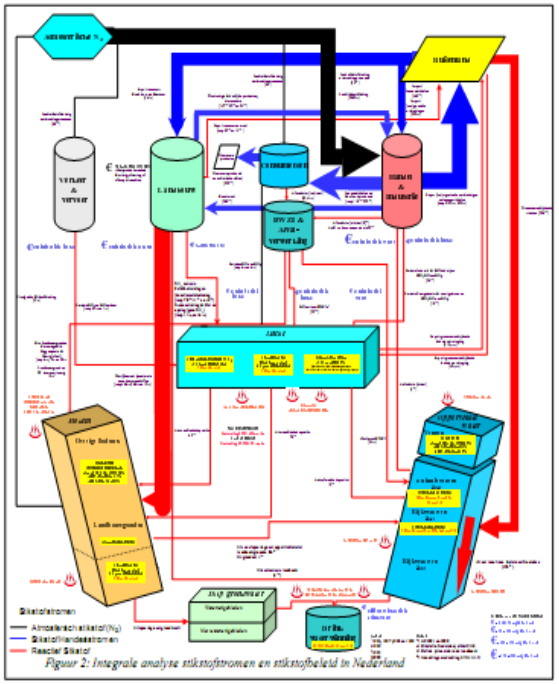
ECN

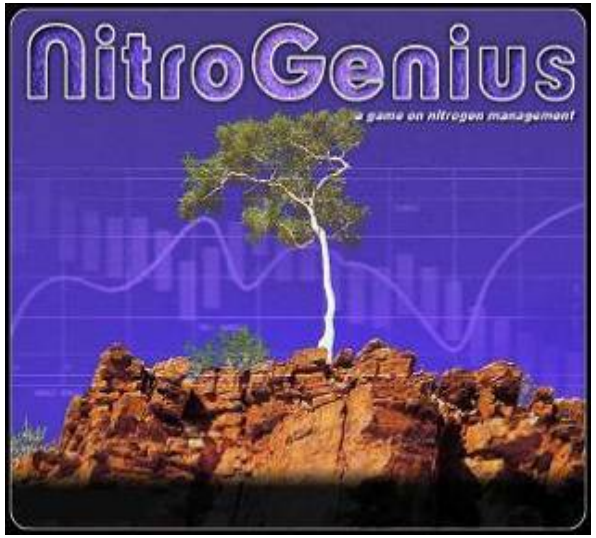
Energy research Centre of the Netherlands

VisualisatioN

Jan Willem Erisman, Albert Bleeker and Arjan Hensen

Simplification of complex issue



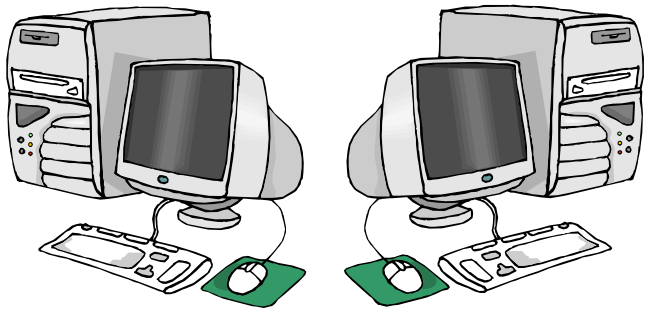


www.initrogen.org
www.nine-esf.org


NitroGenius
a game on nitrogen management
Arjan Hensen, Jan Willem Erisman,
Wim de Vries, Hans Kros, Tamme van de Wal,
Wim de Winter, Jan Erik Wien, Mark v.Elswijk, Matthijs
Maat
ECN
N-problems?
contact our
N-geneers:
ALTERRA
For all your
environmental problems!
serc
Software
Architecture
& Quality
BEST SOFTWARE
FROM
WISL

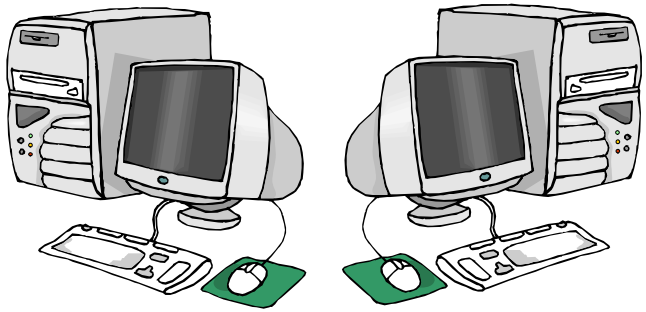
NitroGenius

Industry



Government

Agriculture



Consumer

Game with 4 linked computers.
The aim of the game is to solve the nitrogen problems in the Netherlands against the lowest cost and with minimal social consequences

Basics

- Modelling of N-flows and measures to modify the flows and/or effects
- Simple/pragmatic modelling system
- Output parameters for decision: emissions, GDP, unemployment, ‘happiness’, ...
- Effect parameters include NO_3 in surface water and groundwater, critical N load exceedances, air quality, N_2O emission

Measures

Agriculture

Consumer

Government

Industry

Your budget for the next round is: Meuro 2,000

Jan Willem,
next round you'll be making decisions for the Agriculture

Your goals for the next round are:

- maximize your profit
- protect your public image

Government

Industry

Environment

Next

1:33 remaining

Making decisions...

Current situation

N-deposition

0 Target: 20 kg/ha.yr 50

Groundwater Nitrate

10 Target: 50 mg NO3/l 150

excess AOT40

0 Target: 250 km2.ppm.hours 500

Happiness

-100 Target: 0 % 150

N-concentration in surface water

Target: 2.2 mg/l

Decision list

- **Decrease intensive livestock.**
- **Increase livestock intensity**
- **Low NOx agricultural heating**
- **Cover manure storage**
- **Decrease livestock intensity in the south.**
- **Adjust animal feeding**
- **Optimal irrigation**

Use an improved fodder with a lower nitrogen content. (Use of the improved fodder does not reduce animal production.)

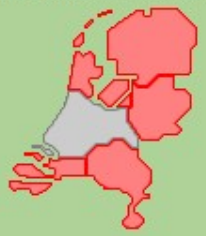
NH3 emission -
N2O emission -
NO3 concentration -

Cost: Meuro 500

Livestock

- [x] Cattle
- [x] Pigs
- [x] Poultry

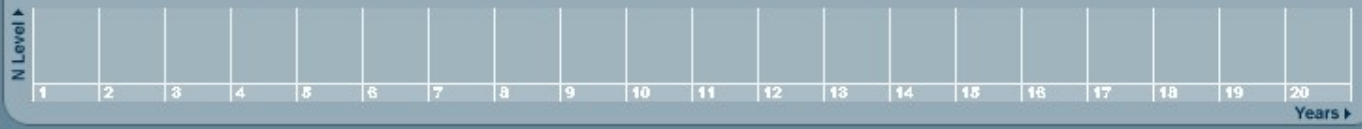
Select one or more regions



Agriculture

History

[x] N-deposition [x] Groundwater Nit [x] excess AOT40 [x] Happiness

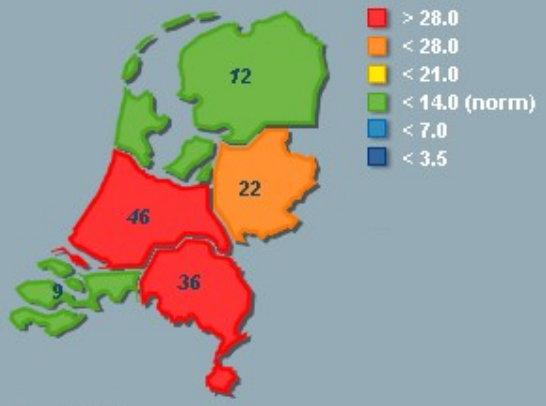


Done

Player: Jan Willem **Score: 0** **Budget: Meuro 0** **Year: 2000 (round 1 of 2)**

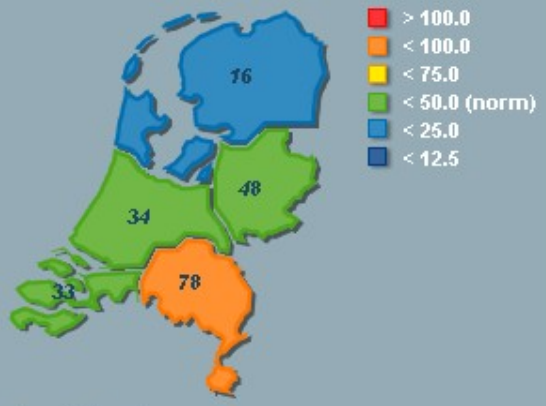
Details...

Nitrogen Deposition



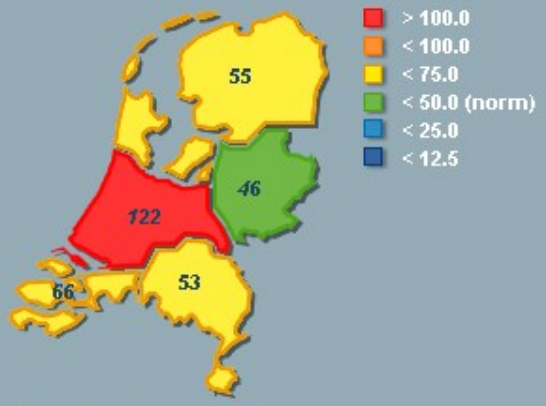
Target: 14 kg/ha.yr

Nitrate Concentration in groundwater



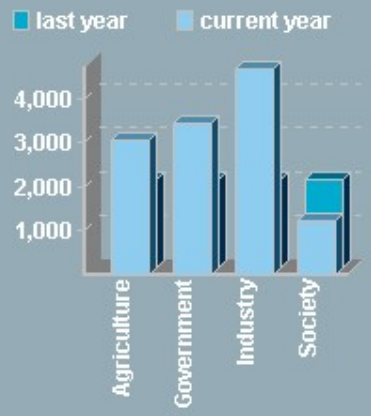
Target: 50 mg/l

AOT40

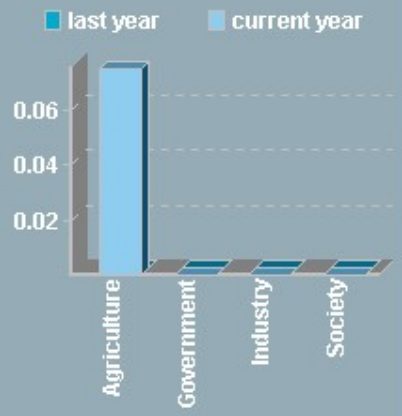


Target: 50 km2.ppm.hours

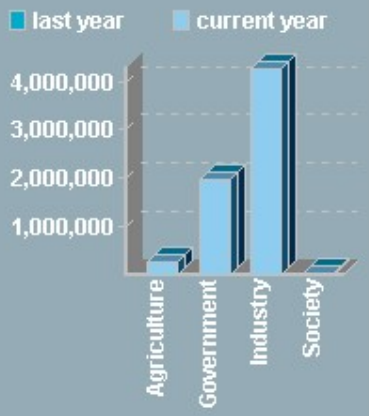
Budget



Image



Jobs



Nitrogen indicators

National NH3 emission

25 Target: 100 kton/yr 200

National NOx emission

100 Target: 238 kton/yr 1000

National N2O emission

1000 kton/yr 0

Year: 2001 (round 2 of 2)

