Integrated Nitrogen Ceilings Approach

How to manage excess nitrogen

A. Bleeker

A. Hensen

C. Rougoor

K. Sanders

J.W. Erisman

Presented at the 5th International Nitrogen Conference, 3-7 December 2010, Delhi, India

ECN-L--10-122 December 2010

ECN

Energy research Centre of the Netherlands

Integrated Nitrogen Ceilings Approach

How to manage excess nitrogen

A.Bleeker, A.Hensen, C.Rougoor, K. Sanders & J.W. Erisman

The Netherlands: where / what is it?

Netherlands: more than that

- population: 16,609,000
- (land) area: 33,000 km^2
- pop. density: 492 cap/km^2 (India: 360 cap/km^2)
- Agriculture:
  - 68% of area
  - cattle: 4,000,000
  - pigs: 13,000,000
  - poultry: 97,000,000
- Intensive industry
- Largest harbour of Europe – much transport


Bit crowded!

Netherlands & Nitrogen

What do we see:

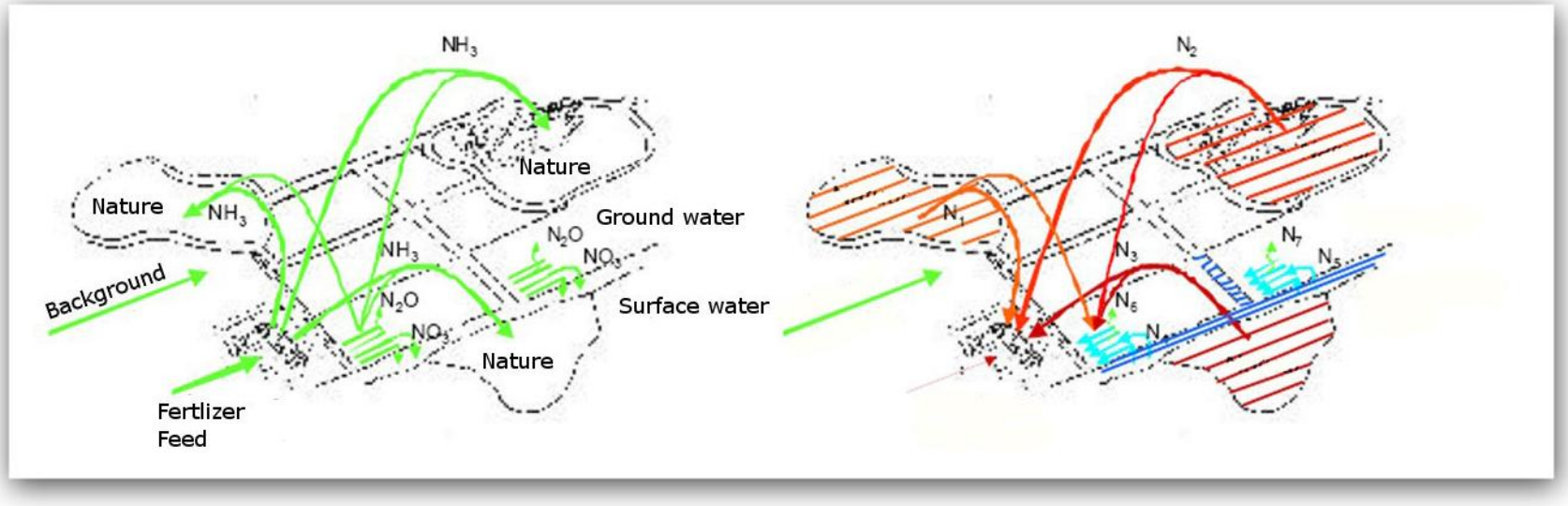
- Much tension between activities and the things we want to protect
  - Human health
  - Nature areas
  - Water quality
  - Etc.
- Policy is still treating these areas separately (both emissions / effects)
  - Resulting in possible pollution swapping

Integrated approach needed

- All the nitrogen forms/sources/effects are treated simultaneously
- When possible, regulate the input into the system (fertilizer, feed, fossil fuel)
- Policy-makers can then evaluate possible measures in an integrated way
- Methodology has been set up for the Netherlands, but (with proper data) also applicable in other parts of the world
- No detailed information, but a general description of the methodology (work in progress)

