Tackling uncertainty, perceptions and passivism

ME 4-tool

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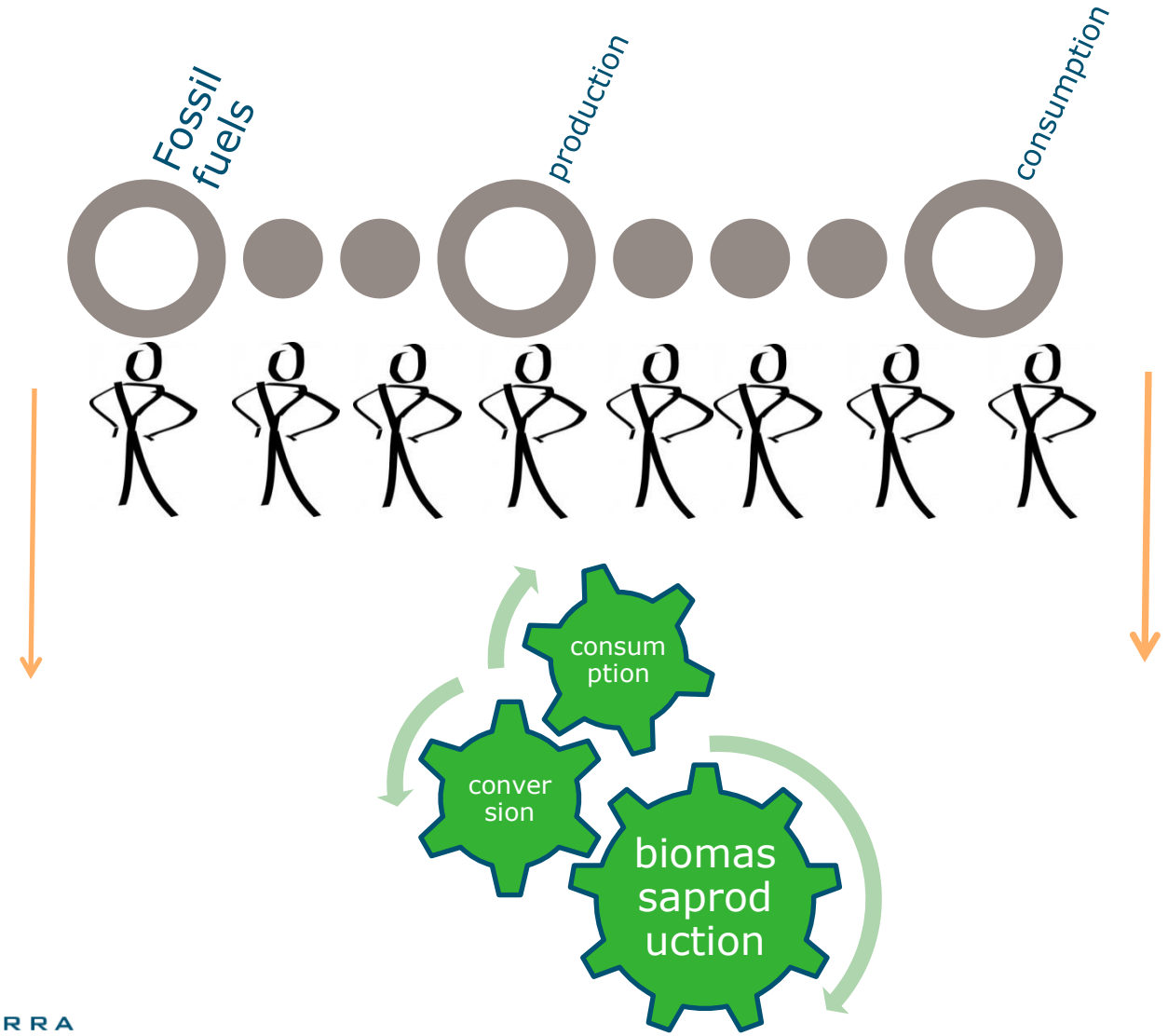
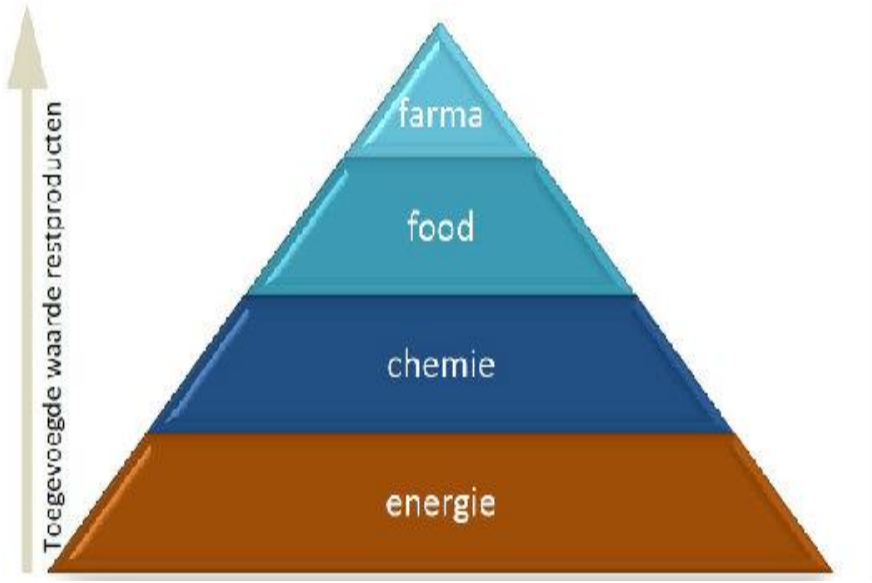
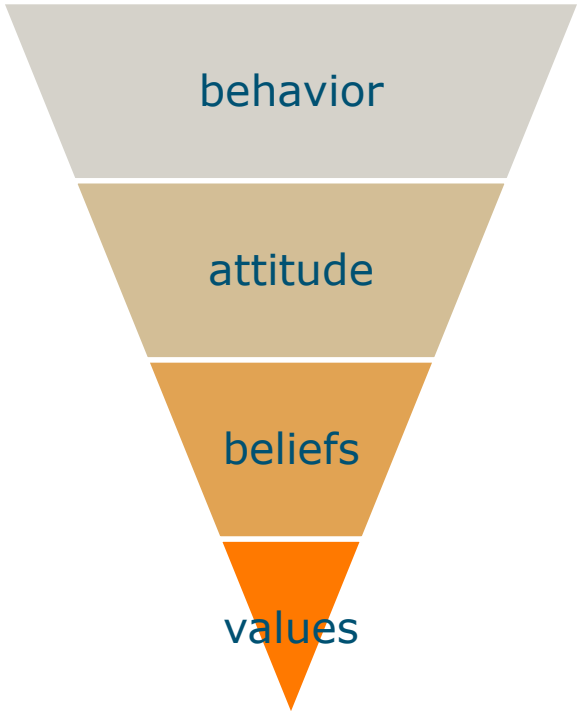
Transition towards a biobased economy



Technology and behavioral transition



Transition in technology



Transition in behavior

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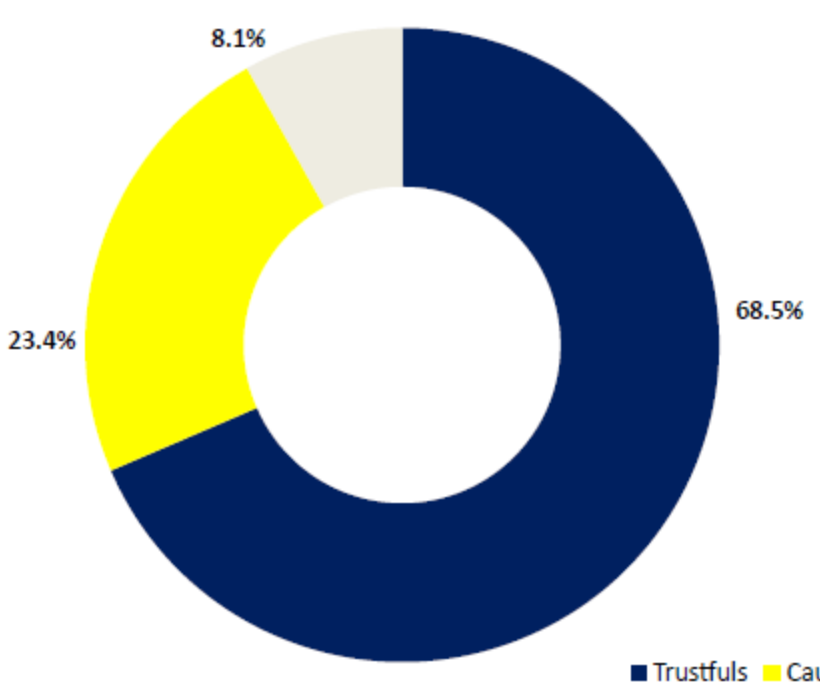
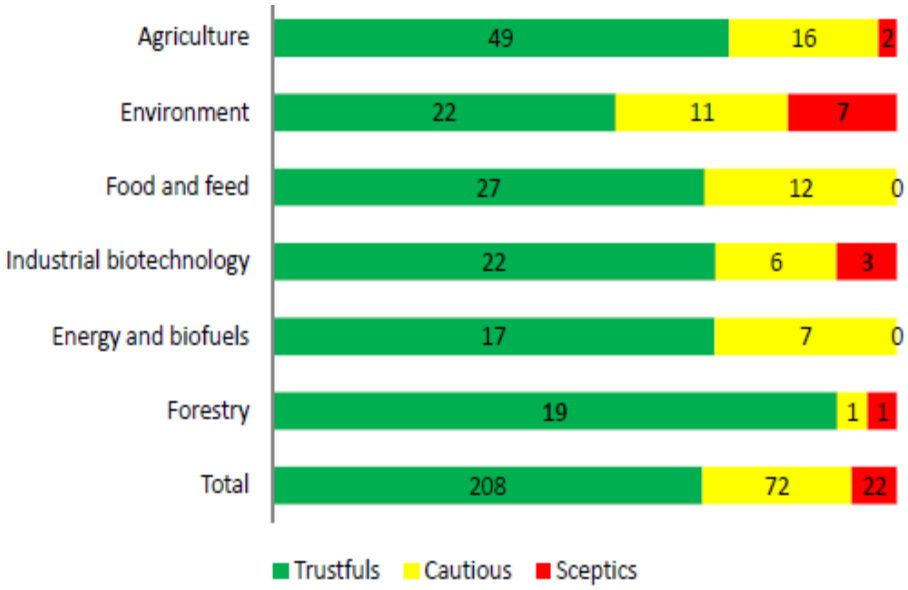
Attitude research EU