Close

nitrogen 2nd conferNs
14-18 October 2001
Bolger Conference Center
Potomac Maryland, USA

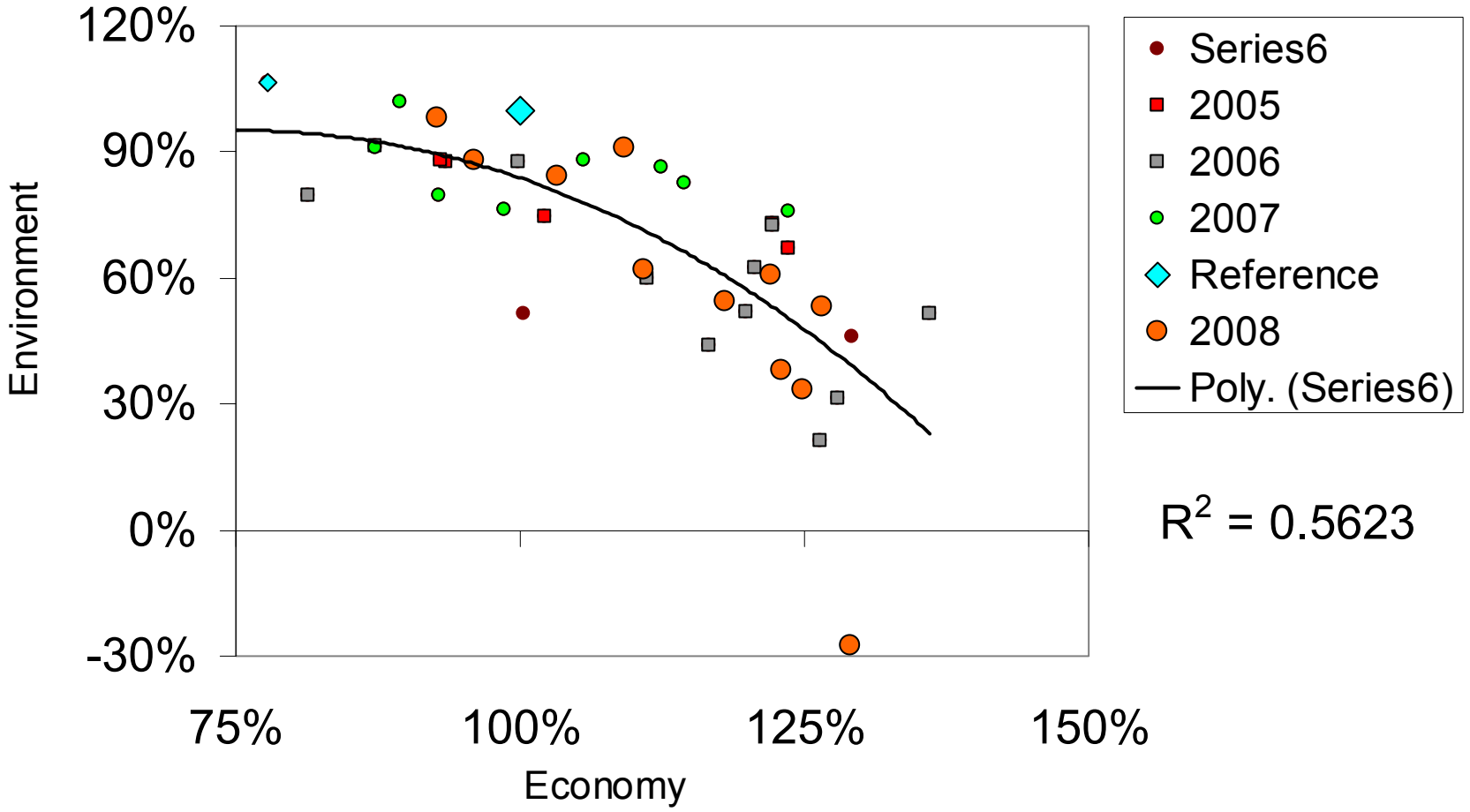
- Developed for 2000 Washington N conf
- It is a team effort!
- Make money first and start working on the environment next.
- Most difficult to abate is NO_x
- Environmental problems can be solved:
- Air quality, surface and groundwater quality targets reached
- Education

Nitrogenius used since 2000

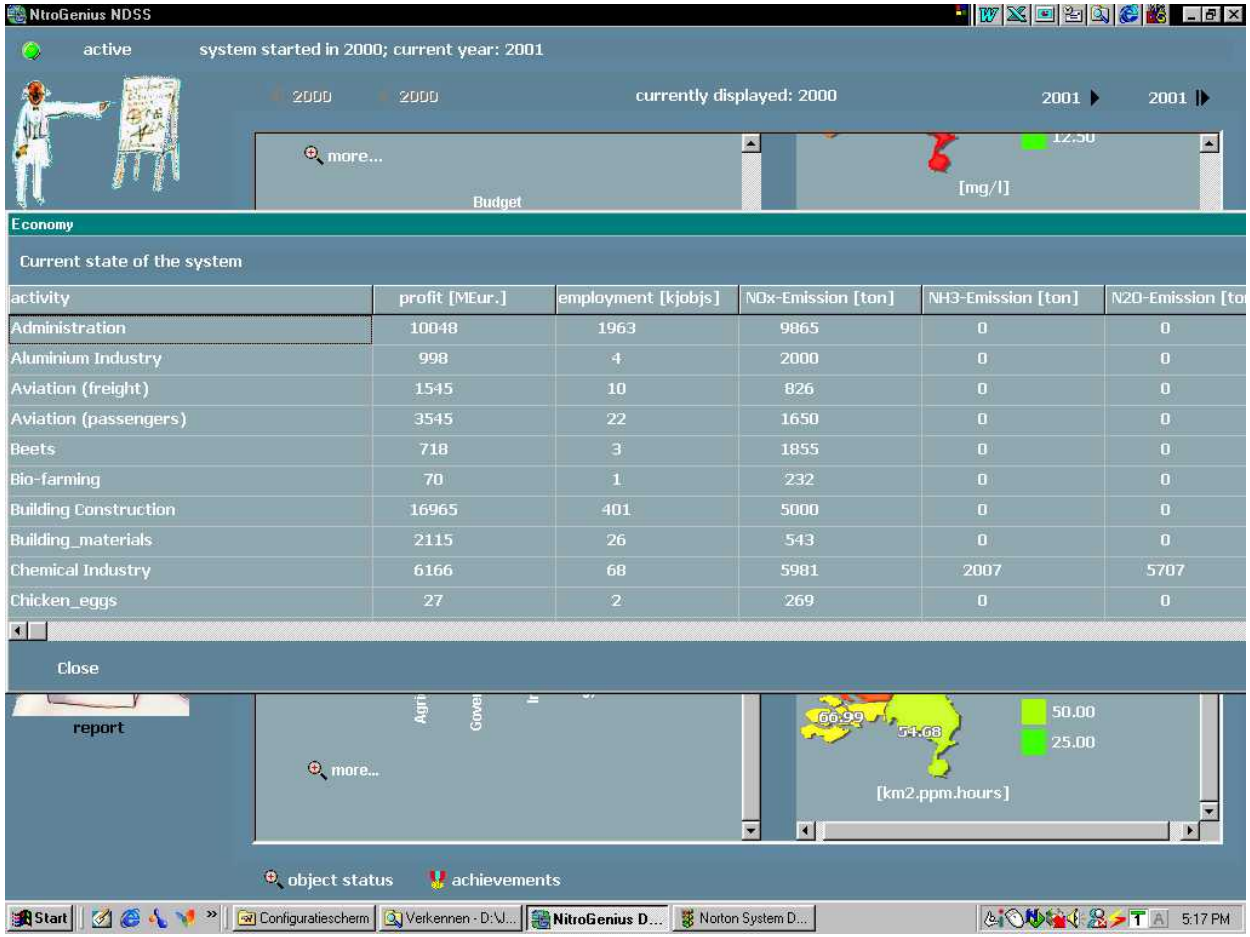
- Wageningen (Carolien Kroeze) course “pollution management”
  - Starting 2003 every year 15-30 students

- Michigan university: (Don Scavia)
  - Two courses (67 and 107 students)

