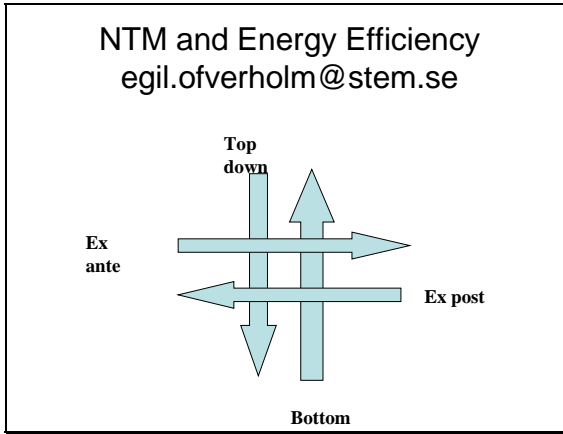
- Baseline (energy) projections are often produced with engineering cost-minimizing models. If so, there are per definition no further cost-effective measures.
- Such projections do not necessarily predict consumer's behavior in a realistic way (e.g., for transport).
- Thus they underestimates the real potential for cost-effective measures from a (more realistic) non-optimal baseline.
- If a partial RAINS/GAINS analysis finds additional cost-effective measures, this is only because system boundaries of RAINS/GAINS and the energy model are not the same. RAINS/GAINS presumably too simplistic.

Conclusions



- "NTM" offer potential for further emission reductions. This can be modeled, but it is strongly depending on subjective assumptions.
- Their cost-effectiveness depends on the costing concept. There is disagreement in the economic literature about the validity of the costing concept used in engineering/bottom-up costing studies.
- This calls for caution against the cost-effectiveness potentials derived from least-cost baseline projections.

4.2.2 Egil Öfverholm "Energy efficiency potential in buildings"



- ENERGY EFFICIENCY some Swedish Programs**
- Technology procurement
 - Local advisors
 - Voluntary agreements with building owners
 - Windows - tax reduction
 - Oil burner replacement
 - Government buildings e.e.
 - Industry – energy management systems


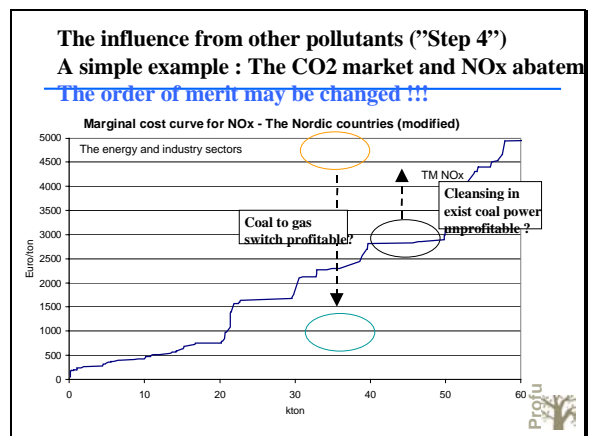
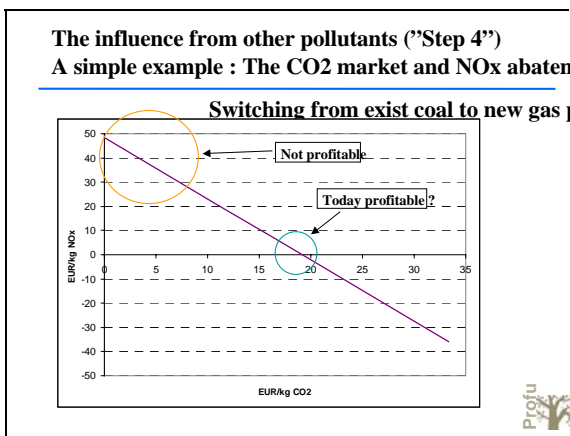
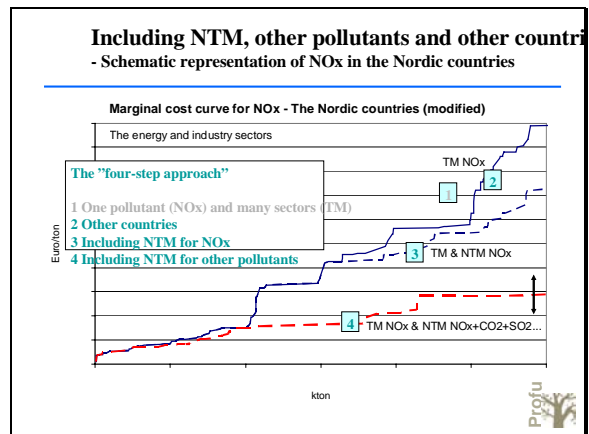
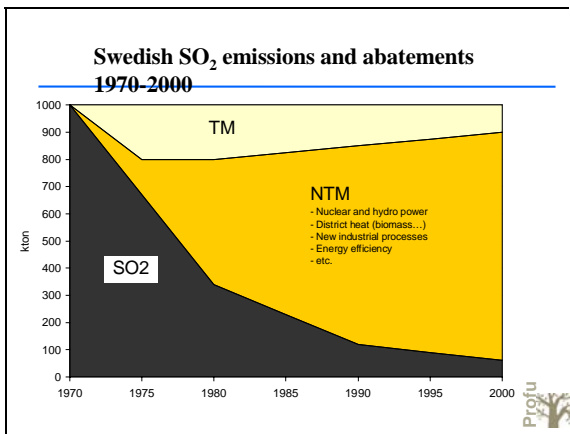
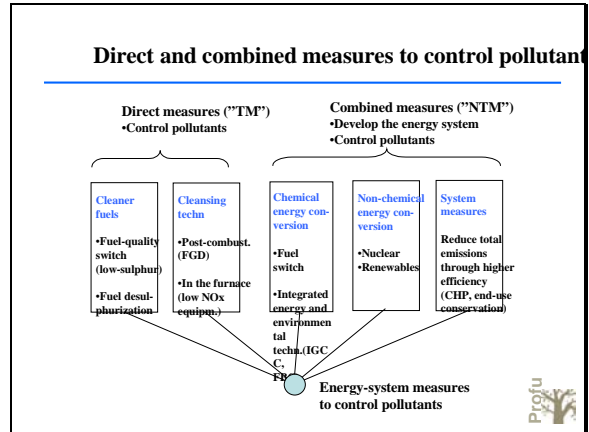
finally

- There is a rebound effect but.....
- Energy efficiency can reduce demand significantly
- It is possible to measure energy efficiency

4.2.3 Bo Ryden and Thomas Unger "NTM give synergies in emission reduction - a four step example"

Synergies in emission reductions

- **TM** ⇒ **TM + NTM**
- **One pollutant** ⇒ **Several pollutants**
- **One sector** ⇒ **Several sectors**
- **One country** ⇒ **Several countries**
A common "environmental currency" would in theory all synergies !

Conclusions

- As of today, RAINS covers some synergies (e.g. time-dependent activities and GAINS) but not enough

- We believe that synergies should, as far as possible, be systematically included in the abatement options

Pros : Synergies may be modeled (PRIMES, MARKAL/TIMES)
Better representation of the real complexity

Cons: A systematic analysis including NTM is far more dynamic (and scenario dependant) ⇒ Increased complexity of the analysis



4.2.4 Mike Woodfield "Reducing emissions from small combustion installations - the cost-effective of preventative measures for plant"

The importance of NTM for reducing emissions - Gothenburg Workshop Dec 2005

How to treat NTM in IAM

Mike Woodfield
AEA Technology Environment



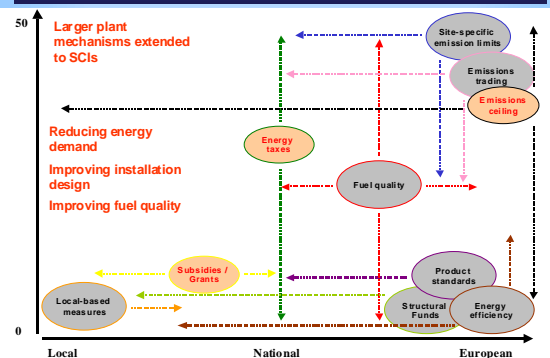
RAINS Review – Questions re NTM

- Question:
 - Is there bias due to the restriction of modelling to end of pipe control measures?
 - Would including non-technical measures improve forecasts of i) environmental results or ii) economic impact?
 - Is the current means of assessment and verification adequate?
 - Are there differences between ex-ante and ex-post assessments of the costs of control, if so why?
 - Would these differences have influenced the results of the Gothenburg Protocol and the NEC Directive?

RAINS Review findings re NTM

- Historically, costs have been overestimated in RAINS
 - Are end of pipe solutions more expensive than options associated with structural changes and economic reactions to market stimuli?
 - If so will this conservative bias become more important when considering multiple pollutants?
- Inclusion of NTM (market-orientated mechanisms) would:
 - result in a more accurate estimate of the costs of a policy but may lead to greater uncertainty.
 - a more rapid realisation of environmental (policy) results.
 - but what would happen/when, what would be the side effects?
 - Is it appropriate to include NTM measures as alternatives to EoP measures on a cost curve?
- Sensitivity analysis is needed, at country and sector level, to better understand the nature of the bias.
 - Does it matter for IAM that any overestimate of costs may differ from country to country as a result of differences of the real costs of capital?
 - Is a uniform discount rate appropriate for economies in transition

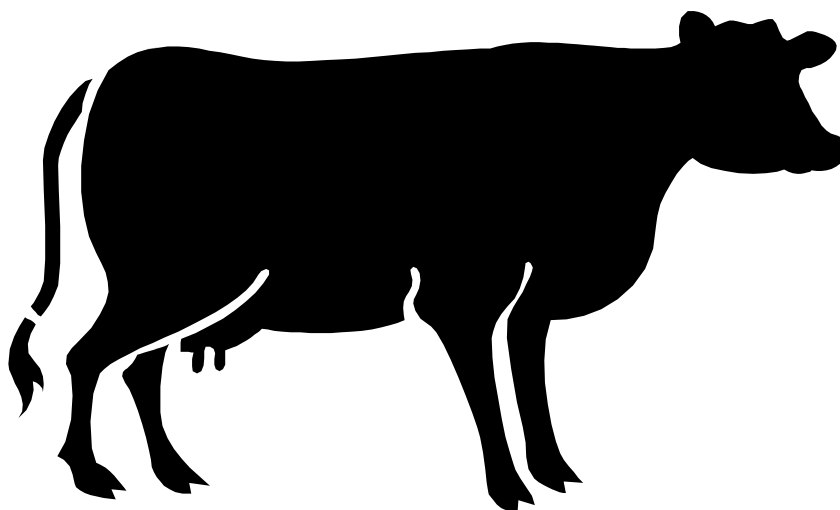
Review of policies and measures for SCIs



Questions relating to the inclusion of NTMs raised by the SCI work

- Questions:
 - do we have the data needed to assess NTMs in the same way as EoP measures?
 - Efficiency
 - Applicability
 - Cost
 - Can we analyse NTMs independently of a policy scenario.
 - Issues
 - Modelling at sub national spatial levels
 - Compatibility of combinations of options


4.3 Session 3: Estimates of the potentials and cost of possible measures in agriculture sector



4.3.1 Corjan Brink and Kaj Sanders "Non-technical abatement measures for agricultural emissions


Non-technical abatement measures for agricultural emissions

Corjan Brink
based on work by various colleagues



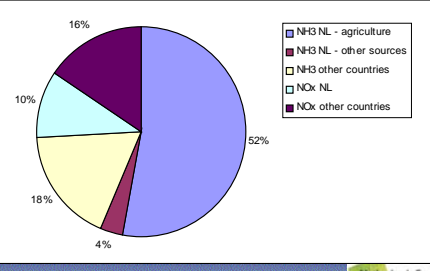
Diet changes

- meat consumption ? environmental pollution
 - one of the most polluting parts of our diet
- alternatives with less environmental pollution
 - fish (limited potential, other environmental impacts)
 - novel protein foods (NPFs)
- replacing 40% meat by NPFs in the Netherlands
 - reductions in CH₄ (9%), NH₃ (9%), N₂O (3%) emissions (2030)
 - reduction in land requirements
 - meat more expensive than NPFs ? direct savings consumers
- But...
 - welfare cost?
 - implementation? (e.g. tax on meat?)




NTM for NH₃ from agriculture

- Sources of N-deposition in NL (2000)



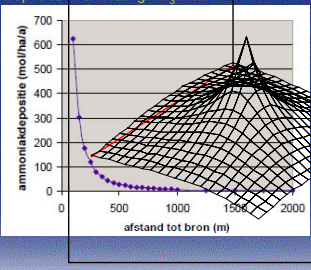

| Source | Percentage |
|------------------------------------|------------|
| NH ₃ NL - agriculture | 52% |
| NH ₃ other countries | 18% |
| NO _x other countries | 16% |
| NO _x NL | 10% |
| NH ₃ NL - other sources | 4% |



Abatement of NH₃ from agriculture

- deposition NH₃ relatively close to source

deposition from 800kg NH₃ at farm

Abatement of NH₃ from agriculture


- sources of emissions near nature reserves have relatively large impact on biodiversity
- 20% of NH₃ emissions deposited within 1000m
- remaining part contributes to background deposition levels

So...