1. Research to be translated into behavioural change
2. Lack of general public information and understanding of sustainable biobased economy
3. Lack of policy coordination and insufficiant linkages between policy and stakeholders
4. Need to engage society in the transition towards the biobased economy –

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ME4 Interactive tool for the specification and assessment of bio-energy chains

The overall objective of the ME4 tool is to assess opportunities and spatial implications of biomass delivery chains for energy, biofuels and bio-chemicals

Project Partners

Wageningen UR

- AFSG – Valorisation of Plant Production chains
- AFSG – Biobased Products division
- ESG – Alterra

Energy research Centre of the Netherlands (ECN)

Copernicus Institute Utrecht University

KEMA

Project Details

January 2007- June 2011

Duration: 4.5 years

Budget: 2075 kEuro

Main financer: **Climate changes spatial planning**

climate changes spatial planning

Co-financing:

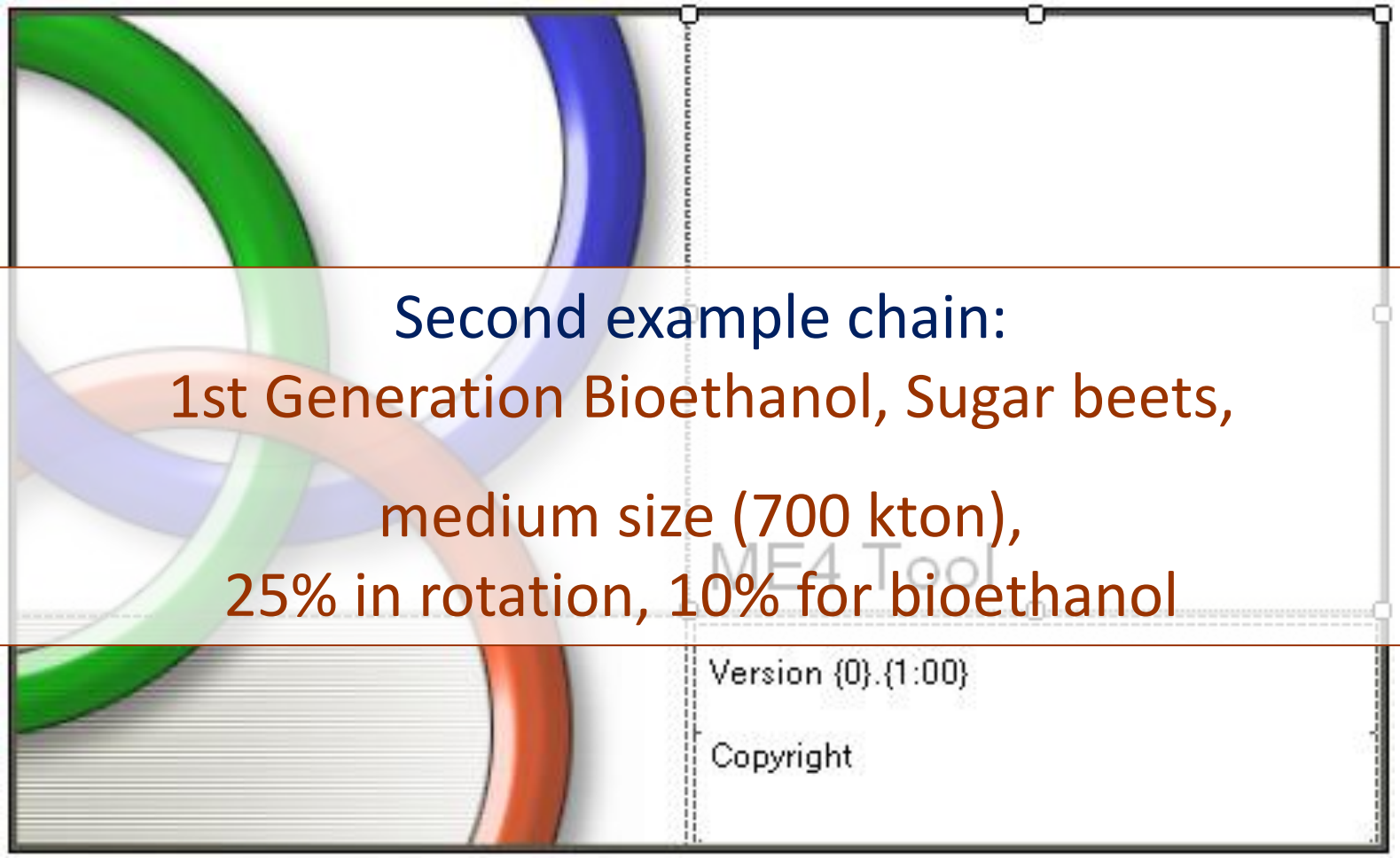
agriculture, nature and food quality

ME4 tool –different modes for different purposes

- Tackling uncertainty by increasing understanding
- Dealing with perceptions by objective ‘facts’
- Overcoming passive behaviour by enabling regional collaboration

ME4 as a tool to increase understanding

- Who? Public and private sector
- Uncertainty:
  - What kind of biomass?
  - How much biomass?
  - Return?



Second example chain:

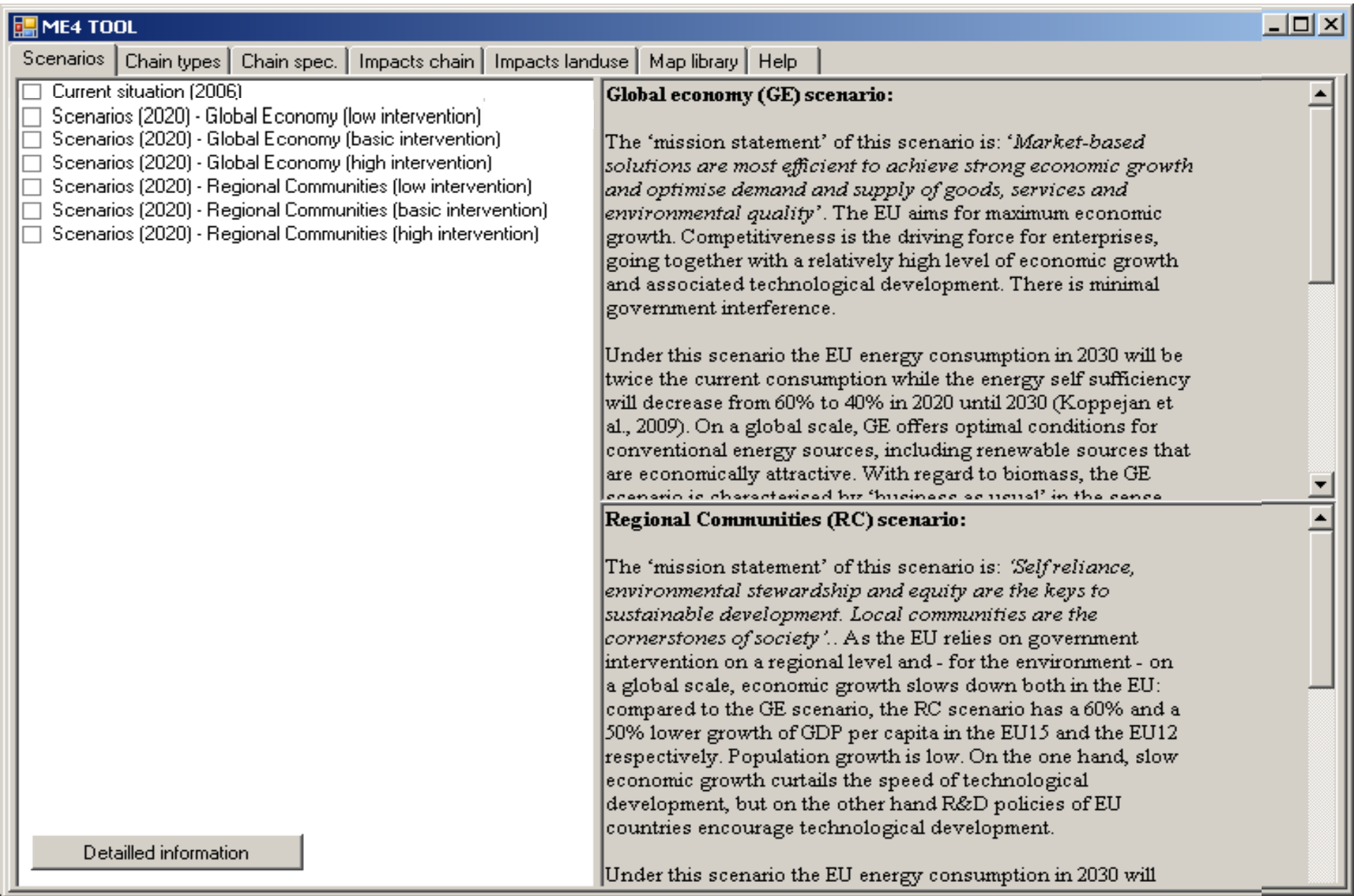
1st Generation Bioethanol, Sugar beets,

medium size (700 kton),

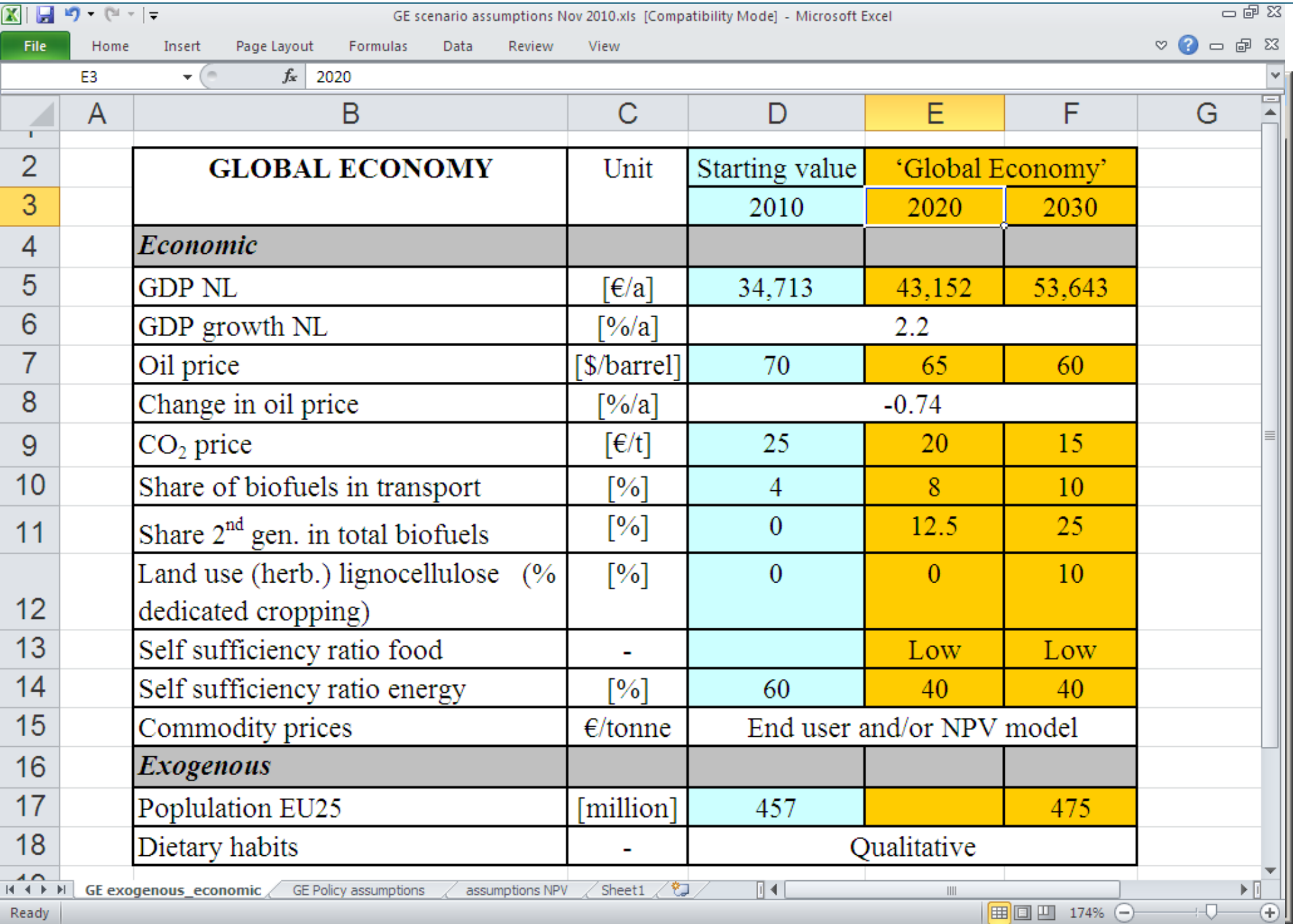
25% in rotation, 10% for bioethanol

Step 1: Choose a scenario (after reading the descriptions below)

Scenario: GE low



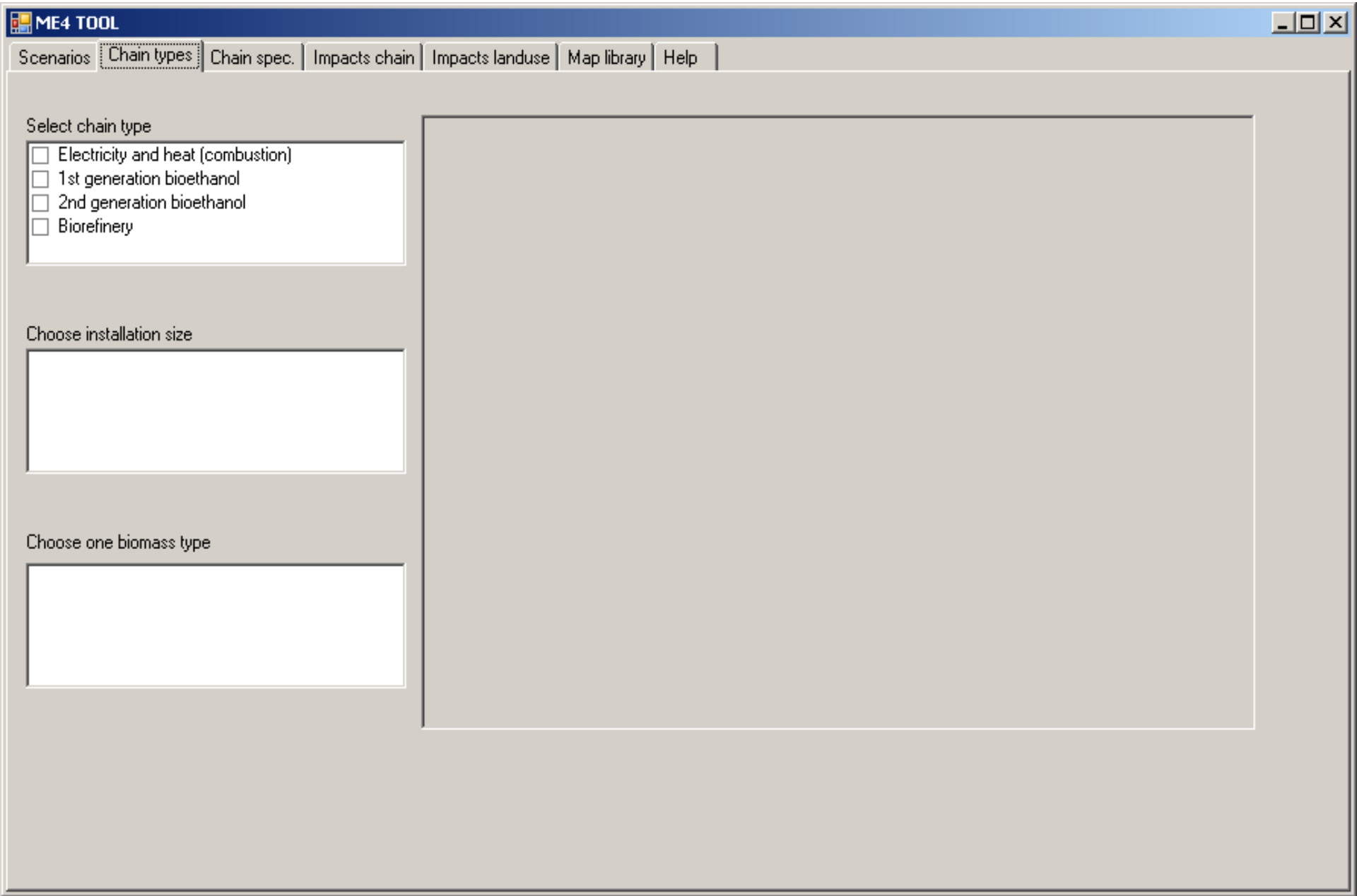
Step 1: Choose a scenario: detailed information (in excel)