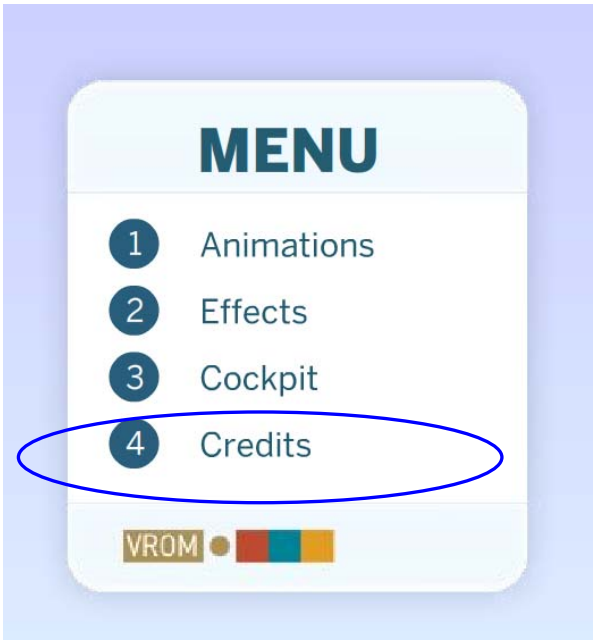
Wageningen results: Economy-Environment



NDSS version: Decision support system



Nitrogen visualisation



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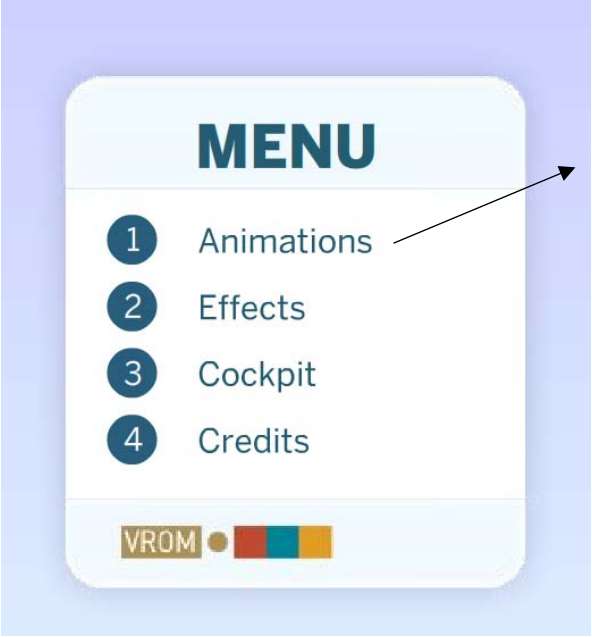
Arjan Hensen (hensen@ecn.nl)

International Nitrogen Initiative (INI)
Jim Galloway

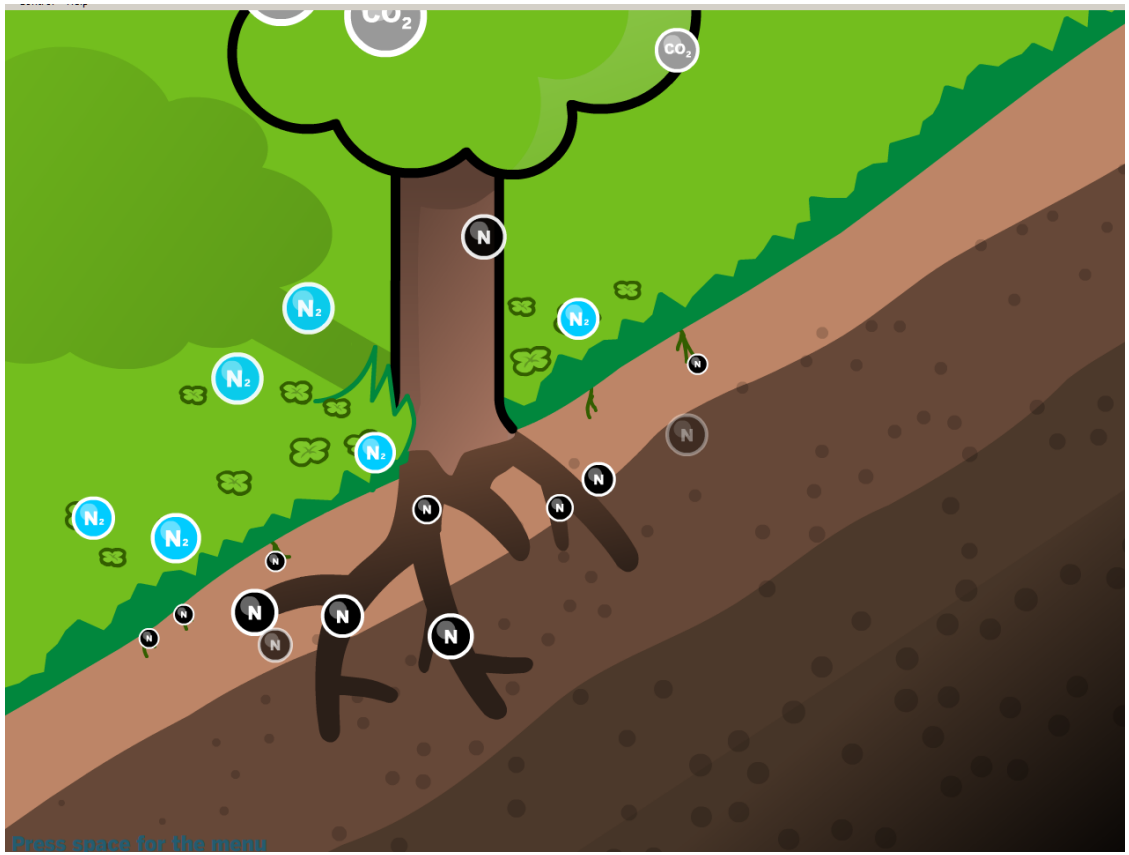
MediaMonks - Interactive Art
Hilversum, The Netherlands
Wesley ter Haar, Bas Helderman, Rozemarijn Rotting, Wouter van Twillert, Arjan van Wijk, Pierre Nelwan, Joey Schmidt

Dutch Ministry of Housing, Spatial Planning and the Environment (VROM)
P.O. Box 30945, 2500 GX, The Netherlands
Kaj Sanders (kaj.sanders@minvrom.nl) Johan Sliggers, Henk Strietman, Renske van Tol