- NH₃ abatement close to nature reserves most effective

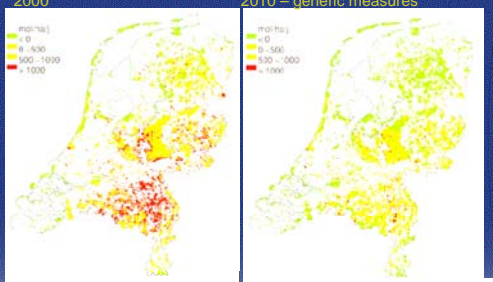

But...

- in the Netherlands background concentration high
⇒ abatement close to nature reserves not sufficient

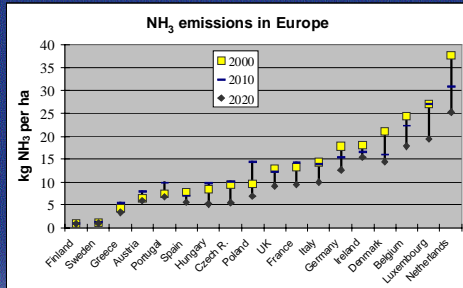


Exceeding critical loads for N deposition

2000 2010 – generic measures

Netherlands vs. Europe



Netherlands Environment Assessment Agency

Measures for agricultural NH₃ emissions

| | Generic reduce emissions and background deposition | Location specific reduce deposition on a specific nature reserve |
|----------------------|--|---|
| Technical | ✓ general rules for manure storage, application, animal houses, etc. | ✓ local implementation of technical measures |
| Non-technical | ✓ buying up livestock quota | ✓ relocation of farms ✓ closure of farms ✓ restrictions on farming within certain areas |

Netherlands Environment Assessment Agency

Location specific NH₃ abatement

- Options
 - local implementation of technical measures
 - IPPC takes into account local environmental conditions
 - buffer zones (250m) around nature reserves in which economic expansion is restricted
 - relocation or closure of farms
- General conclusions
 - Non-technical measures (relocation, closure) relatively expensive
 - in specific areas they can help to reduce N deposition exceeding critical loads cost-effectively
 - location specific abatement more efficient with lower background concentration levels

Netherlands Environment Assessment Agency

Cost-effectiveness

- Measure effect:
 - kton/yr reduction in emissions
 - mol/ha/yr reduction in deposition (average/on specific area)
 - ecosystem protection percentage
 - Mmol/yr reduction accumulated exceedance

Cost-effectiveness

| | technical generic | technical location-spec. | non-techn. generic |
|-----------------------|---------------------|--------------------------|--------------------|
| emissions (€/kg/yr) | 0.4 – 25 (9.0 avg.) | 9.2 (avg.) | 3.6 |
| exceedance (€/mol/yr) | 0.2 - 4 (1.7 avg.) | 1.2 (avg.) | 0.4 |

- cost-effectiveness of relocation in most favourable situations can be as low as ~€0.2/mol/yr

Netherlands Environment Assessment Agency

Non-technical vs. technical measures (local)

- Relocation/closure:
 - can be cost-effective for farms dominating N-deposition on specific natural areas? local reduction may amount to 1000 mol/ha/yr
 - relocation? no reduction emissions
 - closure more effective than relocation - emissions removed
- Technical measures
 - location specific implementation of technical measures with high reduction potential more efficient than relocation/closure
 - e.g. air scrubbers (reduction NH₃ >90%; also reduction PM₁₀)

Netherlands Environment Assessment Agency

Non-technical vs. technical measures (local)

Cost (for average farm)

- relocation €450,000
- closure > €500,000 (based on price livestock quota)
- air scrubber €300,000 (NPV; invest. €100,000-€150,000)

Spatial scale analysis:

- high level of spatial detail required for calculating effect (and cost-effectiveness) of location specific abatement
- studies for the Netherlands:
 - 5x5 km ('96) ? 1x1 km ('01) ? 500x500 m (present)

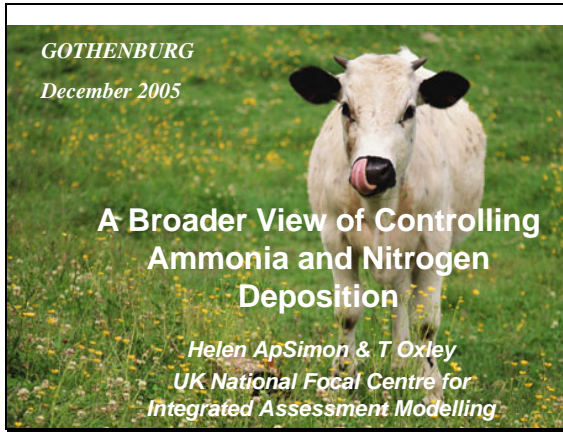
Netherlands Environment Assessment Agency

Implementation

- various difficulties with relocation in NL
 - high level of fragmentation of nature reserves
 - conflicting interests of many stakeholders
 - not all stakeholders involved in decision-making process
 - farmers less willing to relocate than expected
 - existing but unused rights (e.g. for expansion) remain valid
 - governments hesitant to pay for damage due to loss of rights
 - insufficient funds

- Promises for 'deposition tax'?
 - levy tax on contribution of farm to critical load exceedance
 - let farmer opt for relocation, closure, technical measures

4.3.2 Helen ApSimon "A boarder view of controlling ammonia"



Why do we need to think further about NH3?

How might “non-technical” measures help?

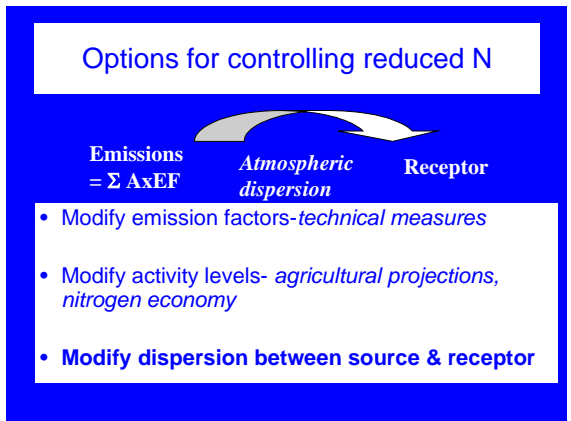
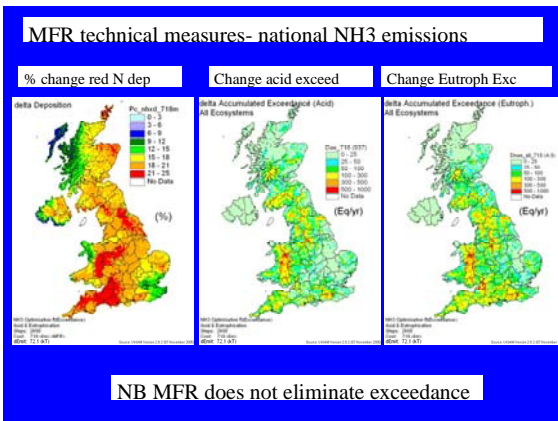
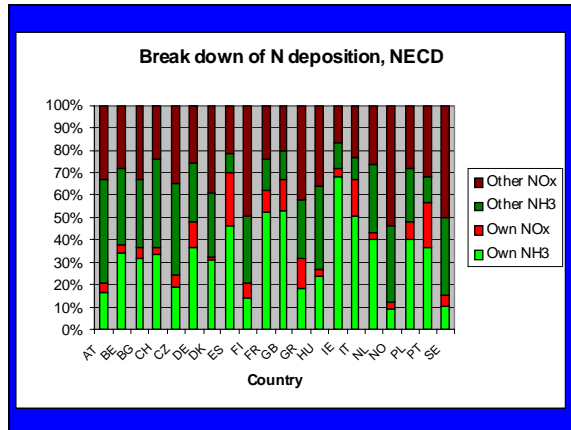
What are the priorities and benefits for ecosystem protection?

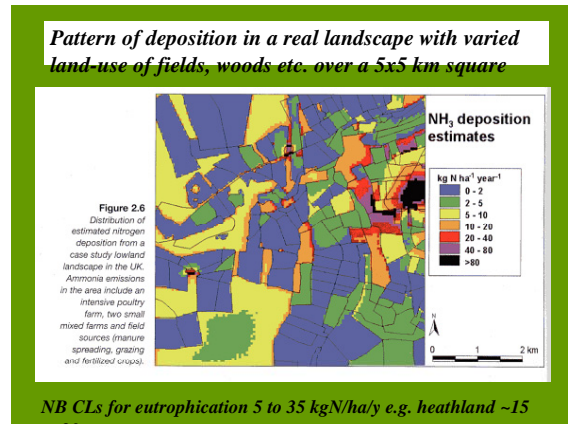
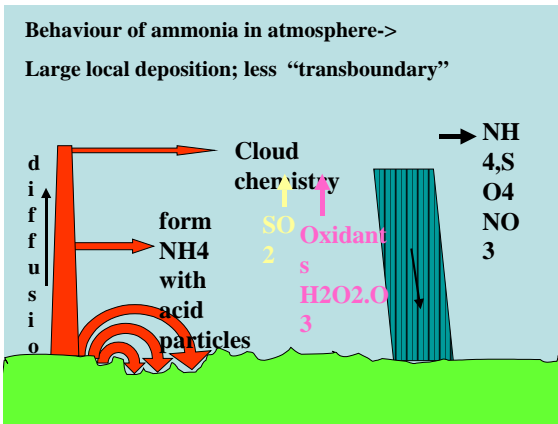
Are there other “costs” of ammonia control to consider?

Emphasis on NH3 in Thematic Strategy from RAINS for CAFE

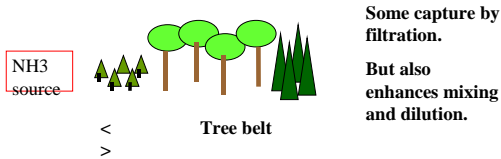
Emissions from EU-25 and cost of them, strat on top of CLE

| Pollutant | 2000 | 2010 | 2020 | | Cost M€/y |
|-----------|-------|------|------|--------------|-----------|
| | | | NECD | CLE Strategy | |
| NH3 | 3824 | 3976 | 3686 | 2774 | 2600 |
| NOx | 11581 | 8319 | 5888 | 4657 | 998 |
| SO2 | 8735 | 6543 | 2805 | 1602 | 933 |
| PM2.5 | 1749 | 964 | 714 | | 636 |
| VOC | 10661 | 8150 | 5916 | 5252 | 114 |





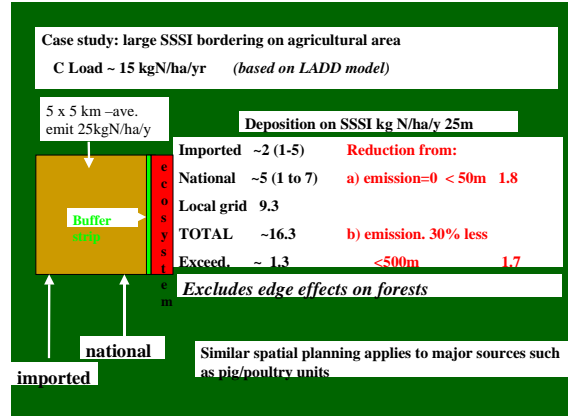
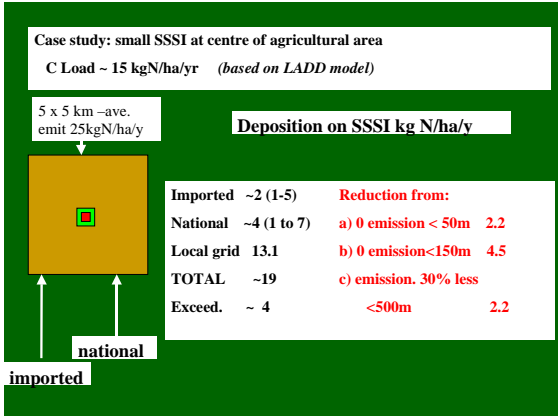
AMBER project: CEH Edinburgh (report 2004)
Ammonia Mitigation by Enhanced Recapture:
Tree belt surrounding source



BUFFER ZONES
 H ApSimon (2003) TFIAM paper

Introduce a low N strip round perimeter of SSSIs/ sensitive ecosystems

Can make set-aside or use for e.g. coppicing, biofuels



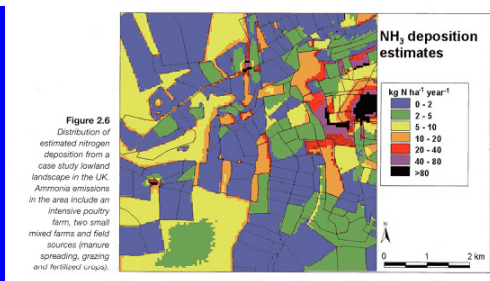
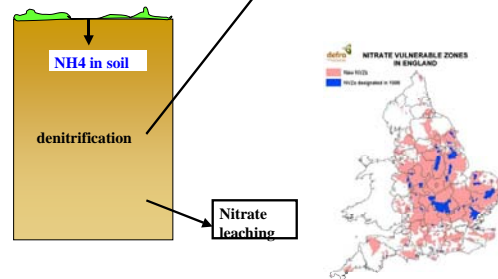
Costs of buffer zones

Set-aside schemes : low cost ~ 0- 150 euro/ha/y

NB Agri-environment schemes have options for narrower strips ~ 6 m wide attracting payments of ~600 euro/ha if beyond set-aside requirement

Otherwise for arable or grassland (non-dairy) cost to farmer would be ~ 450 to 600 euro/ha/y

OTHER FACTORS TO CONSIDER IN NH3 CONTROL



Buffer zones ~50-100 M round small SSSIs/ecosystems
 Buffer zones along edge of larger ecosystem areas, or ignore edge area
 Site major units away from sensitive areas with lower limit on distance. Grow woodland shelter belts round farm units.