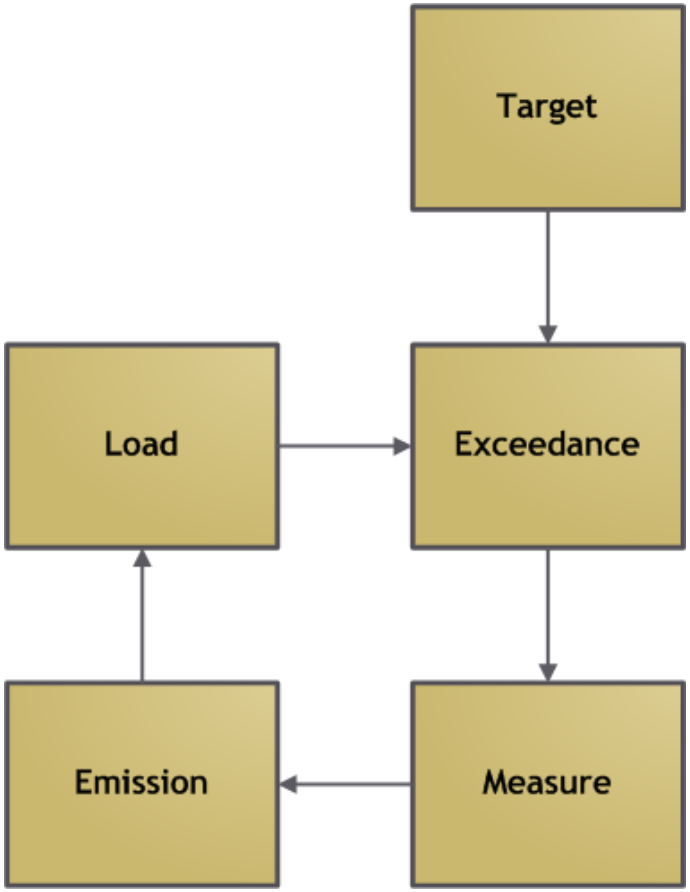
Principle of the emission ceilings approach

- Defined as the maximum level of emission from a region that doesn't have a negative effect on its surroundings



- Previous studies had a focus on agriculture
- Now extending this to other sources and larger regions