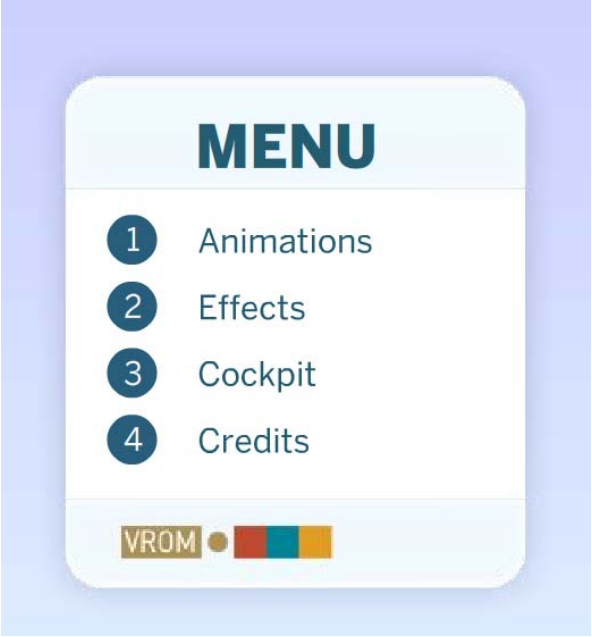
Visualisation: Animations



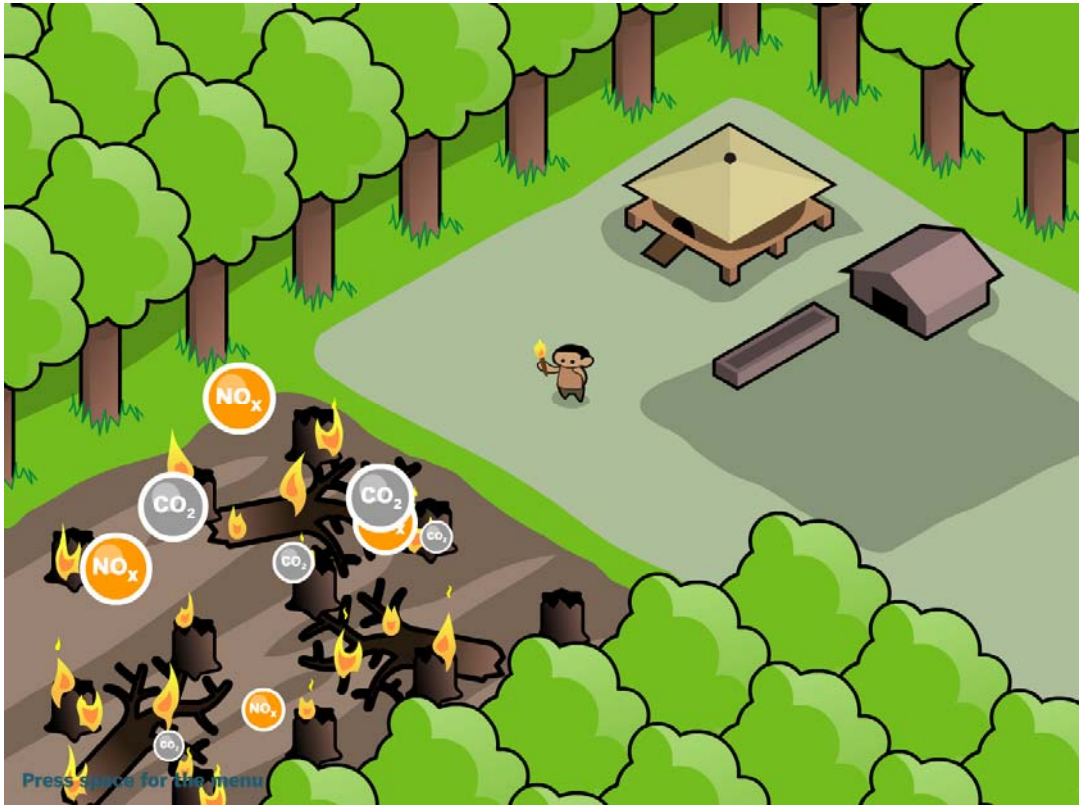
1: Biological N fixation



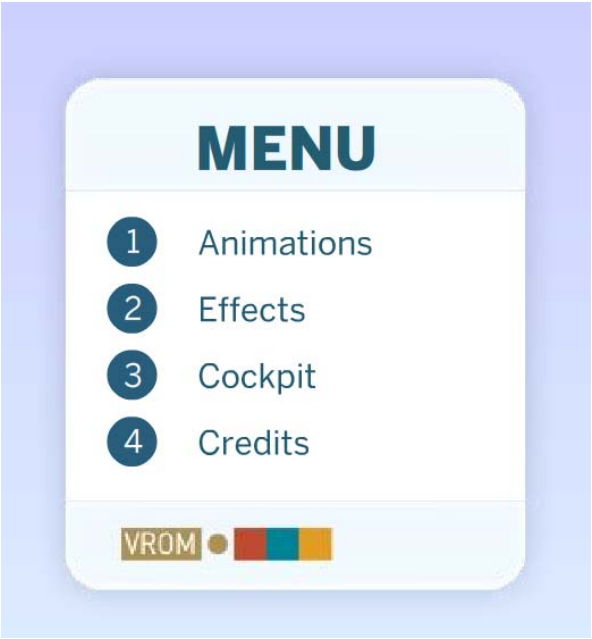
Visualisation: Animations



2: In the beginning



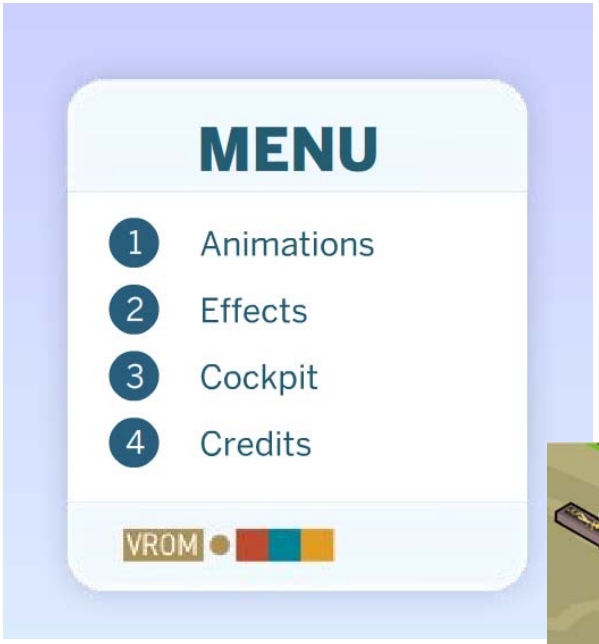
Visualisation: Animations

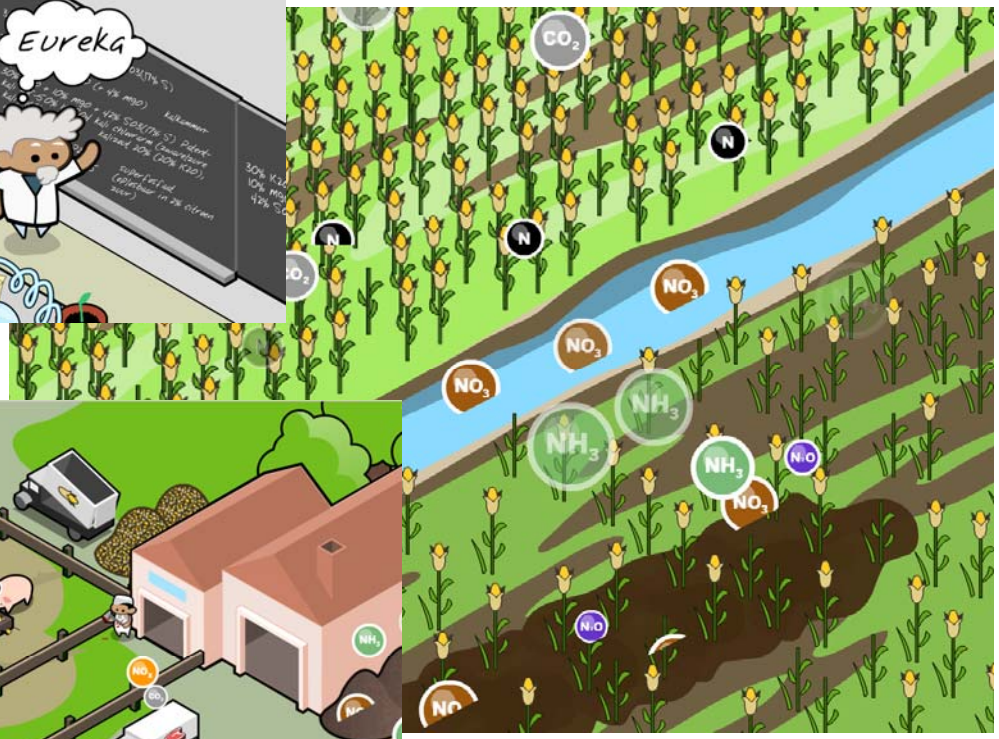


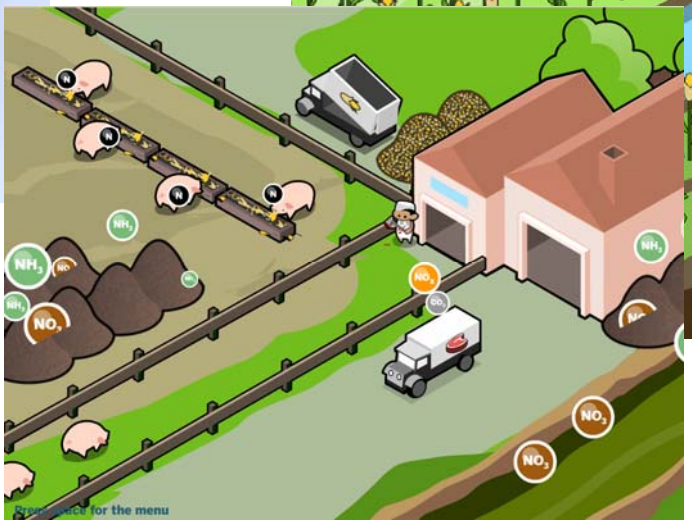
3: Industrial Revolution

Visualisation: Animations

4: Artificial Fertilizer

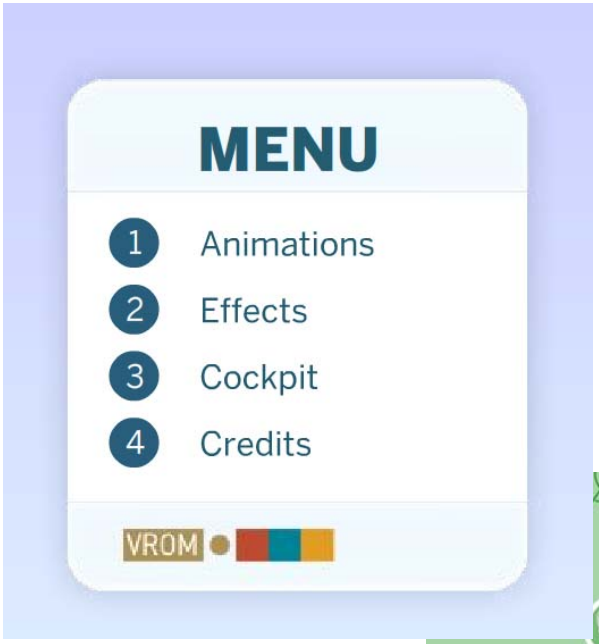


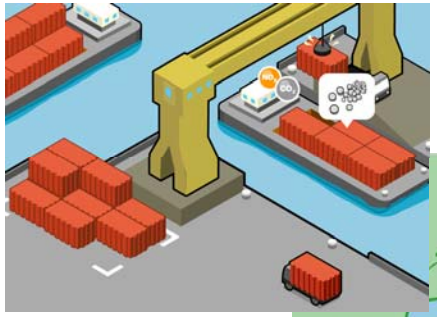


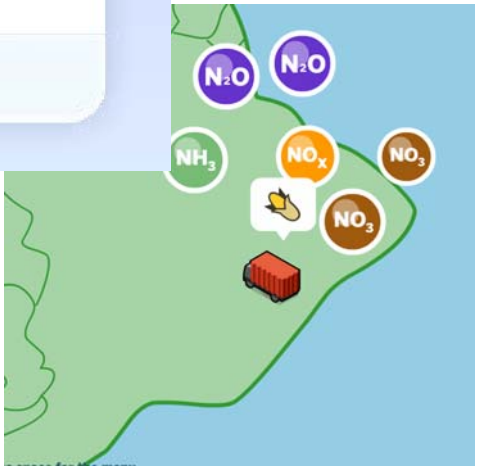