Acknowledgements


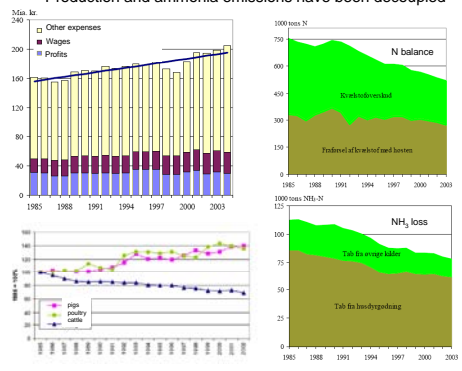
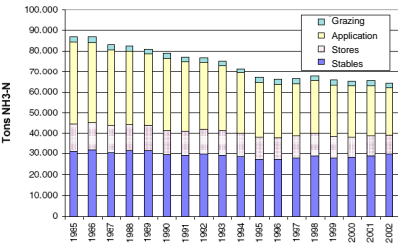
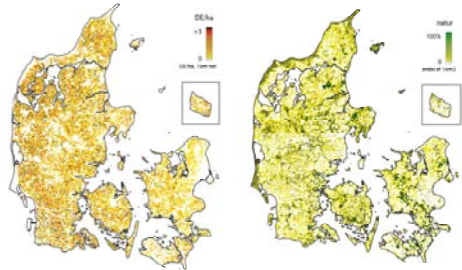
CEH Edinburgh on AMBER project

Martin Ryan (DEFRA) on costs of buffer zones

AEQ Division of DEFRA and their support for our integrated assessment modelling with UKIAM

UK Air Quality Expert Group- currently addressing links between air quality and climate change

4.3.3 Jesper Bak "Danish examples of effects and costs of measures in the agricultural sector"

| | |
|--|--|
| <p style="text-align: right;"></p> <p style="text-align: center;">Danish examples of effects and costs of measures in the agricultural sector</p> <p style="text-align: center;">Jesper Bak Danish National Environmental Research Institute</p> | <p style="text-align: center;">Production and ammonia emissions have been decoupled</p>  |
| <p style="text-align: center;">Agricultural ammonia sources</p>  |  |
| <p style="text-align: center;">Key legislation</p> <ul style="list-style-type: none"> • NPO Action Plan 1987 Action Plan I on the Aquatic Environment 1991 Action Plan for a Sustainable Agriculture 1998 Action Plan II 2000 AP II Midterm Enforcement 2001 Ammonia Action Plan 2004 Action Plan III | <p style="text-align: center;">Key regulation</p> <ul style="list-style-type: none"> • Limit on livestock density (1.4 - 2.3 LSU / ha) • Regulation of N utilisation in manure • Ban on broad spreading of manure • Mandatory coverage of manure stores • IPPC approval • New: Stop for extra emissions in 300 m bufferzones |

Elements in an approval Procedure for Livestock Farms

- Increased environmental protection
-focusing on ammonia and odour,
- Reduced emission of ammonia per livestock
-both in areas sensitive to ammonia and in general,
- Development of guidelines for uniform administration
- Increased focus on Best Available Technology,
Simplified administrative procedures and reduced time used for administration work,
- Internet based application in order to enable farmers to prepare tailor made applications

Example demands on future production

| | Ab animal Kg N / LSU | Ab store Kg N / LSU | -90% Ab store | -60% Ab store | -30% Ab store |
|------------------------------------|-------------------------|------------------------|------------------|------------------|------------------|
| Pigs for slaughter, slurry | 112 kg N | 97 kg N | 110 kg N | 106 kg N | 101 kg N |
| Pigs for slaughter, Deep litter | 112 kg N | 66 kg N | 108 kg N | 94 kg N | 81 kg N |

Reduction potential, pig stables

| Technique | Ammonia loss % of total N Reference | Ammonia loss % of total N W. tech. | Cost / kg N red. | Available | Under dev. |
|----------------------------|---|--|---------------------|-----------|---------------|
| partly slotted floor | 14 | 8 | 2.6-3.3 € | + | |
| Cooling of slurry | 14 | 8 | | + | |
| acidification | 14 | 4 | 6.6 € | + | |
| Drip noses on slots | | | | | + |
| V shaped slurry channel | 14 | 10 | 0.8 € | + | |
| Stable separation | 14 | 7 | | | + |

Reduction potential, cattle stables

| Technique | Ammonia loss % of total N Reference | Ammonia loss % of total N W. tech. | Cost / kg N red. | Available | Under dev. |
|--------------------|---|--|---------------------|-----------|---------------|
| Manure scrapers | 7 | 4 | 3.3 € | + | |
| Acidification | 7 | 2 | 20 € | + | |

Air cleaning

| Technique | Expected reduction of NH ₃ in air | Cost pr kg N red. | Available | Under dev. |
|------------------------|--|----------------------|-----------|------------|
| Chemical shrubber | 90% | 7 € | + | |
| Biological shrubber | 50% | | + | |
| Biofilter | 50% | | | + |

Covering of slurry tanks

| €/ ton | Pigs | Cattle |
|------------------------|------|--------|
| Natural floating layer | | 0 |
| Straw | 0.2 | 0.18 |
| Floating lid | 0.5 | 0.47 |
| Tent | 1.1 | 1.1 |

Manure application

| Emission factor (%) | Pigs | Cattle |
|--------------------------|-------------------------------------|--------|
| Untreated slurry | 12.2 | 17.7 |
| Biogas | 9.5 | |
| Biogas and separation | 9.2 | |
| Injection in crop | 9.2 | 13.3 |
| Injection on black soil | 1.2 | 1.8 |
| Acidified to pH 6 | 5.4 | 7.9 |
| Price / kg N red. | | |
| Acidification | 1.5 € | 2.7 € |
| Injection | Cost: 6.4 €/ ha, red.: 8.5 kg / LSU | |

Stop of production

Price: 62.4 €/ LSU, budget economy
146.6 €/ LSU, welfare economy

NH₃ red.: 31.5 kg N / LSU, pigs = 2.0 €/ kg
17.4 kg N / LSU, cattle = 3.6 €/ kg

NEC directive

Der kræves QuickTime™ og et TIF (LZW) komprimeringsværktøj, for at man kan se dette billede.

..neither the measures to be included in the third Action Plan for Aquatic Environment nor the technological development are included in the projection for ammonia for 2010. These shortcomings are prohibitive in making realistic conclusions about the emissions in 2010. New computations will be made when sufficient information is available.

- Habitat and Water Framework directive**
- Experience I -general regulation based on Nitrates directive
 - Experience II -Individual regulation based on IPPC Directive
 - New Approach
 - Individual regulation of livestock farms with more than 75 livestock units (LU)
 - New Approach
 - design Rural District Programme to offer new incentives to meet standards set by WFD and Habitats Directive

- Conclusions**
- 30% reduction has been achieved at very low cost
 - Future regulation will
 - Avoid over-regulation by targeting individual farms
 - 1) Increase feeding management, 2) increased use of catch crops, 3) changes in crop rotation, 4) buffer zones and 5) restoration of wetland rather than 6) reducing livestock numbers
 - Integration of investment in environmental protection equipment with on going investment activities at livestock farms.

4.4 Session 4: How to treat Non-technical measures in IAM

4.4.1 Catarina Sternhufvud "The NTM concept"

The NTM concept

Catarina Sternhufvud - IVL
Stefan Åström - IVL
Mohammed Belhaj - IVL
2005-12-07

NTM - a diverse concept

- Homogeneous group of measures?
- Are there common characteristics?
- Classification of NTM?
- Policy instruments?
- Distinction TM/NTM?

The distinction between NTM and policy measures

- Policy instruments are frequently defined as NTM.
- CANTIQUE defines all measures that influence drivers behaviour, as NTM.
- In Auto Oil II all measures that changes the use of transport are defined as NTM.
- Merlin clearly point out the importance to separate policy instruments from NTM, as policy instruments often leads to both TM and NTM.

Definitions of TM/NTM

- Technical measures affect the emission factors, but not the activity levels, while NTM affect the activity levels, but not the emission factors.
- Distinction between measures based on how the measures affect prices and demand.
- Technical measures affect the supply side and NTM affect the demand side of produced commodities.

Alternative definition of NTM

A NTM reduces emissions by changing the mix or quantity of input to production, without the requirement of additional input.

(Input and output reflect the firm's production where output is the produced commodity and input is the resources required to the production of the commodity.)

Classification

- Important to classify the Non-technical measures
- Efficiency improvements, substitution and demand measures
- Different classes of NTM might need to be treated differently in IAM

Concluding remarks

- Many different definitions found in the literature review.
- It is important to make a difference between NTM and policy instruments, as policy instruments can lead to both TM and NTM.
- A clear definition and classification of NTM can facilitate the discussions on how to incorporate these measures into IAM.
- One possibility is to define NTM as measures that reduce emissions by changing the mix or quantity of input to production, without the necessity of additional input.

NTM as a concept

Catarina Sternhufvud, Stefan Åström, Mohammed Belhaj - 2005-12-07

Thank you for your attention!

NTM as a concept

Catarina Sternhufvud, Stefan Åström, Mohammed Belhaj - 2005-12-07

4.4.2 Mohammed Belhaj " Meta-analysis: the cases of the agricultural, energy and marine sectors "

Meta-analysis and meta regressions: the cases of the agricultural, energy and the shipping sectors

Mohammed Belhaj, Stefan Åkström, Catarina Sternshövud
Swedish Environmental Research Institute

051207

The general definition of a meta-analysis is a study of other studies.

There are different ways to carry out a meta-analysis.

- to carry out a literature review, i.e., a summary;
- to carry out a regression analysis, e.g., OLS.