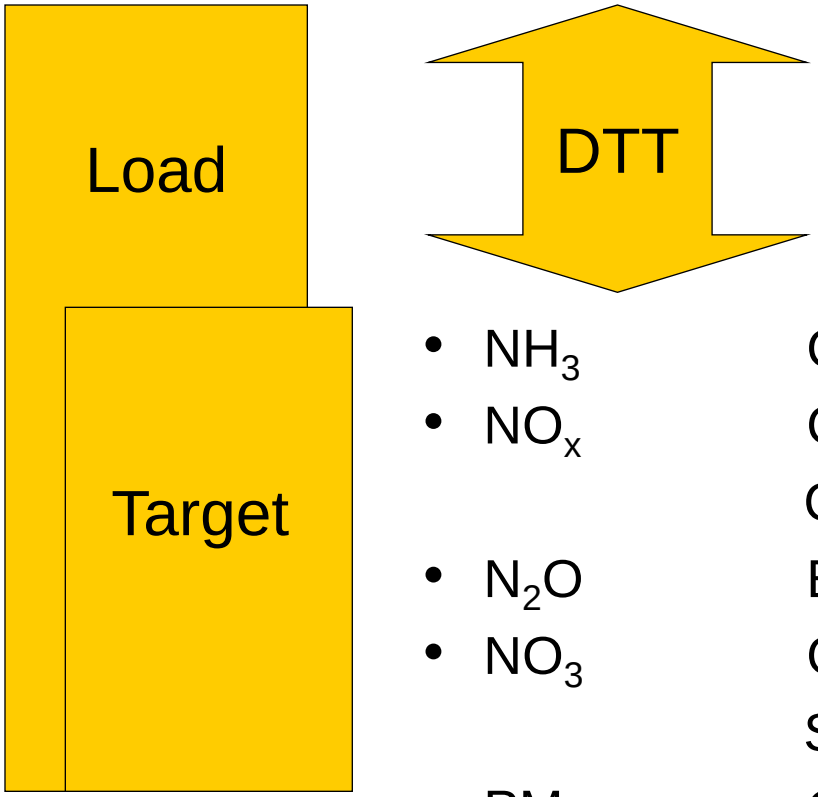
Setting up the system



- However:
  - Multiple sources
  - Multiple targets
  - Multiple measures

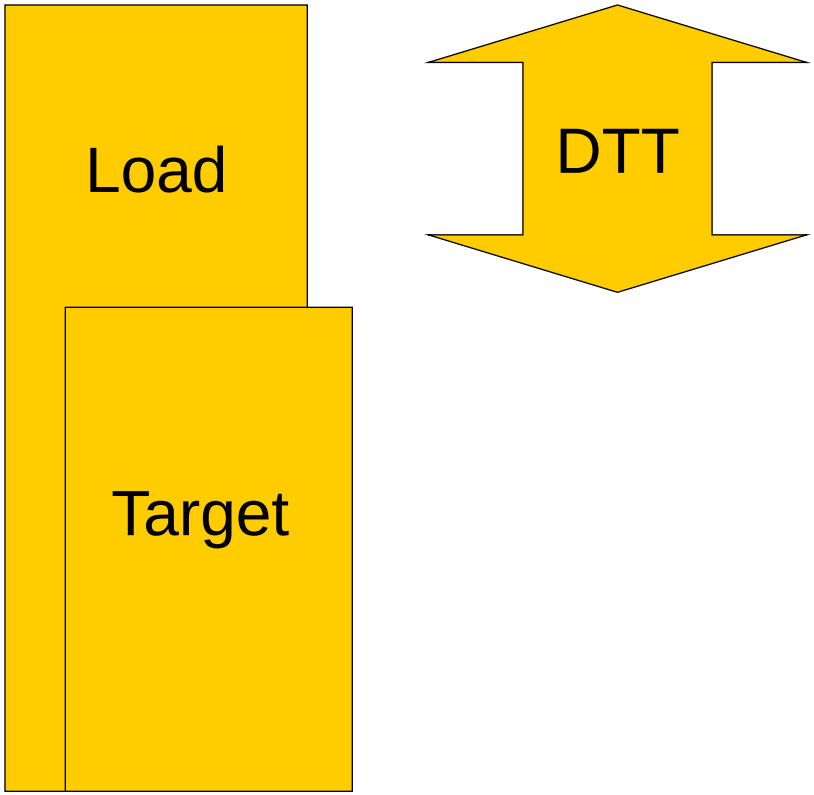
- Distance To Target (DTT) is used for evaluating the exceedances (and actions to be taken)

Distance to Target (DTT)

