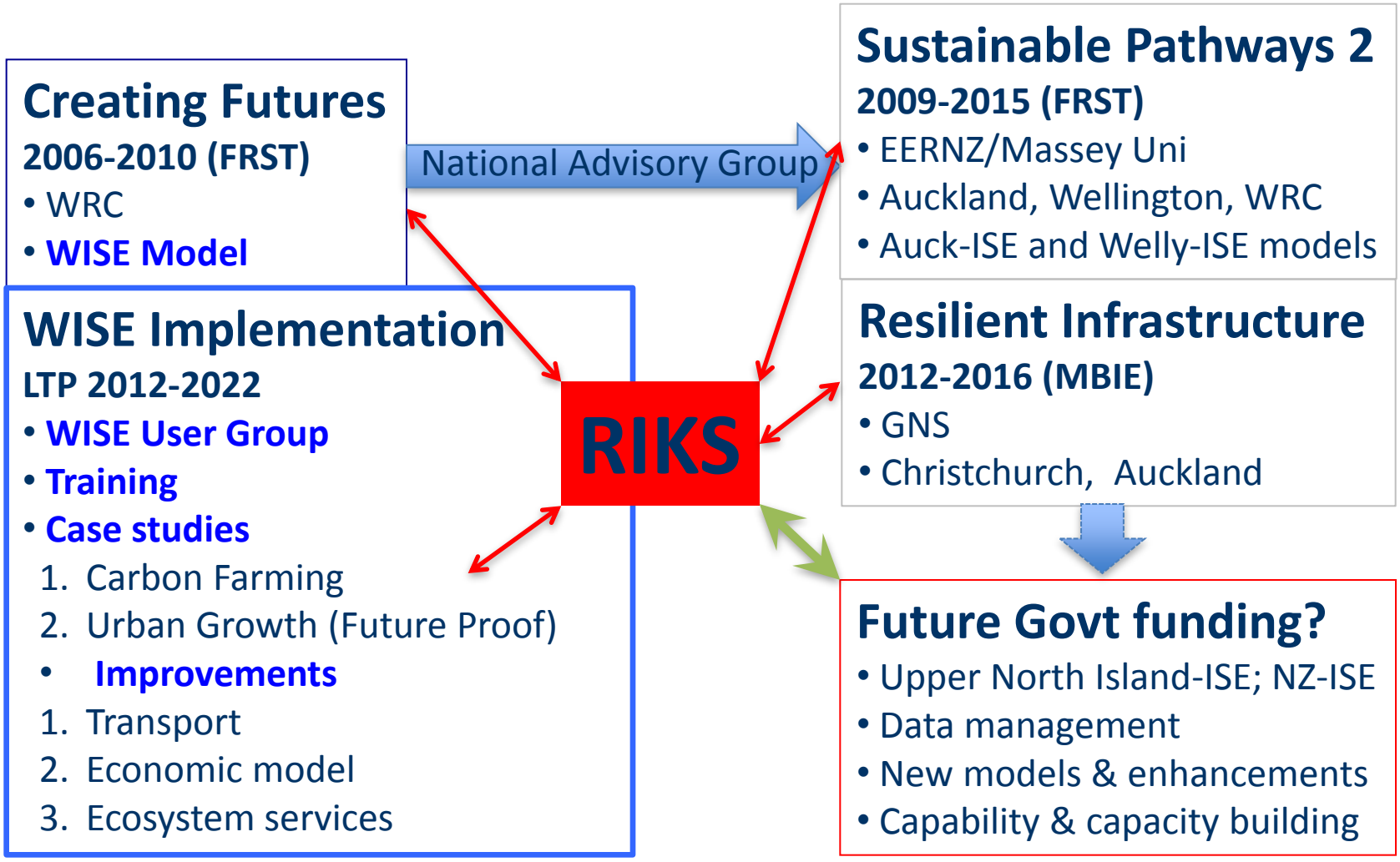
WISE User Group, 12 October 2012

Use of Spatial Models for Policy

Hedwig van Delden, RIKS

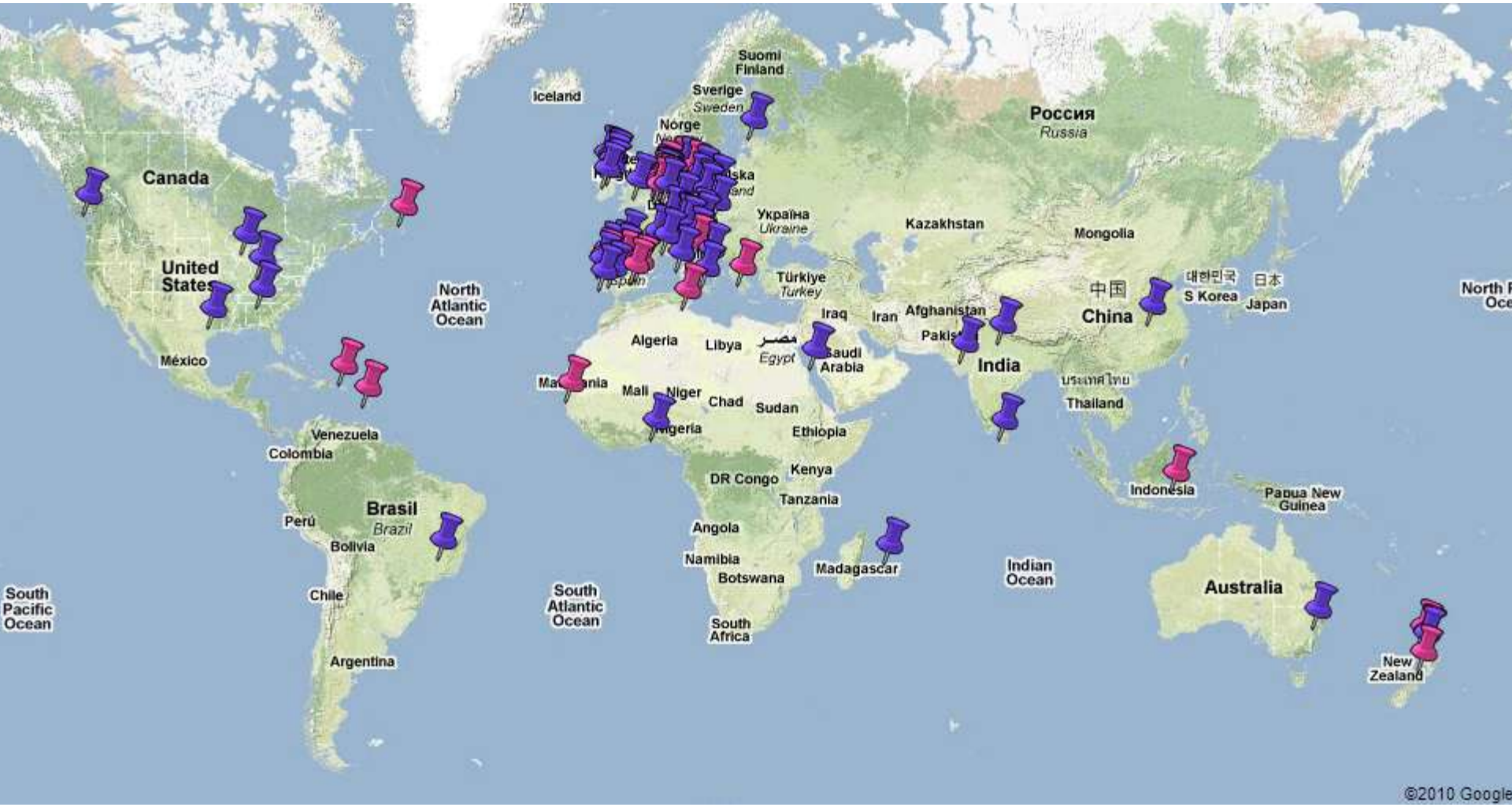
Developing Spatial Models



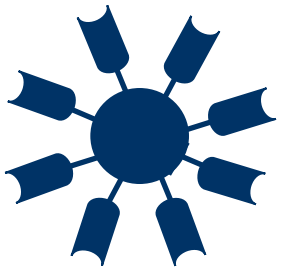
Use of models in integrated spatial planning in Europe

- Increasing interest in integrated approaches to show side-effects, trade-offs and win-win
- Good disciplinary knowledge and models, but knowledge on integration not always available
- Progress made in technology/IT
- Policy organisations have a need for integration, but political and bureaucratic processes can limit effective collaboration
- NZ has close links between science and policy

Geonamica applications in the world…

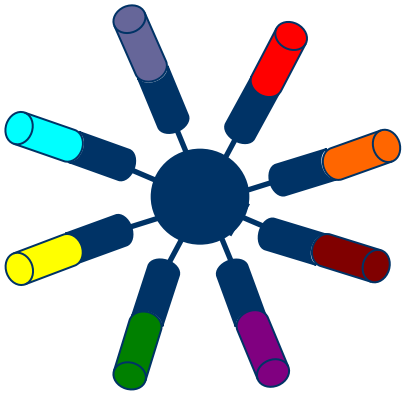


Model integration

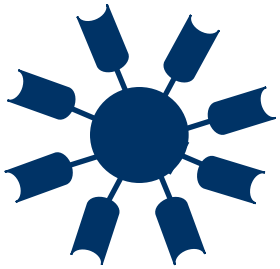


Geonamica model integration platform

- Land use
- Demography
- Economy
- Transport
- Climate
- Hydrology
- GIS datasets – statistical, use, cover, zoning, etc
- Other models



Integrated Scenario Explorer



GEONAMICA

Land use local level (RIKS – CA)

Regional interaction

Transport

Age cohort

Plant growth

Climate

Hydrology

…

Model library

DECISION SUPPORT SYSTEM (DSS)	APPLICATIONS
MOLAND	Greater Dublin, Northern Ireland, Friuli
Murbandy	Dublin, Prague, Vienna, Milan
Environment Explorer	Netherlands
BabyLOV	Greenheart
Xplorah	Puerto Rico
METRONAMICA	Estonia, Italy, Netherlands,
METRONAMICA SL	Vitoria, Poland, Belfast, New Zealand, Panama
ScenDes	Portugal, Sardinia, Sicily, Basilicata
LUMOCAP	EU-27
DeSurvey	Italy, Spain, Portugal
LADAMER	Mediterranean