The agricultural sector

- literature review;
- the data;
- estimation results

Cost effectiveness in the agricultural sector.

| Variable | NTM saving | | TM cost |
|--------------------|----------------|-----------------|----------------|
| | Estimate | Estimate | Estimate |
| Emission reduction | 1.56 (6.49) | 1.35 (13.98) | 1.08 (7.16) |
| Adj R ² | 0.73 | 0.89 | 0.89 |
| N | 14 | 23 | 41 |

Emission reduction 0.47 0.65 0.51

The energy sector

- literature review;
- the data;
- estimation results

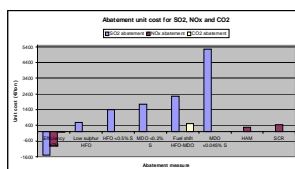
Cost effectiveness in the energy sector.

| Variable | NTM saving | | TM cost |
|--------------------|-----------------|----------------|-----------------|
| | Estimate | (Estimate) | Estimate |
| Emission reduction | 0.98 (29.56) | 0.71 (4.42) | 0.96 (11.47) |
| Adj R ² | 0.96 | 0.65 | 0.70 |
| N | 31 | (9) | 53 |

Emission reduction 0.98 0.95 0.73

The shipping sector

- literature review;
- the data;
- description



4.4.3 Mike Woodfield "The findings of the RAINS review on the incorporation of NTM in IAM"

See session 2 Mike Woodfield

4.4.4 Stefan Reis "Incorporating NT-measures in IAMs based on the MERLIN work"

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Multi-Pollutant Multi-Effect Modelling of European Air Pollution Control Strategies - an Integrated Approach

Integration of Non-technical Measures

(funded by DG Research 5th FP)

MERLIN Universität Stuttgart Institut für Energiewirtschaft und Rationelle Energieanwendung IER

Objectives

Development and application of methodologies and tools for an integrated assessment of European air pollution control strategies

Features

- multi-pollutant, multi-effect assessment
- cost-effectiveness and cost-benefit analysis
- application of advanced optimisation methods
- inclusion of non-technical measures
- macroeconomic effects and distributional burdens of air pollution control
- inclusion of new member states

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MERLIN Model Framework

Databases compiled for 2000, 2010, 2020

SADB (Stock + Activities) → Scenario-Tool (Scenario development and data management) → Scenarios → MDB* (Modified databases)

MDB (Measure Data) → Scenario-Tool → OMEGA (Optimisation) → SADB* (Modified databases)

Optimal Strategies, including:

- Emissions by country
- Concentrations by gridcell
- Abatement costs by country and sector
- Avoided damage costs

Changing Stock and Activity by implementing measures

Emission Scenarios for future years, giving:

- Emissions by country and sector
- Implementation degrees of measures
- Changes in emissions relative to the base case by country and sector

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Measure-Matrix-Approach

Costs of implementation (typically with reference to Stock or Activity)

Measure-Database (MDB): Reference, Description, $\Delta EF_1, \Delta EF_2, \dots, \Delta EF_n$, Costs, Meta-Information

non-tech. measures (affecting S or A) | techn. measures (affecting EFs)

Stock-Activity-Database (SADB): Reference, Description, Stock (S) Activity (A), EF_1, EF_2, \dots, EF_n , Meta-Information

$e = A \cdot EF$

$E = S \cdot e$

EF = Emission Factor
S = Stock (e.g. # of vehicles)
A = Activity (e.g. km/yr)
e = source emissions
E = source-group emissions

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Defining technical and non-technical measures (I)

"Technical measures" within MERLIN can be represented either as

- changes in the **emissions coefficient (EF)** for a particular sector (or sub-sector or technology type), or as a
- **shift in the pattern of activity** within a sector or sub-sector between different technology types ('switch measures').

In representing the impact of technical measures on emissions, activity levels are held constant at the sector level (though activity may shift between technology types).

This is a simplification, because in general it can be expected that implementing technical measures will have effects on costs, and hence prices, and hence may affect the sector's level of activity.

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Defining technical and non-technical measures (II)

"Non-technical measures" in the MERLIN context comprise those measures which have their **primary impact on the level of sectoral activity** [and a lesser impact on the coefficient relating activity to emissions (EF)].

It is clear, that any of these measures would not only have an effect solely confined to activity levels. Effects on the coefficient relating activity to emissions might arise through a number of routes, e.g. a fall in activity might lead to

- closure of the most-polluting plants,
- reducing average emissions per unit of output,
- etc.

NTMs need to be discussed as well with regard to policy instruments, as often a tax e.g. on fuel may be seen as an instrument to induce (longer term) technology changes rather than immediate effects on activity levels.

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Integrating NTM into a 'technical' optimisation model (I)

NTMs can include both fiscal and non-fiscal measures.

Among the **fiscal** measures the relevant set of measures include:

- Higher motor fuel taxes
- Parking charges
- Road congestion pricing
- Motorway tolls
- Public transport subsidy
- Accelerated scrapping incentives
- Restructuring vehicle fuel taxes (e.g. the balance between diesel and gasoline)
- Higher taxes on motor vehicle ownership

Non-fiscal measures include road-use restrictions (e.g. city-centre pedestrianisation), and quantitative parking restrictions. Both of these, however, have effects that, at the broad level of spatial aggregation used in MERLIN, may differ little from the impact of corresponding pricing or city-centre traffic congestion and of parking spaces.

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Integrating NTM into a 'technical' optimisation model (II)

Example for **road transport fuel tax increase**:

Assumption: "An increase in fuel tax will increase the retail price of petrol, and hence the cost of travel compared to other goods and services that individuals can buy."

This effect on the relative price of petrol may lead to a number of behavioral responses by individuals:

- a **reduction in amount of travel compared to other goods and services** (as consumers decide, at the margin, to shift spending to other commodities)
- **modal shifts within the transport sector, if the higher petrol tax has a differential effect on the prices of private motoring and public transport** (for example, if the fuel cost component in the price of public transport is lower than in the case of private motoring, or if the tax increase applies only to private motorists' fuel purchases).
- an **improvement in fuel efficiency (long term effect)** (as the higher price of fuel induces consumers buying new cars to choose more fuel-efficient models),

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Integrating NTM into a 'technical' optimisation model (III)

Hanly, Dargay and Goodwin (2002) conclude that the overall consensus of several studies, based on the best-defined results, is that a 10% increase in the real price of motor vehicle fuel would:


- reduce the volume of fuel consumed by 2.5% within one year, and over 6% in the longer run (i.e. 5+ years)
- increase the efficiency of fuel use by about 1.5% within one year, and about 4% in the longer run
- reduce the number of vehicles owned by less than 1% within the first year, and 2.5% in the longer run
- reduce the volume of traffic by 1% within the first year, and 3% in the longer run.

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Integrating NTM into a 'technical' optimisation model (IV)

| Country | 5 per cent | 10 per cent | 20 per cent |
|-----------------|------------|-------------|-------------|
| Austria | 0.5 | 1.0 | 1.5 |
| Belgium | 0.5 | 1.0 | 1.5 |
| Denmark | 0.5 | 1.0 | 1.5 |
| Finland | 0.5 | 1.0 | 1.5 |
| France | 1.0 | 2.0 | 3.0 |
| Germany | 1.0 | 2.0 | 3.0 |
| Greece | 0.5 | 1.0 | 1.5 |
| Ireland | 0.5 | 1.0 | 1.5 |
| Italy | 1.0 | 2.0 | 3.0 |
| Luxembourg | 0.5 | 1.0 | 1.5 |
| Netherlands | 0.5 | 1.0 | 1.5 |
| Portugal | 0.5 | 1.0 | 1.5 |
| Spain | 0.5 | 1.0 | 1.5 |
| Sweden | 0.5 | 1.0 | 1.5 |
| Bulgaria | 1.0 | 2.0 | 3.0 |
| Czech Republic | 0.5 | 1.0 | 1.5 |
| Estonia | 0.5 | 1.0 | 1.5 |
| Hungary | 0.5 | 1.0 | 1.5 |
| Latvia | 0.5 | 1.0 | 1.5 |
| Lithuania | 0.5 | 1.0 | 1.5 |
| Poland | 0.5 | 1.0 | 1.5 |
| Romania | 0.5 | 1.0 | 1.5 |
| Slovak Republic | 0.5 | 1.0 | 1.5 |
| Slovenia | 0.5 | 1.0 | 1.5 |

Total costs for a 5%, 10% and 20% increase of fuel prices respectively calculated based on dead-weight loss (DWL)

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Summary and Conclusions

Integrating NTM in the framework of a technology based optimisation model presents several challenges


- formulating measures and expressing emission control options in a way that technical and non-technical measures and their effects can be calculated with the same basic data (*EFs, activities, costs*)
- allow for **cross-sectoral interaction**, e.g. to re-allocate activities from individual transport to public transport
- clear distinction between **short term** and **long term** effects
- the level of detail of modeling activities, EFs, technologies determines the degree of NTM effects that can be accounted for (*e.g. vehicle stock vintages, driving modes, vehicle utilisation etc.*)
- careful to avoid *'double counting'* of effects and distinguish clearly between measures and instruments
- open discussion, how far to integrate NTMs into technology based models or rather technical measures into (macro)economic models?!

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Institut für Energiewirtschaft und Rationelle Energieanwendung **IER**

Contact:

- Rainer Friedrich: rf@ier.uni-stuttgart.de
- <http://www.merlin-project.info>
- <http://www.imperial-consultants.co.uk/intarese.org/home.htm>

4.4.5 Simone Schuch "Including structural changes into IAM: some ideas and possible implecations"



Including structural changes into IAM :
some ideas and possible implications

Simone SCHUCHT & Sébastien SOLEILLE
Workshop TFIAM, Gothenburg, 7 to 9 December 2005

INERIS

DRG / MECO • 7.01.12.2005 • TFIAM workshop

Outline

1. Emission abatement measures versus policy instruments to implement these measures and reasons for including 'non-technical' measures into IAM
2. Some questions and points for discussion
 - 1) Different types of costs involved in reducing emissions
 - 2) To what extent are price effects and their impacts taken into consideration?
 - 3) How to deal with transport emissions?

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1. Emission abatement measures versus policy instruments and reasons for including 'non-technical' measures into IAM

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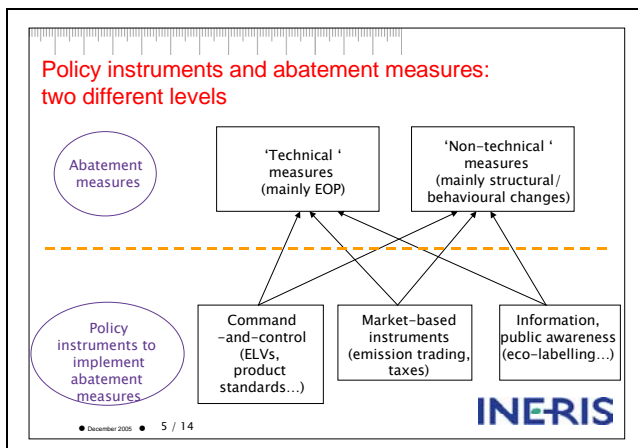
Emission abatement measures

- a) 'Technical' measures: mainly end-of-pipe (EOP)
 - Filters, flue gas desulphurisation, selective catalytic reduction, etc. but also low-sulphur fuel
 - ⇒ endogenous variables in RAINS
- b) 'Non-technical' measures ≈ structural & behavioural changes
 - Changes in production and consumption modes, e.g. modal change (such as use of rail instead of road transport)
 - Reduced transport or energy demand
 - More efficient production techniques, e.g. energy efficiency measures
 - Fuel switch
 - ⇒ exogenous variables for the RAINS model

} non-technical?

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Policy instruments versus 'non-technical' measures

Policy instruments are not explicitly modelled in RAINS:

- RAINS identifies the ('technical') measures to be implemented to reduce emissions in a cost-effective way
- RAINS leaves open with which policy instruments to implement these measures
 - e.g. sector-differentiated command-and-control policy (CAC), market-based instruments (MBIs)

=> introducing MBIs in RAINS does not reduce the costs resulting from the optimisation

=> costs could be reduced by introducing 'non-technical' measures, thus increasing the range of possible emission reduction measures

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Further reasons for including 'non-technical' measures in IAM

- Scenario CLE is close to scenario MTRF
 - We are reaching the limits of what is technically feasible
 - => the scope of possible further environmental improvements can be enlarged by studying 'non-technical' measures
- Short-term versus long-term changes
 - When studying short-term issues (2010, 2015) and only air pollution
 - => taking into account only 'technical' measures may be sufficient
 - When studying longer-term (2030, 2050) and more global issues (links with climate change)
 - => necessity to take into account structural changes (modifications of activity scenarios)

<=> GAINS

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2. Some questions and points for discussion

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1a) IAM and cost types involved in reducing emission

- Costs related to the pollution abatement measure borne by the regulated actor (industry, agriculture, etc.)
 - > e.g. cost for applying the 'technical' measure SCR (investment + fixed and variable O&M) => currently included in RAINS
 - > e.g. cost for the 'non-technical' measure modal change from road to rail (train fare - cost of car travel) => not currently covered by RAINS
- Costs related to the policy instrument
 - to the regulated actor
 - > managing permits, monitoring emissions, etc. => not currently included in RAINS
 - to the regulator
 - > policy making & implementation costs (design & negotiation of policy and of pollution reduction programmes, monitoring & enforcement)
 - => not currently included in RAINS

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1b) Include costs related to the policy instrument into the models?

- Policy instrument costs borne by the regulated actor: monitoring & reporting costs
 - Costs for continuous monitoring equipment: partly country dependent
 - Additional monitoring and reporting costs: case and country dependent
 - => could probably be included in the model
- Policy instrument costs borne by the regulator: policy making & implementation costs
 - => fit rather into the impact assessment (c/b analysis)
 - => costs are case and country dependent (e.g. dependent on the sector concerned and on regulatory enforcement procedures)
 - => data is scarce (CAC and MBIs)

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2) To what extent are price effects and their impacts taken into consideration?