GLOBAL ECONOMY	Unit	Starting value	'Global Economy'	
		2010	2020	2030
Economic				
GDP NL	[€/a]	34,713	43,152	53,643
GDP growth NL	[%/a]	2.2		
Oil price	[$/barrel]	70	65	60
Change in oil price	[%/a]	-0.74		
CO_2 price	[€/t]	25	20	15
Share of biofuels in transport	[%]	4	8	10
Share 2nd gen. in total biofuels	[%]	0	12.5	25
Land use (herb.) lignocellulose (% dedicated cropping)	[%]	0	0	10
Self sufficiency ratio food	-		Low	Low
Self sufficiency ratio energy	[%]	60	40	40
Commodity prices	€/tonne	End user and/or NPV model		
Exogenous				
Poplulation EU25	[million]	457		475
Dietary habits	-	Qualitative		

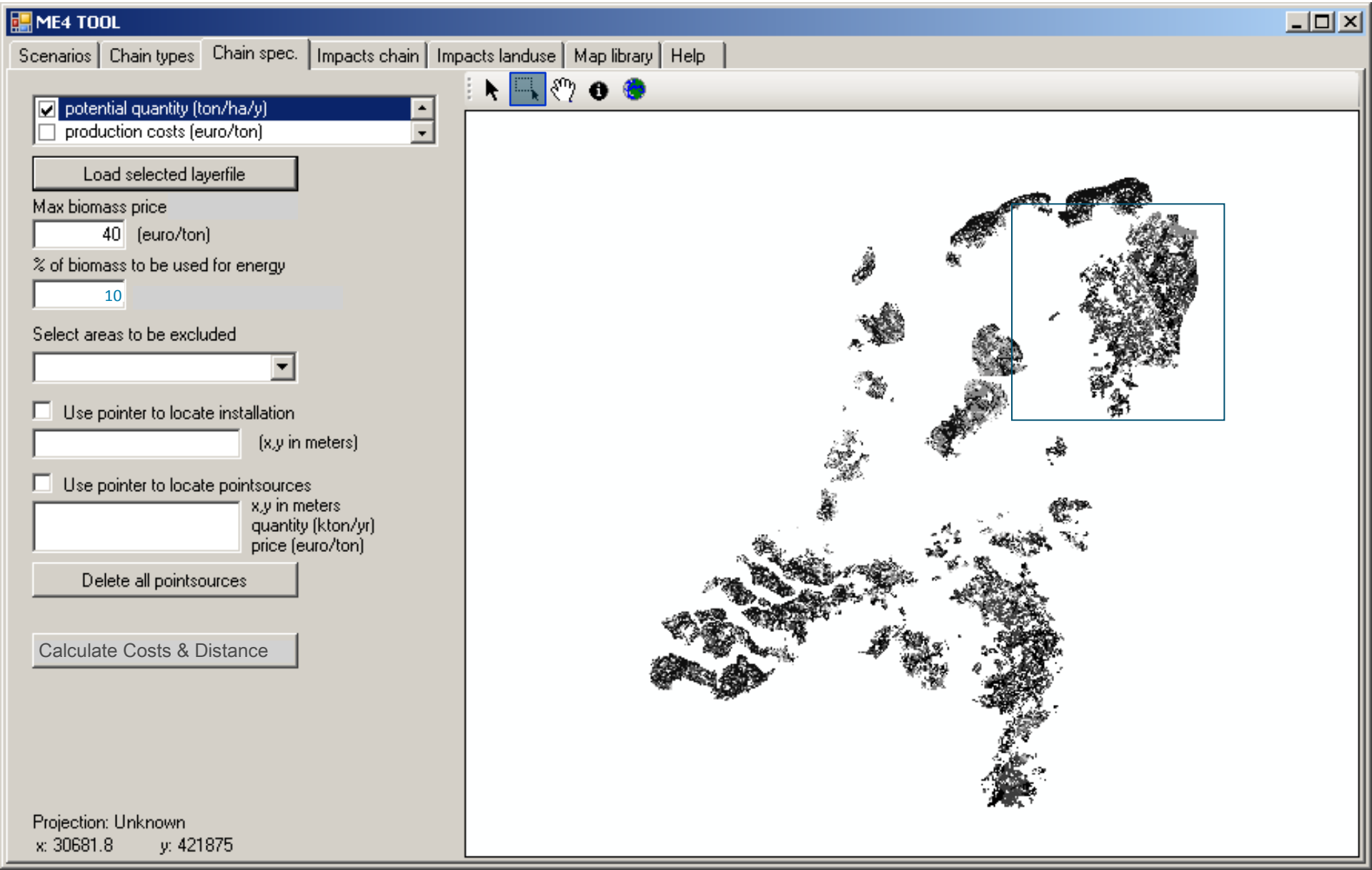
Step 2: Choose a chain type

Scenario: GE low



Step 3: Specify the chain: specify % biomass to be used (and zoom in)

Scenario: GE Low, 1st Generation Bioethanol, Sugar beets, 25% rotation , 10% for energy



Step 3: Specify the chain: choose location a

Scenario: GE Low, 1st Generation Bioethan

C:\WINDOWS\system32\cmd.exe - arc "&r oogsten 257955, 549

```
Biomass found in circle with radius 101.39 km
Quantity (tons/yr)              =    675859.31
Purchase costs (euro/yr)        =  22738954.01
Average costs (euro) per ton =         33.64
Transport distance in tonkm  = 355067297.79
```

ME4 TOOL

Scenarios | Chain types | Chain spec. | Impacts chain | Impacts landuse | Map library | Help

- [x] potential quantity (ton/ha/y)
- [ ] production costs (euro/ton)

Load selected layerfile

Max biomass price
40 (euro/ton)

% of biomass to be used for energy
10

Select areas to be excluded

- [ ] Use pointer to locate installation

(x,y in meters)

- [ ] Use pointer to locate pointsources

x,y in meters
quantity (kton/yr)
price (euro/ton)