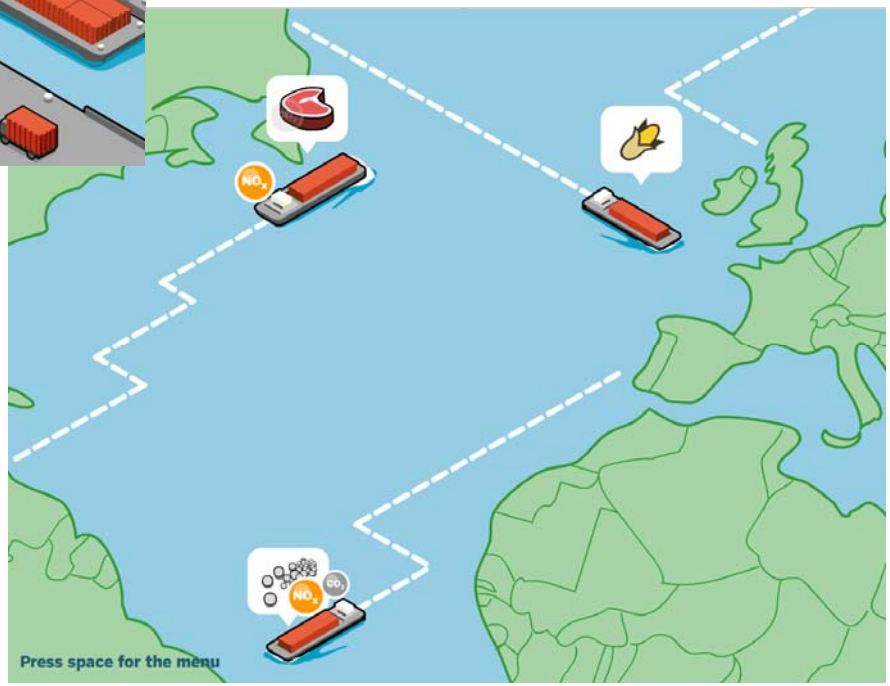
Visualisation: Animations

5:Global transport



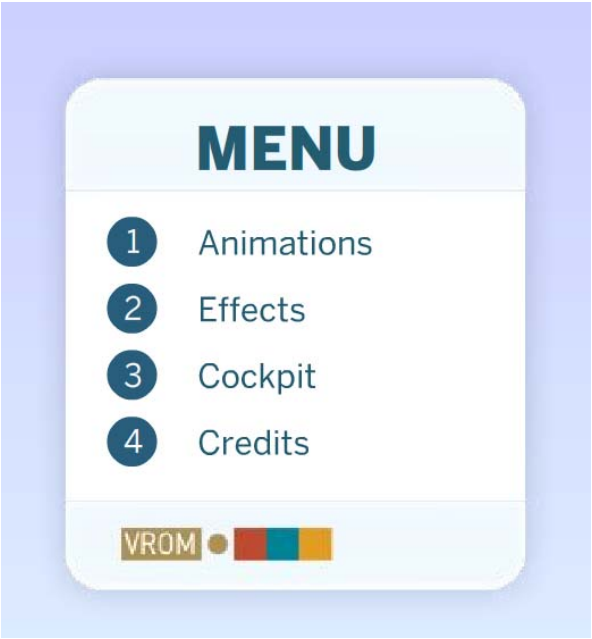




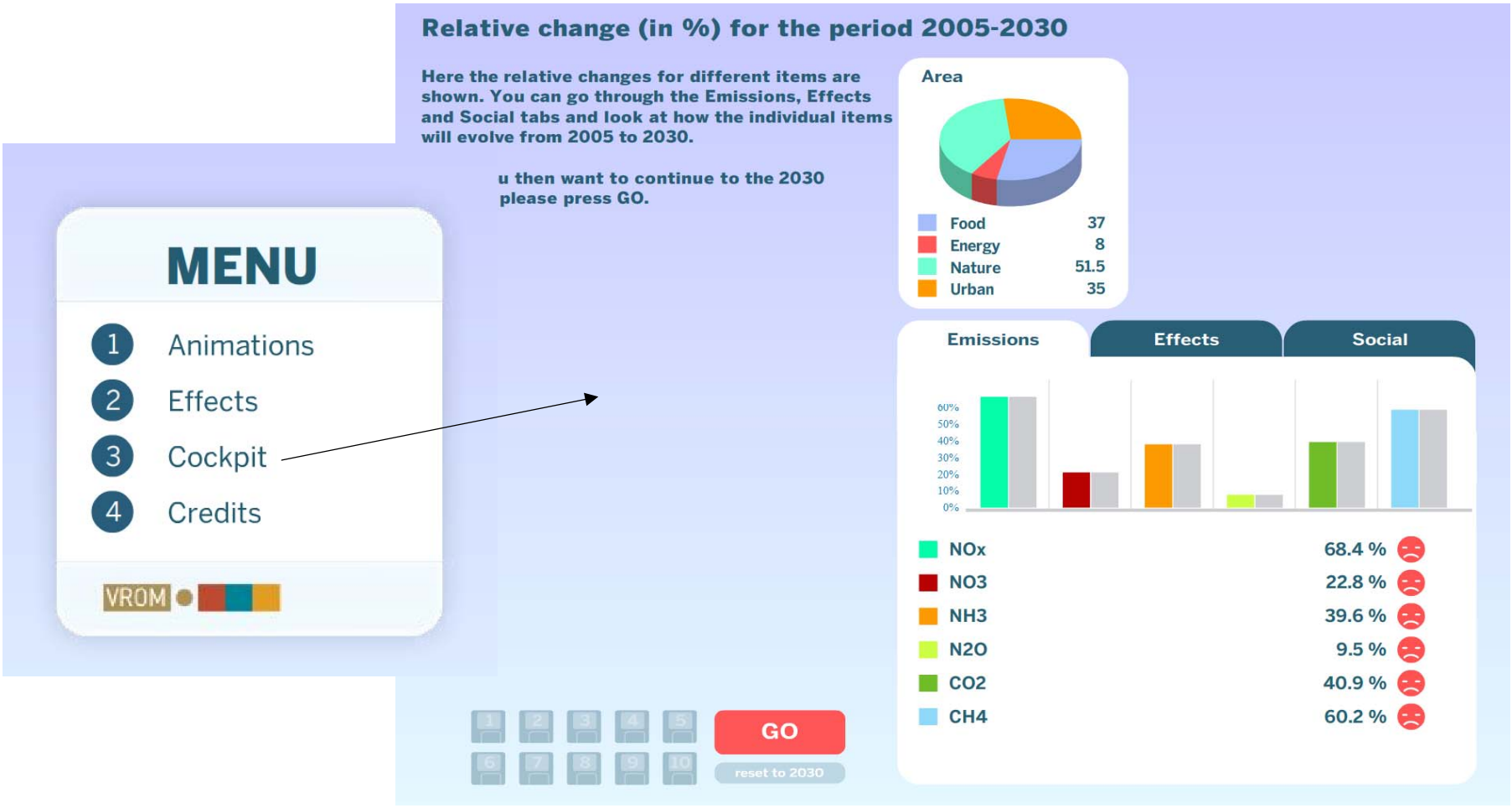


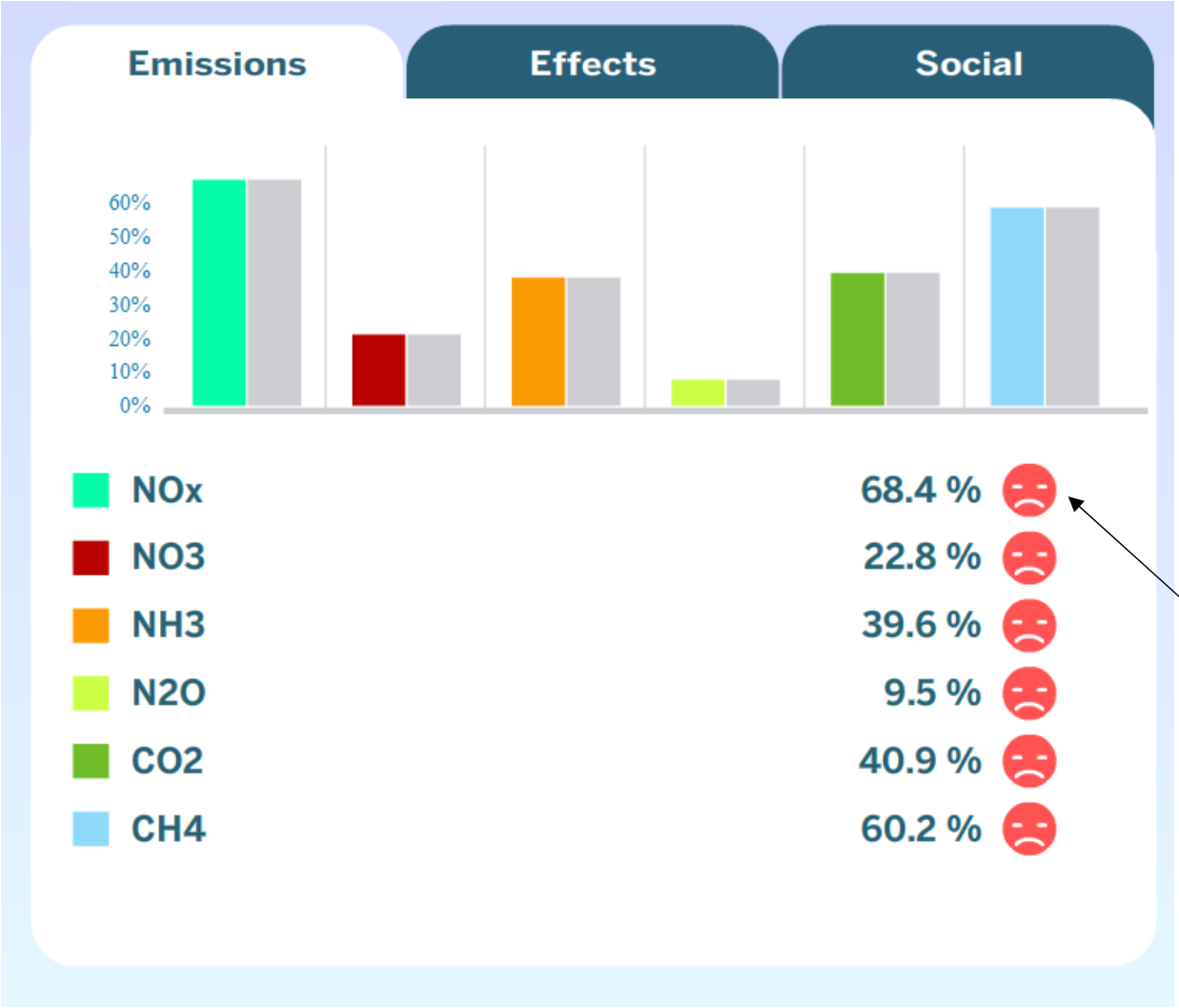
Visualisation: Animations

7: Energy from Biomass



Visualisation: The cockpit overview 2005-2030





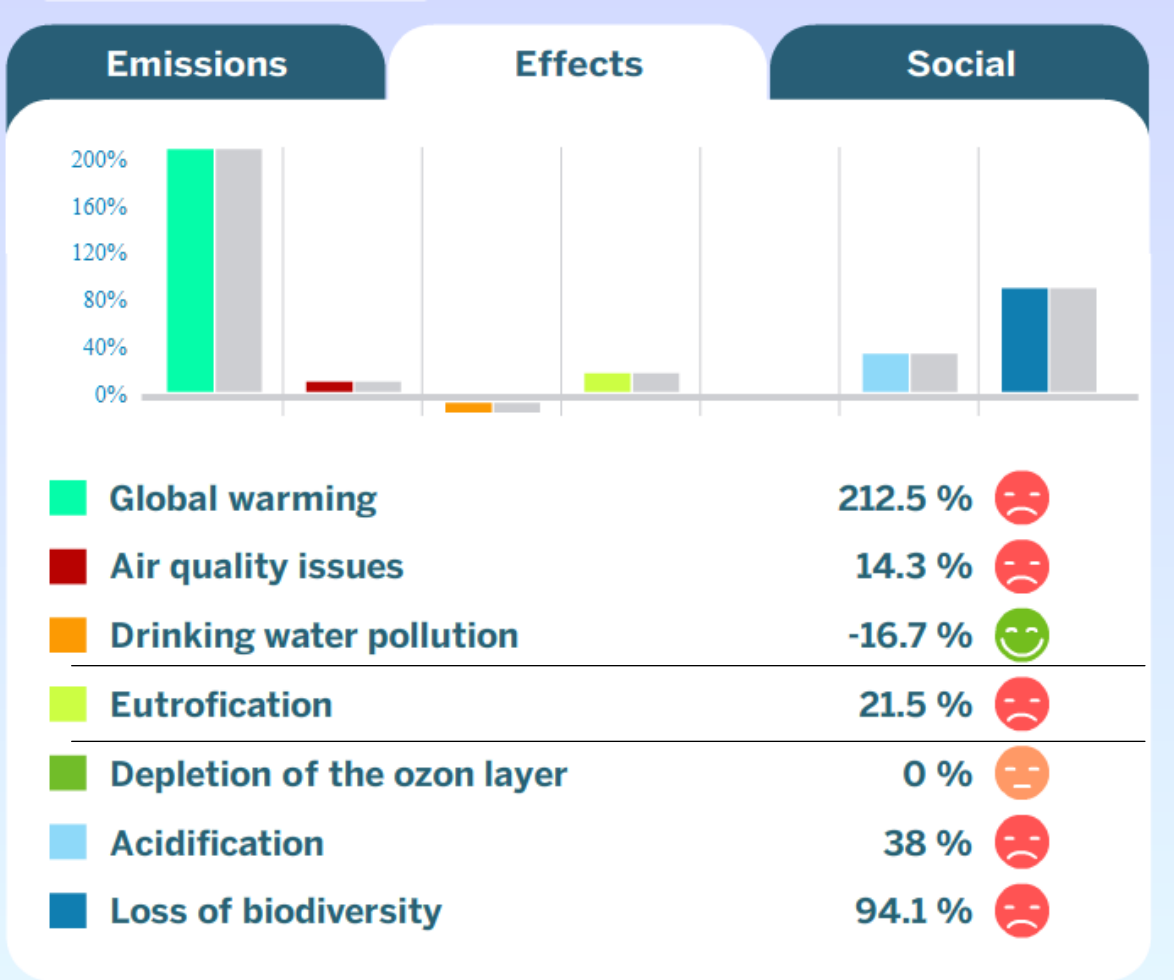
2030 versus 2005

Emissions all increase

NO_x 2005 38 TgN
2030 64 TgN

+68.4%

Ref: Dentener et.al.
NOx emissie 2030 in A2 scenario

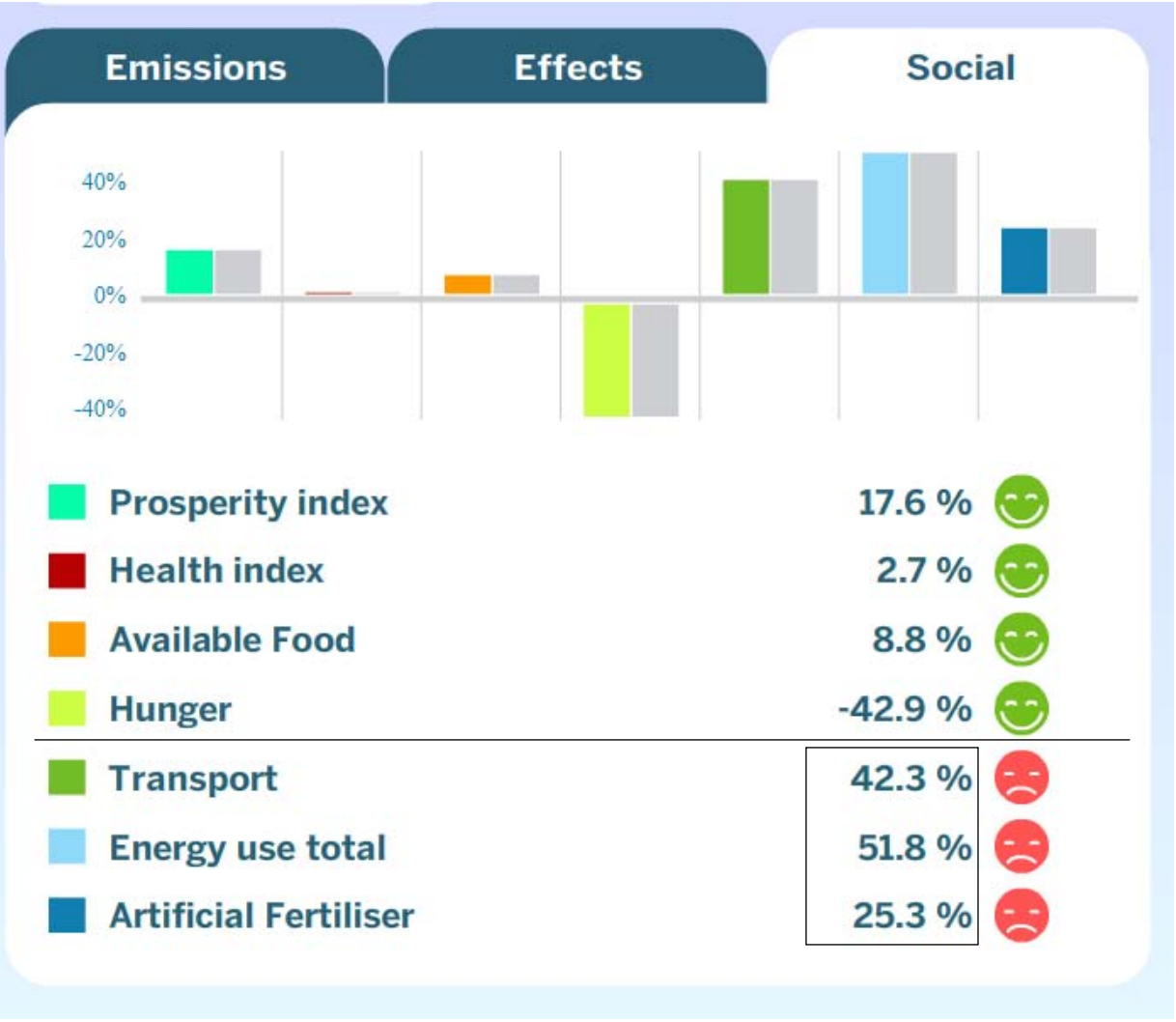


Effects
2030 versus 2005