- Price effects can result from market based instruments (MBIs) and command-and-control (CAC) policy
 - A direct effect of a policies based on MBIs
 - An indirect effect of CAC policies (costs of abatement techniques may increase the production costs, industry may try to pass on the costs to the purchaser)

=> price effects can induce behavioural and structural changes

=> they are not treated by RAINS

=> they are the issue of macro-economic models (GEM-E3)

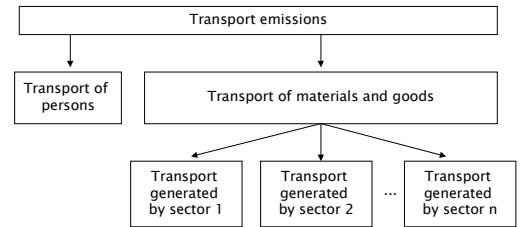
=> no link back from structural effects resulting from price effects to calculate impact on emissions

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3a) How to deal with transport emissions?

- Vary the sector frontiers - allocate transport emissions to the sectors generating the transport



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3b) Allocate transport emissions to the sectors generating them

- Why?
 - => to go beyond the artificial opposition of transport and industry
 - => to introduce measures to reduce emissions that are not yet taken into account (e.g. optimisation of logistics)
 - => to induce industry to improve logistics (e.g. modal change, increase in rates of load capacity utilisation)
- Open questions
 - => possible with inventory format SECTEN?
 - => how to define emission ceilings - by country, industrial sectors across countries, or by sectors and countries?

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Thank you for your attention

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www.ineris.fr

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4.4.6 Mark Barret "The potential for use of alternative scenarios for implementation of NTM in IAM"

SENCO

**Including Non-Technical Measures for reducing air pollution
in Integrated Assessment Modelling**

Workshop Göteborg 7-8 December 2005
Mark Barrett

Mark.Barrett@senco.co.uk

SENCO Sustainable Environment Consultants
www.senco.co.uk

SENCO

Non-Technical Measures

- Define NTMs
- Illustrate certain NTMs
- Modelled results of NTMs
- Modelling issues

Some references:
Report on consumption and NTMs
<http://www.senco.co.uk/Consumption/Consumption.htm>

Work in progress energy scenario including NTMs
<http://www.senco.co.uk/Energy/Energy.htm>
[For comment and discussion only](#)

SENCO

The need for Non-Technical Measures

- Assuming emission equity, global population of ten billion, GHG emission reductions of over 90% required in rich countries to stabilise climate.
- Conservation, energy efficiency and renewable energy sources are vital options, but these measures run into increasing marginal economic and environmental cost, and technical limits. This makes it difficult to reach reductions of over 90% with these means, at least with known technologies.
- Cost-effective limits to some emission control technologies being approached
- Some NTMs can reduce multi pollutants, penetrate quickly and have low cost

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Non-Technical Measures: definition and examples

Non-technical measures (NTMs) may be defined as measures where the behaviour of people changes such as to reduce a given environmental impact. This does not include the instruments for achieving behavioural change, such as fiscal or regulatory instruments.

NTMs may be put into four classes, as follows (with examples):

Reduce consumption

- change expenditure patterns to purchase commodities with less impact, e.g. buy a hi-fi rather than an air ticket
- reduce travel needs by living close to work or teleworking
- holiday locally rather than abroad

Substitution

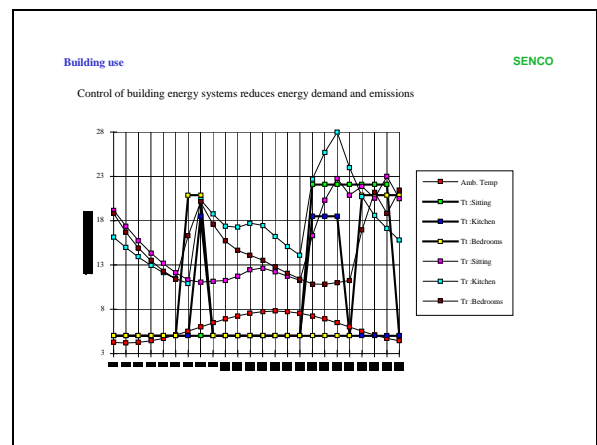
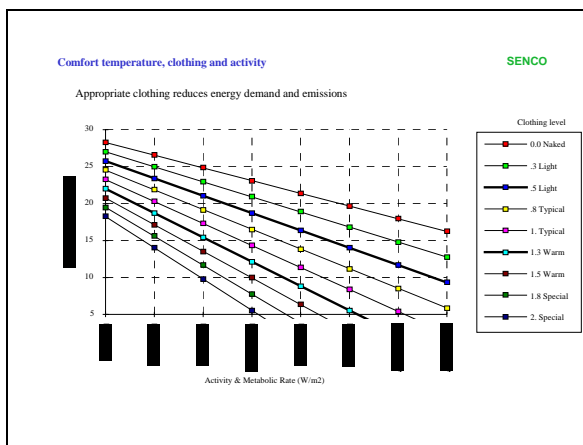
- use telecommunications for business rather than air travel
- modal shift from car to bus, or truck to train
- wear warmer clothes to reduce thermostat setting

Technology choice

- purchase of small car rather than a large one

Technology use

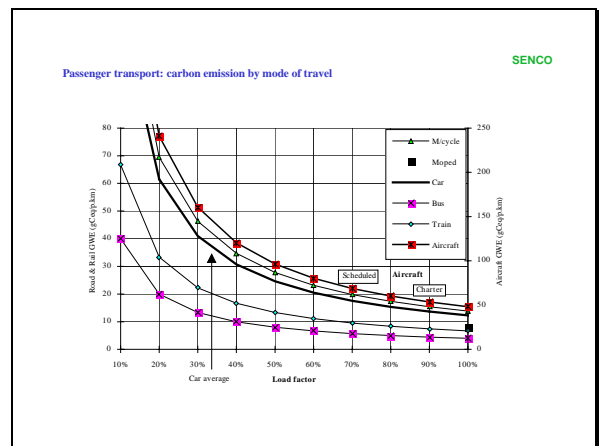
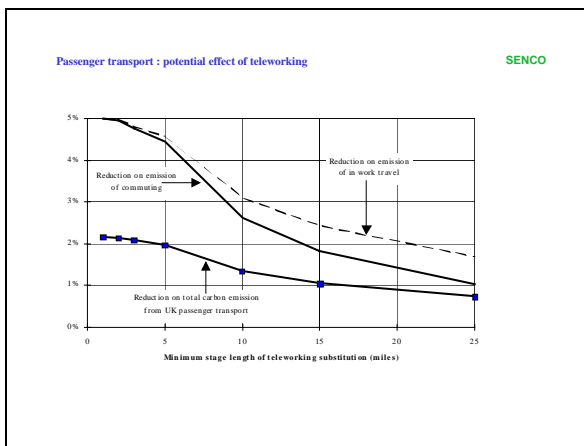
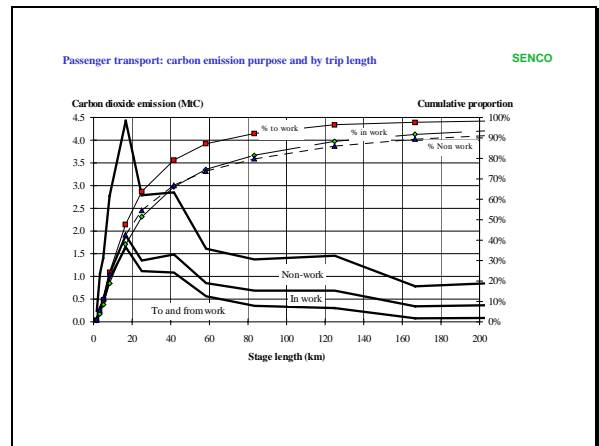
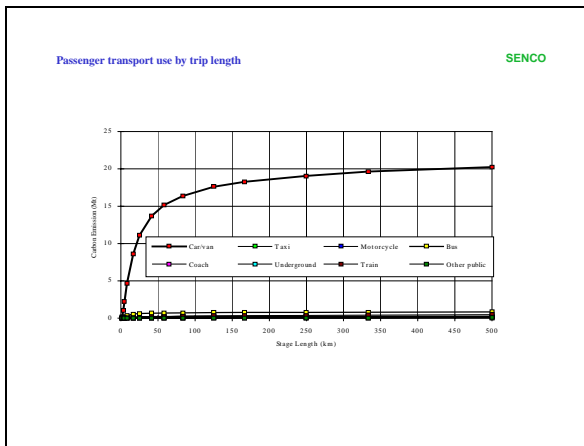
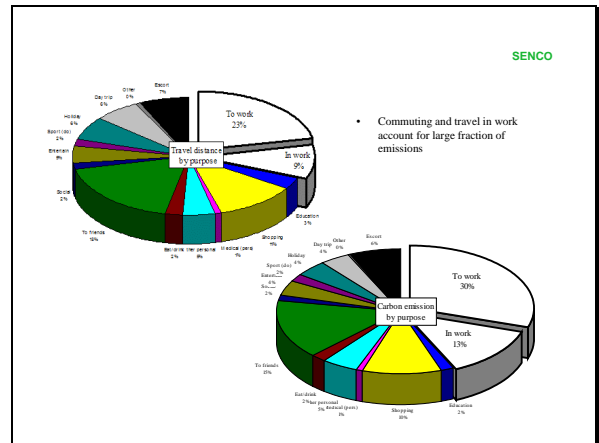
- Transport
 - reduce vehicle speeds on motorways
 - increase vehicle load factor
- Buildings
 - control of lights and appliances

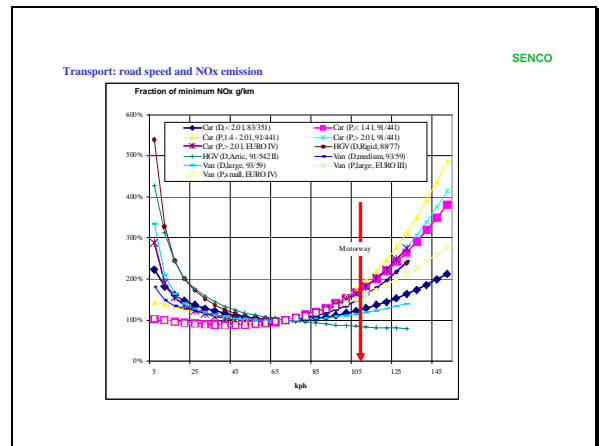
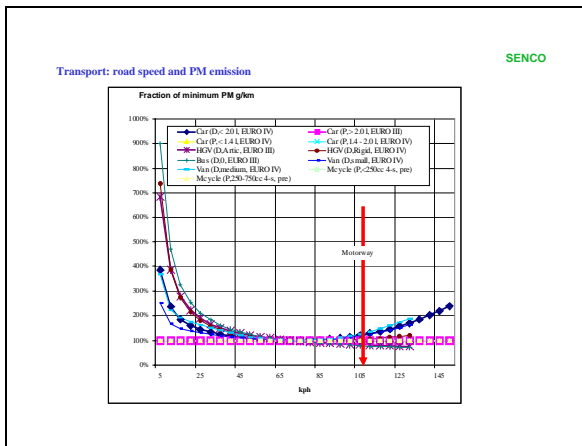
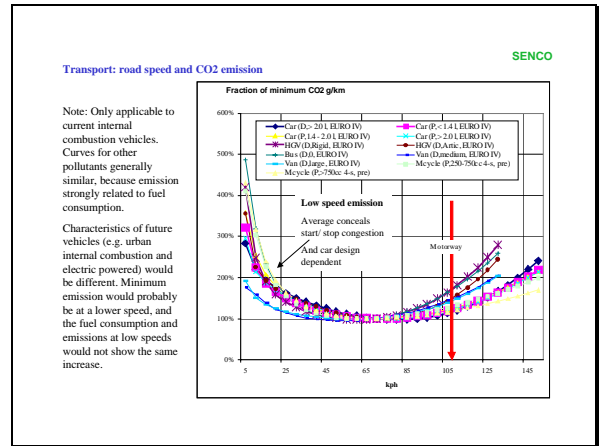
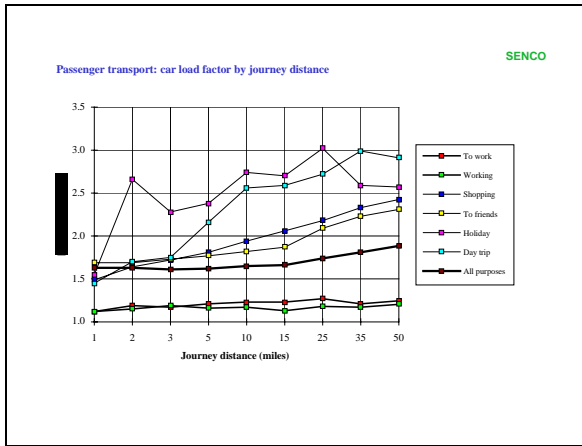
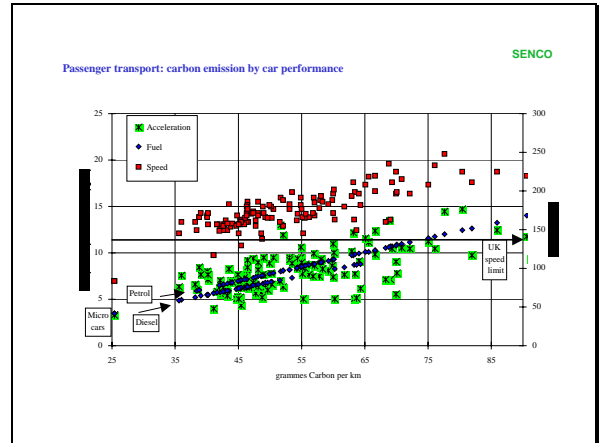
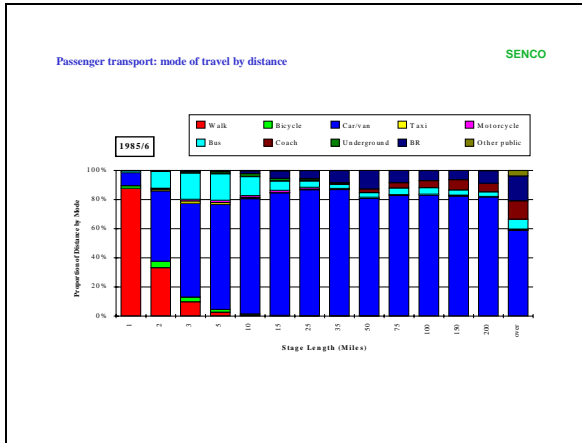