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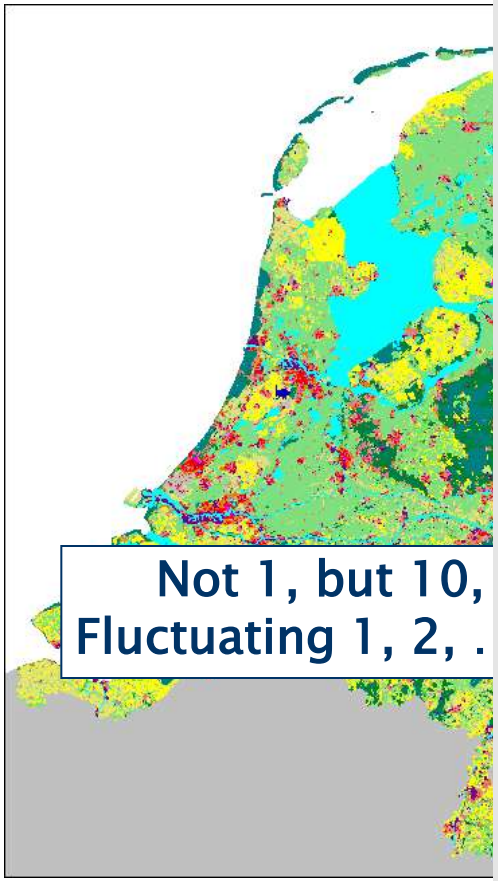
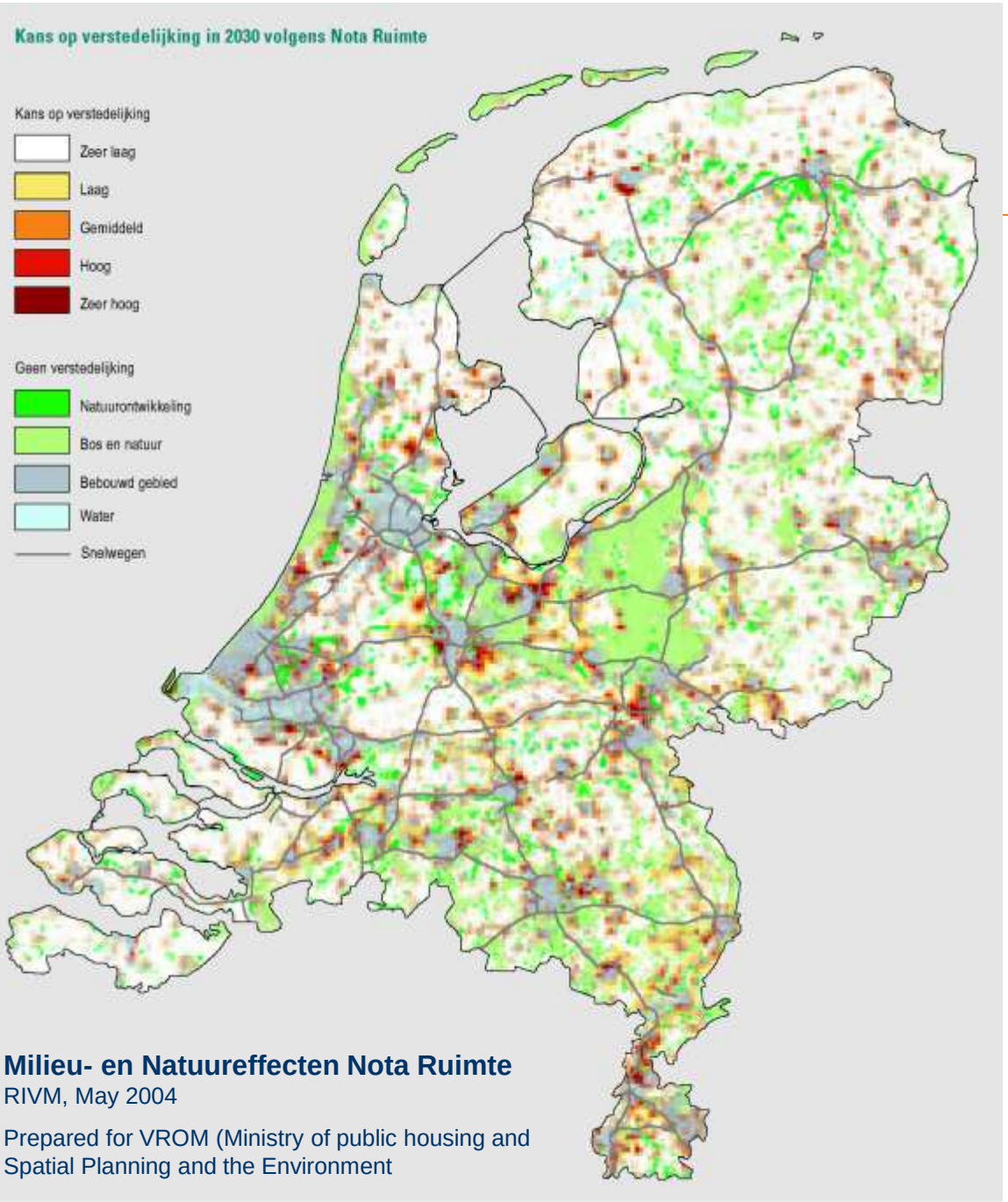


Not 1, but 10,
Fluctuating 1, 2, .



Milieu- en Natuureffecten Nota Ruimte
RIVM, May 2004

Prepared for VROM (Ministry of public housing and Spatial Planning and the Environment

Figuur 2.3: Modelmatige ruimtelijke projectie 2030 van de Nota Ruimte

Steps policy exercise Utrecht province

Preparation

- Interviews
- Construction of preference and zoning maps

Workshop 1: Design of alternatives

- Integration of sectoral maps
- Discussion and choice of alternative locations

Workshop 2: Calculation of the alternatives

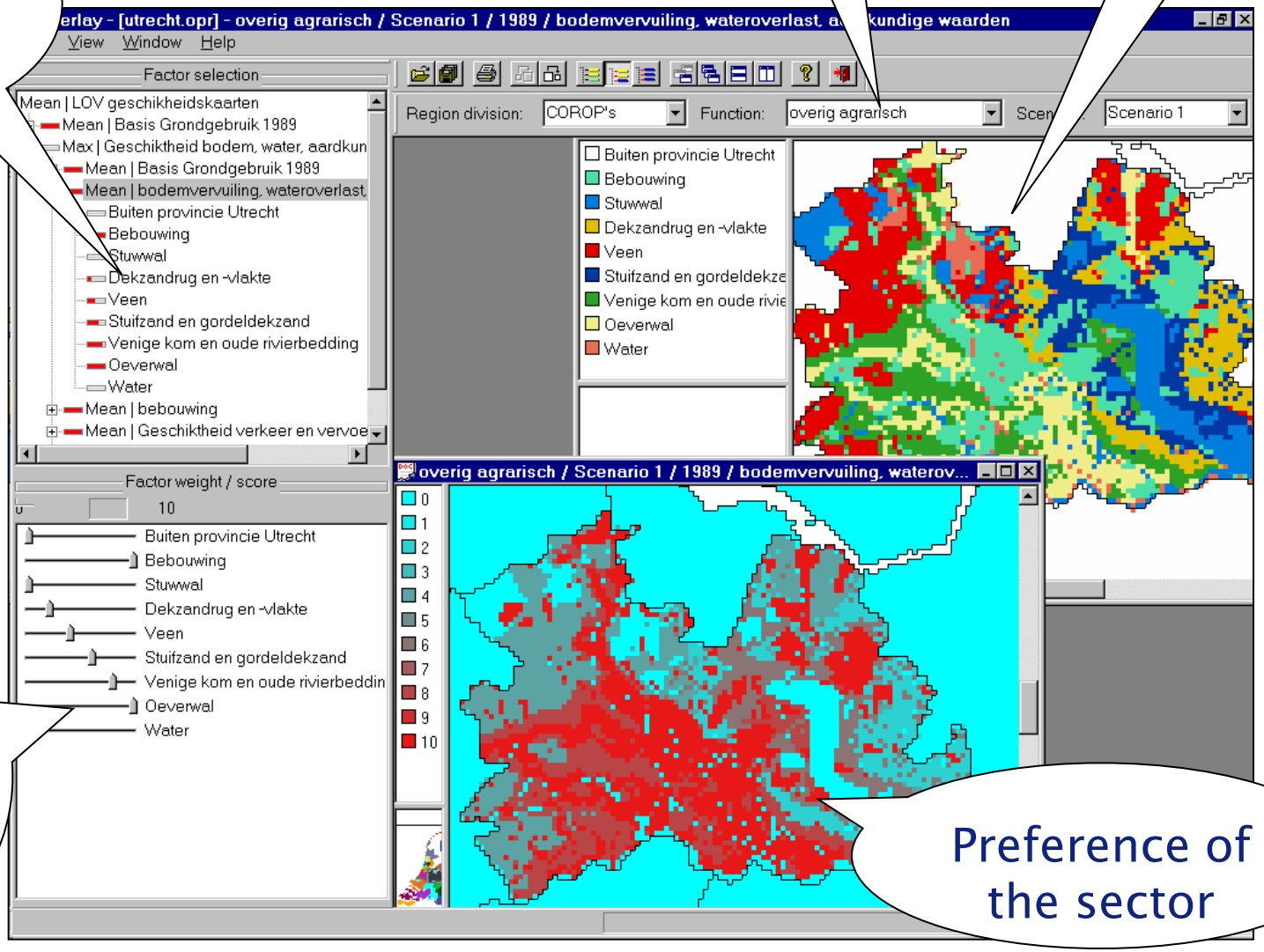
- Different growth figures
- Chosen alternatives
- Indicators
- Analysis of results and discussion