Drinkingwater improved

But more run-off
To coastal water

Ozonlayer stable



Social parameters 2030 versus 2005

Hunger problem reduced substatially

Energy use and transport increase

Visualisation: Actions in the cockpit

Select measure
Push GO

Evaluate effects

Last 10 sets stored

The questions ….

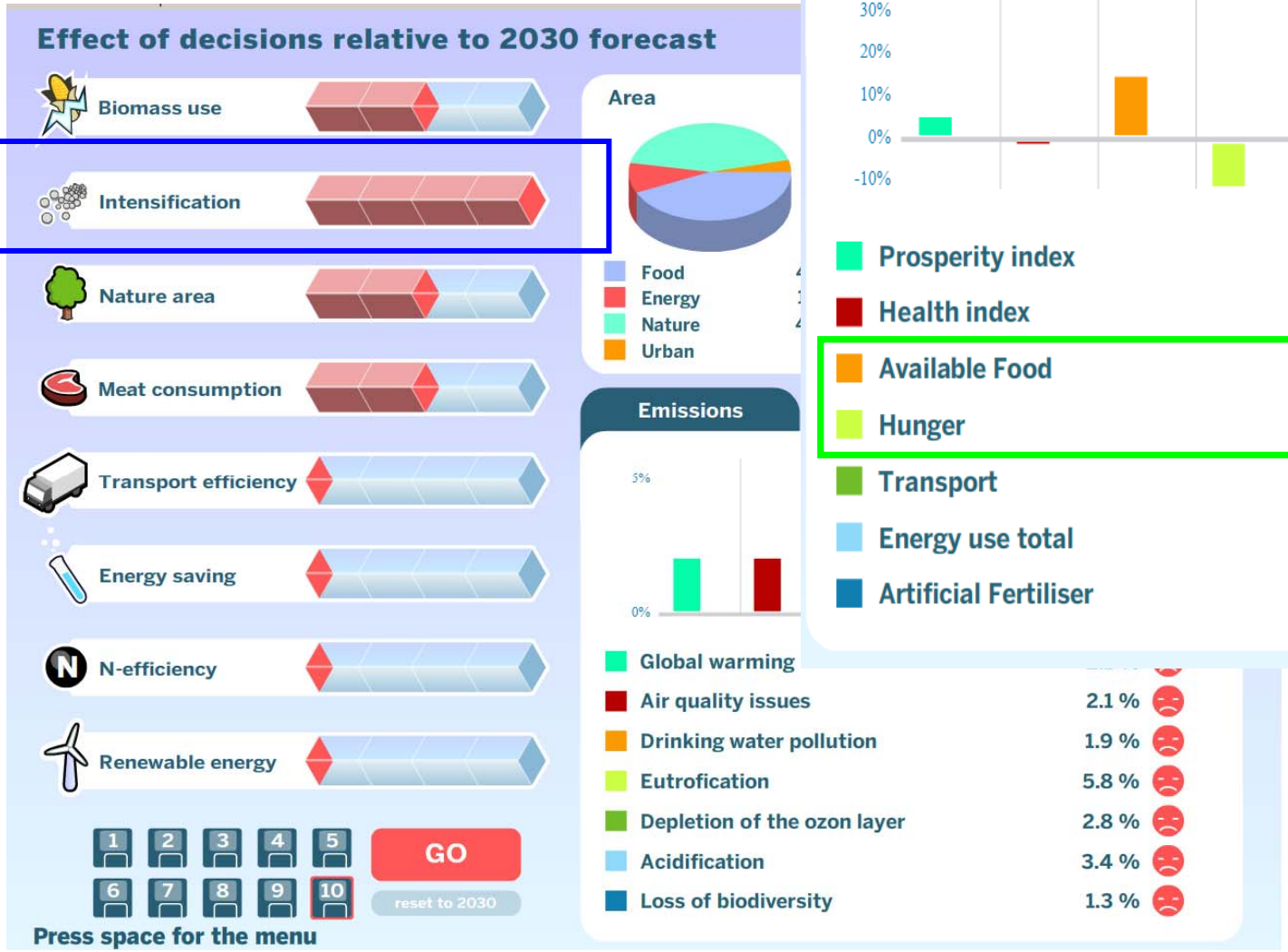
- Use of Biofuel
- Intensification of agriculture ?
- More room for nature ?
- Meat consumption decrease/Increase ?
- Optimize transport ?
- Energy technology a solution ?
- N use efficiency ?
- Renewable wind/water/solar