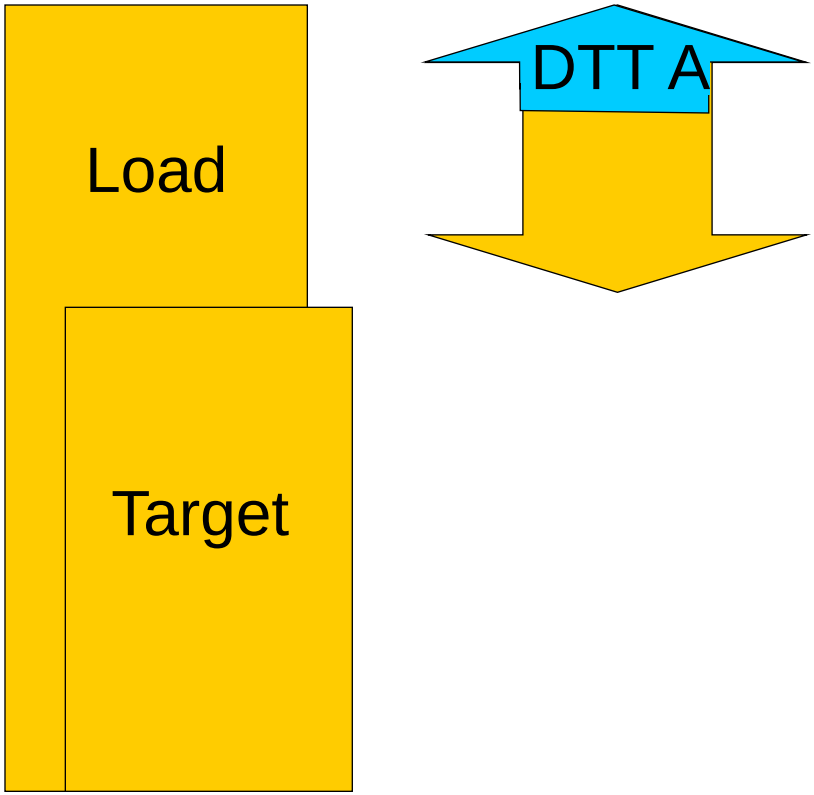


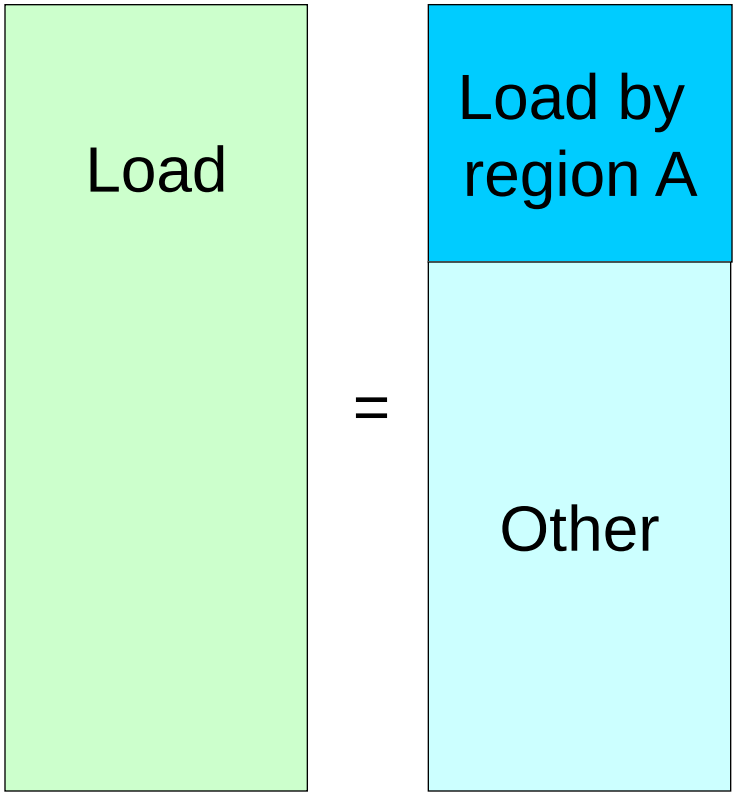
- NH_3 Critical load
- NO_x Critical load
  Concentration (40 µg/m³)
- N_2O Emission: -6% (for NL)
- NO_3 Groundwater (inside area)
  Surface water (outside area too)
- PM Concentration (35 µg/m³)