The preference maps

Land use function

Factor map

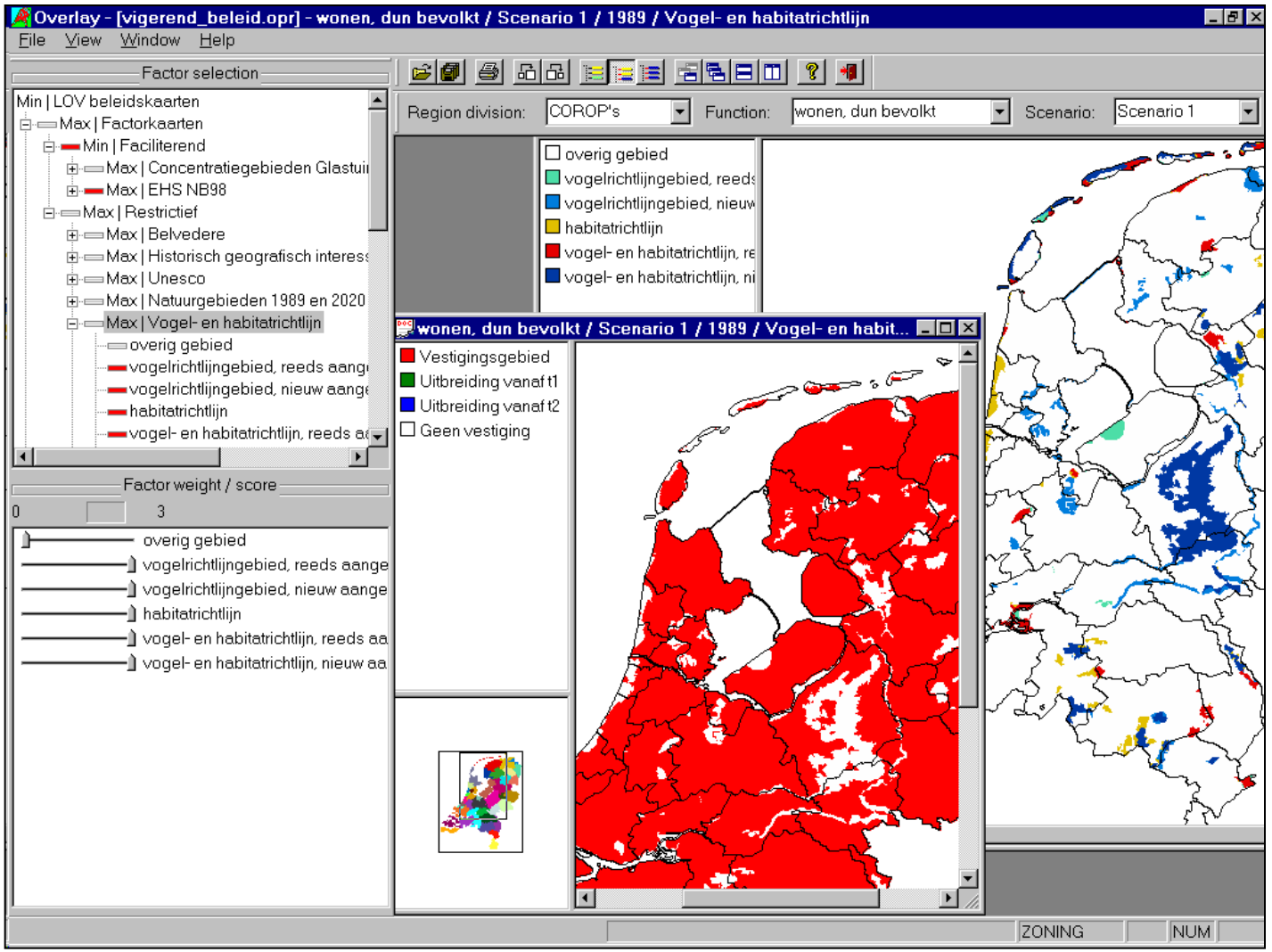
List of factor maps



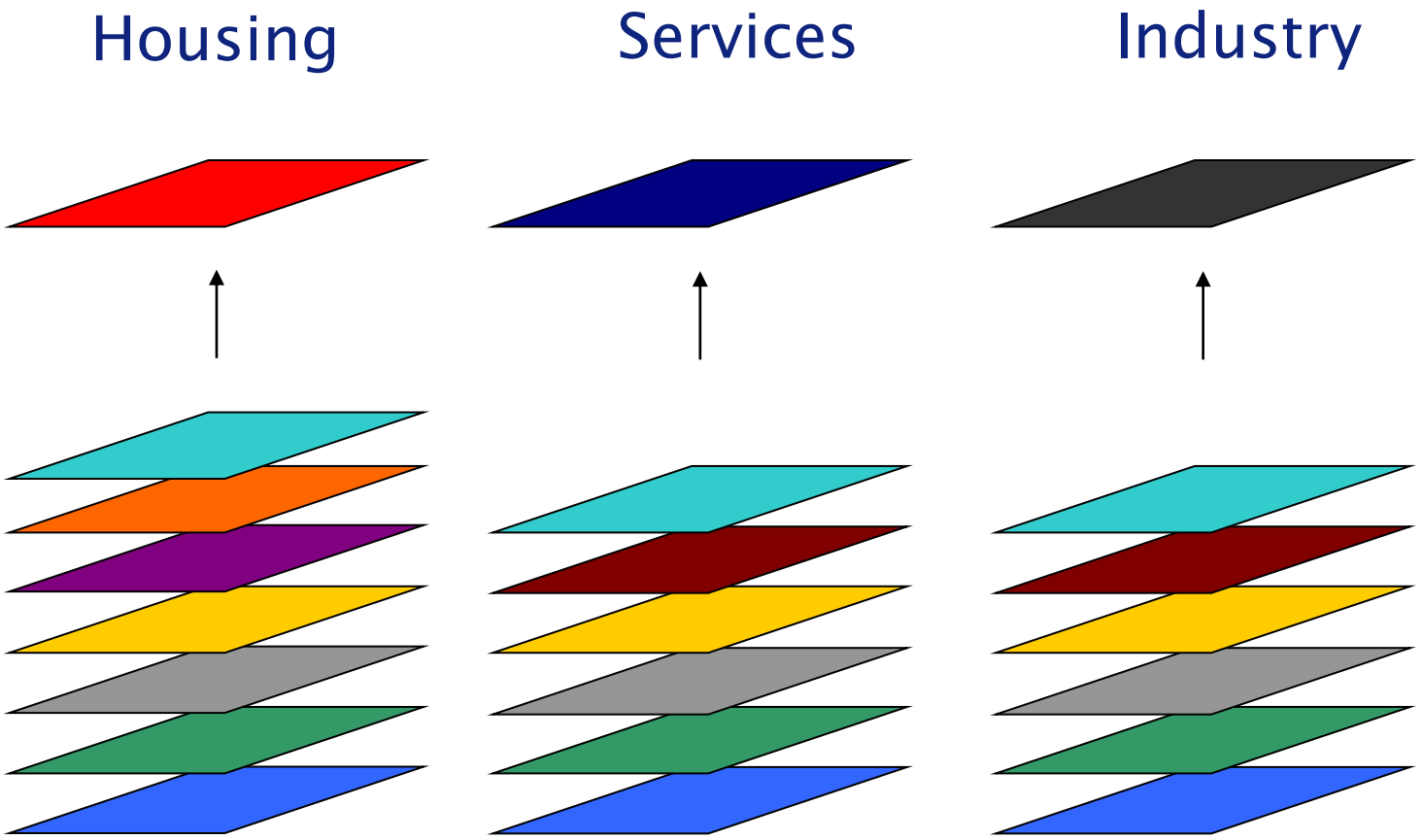
Giving a value to the legend items