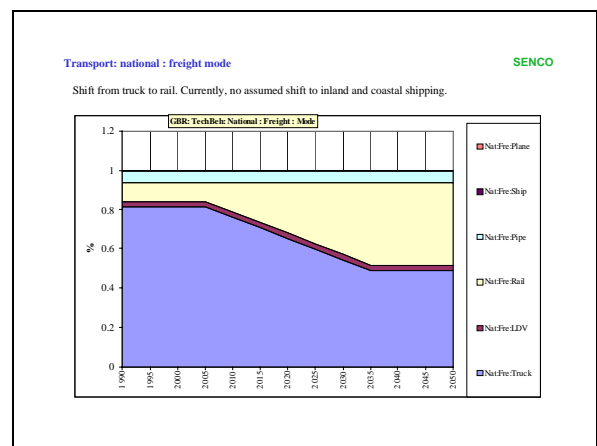
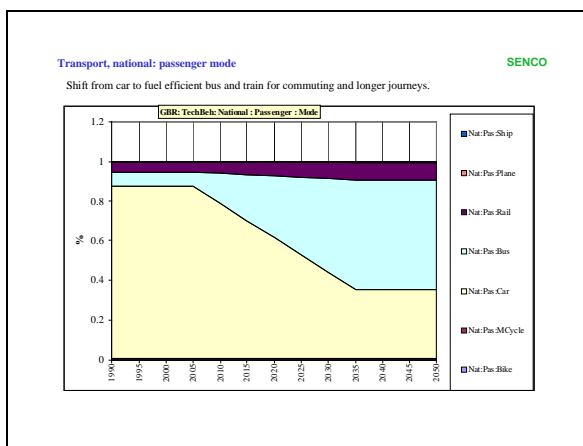
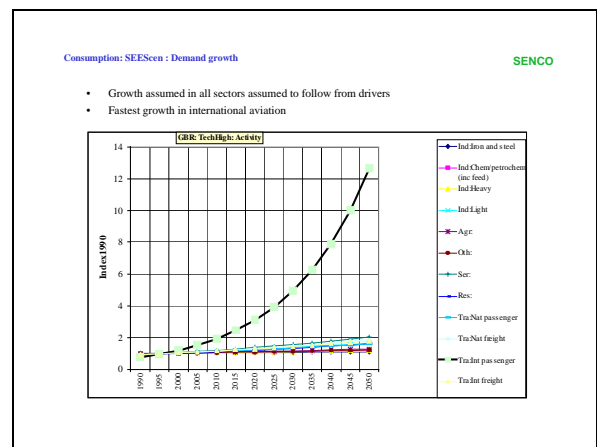
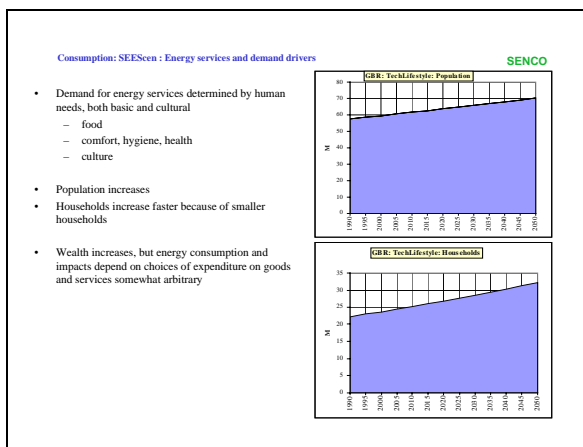
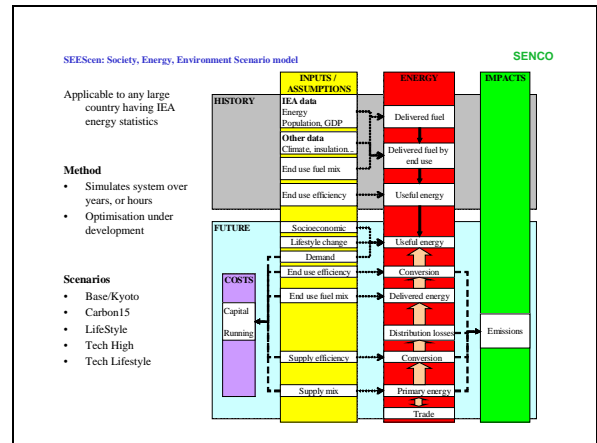
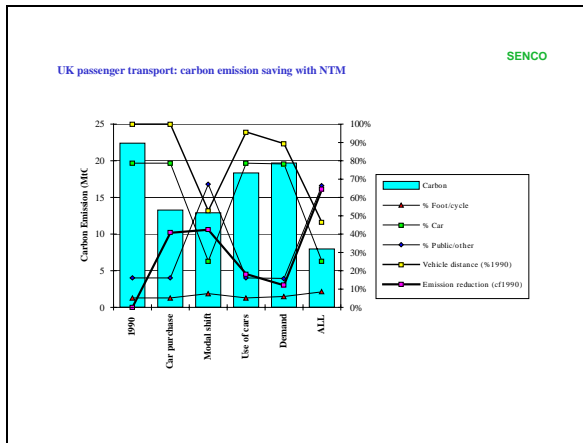
Transport NTMs SENCO

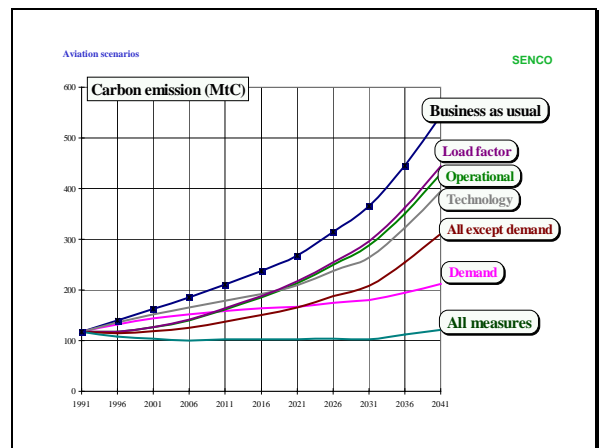
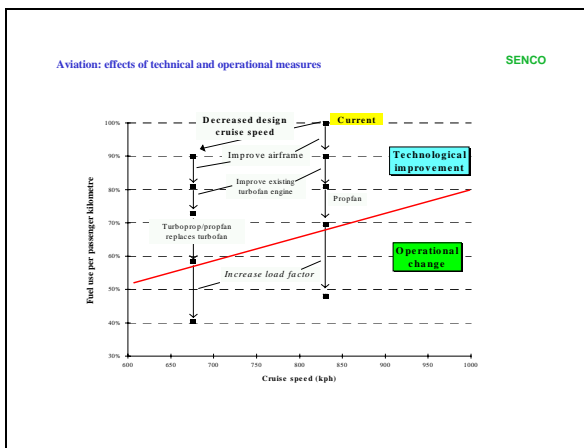
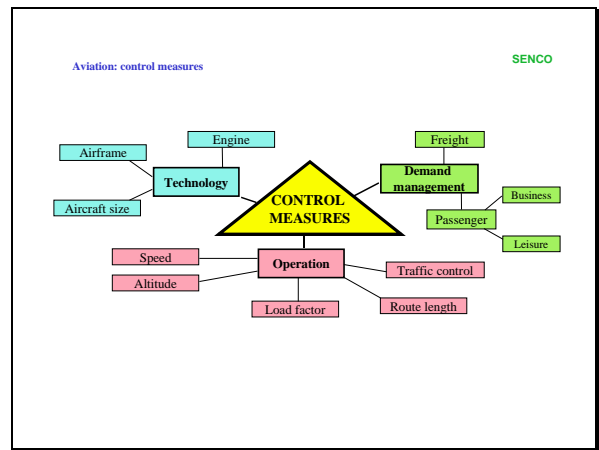
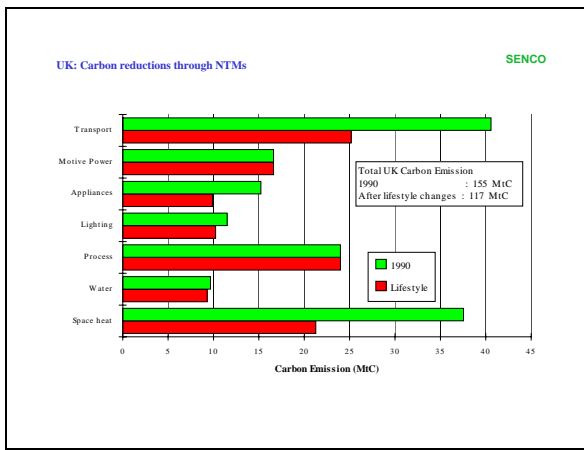
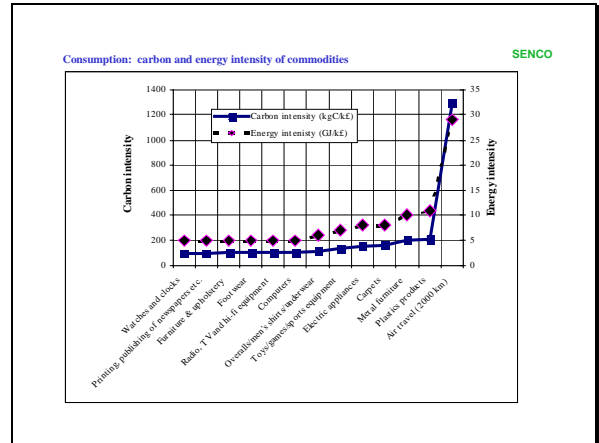
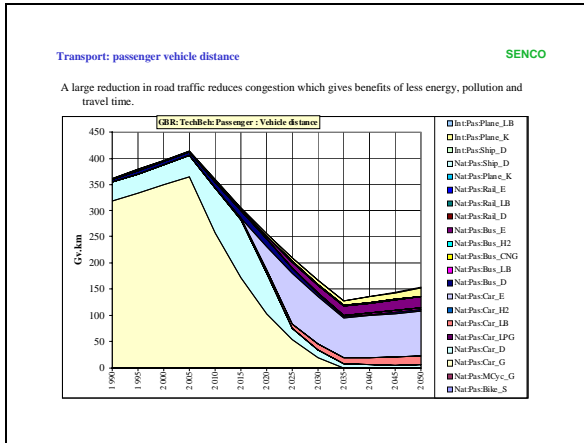
In general energy use and carbon emissions resulting from transport depend on:

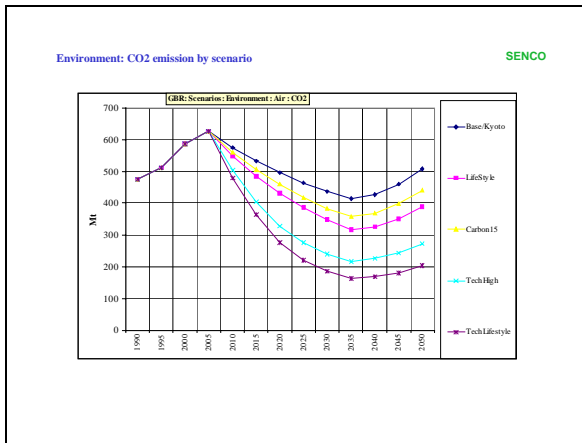
- Demand:** the load distance and timing of travel
 - employment patterns
 - land use patterns
 - production patterns
- Substitution**
 - trips shifted from cars to other modes;
 - primary change - vehicle performance
 - secondary system change - congestion
- Choice of technology**
 - car size/power
 - technology type (liquid, electric fuelled)
- Use of technology**
 - speed and acceleration
 - the proportion of vehicle load capacity utilised











Non-Technical Measures: summary of use as policy options SENCO

NTMs have these advantages, they:

- can have a significant and rapid effect on emissions
- do not assume speculative technological development
- often do not have negative environmental side effects
- can have low or net negative direct costs

NTMs have disadvantages, they:

- require visible changes in behaviour that will generally be resisted by consumers, whereas most technical emission control measures (catalytic converters, loft insulation) are virtually invisible to the consumer
- TMs, if based on standards, have a fairly predictable easily calculated effect on future emissions. NTMs are more uncertain.
- have indirect costs that are difficult to quantify

Modelling approach, conceptual and practical problems: costing NTMs SENCO

Indirect cost calculation

- Net direct costs (capital and running) of NTMs often negative
 - small cars cost less than big ones
 - driving more slowly saves money
- Why don't people realise these savings?
 - they don't realise cost savings and therefore make economically sub-optimal choices?
 - they attach a value to car size and speed?
- How can this value be imputed?
 - from cost savings foregone
 - with willingness-to-pay (WTP)

Modelling approach: conceptual and practical problems: effects of NTMs SENCO

Energy, emission and cost calculation

Changes to energy demand, whether by TM or NTM, cause multiple, interdependent changes to the energy supply system, so it is problematic to assign energy, cost and emission saving to any single measure.