Responsibility for reaching the target

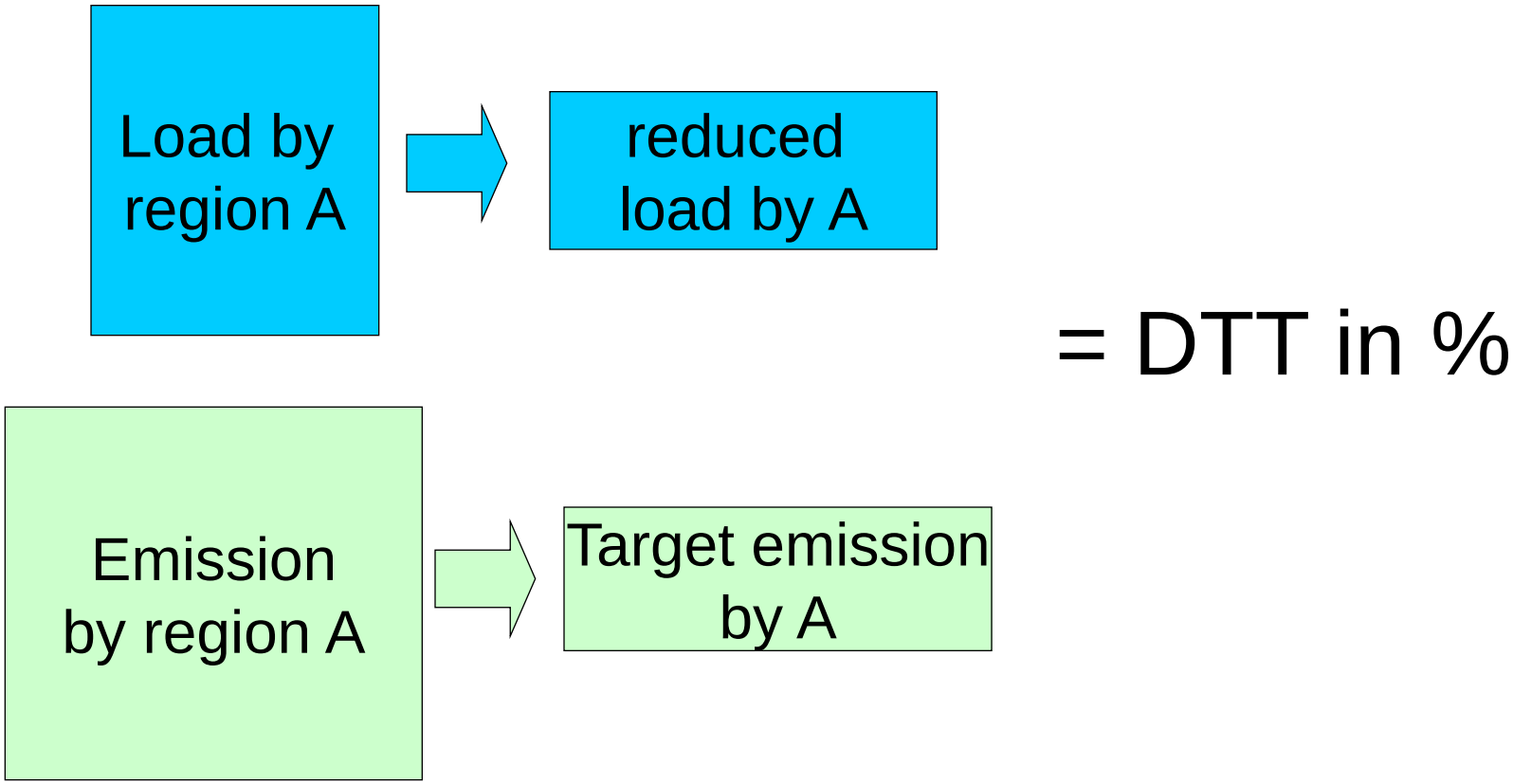


Responsibility





Using the responsibility



Measures

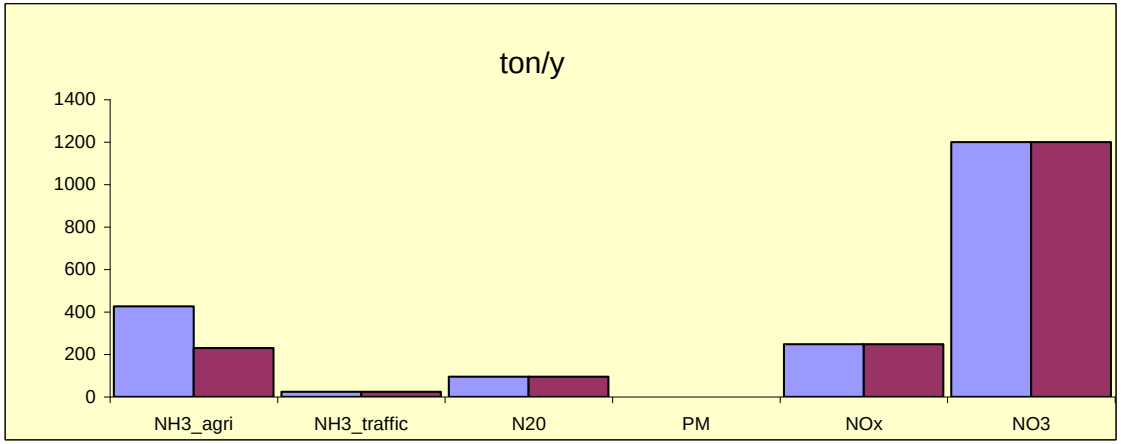
- List of measures with:
  - Emission reduction percentages
  - Costs for implementation (in Euro/kg reduced)
- For ranking the measures according to their efficiency, ‘compensating costs’ are taken into account:
  - Measure taken for NH_3 gets ‘extra costs’ when at the same time additional N_2O is emitted, but ‘extra credits’ when additional N_2O is reduced.

The emission ceiling ‘system’

- The system was build, using
  - Hypothetical region
  - Hypothetical data
- NH_3, NO_x, NO_3, N_2O included – PM not yet
- Not all measures complete (costs are sometimes a problem)
- First version in MS-Excel, next version will also be able to deal with geographical data

Emission overview per area

EMISSION LEVELS IN REGION: 2 Name Bolerveld



	NH3_agri	NH3_traffic	N20	PM	NOx	NO3
Default emission levels	427	25	95	0	248	1200
Dairy	60%	0%	45%	10%	0%	40%
Domestic	0%	0%	5%	5%	20%	10%
Industry	0%	0%	10%	30%	20%	5%
Pigs	18%	0%	5%	5%	0%	20%
Poultry	22%	0%	5%	10%	0%	20%
Traffic	0%	100%	30%	40%	60%	5%

Distance To Target

Area	3				
	Default Emission tonN/y	Depo (tonN/y)	Conc	Exceed/Respons	Start DTT
Whole domain					
NH3	427	106		32	30%
NOx	13	10		4	34%
N2O	85				6%
NO3	260		18	0	0%
PM					