Preference of the sector

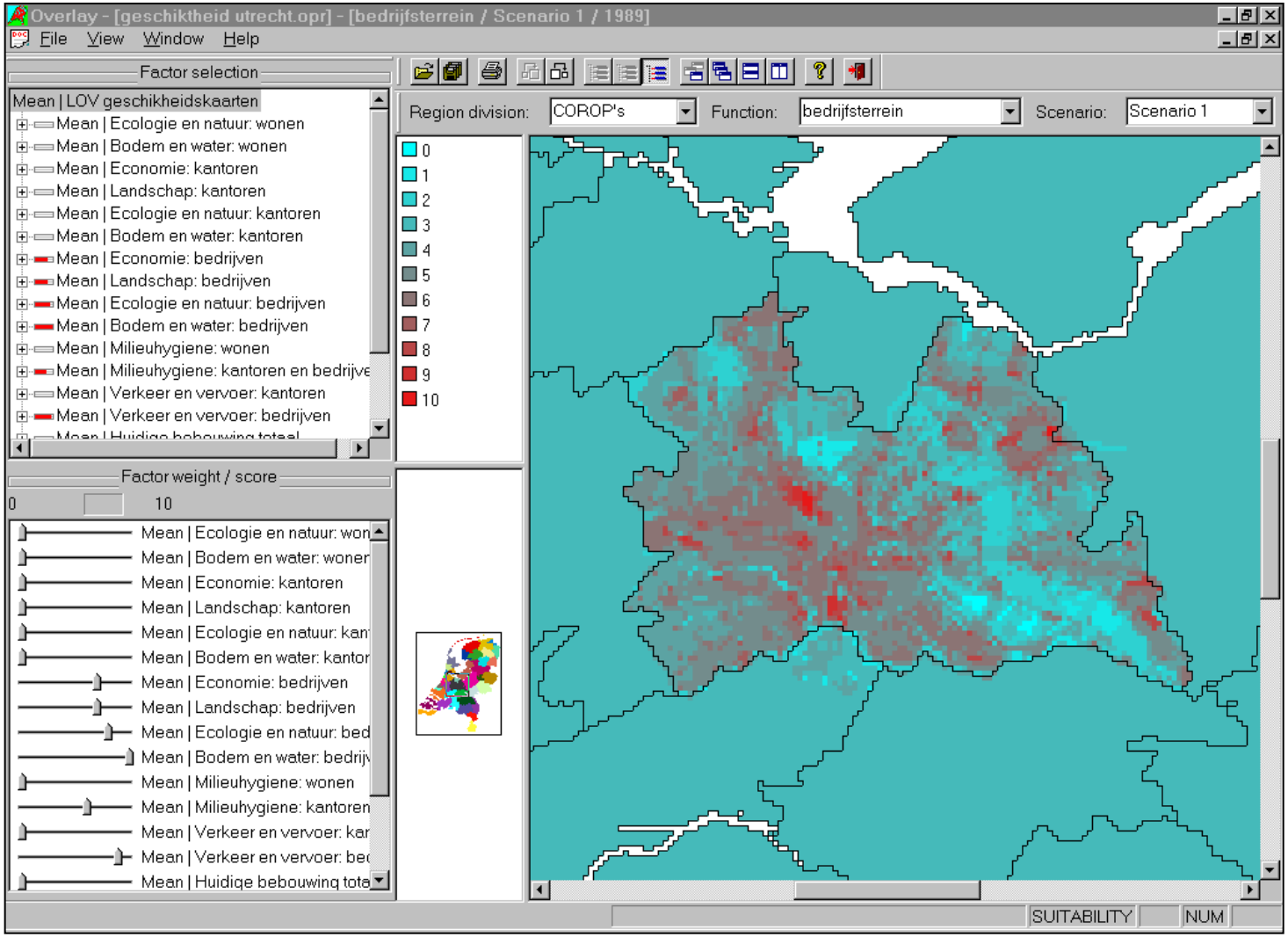
The zoning maps



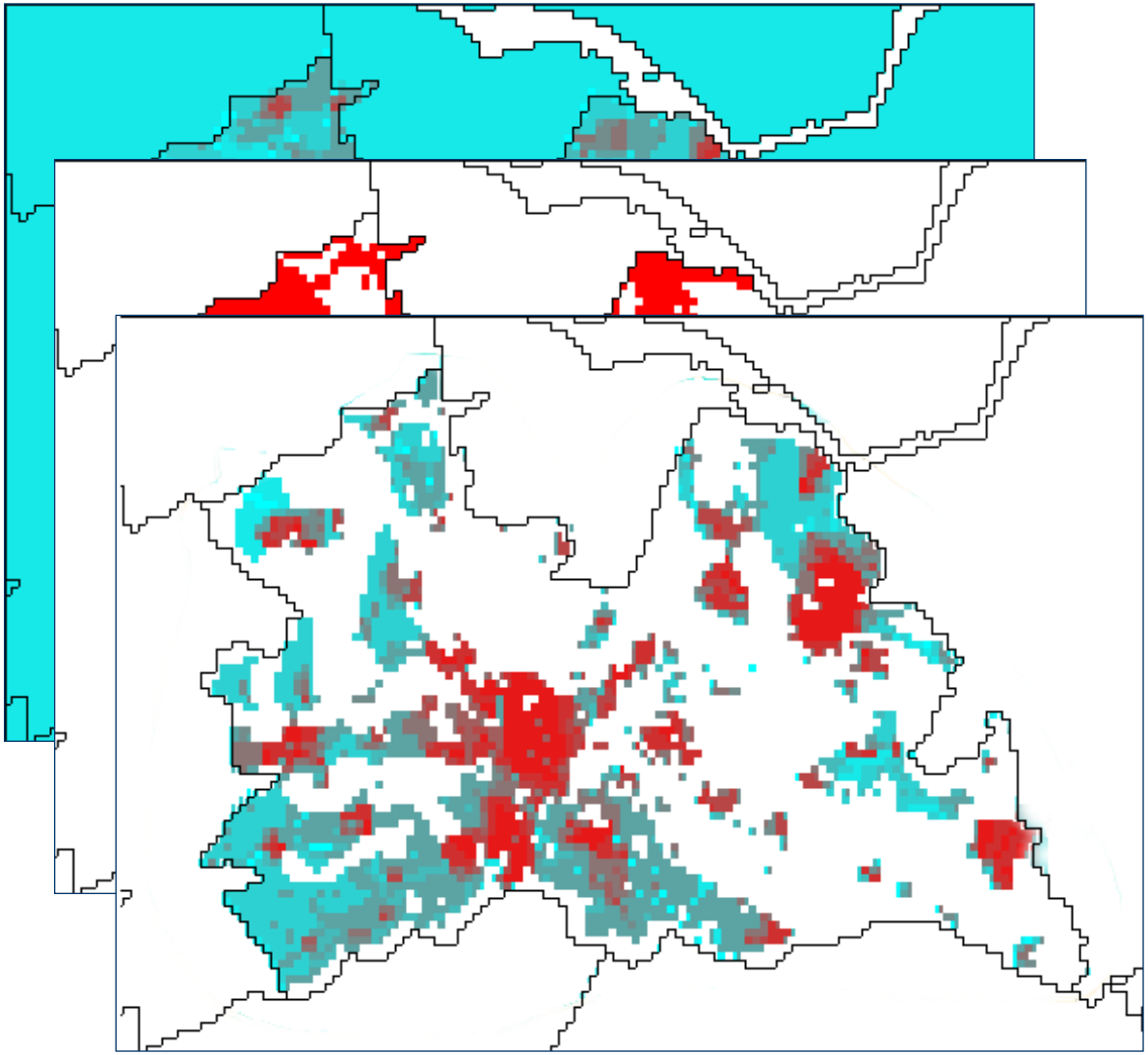
Combining the preference maps



Result of weighing the preference maps of the different sectors for industry