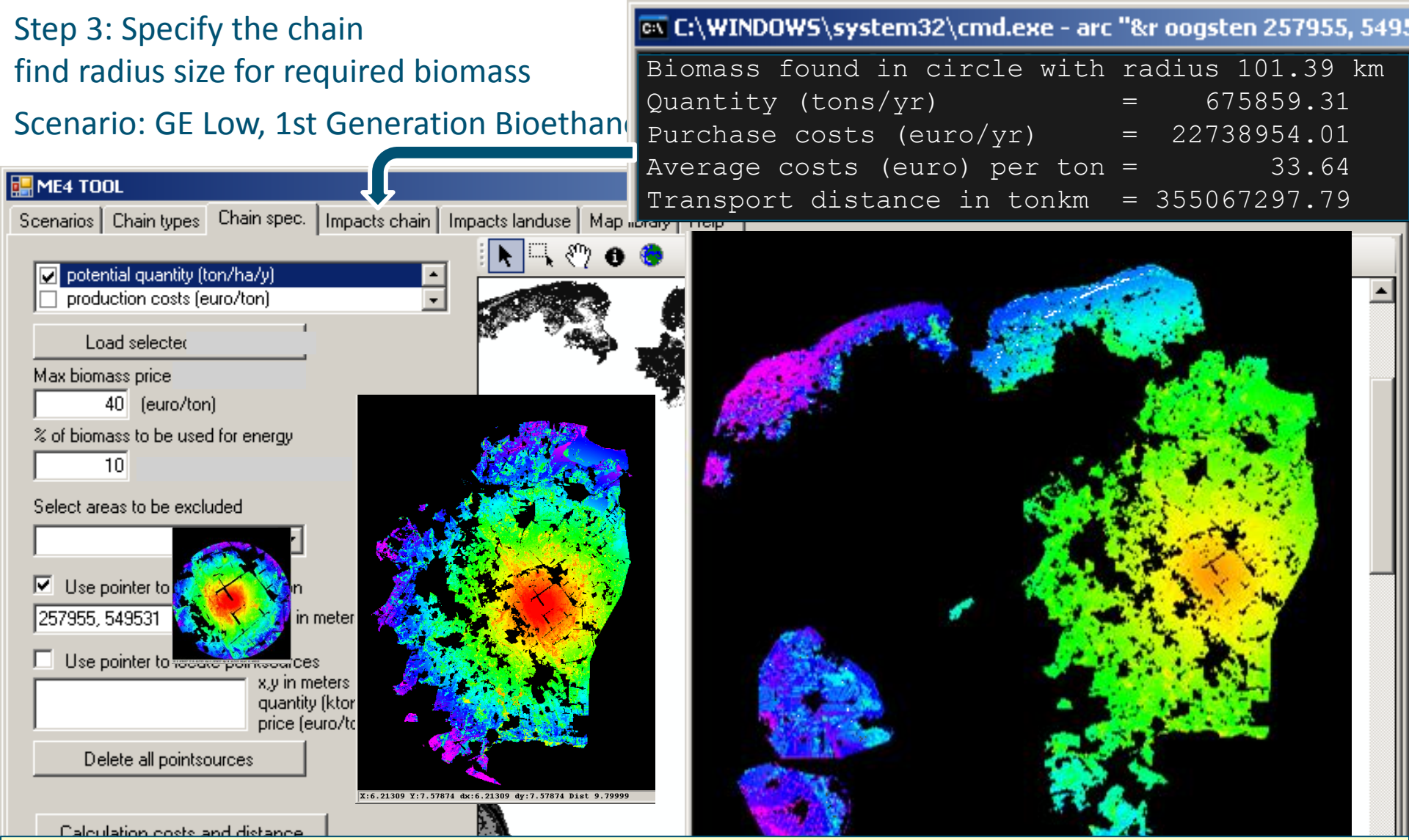
Delete all pointsources

Calculation costs and distance

Projection: Unknown
x: 257954.5 y: 549531.3

Step 3: Specify the chain
find radius size for required biomass

Scenario: GE Low, 1st Generation Bioethan



The coloured maps are (invisible) steps in finding the radius of the circle around the installation within which sufficient biomass from the biomass availability map can be collected. First the biomass quantity within a circle of 10 km around the installation is determined (1). Based on the biomass demand of the installation and the average biomass density in the first circle a radius size is estimated and the biomass availability in the 2nd circle is determined (2). By iteratively resizing, an approximate radius is found within which the required biomass quantity for the installation is available (3).

Step 4: Evaluate chain performance (with excel sheet)

Scenario: GE Low, 1st Generation Bioethanol, Sugar beets, 25% rotation, 10% for energy

ME4 TOOL

Scenarios | Chain types | Chain spec. | Impacts chain | Impacts landuse | Map library | Help

Evaluate impacts chain chain\Simple chain calculation Sugar.xls

Output simple chain calculation

Calculation number	1
Biomass chain name	Ethanol from sugar beet
Scenario name	GEL
Scenario policy variant	low
Scenario year	2020

Total throughput: [ton dm]

from sources	155,448

Revenues and costs: [euro]

heat revenues	0		
ethanol revenues	28,030,319	total revenues	28,030,319
purchase costs	5,229,959		
storage costs	0		
transport costs	9,569,064		
loading/unloading costs	169,506		
pretreatment costs	0		
drying costs	0		
conversion costs	4,557,171	total costs	19,525,700
		profit	8,504,619

Knowledge users

- Companies – to develop investment plans
- Development agencies and financial banks – to provide funding

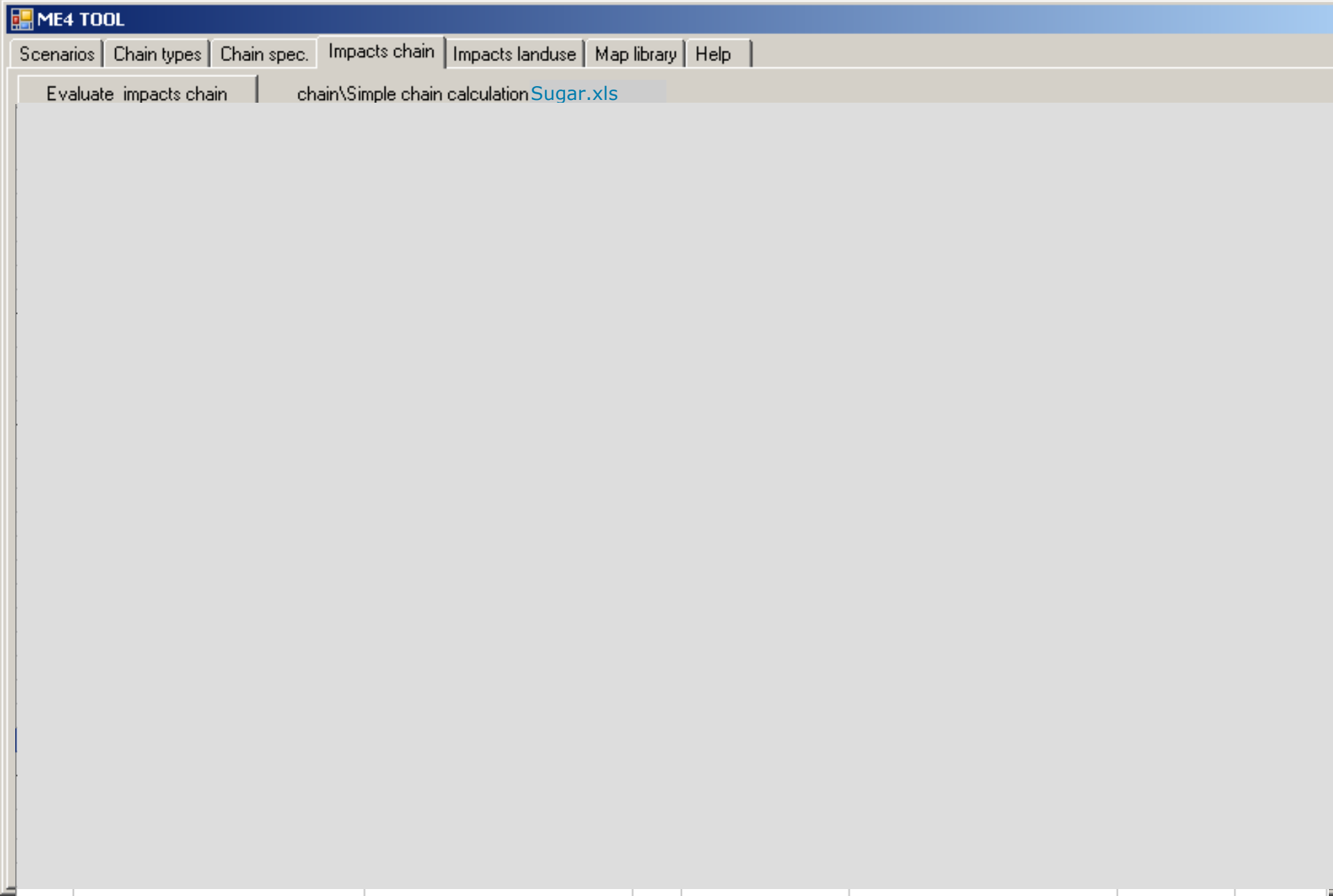
ME4 tool as a tool to enable collaboration and coordination

- Dealing with beliefs and enabling alignment
  - Unsustainable
  - Over-exploitation

Avoiding unsustainable practices

Step 4: Evaluate chain performance (with excel sheet)

Scenario: GE Low, 1st Generation Bioethanol, Sugar beets, 25% rotation, 10% for energy



Step 4: Evaluate chain performance (with excel sheet)

Scenario: GE Low, 1st Generation Bioethanol, Sugar beets, 25% rotation, 10% for energy

ME4 TOOL

Scenarios | Chain types | Chain spec. | Impacts chain | Impacts landuse | Map library | Help

Evaluate impacts chain — chain\Simple chain calculation Sugar.xls

Energy returns and use:

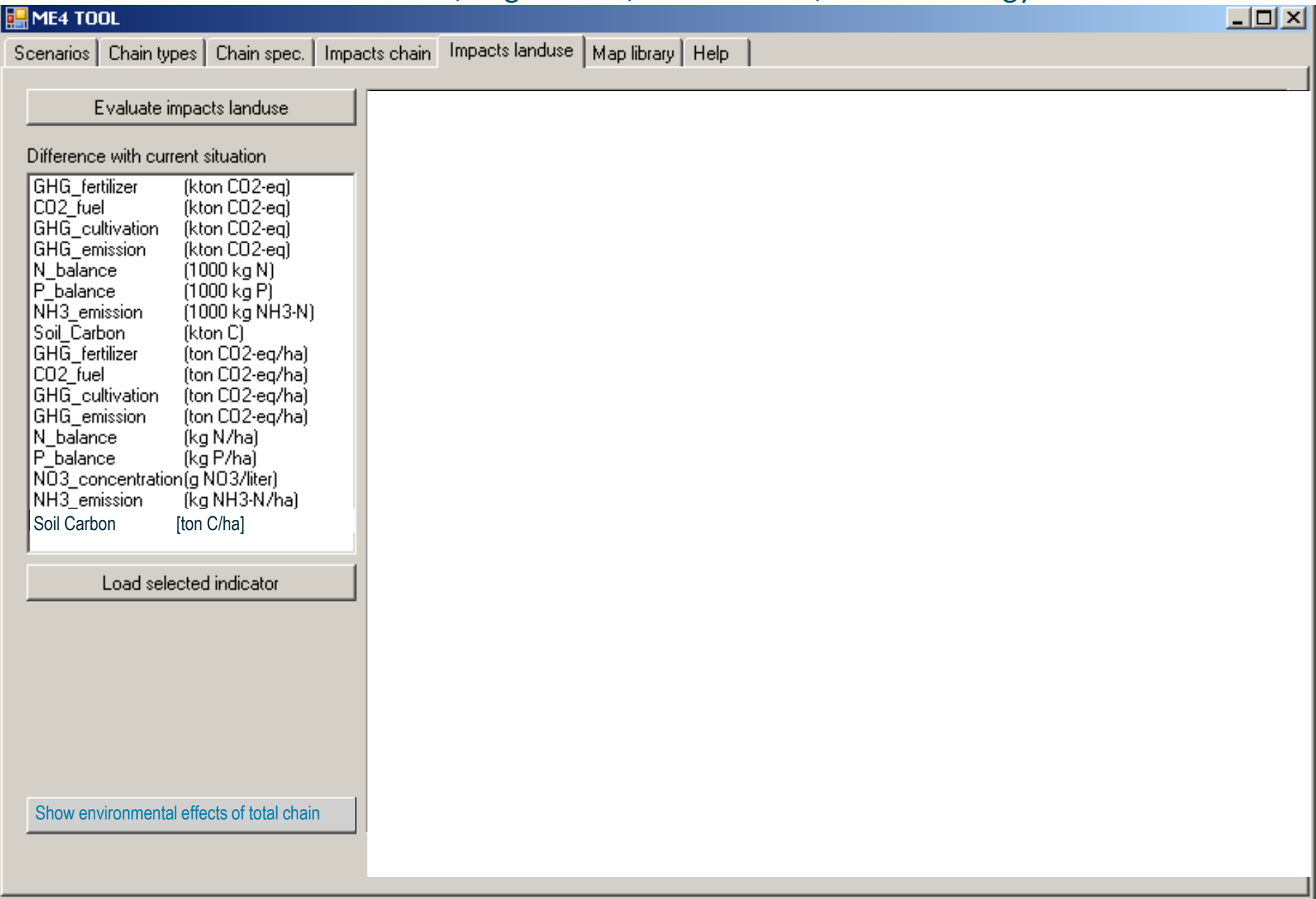
	[GJ]		
heat returns	0		
ethanol returns	1,401,516	total energy returns	1,401,516
energy used for purchase	250,426		
energy used for storage	0		
energy used for transport	397,675		
energy used for loading/unloading	1,166		
energy used for pretreatment	0		
energy used for drying	0		
energy used for conversion	456,725	total energy use	1,105,992
		energy profit	295,524

GreenHouse Gas avoided and emission

	[ton CO2-equivalents]		
heat GHG avoided	0		
ethanol GHG avoided	132,587	total GHG avoided	132,587
GHG emission for purchase	23,800	first rough estimate	
GHG emission for storage	0		
GHG emission for transport	29,566		
GHG emission for loading/unloading	87		
GHG emission for pretreatment	0		
GHG emission for drying	0		
GHG emission for conversion	33,956	total GHG emission	87,408
		net GHG avoided	45,179
first rough estimate of % Mitigation (net versus total GHG avoided)			34.07%

Step 5: Evaluate impacts of Land use change: GE low *versus* Current situation 2010

Chain: 1st Generation Bioethanol, Sugar beets, 25% rotation, 10% for energy



Step 5: Evaluate impacts of Land use change: GE low *versus* Current situation 2010

Chain: 1st Generation Bioethanol, Sugar beets, 25% rotation, 10% for energy

ME4 TOOL

Scenarios | Chain types | Chain spec. | Impacts chain | Impacts landuse | Map library | Help

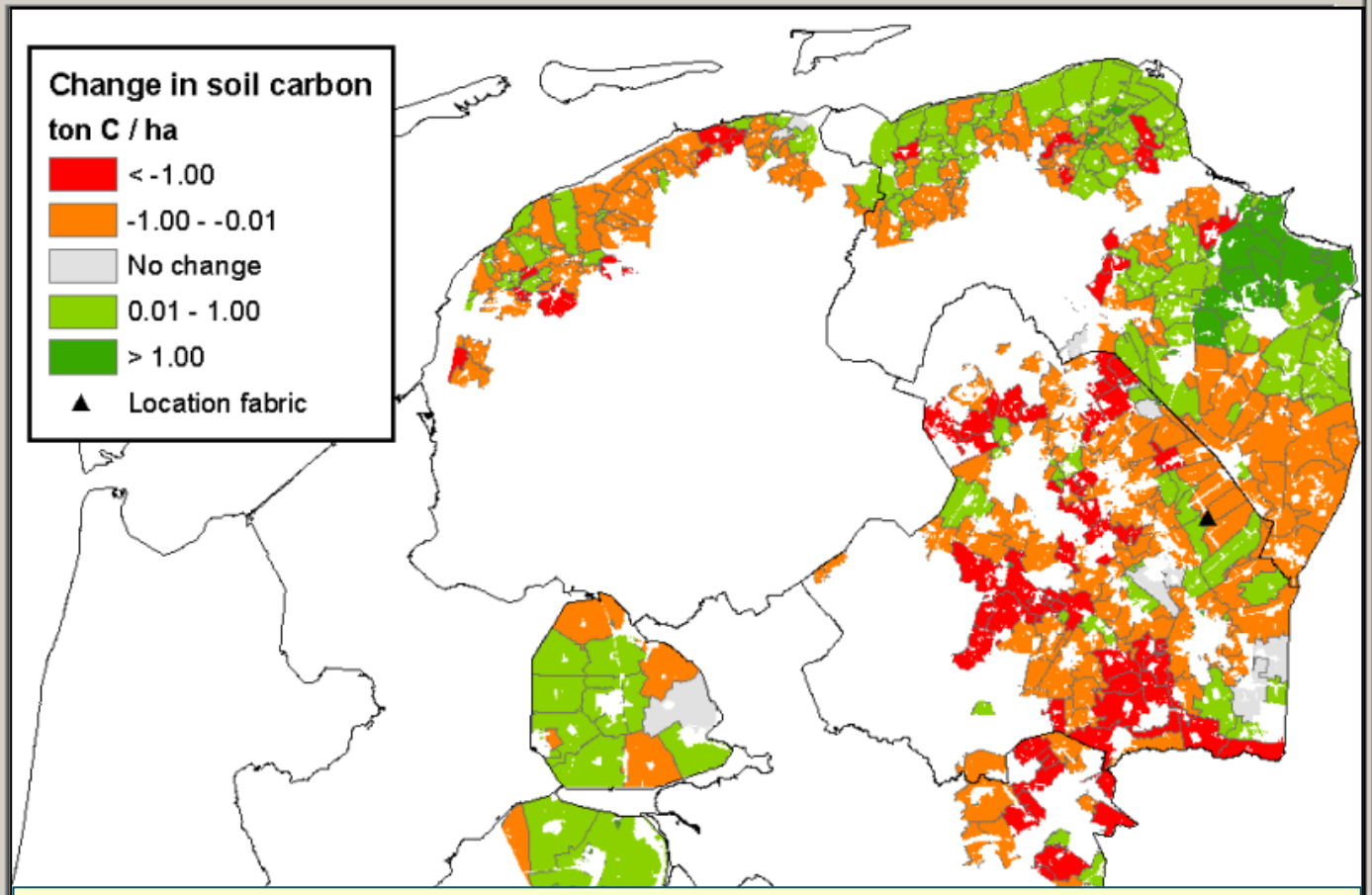
Evaluate impacts landuse

Difference with current situation

GHG_fertilizer	(kton CO2-eq)
CO2_fuel	(kton CO2-eq)
GHG_cultivation	(kton CO2-eq)
GHG_emission	(kton CO2-eq)
N_balance	(1000 kg N)
P_balance	(1000 kg P)
NH3_emission	(1000 kg NH3-N)
Soil_Carbon	(kton C)
GHG_fertilizer	(ton CO2-eq/ha)
CO2_fuel	(ton CO2-eq/ha)
GHG_cultivation	(ton CO2-eq/ha)
GHG_emission	(ton CO2-eq/ha)
N_balance	(kg N/ha)
P_balance	(kg P/ha)
NO3_concentration	(g NO3/liter)
NH3_emission	(kg NH3-N/ha)
Soil_Carbon	(ton C/ha)

Load selected indicator

Show environmental effects of total chain



Explanation In the red and orange areas the carbon stock in the soil will decline due to an increase of sugar beet area at the expense of arable crops with higher C input to the soil e.g. cereals.
In the green areas the soil carbon will increase due to a replacement of arable crops with lower C input to the soil (e.g. potato) by sugar beet.