Measures

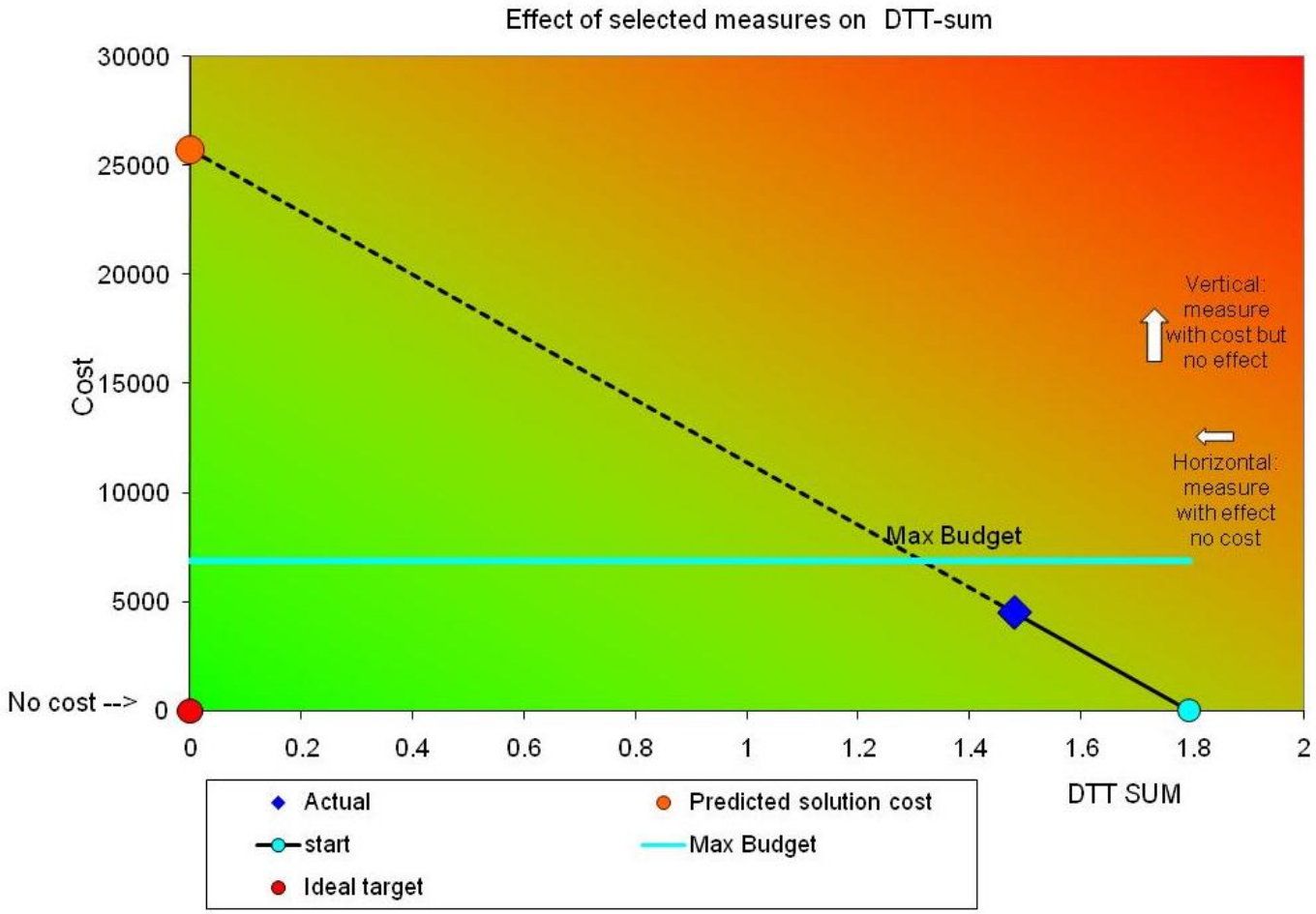
Dairy sector measures

AREA 2	NH3_agri	NH3_traffic	N20	PM	NOx		NO3
Default emission levels	427	25	95	0	248		1200
Emission levels with measures	214	25	95	0	161		1200