Combining zoning and preference



Integrated Preference & Zoning

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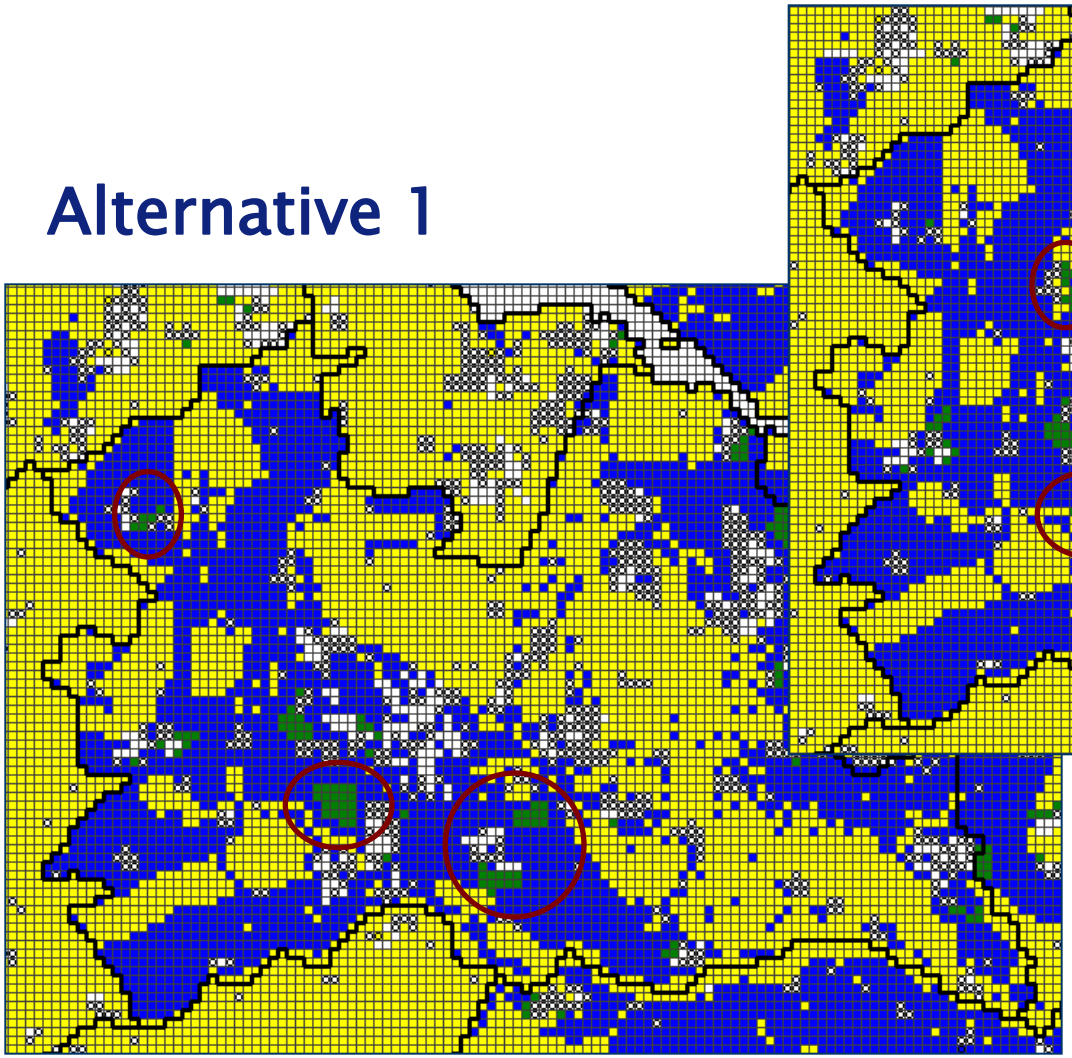
Search space