Step 5: Evaluate impacts of Land use change: GE low *versus* Current situation 2010

Chain: 1st Generation Bioethanol, Sugar beets, 25% rotation, 10% for energy

ME4 TOOL

Scenarios | Chain types | Chain spec. | Impacts chain | Impacts landuse | Map library | Help

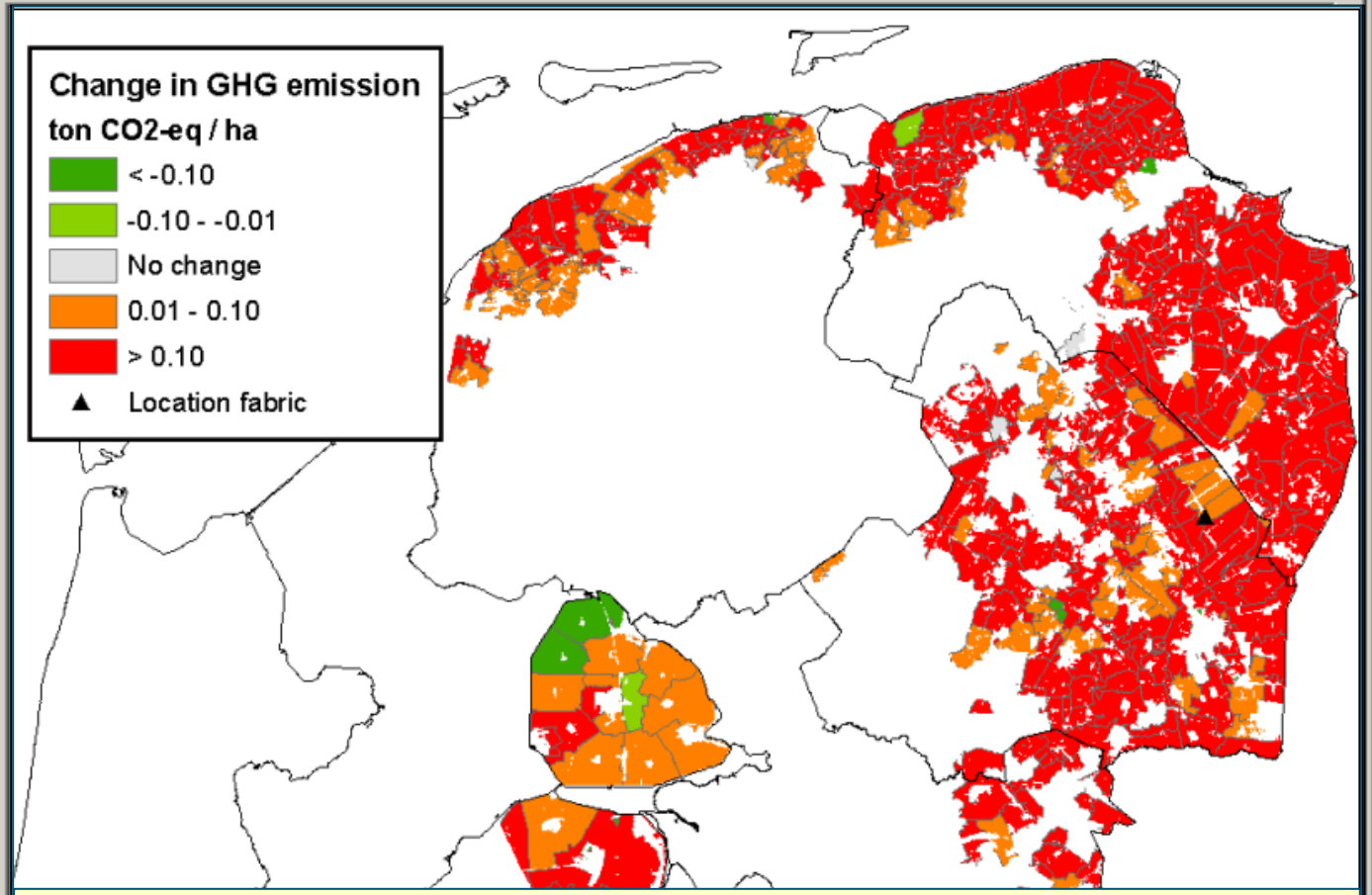
Evaluate impacts landuse

Difference with current situation

GHG_fertilizer	(kton CO2-eq)
CO2_fuel	(kton CO2-eq)
GHG_cultivation	(kton CO2-eq)
GHG_emission	(kton CO2-eq)
N_balance	(1000 kg N)
P_balance	(1000 kg P)
NH3_emission	(1000 kg NH3-N)
Soil_Carbon	(kton C)
GHG_fertilizer	(ton CO2-eq/ha)
CO2_fuel	(ton CO2-eq/ha)
GHG_cultivation	(ton CO2-eq/ha)
GHG emission	**(ton CO2 eq/ha)**
N_balance	(kg N/ha)
P_balance	(kg P/ha)
NO3_concentration	(g NO3/liter)
NH3_emission	(kg NH3-N/ha)
Soil Carbon	(ton C/ha)

Load selected indicator

Show environmental effects of total chain



Explanation In the red and orange areas the GHG emissions will increase due to a shift from less intensive crops (e.g. cereals) to sugar beet, which has higher nutrient requirements and requires a higher fuel consumption. Only in a few areas the GHG emissions will decrease due to a shift from highly intensive crops (e.g. flower bulbs) to sugar beet.

Environmental effects of total chain GE low

Chain: 1st Generation Bioethanol, Sugar beets, 25% rotation, 10% for energy

ME4 TOOL

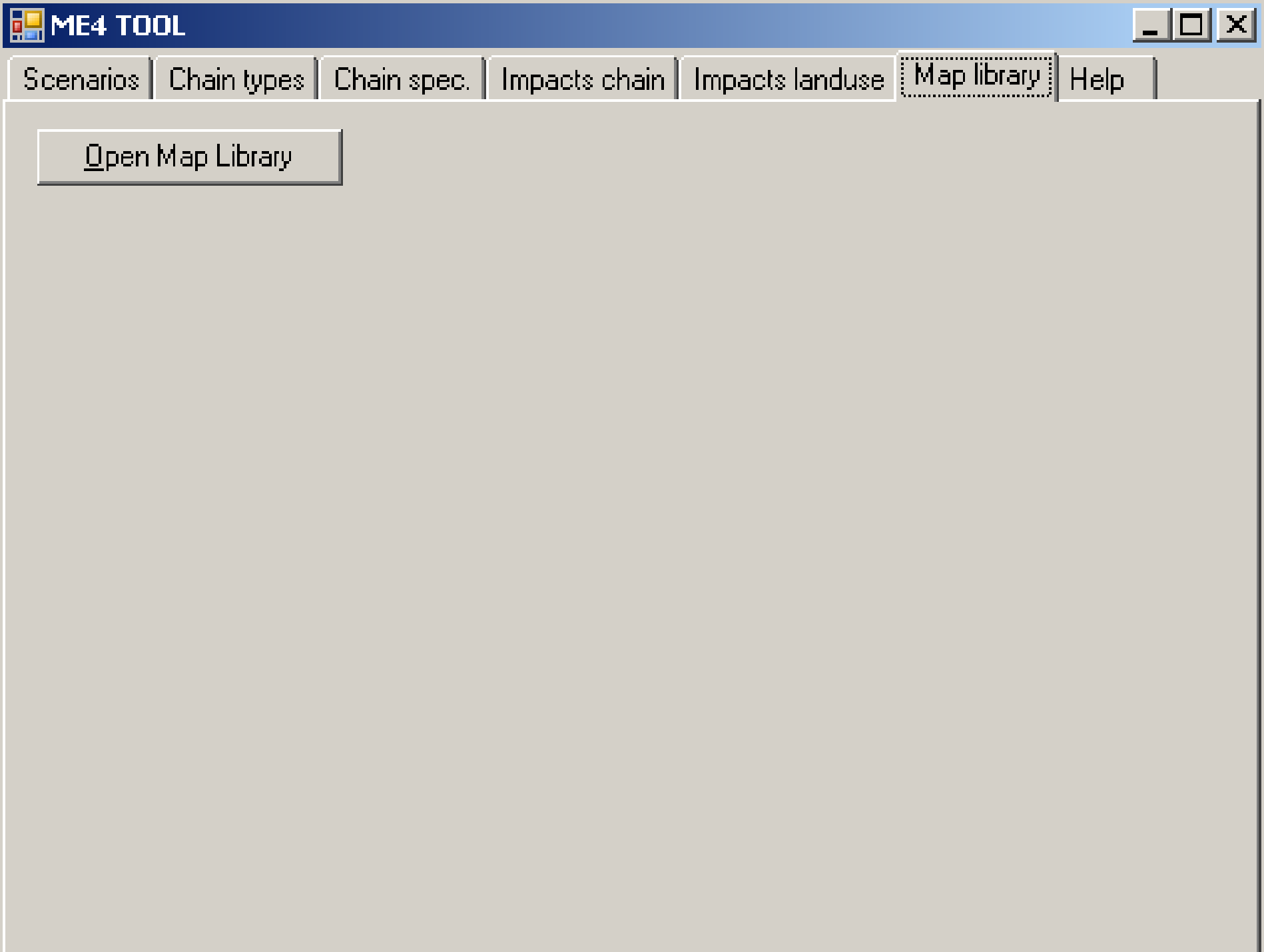
Scenarios | Chain types | Chain spec. | Impacts chain | Impacts landuse | Map library | Help