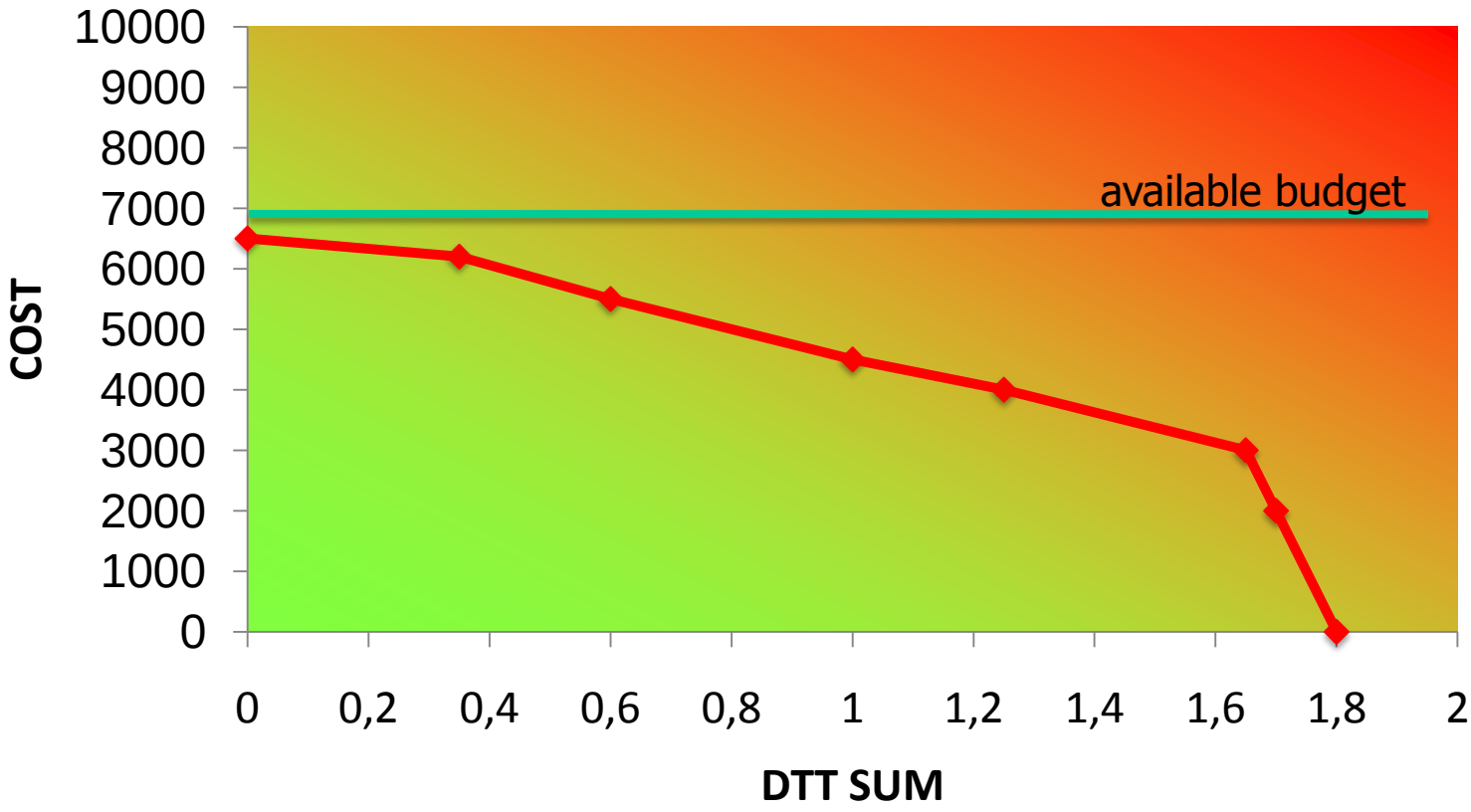
Information % reduction

Number Label	Implement	NH3_agri	NH3_traffic	N20-emissie	Fijn stof	NOx	N-emission 'other'	totale N-emission-change	Cost (/kg NH3)	Cost (/kg NOx)	Cost (/kg N20)	Cost / kg N-emission
A1. Reduce N-input												
1.1 Dairy reducion artificial fertiliser/use	0%	-0.9	-1	-2.8			-38	-561				
1.2 Reduced krachtvoergebruik	0%	0		0			-0.3					
A2. Manure application												
2.1 minder mestaanwending	0%	-3.5		-1.9			-53	-813	1	nvt	5	0
2.2 low emission application	0%	-25		-1.1			26.6	67	1	nvt	66	-6
2.3 use diferent type artificial fertiliser	0%	-7		0			7.5	19	1	nvt	nvt	-6
2.4 trailing hose	0%	-1.7						-21	0.00	nvt		
2.5 use injector on arable land	0%	-5.0						-63	0.30	nvt		
2.6 low emission housing system	0%	-3.3						-42	12.10	nvt		
A3. Manure storage												
3.1 Cover solif manure storage	0%											
3.2 Increase manure storage capacity/ reduce application episode	0%			0								
A4. Feeding												
4.1 low ureum/ food adaptation	0%	-1.7		-0.6			9.03	106	9.00	nvt		0.00
A5. Grazing												
5.1 Increase share grazing	0%	-1.2		3.4			35.8	512	0.00	nvt		0.00
A6. Technical adaption / housing												
6.1 Low emission housing dairy	0%	-4		0			27.3	342	25	nvt		-4
6.2 Acidify manure	100%	-17		-2.1			18.6	46	7	nvt		-39
6.3 Manure burning / energy generation	0%											
6.4 Codigesting	0%											