Example

Transport efficiency

Example

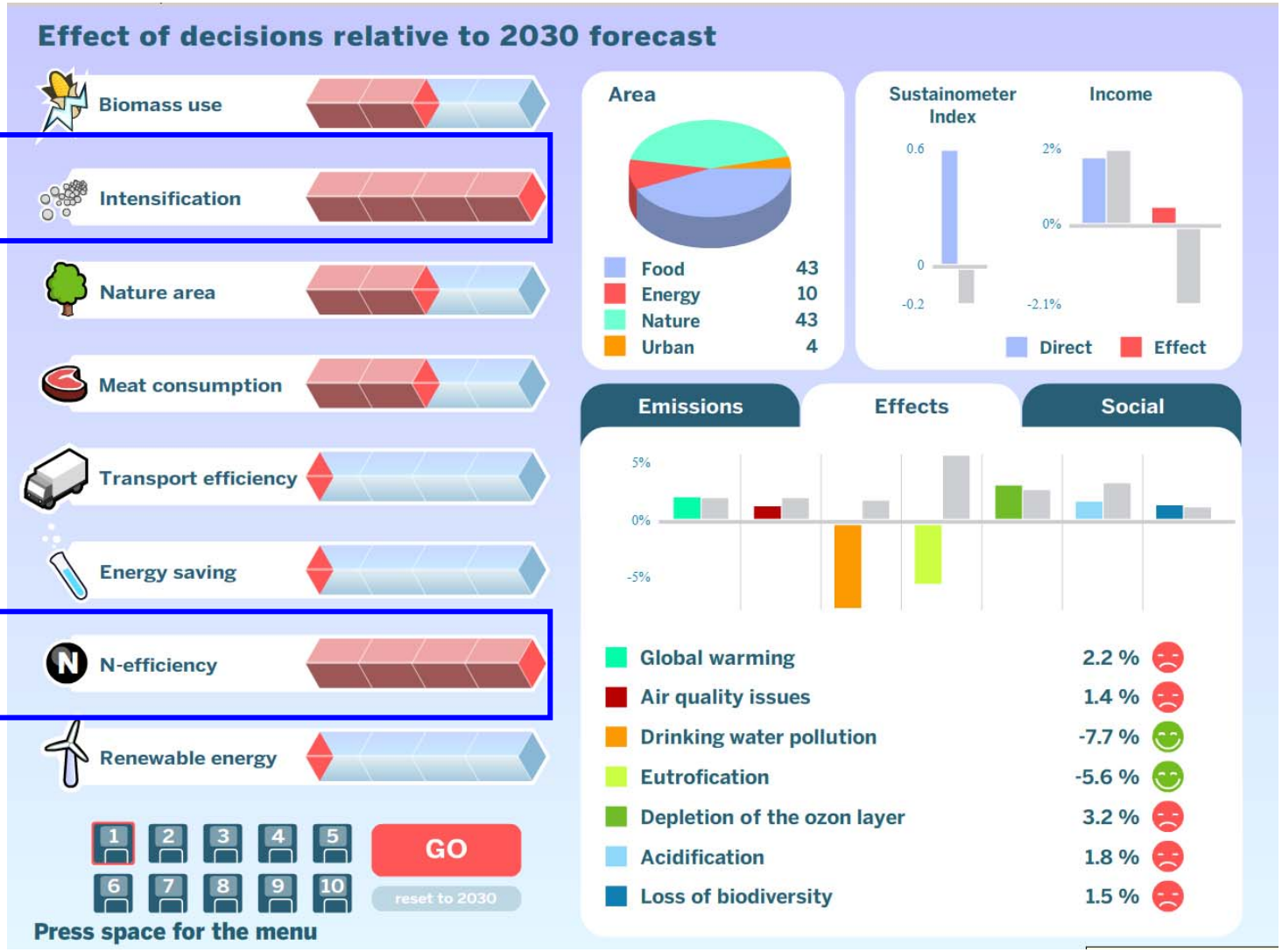
Transport efficiency



Example

Intensive agriculture


Effect of decisions relative to 2030 forecast
Biomass use
Intensification
Nature area
Meat consumption
Transport efficiency
Energy saving
N-efficiency
Renewable energy
1 2 3 4 5
6 7 8 9 10
GO
reset to 2030
Press space for the menu
Area
Food 43
Energy 10
Nature 43
Urban 4
Sustainometer Index
0
-0.2
Income
2%
0%
-2.1%
Direct
Effect
Emissions
Effects
Social
5%
0%
Global warming 2.1 %
Air quality issues 2.1 %
Drinking water pollution 1.9 %
Eutrofication 5.8 %
Depletion of the ozon layer 2.8 %
Acidification 3.4 %
Loss of biodiversity 1.3 %


Effect of decisions relative to 2030 forecast
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0.6
0
-0.2
Income
2%
0%
-2.1%
Direct
Effect
Emissions
Effects
Social
5%
0%
-5%
Global warming 2.2 %
Air quality issues 1.4 %
Drinking water pollution -7.7 %
Eutrofication -5.6 %
Depletion of the ozon layer 3.2 %
Acidification 1.8 %
Loss of biodiversity 1.5 %

Contest at the 4th N conference in Brasil

- Solutions submitted to the Nine/INI website
- Criteria:

  "All green smiles"
- Winner ….

From: Toby Daniel Ahrens [mailto:tahrens@stanford.edu]
Sent: vrijdag 1 februari 2008 20:07
To: Bleeker, A. (Albert)
Subject: Re: N-contest Winner

2007 WINNER !!!

Hi Albert:

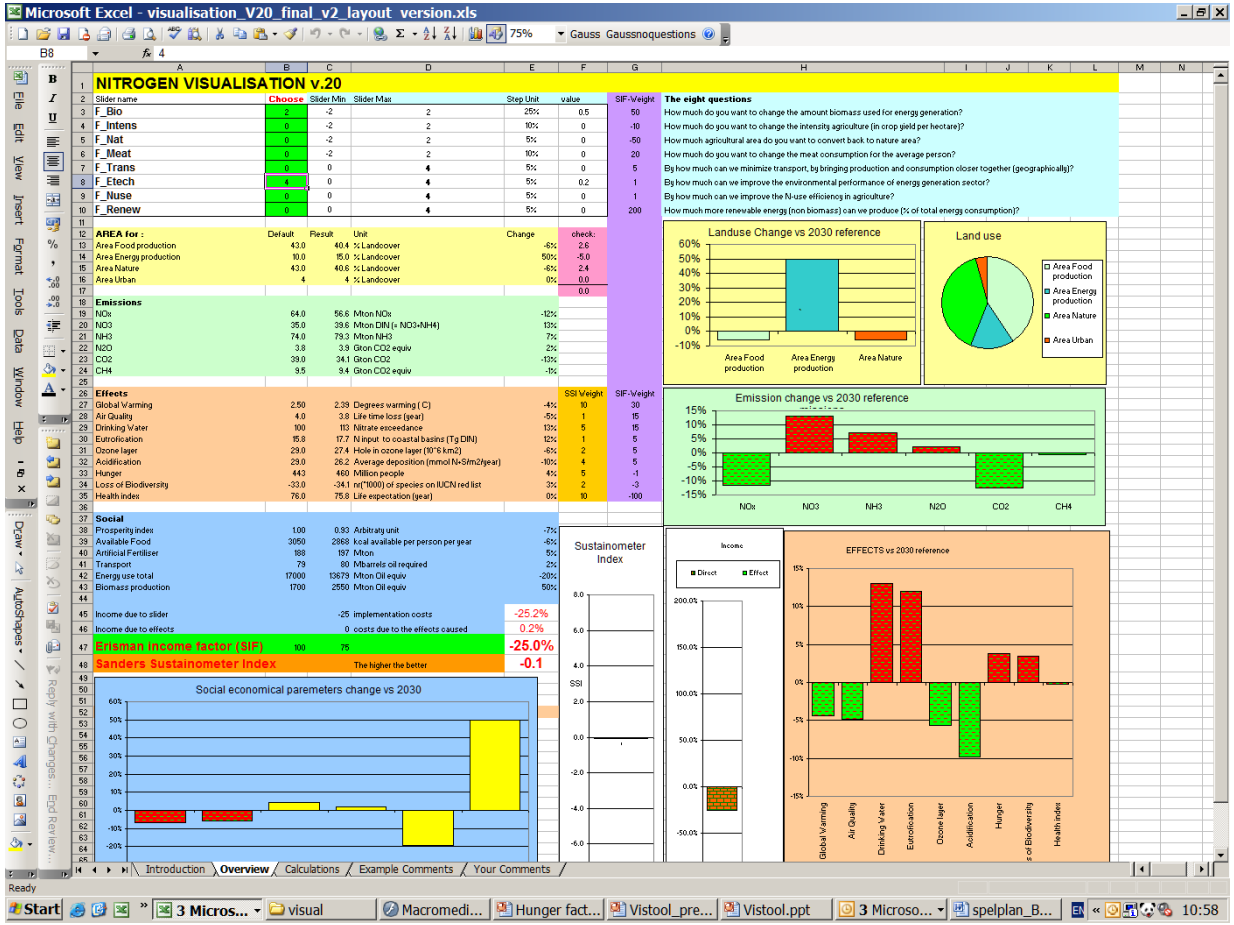
Wow - great news! My wife was 8 months pregnant at the time of the conference, and the Visualization tool was **the perfect distraction** as I was waiting impatiently in the many airports on the return trip. I may have spent an hour or two on it after I returned as well... I am finishing up a PhD at Stanford University working on nitrogen use efficiency in high-input agricultural systems, and what a perfect addition to my CV as I start looking for jobs - to be deemed the Best Global Nitrogen Manager by the International Nitrogen Initiative! I really enjoyed the Visualization, and I commend the INI for all of their hard work on the tool. It **does a great job of introducing some of the complexities associated with policy choices and nitrogen management**.