Environmental effects of total chain

GHG emissions and mitigation of total chain		GHG during cultivation	Total GHG emissions
1000 Kg CO2	GHG emissions from fertiliser production	190	
1000 Kg CO2	GHG emissions from fuel consumption for crop mechanisation	2,349	
1000 Kg CO2	GHG emission from cultivation (soil N_2O emission + CO_2 from peat soils)	34,965	37,504
		GHG after cultivation	
1000 Kg CO2	GHG emission for storage	0	
1000 Kg CO2	GHG emission for transport	29,566	
1000 Kg CO2	GHG emission for loading/unloading	87	
1000 Kg CO2	GHG emission for pretreatment	0	
1000 Kg CO2	GHG emission for drying	0	
1000 Kg CO2	GHG emission for conversion	33,956	63,609
		Total GHG emission:	**101,113**
		Total GHG avoided	**Net GHG avoided**
1000 Kg CO2	ethanol GHG avoided	**132,587**	**31,474**
	% Mitigation (Net GHG avoided versus Total GHG avoided)		**23.74%**

Environmental effects of direct land use changes (as compared to present land use)		
1000 Kg N	Change in nitrogen soil surplus due to land use change	-1.26
1000 Kg P	Change in phophorus soil surplus due to land use change	0.02
1000 Kg NH3-N	Change in ammonia emission due to land use change	0.00
1000 Kg CO2	CO_2 emission from changes in soil carbon due to land use change	89
1000 Kg CO2	Net difference in GHG emissions resulting from land use change	1,515

Coordinating exploitation


ME4 TOOL
Scenarios
Chain types
Chain spec.
Impacts chain
Impacts landuse
Map library
Help
Open Map Library

Maplibrary.mxd - ArcMap - ArcView

File Edit View Bookmarks Insert Selection Tools Window PLTS Help

1:2,624,233

100%

Spatial Analyst

Layer: Gewassenkaart 2007

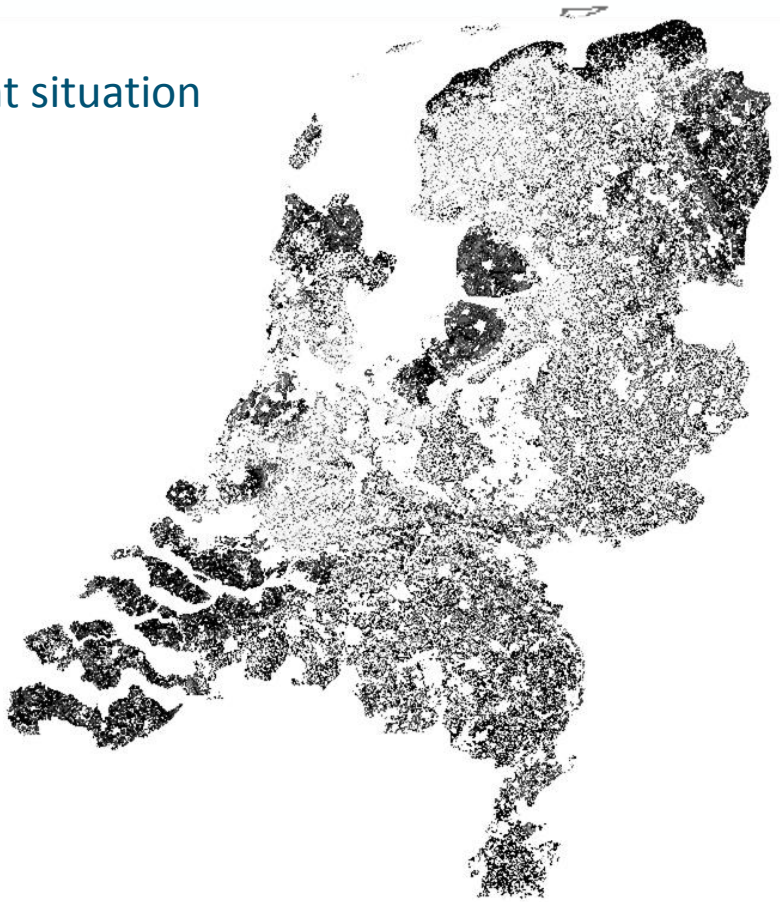
Yields & Costs of biomass per Scenario

- Landsgrens 2010 Bridgis
- Miterra
- Miscanthus
- Straw
  - Current Situation
    - straw_cost
    - straw_yield
      - Value
      - High : 7.46
      - Low : 0.74
  - Global Economy
  - Regional Communities
- Sugarbeet

Display Source Selection

Potential Yield of straw

Current situation



Drawing Arial 10

-51982.188 310094.61 Meters

Maplibrary.mxd - ArcMap - ArcView

File Edit View Bookmarks Insert Selection Tools Window PLTS Help

1:2,624,233

Spatial Analyst Layer: Gewassenkaart 2007

- Yields & Costs of biomass per Scenario
  - Landsgrens 2010 Bridgis
  - Miterra
  - Miscanthus
  - Straw
  - Sugarbeet
    - mask_sugarbeet
    - Current Situation
    - Global Economy
      - Low intervention
        - sugb_cost
          - Value
          - High : 72.25
          - Low : 7.5
        - sugb_yield
          - Value
          - High : 5.016
          - Low : 0.51325
      - Base intervention
      - High intervention
    - Regional Communities

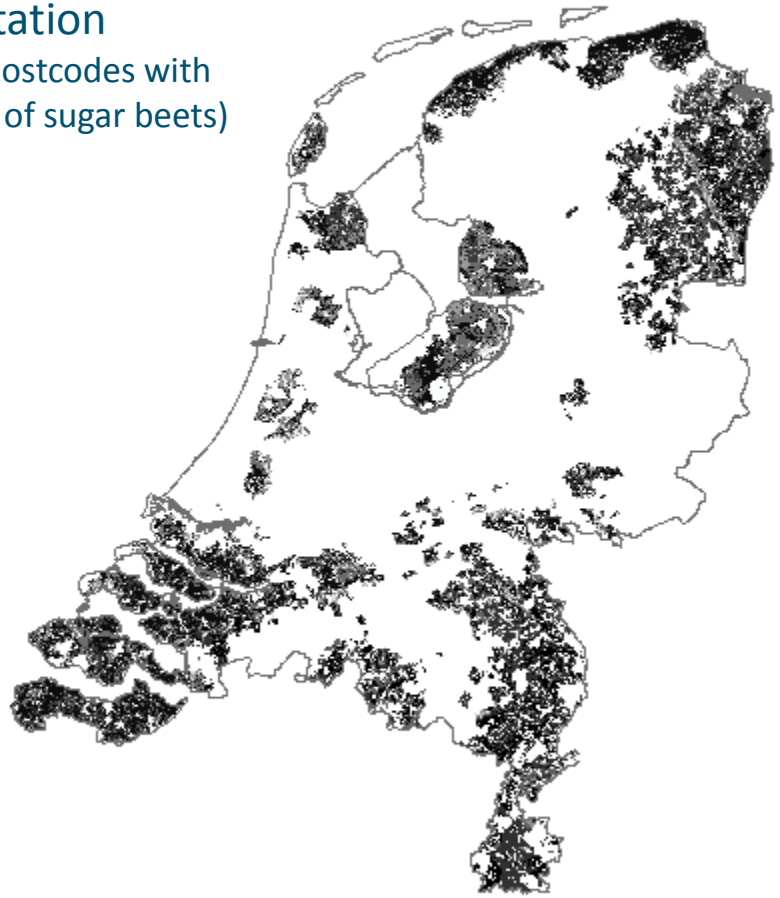
Display Source Selection

Potential yield of Sugar beet GEL

25% rotation

(mask = postcodes with >5% area of sugar beets)

GE low



Drawing Arial 10

118128.611 335784.813 Meters

Knowledge users

- Stakeholders in regional innovation processes
- Government

ME4 in Biobased transition

- Knowledge – the strength of mapping
  - Joint fact finding
  - Structuring complexity
  - Dialogue - making tacit knowledge explicit
  - Integration of science and practice
  - Developing regional strategies
  - Prioritizing options
  - Developing new business models/financial arrangements

Further information on ME4

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Further information on social aspects of biobased transition

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