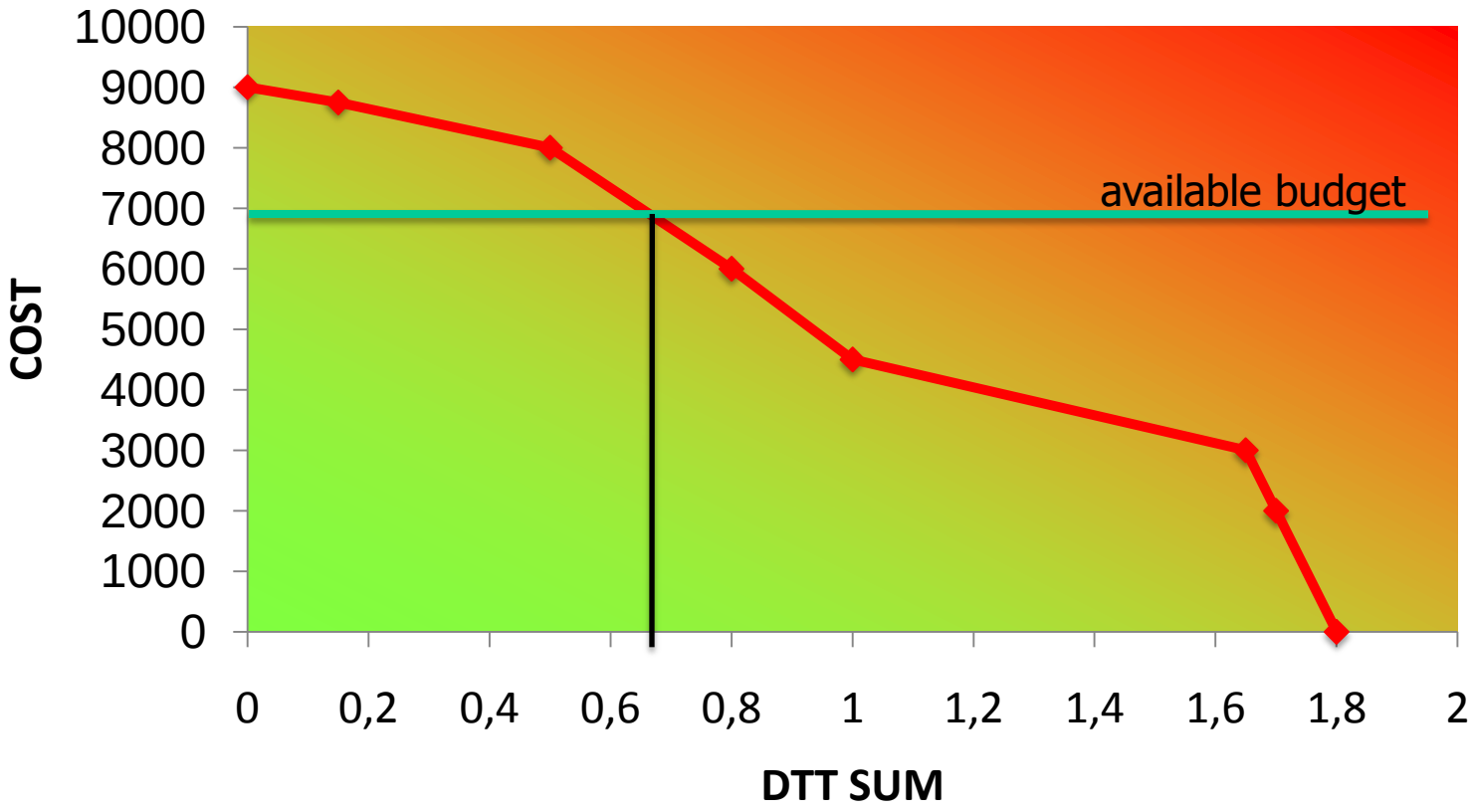
Effect of selected measures on DTT



Scoring the measures



Scoring the measures



Concluding remarks

- System for working with integrated emission ceilings was build
- When full list of measures is available, policymakers can evaluate them in an integrated way
- So far, the system is independent of region/scale. Depending on the availability of data, implementation for different regions/countries is relatively easy
- However,

Still to be done:

- Use real (spatial) data
- Upscaling to larger areas
- Include PM
- Finalize list of measures
- Optimisation procedure for selecting most efficient measures automatically

ECN

Energy research Centre of the Netherlands

More information

a.bleeker@ecn.nl