The **Excel version of the Cockpit was an especially valuable addition to the final product**, and I encourage users to take a look at the equations that we were trying to optimize - lots of good fodder for discussion in there. I would also like to thank the entire Academy, and I hope that the Writer's strike doesn't prevent coders from helping the INI develop similar tools for N conferences in the future.

Thanks very much, and I am looking forward to India,

Toby Ahrens

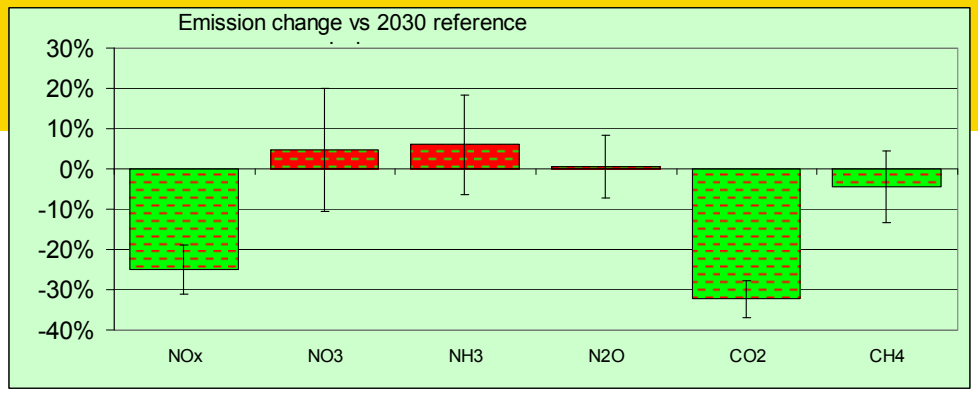
Excel version of the visualisation cockpit

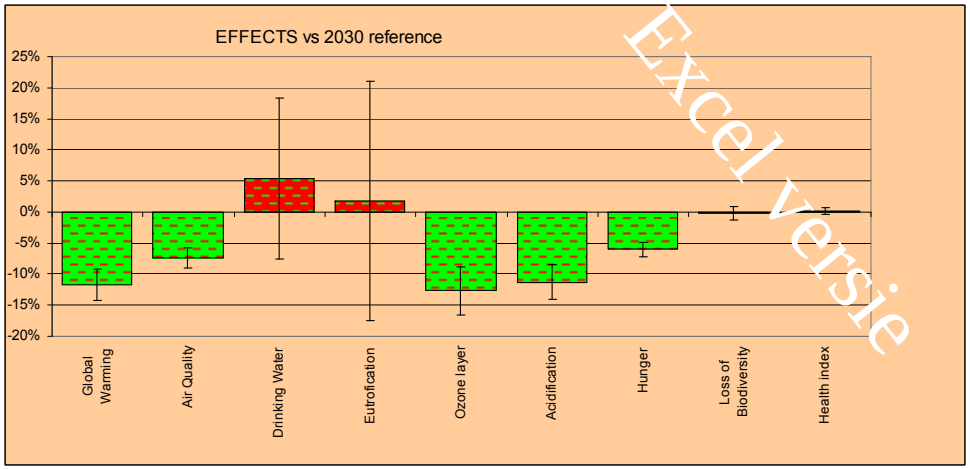


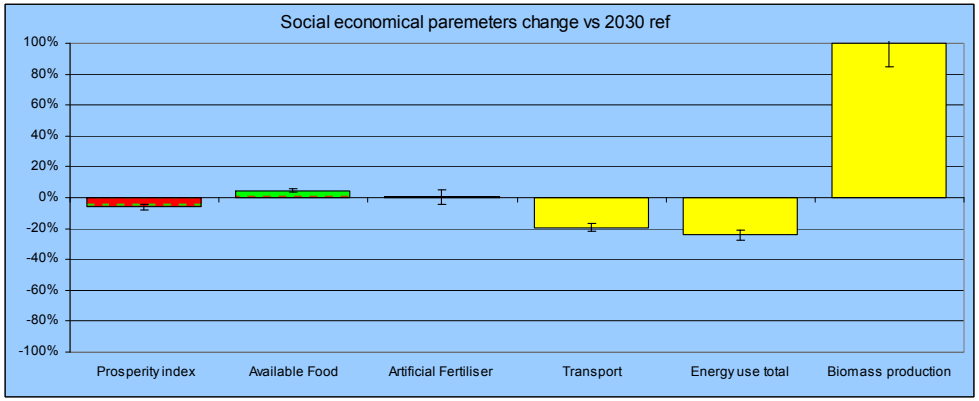
- **Open source !**
- Updates on the internet

New in version 22

- Uncertainties of all input data
- 50-run Monte Carlo simulation providing an indication of uncertainty in all results







Education applications

- Course Pollution management Wageningen 2008
- Every year Nitrogenius & NDSS
- 2008: 22 students
- Assignment: Evaluate a parameter

Group 2008	
China	4
NL	3
Czech	2
Indonesia	2
Brazil	1
Cyprus	1
Ethiopia	1
Germany	1
Ghana	1
Portugal	1
Rwanda	1
Swiss	1
Taiwan	1
UK	1
Zimbabwe	1

Analyse wageningen 2008

Future

- Presentations/workpackages of visualization tool on internet
- Development of a Swedish and German translation
- Wageningen 2009

Advantages and disadvantages

- Provides insight in a lot of integrated information
- Synergy, interaction and feedbacks clearly visible
- Interactive start for discussions and education purposes
- Concept can easily be used for other complex policy fields

- Many parameters without references
- Some parameters difficult to quantify
- Garbage in = garbage out ?

Interactive session: don't focus only on the smiles!

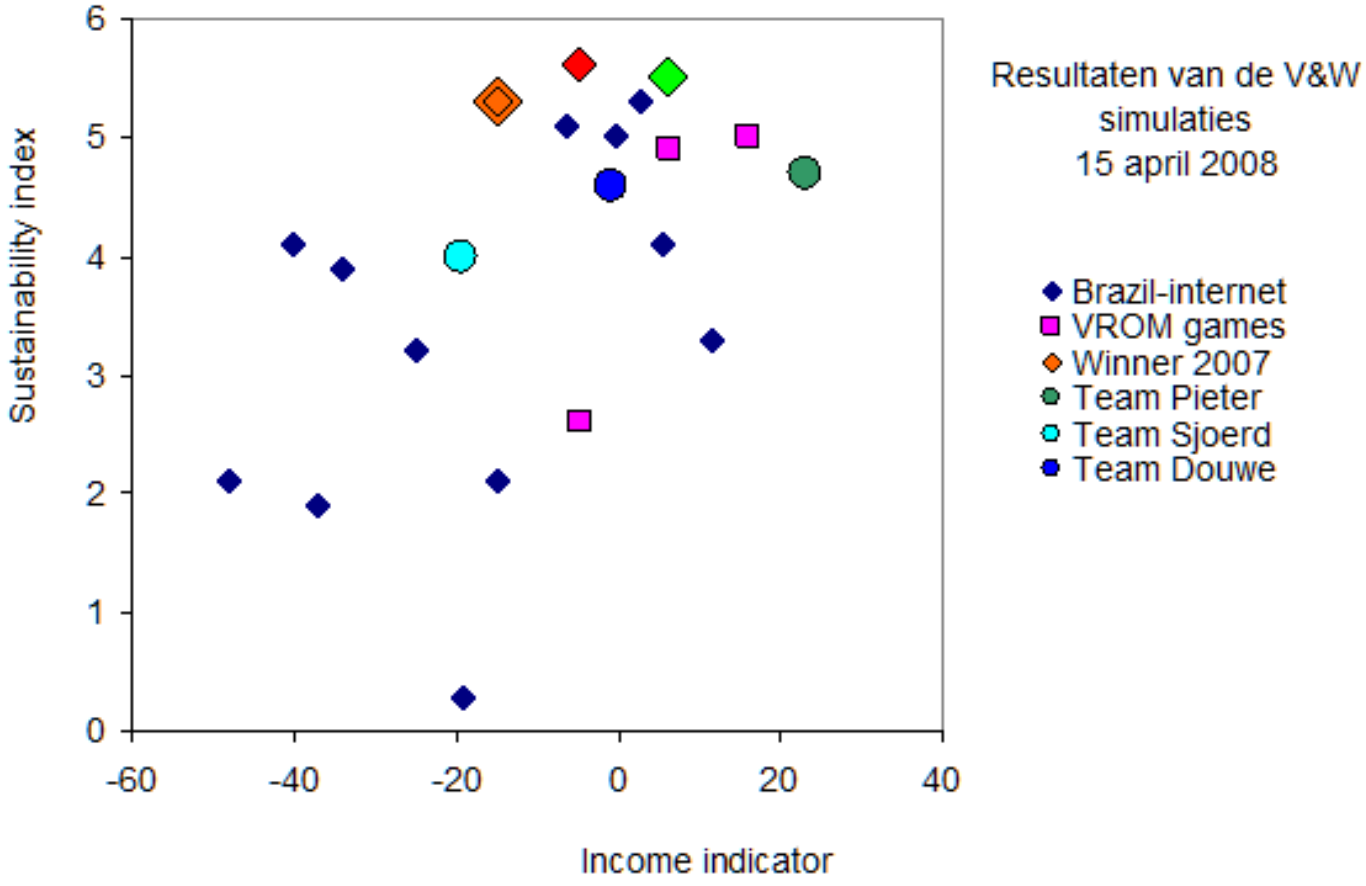
Aggregation parameter: SSI

- Sanders Sustainability index

$$SSI = -\sum (\%\ \text{verandering})_i * (\text{gewicht})_i$$

Effects			SSI Weight
Global Warming	2.50	Degrees warming (C)	10
Air Quality	4.0	Life time loss (year)	1
Drinking Water	100	Nitrate exceedance	5
Eutrofication	15.8	N input to coastal basins (Tg DIN)	1
Ozone layer	29.0	Hole in ozone layer (10^6 km2)	2
Acidification	29.0	Average deposition (mmol N+S/m2/year)	4
Hunger	443	Million people	5
Loss of Biodiversity	-33.0	nr(*1000) of species on IUCN red list	2
Health index	76.0	Life expectation (year)	10

Comparison of solutions



ECN

Energy research Centre of the Netherlands

Thank you for your attention

more information: hensen@ecn.nl