- **Non-additive.**
 - E.g : choosing smaller cars reduces emission by x, and, independently, lowering motorway speed reduces emission by y, then the combined effect will be less than x+y.
- **Multiple effect.**
 - E.g : switching from petrol cars to diesel bus and train
 - reduces petrol car emissions and increases diesel bus and train emissions
 - reduces road congestion, and therefore emissions from all road vehicles
 - reducing liquid fuel consumption will reduce refinery emissions
- **Wider system impacts.**
 - Congestion of transport infrastructure
 - Electricity demand patten and generation mix

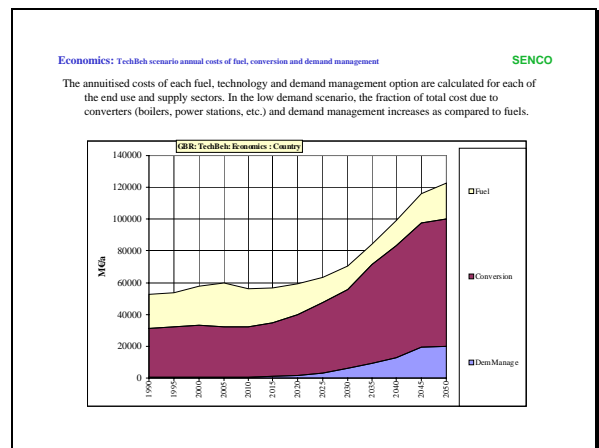
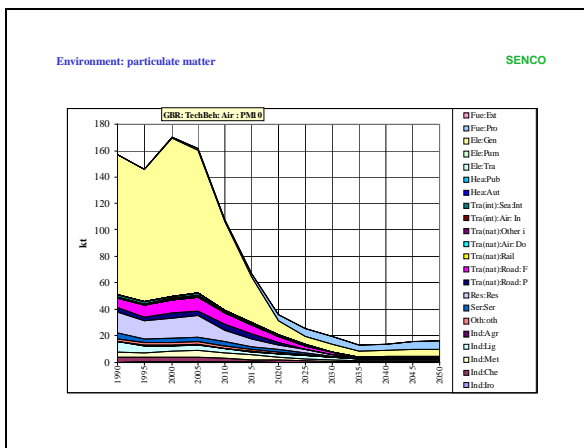
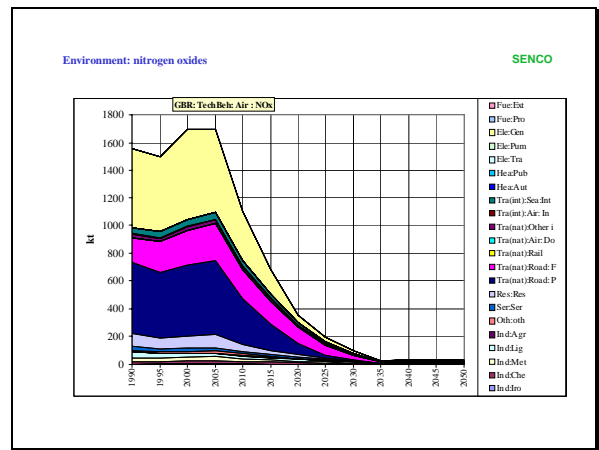
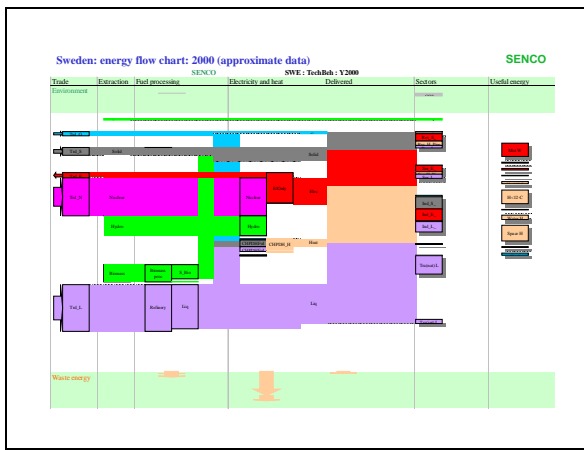
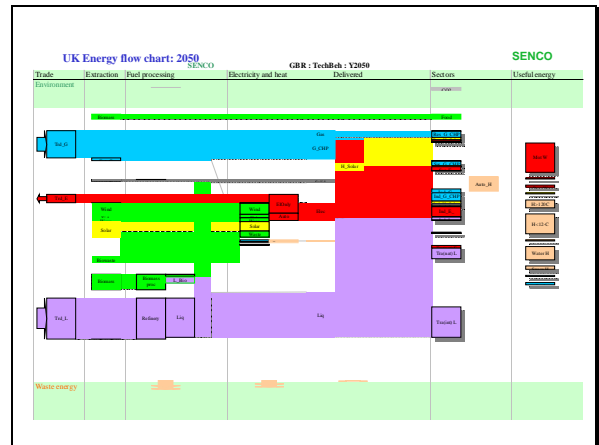
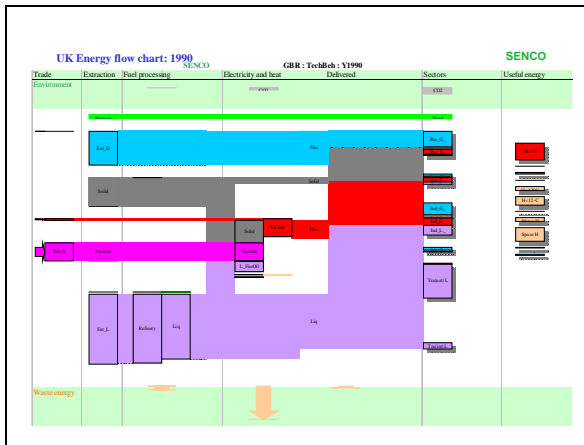
Modelling approach, conceptual and practical problems: model integration SENCO

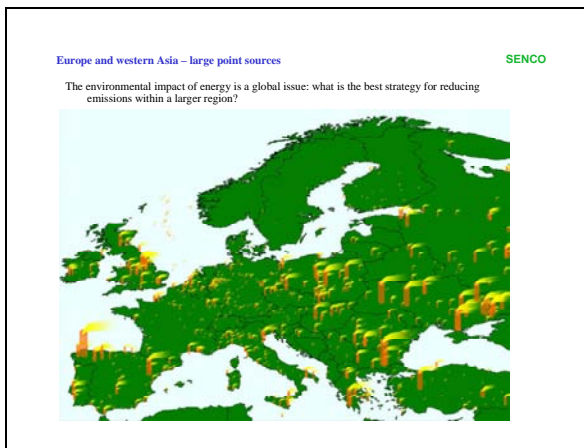
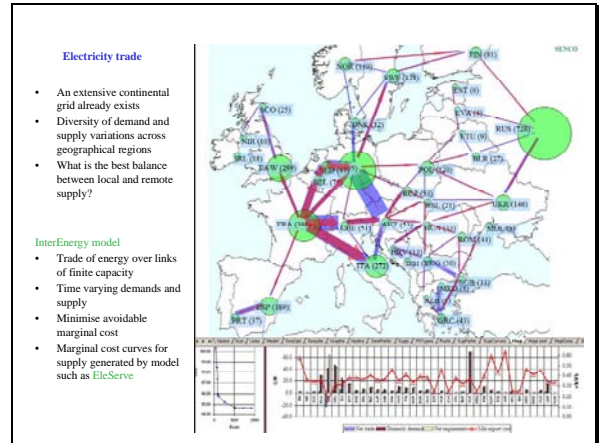
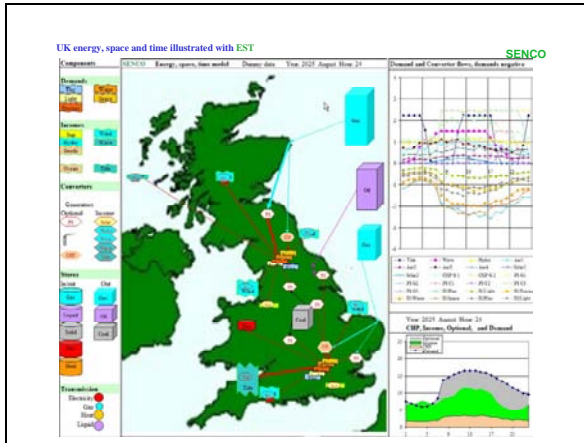
These interconnected aspects of NTMs have implications for modelling approaches.

- To integrate NTMs into a model depends on the structure of the model, the processes and linkages it incorporates, and its databases.
- No general model (RAINS/GAINS, PRIMES, SEEScen, ...) captures all of the detail required to assess NTMs; they have to be supported by sectoral models and other exogenous analysis.
- An approach:
 - Which sectors are most problematic for future emission control?
 - Estimate the potential of each NTM individually in terms of emission reduction, cost, political feasibility, etc.
 - Analyse multiple effects and interactions of NTMs.
 - Estimate the indirect costs (e.g. with WTP) and add to direct costs.
 - Fit the most promising NTMs into models so as to approximate the results of detailed analysis. Consistency must be ensured if there are multiple effects.
- In SEEScen, TMs and NTMs are assumed (mode, speed, load factor, etc.) and then the interdependent consequences are **simulated** with an interconnected system model. The direct costs of technologies, fuels and operation and maintenance are then calculated.

Modelling approach, conceptual and practical problems: country and time dependency SENCO

The effects of NTMs will depend on scenario context and country.