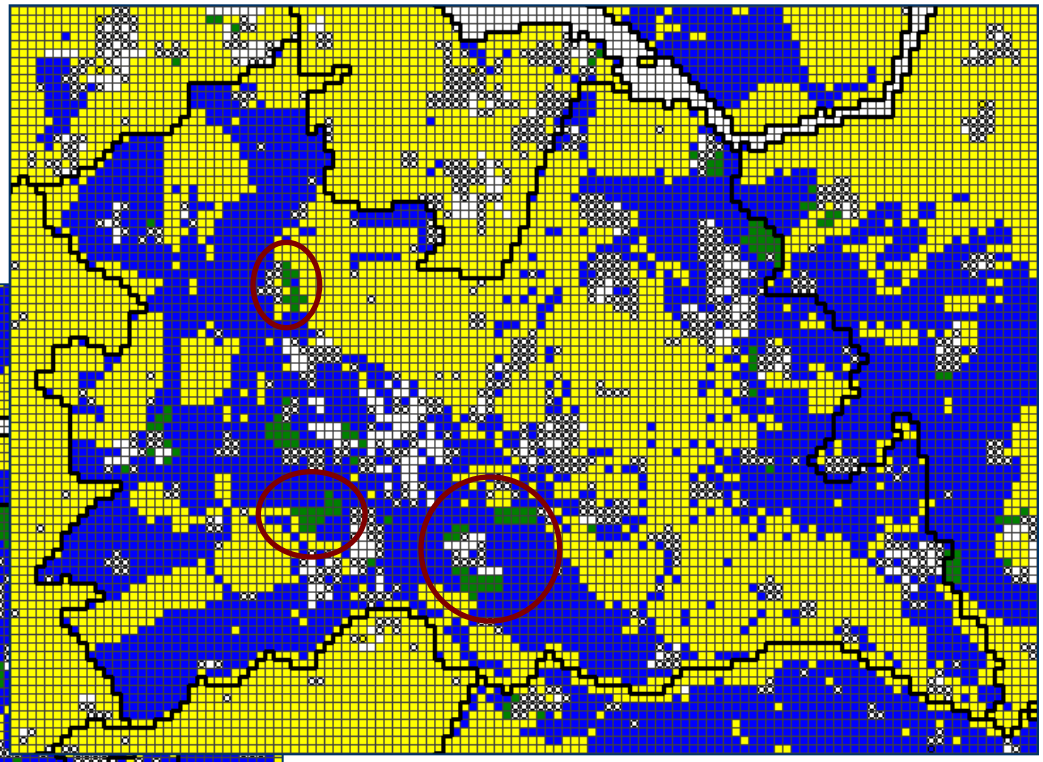
Area to be planned

	Current locations	Fixed plans until 2005	Plans 2005-2015	Expansion 2005-2015
Housing	16825 ha (673 cells)	1350 ha (54 cells)	1425 ha (57 cellen)	1300 ha (52 cellen)
Offices	375 ha (15 cells)	175 ha (7 cells)	125 ha (5 cellen)	50 ha (2 cellen)
Industry	3625 ha (145 cells)	175 ha (7 cells)	375 ha (15 cellen)	300 ha (12 cellen)