4.4.7 Kristin Rypdal "Alternative scenarios"

Linking regionally and globally motivated emission control strategies in Europe

Kristin Rypdal, Nathan Rive (CICERO)
 Catarina Sternhufved, Stefan Åström (IVL)
 Jesper L. Bak (DMU)
 Initiated by the Nordic Council of Ministers

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 Center for International Climate and Environmental Research - Oslo
 Center for Manufacturing

Approach

- Construct scenarios, so far for potential emission trading regimes in Europe until 2020, using the general equilibrium model GRACE
- Transfer of energy data from GRACE to activity data RAINS
- Calculation of emissions of SO₂ and NO_x and acidification eutrophication using RAINS

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Scenarios

| Variable | Option 1 | Option 2 | Option 3 | Option 4 |
|---|--|---|---|---|
| Hot air sale in KP | Hot air sellers (POL, BAL, REE, RUS) restrict supply to maximize revenue | No hot air is allowed. | | |
| Post-2012 Emissions for EU-15 regions | After KP, emissions are reduced at a rate of 1% year-on-year | After KP, emissions are held constant at KP level through to 2020 | | |
| Post-2012 Emissions for hot air sellers | After KP, emissions are reduced by 10 and 20% of BAU in 2015 and 2020 respectively | After KP, emissions follow the BAU, and no abatement or ETS involvement takes place | | |
| Sectoral Inclusion in ETS (for KP and beyond) | Current ETS only | Expanded ETS | Expanded ETS, plus "Extra" sectors join for 2015 and 2020 | Expanded ETS, plus "Extra" and Transport sectors join for 2015 and 2020 |

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Scenarios

| Scenario Number | Scenario Name | Hot air sale in KP | Post-2012 Emissions for EU-15 regions | Post-2012 Emissions for hot air sellers | Sectoral Inclusion in ETS (for KP and beyond) |
|-----------------|-------------------|--------------------|---------------------------------------|---|---|
| 1 | BAU | n/a | n/a | n/a | n/a |
| 2 | Expected Policy | 1 | 1 | 1 | 2 |
| 3 | No Hot Air | 2 | 1 | 1 | 2 |
| 4 | KP Forever | 1 | 2 | 1 | 2 |
| 5 | Current ETS only | 1 | 1 | 1 | 1 |
| 6 | Extra ETS sectors | 1 | 1 | 1 | 3 |
| 7 | Extra+Trans ETS | 1 | 1 | 1 | 4 |
| 8 | NoEE&RUS | 1 | 1 | 2 | 2 |

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Preliminary results

2020/2000: CO2

| Scenario | No. Sw, Fi, Dk | Other EU | Rest Europe |
|----------|----------------|----------|-------------|
| BAU | 1.25 | 1.25 | 1.25 |
| S2 | 1.00 | 1.00 | 1.00 |
| S3 | 1.00 | 1.00 | 1.00 |
| S4 | 1.00 | 1.00 | 1.00 |
| S5 | 1.00 | 1.00 | 1.00 |
| S6 | 1.00 | 1.00 | 1.00 |
| S7 | 1.00 | 1.00 | 1.00 |
| S8 | 1.00 | 1.00 | 1.00 |

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Preliminary results

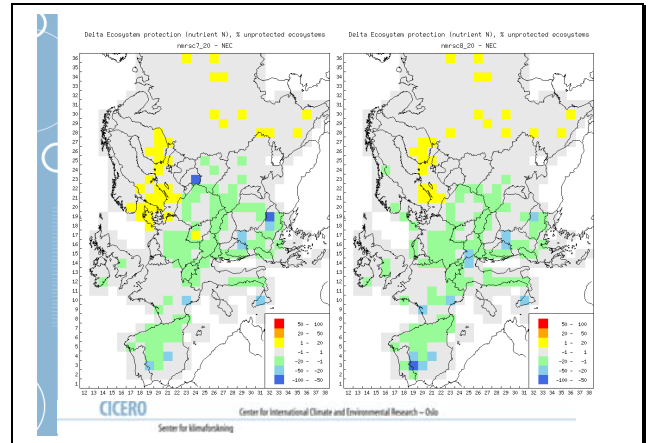
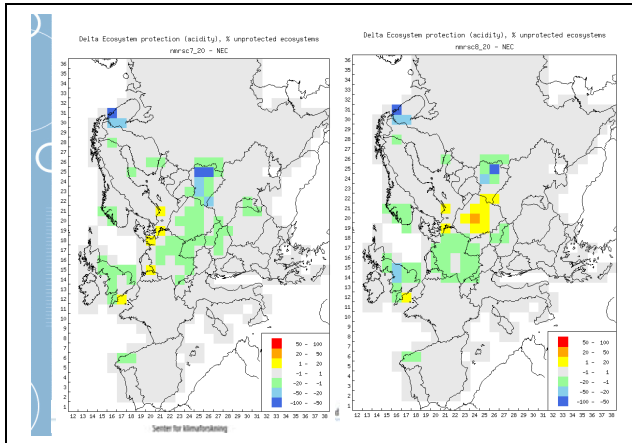
2020/2000: SO2

| Scenario | No. Sw, Fi, Dk | Other EU | Rest Europe |
|----------|----------------|----------|-------------|
| BAU | 1.00 | 1.00 | 1.00 |
| S2 | 0.80 | 0.80 | 0.80 |
| S4 | 0.80 | 0.80 | 0.80 |
| S7 | 0.80 | 0.80 | 0.80 |
| S8 | 0.80 | 0.80 | 0.80 |

2020/1990: NOx

| Scenario | No. Sw, Fi, Dk | Other EU | Rest Europe |
|----------|----------------|----------|-------------|
| BAU | 1.00 | 1.00 | 1.00 |
| S2 | 0.80 | 0.80 | 0.80 |
| S4 | 0.80 | 0.80 | 0.80 |
| S7 | 0.80 | 0.80 | 0.80 |
| S8 | 0.80 | 0.80 | 0.80 |







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Continued work...

- For prioritisation
 - Other scenarios reflecting structural changes in the energy system
 - Changes in costs and redistribution of costs
 - Benefits and damages- PM and ozone

4.4.8 Markus Ahmann "Additional presentation about GAINS"


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| <p style="text-align: right;">Markus Amann International Institute for Applied Systems Analysis (IIASA)</p>  <p style="text-align: center;">The GAINS model</p> <p style="text-align: center;">State of play</p> | <p style="text-align: right;">GAINS GHG-Air pollution Interactions and Synergies model</p>  <ul style="list-style-type: none"> • Extension of RAINS integrated assessment model for air pollution to GHGs • CO₂, CH₄, N₂O, HFC, PFC, SF₆ in addition to SO₂, NO_x, VOC, NH₃, PM • Currently implemented for 43 countries in Europe (funded by the Netherlands), GAINS-Asia (China and India) implementation started last month (funded by DG-Research) |
| <p style="text-align: right;">Methodology</p>  <p>For all anthropogenic sources of GHG emissions in a country:</p> <ul style="list-style-type: none"> • Identification of available mitigation options <ul style="list-style-type: none"> – Including structural changes (fuel switch) and add-on measures • Country-specific application potentials <ul style="list-style-type: none"> – Baseline activity rates: exogenous (national of PRIMES) projections – Substitution potential and costs derived from alternative PRIMES scenarios • Quantification of societal resource costs <ul style="list-style-type: none"> – Excluding transfers (profits, taxes, etc.) • Data sources: <ul style="list-style-type: none"> – GHG emission inventories consistent with UNFCCC – GHG technology cost data from reviewed literature – Activity projections: provided by national governments and EU Commission | <p style="text-align: right;">GAINS GHG-Air pollution Interactions and Synergies model</p>  <ul style="list-style-type: none"> • Extension of RAINS integrated assessment model for air pollution to GHGs • CO₂, CH₄, N₂O, HFC, PFC, SF₆ in addition to SO₂, NO_x, VOC, NH₃, PM • Currently implemented for 43 countries in Europe (funded by the Netherlands), GAINS-Asia (China and India) implementation started last month (funded by DG-Research) |
| <p style="text-align: right;">GAINS GHG-Air pollution Interactions and Synergies model</p>  <ul style="list-style-type: none"> • Extension of RAINS integrated assessment model for air pollution to GHGs • CO₂, CH₄, N₂O, HFC, PFC, SF₆ in addition to SO₂, NO_x, VOC, NH₃, PM • Currently implemented for 43 countries in Europe (funded by the Netherlands), GAINS-Asia (China and India) implementation started last month (funded by DG-Research) | <p style="text-align: right;">Main mitigation options for CH₄ 28 options considered in GAINS</p>  <ul style="list-style-type: none"> • Gas sector <ul style="list-style-type: none"> – Reduced leakages during gas transmission and distribution – Flaring instead of venting • Waste management <ul style="list-style-type: none"> – Recycling/composting of biodegradable waste instead of landfill – Methane recovery from landfills • Enteric fermentation <ul style="list-style-type: none"> – Dietary changes for cattle coupled with livestock reductions • Manure management <ul style="list-style-type: none"> – Anaerobic digestion plants and stable adaptation • Coal mines <ul style="list-style-type: none"> – Upgraded gas recovery in coal mines • Rice paddies <ul style="list-style-type: none"> – Modified rice strains • Structural changes in agriculture (livestock changes) modeled analog to energy changes |

Main mitigation options for N₂O
18 options considered in GAINS




- **Arable land and grassland**
 - Reduced fertilizer application
 - Optimal timing of fertilizer application
 - Nitrification inhibitors
 - Precision farming
 - Less use of histosols (peat soils)
- **Industry**
 - Emission controls in adipic acid and nitric acid industry
- **Combustion**
 - Modified fluidized bed combustion
- **Health care**
 - Reduced N₂O use
- **Waste treatment**
 - Optimized waste water treatment

Main mitigation options for F-gases
22 options considered in GAINS




- **Refrigeration** (domestic, commercial, transport and industrial)
 - Recollection, alternative refrigerants and good practice
- **Mobile and stationary air conditioning**
 - Alternative refrigerants, process modifications, good practice
- **HCFC22 production**
 - Incineration
- **Primary aluminum production**
 - Conversion to other processes
- **Semiconductor industry**
 - Limited PFC use through alternative processes
- **Other sectors**
 - SO₂ cover for magnesium production
 - Good practice for gas insulated switchgears
 - Alternative propellants for foams and aerosols
 - End of life recollection of SF₆

GAINS approach for modeling “NTM”



- Potentials and costs for structural measures derived from difference between alternative PRIMES scenarios (currently 0, 20, 90 €/t CO₂), for CAPRI under development
- GAINS maintains balance on energy/agricultural services.
- Option to include demand elasticities, based on external assessments (Auto/Oil, TREMOVE, CAPRI, PRIMES, etc.)
- **Not included in GAINS:**
 - Behavioral changes
 - Local traffic regulations (incl. speed limits)
 - Spatial shifts in agricultural production
- “Controlled activity levels” are used as decision variables instead of cost curves to capture simultaneous effects on CO₂, PM, SO₂, CH₄, NH₃, N₂O, VOC, etc.

Next steps



- GAINS optimization method under completion
- Will be used for NEC analyses (early 2006)
 - Base cases: traditional RAINS approach
 - Sensitivity cases: with/without GHGs and NTMs
- Structural changes in agricultural sector will take longer.

Annex I. Agenda

The importance of Non-Technical Measures for reductions in emissions of air pollutants and how to consider them in Integrated Assessment Modelling

An International Workshop in collaboration with the UN/ECE Task Force on Integrated Assessment Modelling

7-8 December 2005, Göteborg, Sweden

Organised by the Swedish ASTA programme

Wednesday 7 December 2005

Registration and coffee 9.00-9.30

Opening session 9.30-10.00

Opening address: Anna Engleryd, Swedish EPA

Keynote speech: Rob Maas, MNP

**Session 1: Estimates of the potential and cost of possible measures in the transport sector
10.00-12.00**

Chair: Lars Lindau

Karl-Heinz Zierock, Umweltsbundesamt Germany "The importance of non-technical measures in the transport sector for the UN-ECE emission reduction polices"

Corjan Brink, MNP, "Speed limits for Dutch motorways"

Charles Buckingham, UK, "London's congestion charge"

Karl-Heinz Zierock, Umweltsbundesamt Germany, "The case of Berlin"

Jürgen Isensee, Germany, "The effect of better fuel and low sailing speed on ship emissions"

Discussion

Lunch 12.00-13.00

**Session 2: Estimates of the potential and cost of possible measures in the energy sector
13.00-15.00**

Chair: Peringe Grennfelt

Markus Amann, IIASA, "GAINS"

Egil Övferholm, STEM, "Energy efficiency potential in buildings"

Bo Ryden and Thomas Unger, PROFU, "NTM's gives synergies in emission reduction - a four step example"

Mike Woodfield, AEA Technology, "Reducing emissions from small combustion installations - the cost-effective of preventative measures for plant"

Discussion

Coffee 15.00-15.15

**Session 3: Estimates of the potential and cost of possible measures in agriculture sector
15.15-16.45**

Chair: Rob Maas

Kaj Sanders, MNP, "Non-technical abatement measures for agricultural emissions"

ApSimon, Imperial College UK, "A broader view of controlling ammonia"

Jesper Bak, DMU, "Danish examples of effects and costs of measures in the agricultural sector"

Discussion

Coffee 16.45-17.00

Session 4:1: How to treat Non-technical measures in IAM 17.00-18.00

Chair: Mike Woodfield

Catarina Sternhufvud, IVL, "Is it possible to define NTM?"

Mohammed Belhaj, IVL, "Meta-analysis: the cases of the agricultural, energy and marine sectors"

Mike Woodfield, AEA Technology, "The findings of the RAINS review on the incorporation of NTM in IAM"

Dinner 19.30

Thursday 8 December 2005

Session 4:2: How to treat Non-technical measures in IAM 9.00-11.00

Chair: Mike Woodfield

Stefan Reis, University of Stuttgart, "Incorporating NT-measures in IAMs based on the MERLIN work"

Simone Schucht, INERIS, " Including structural changes into IAM: some ideas and possible implications "

Mark Barrett, UK, " The potential for use of alternative scenarios for implementation of NTM in IAM"

Kristin Rypdal, Cicero, "Alternative scenarios"

Discussion

Coffee 11.00-11.30

Workshop conclusions 11.30-13.00

Chair: Rob Maas

Annex II. List of participants

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