Designing alternatives for housing

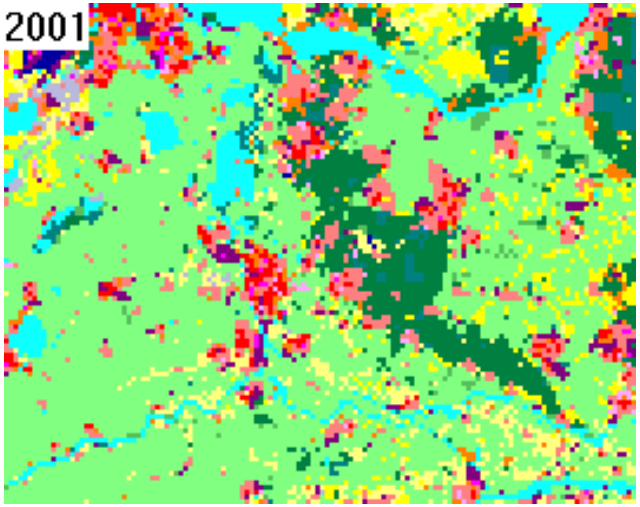
Alternative 1





Alternative 2

Calculation of alternatives



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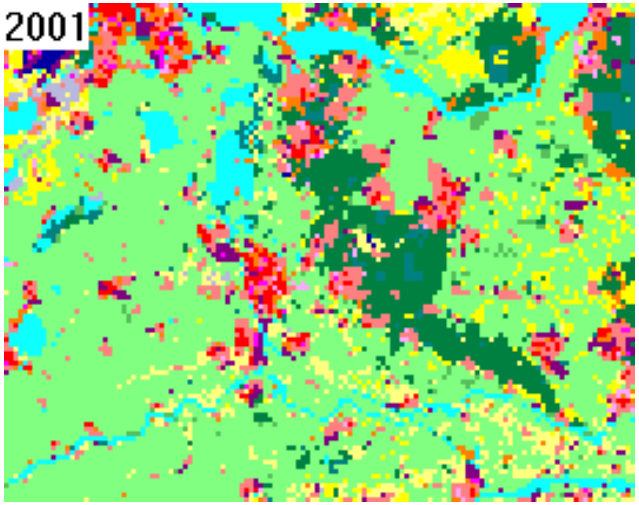
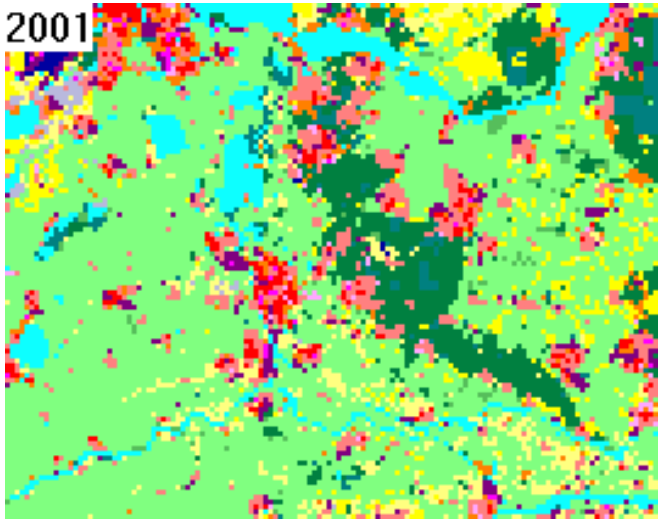
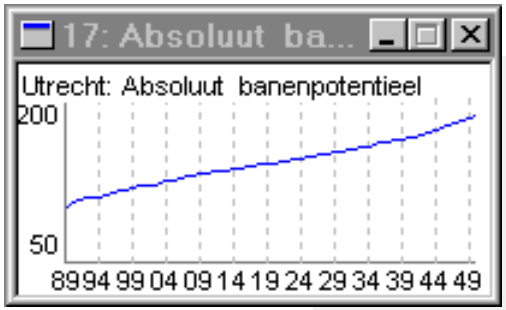


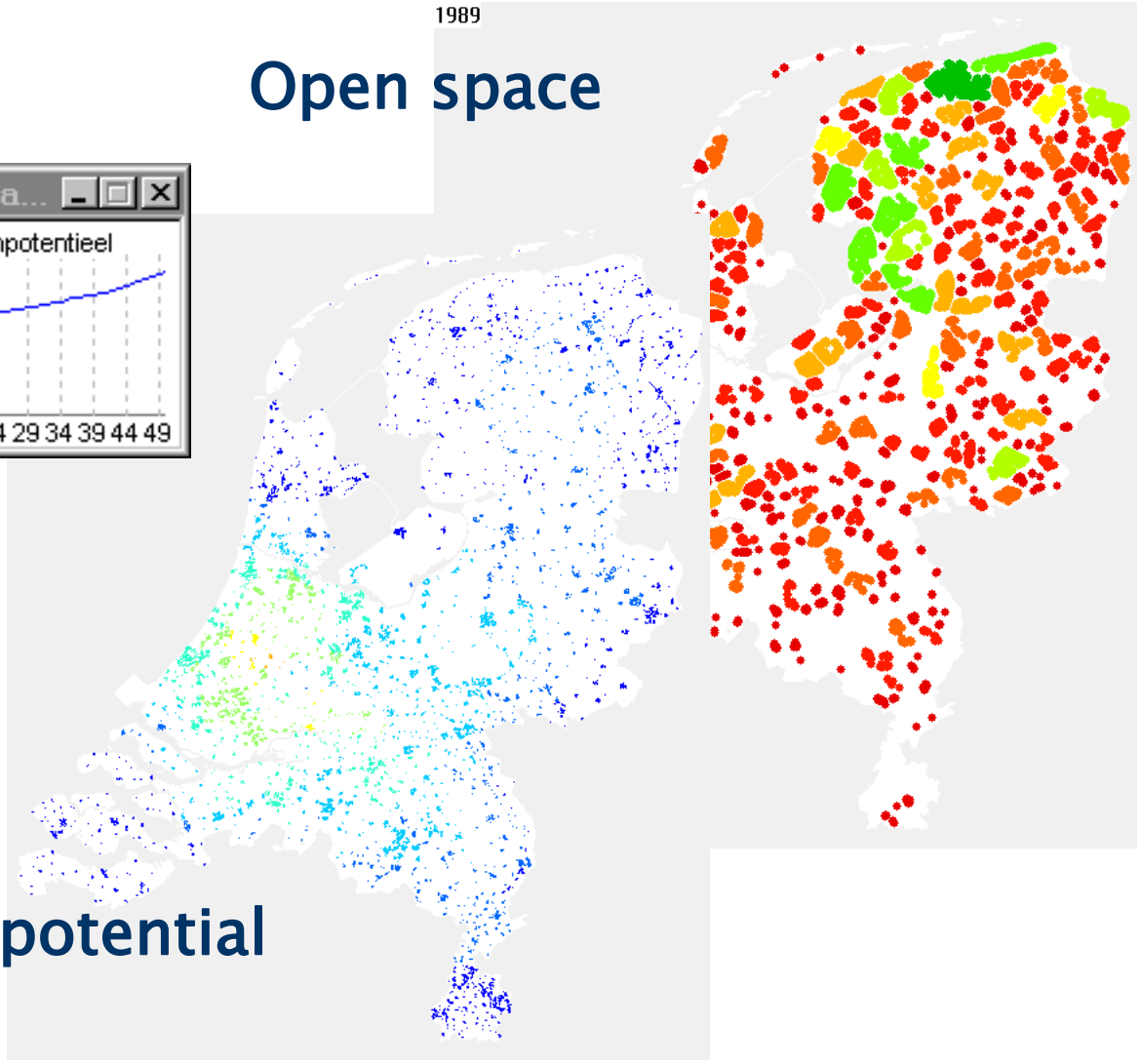
Alternative 2



Alternative Environment Explorer

Indicators





Open space

Job potential

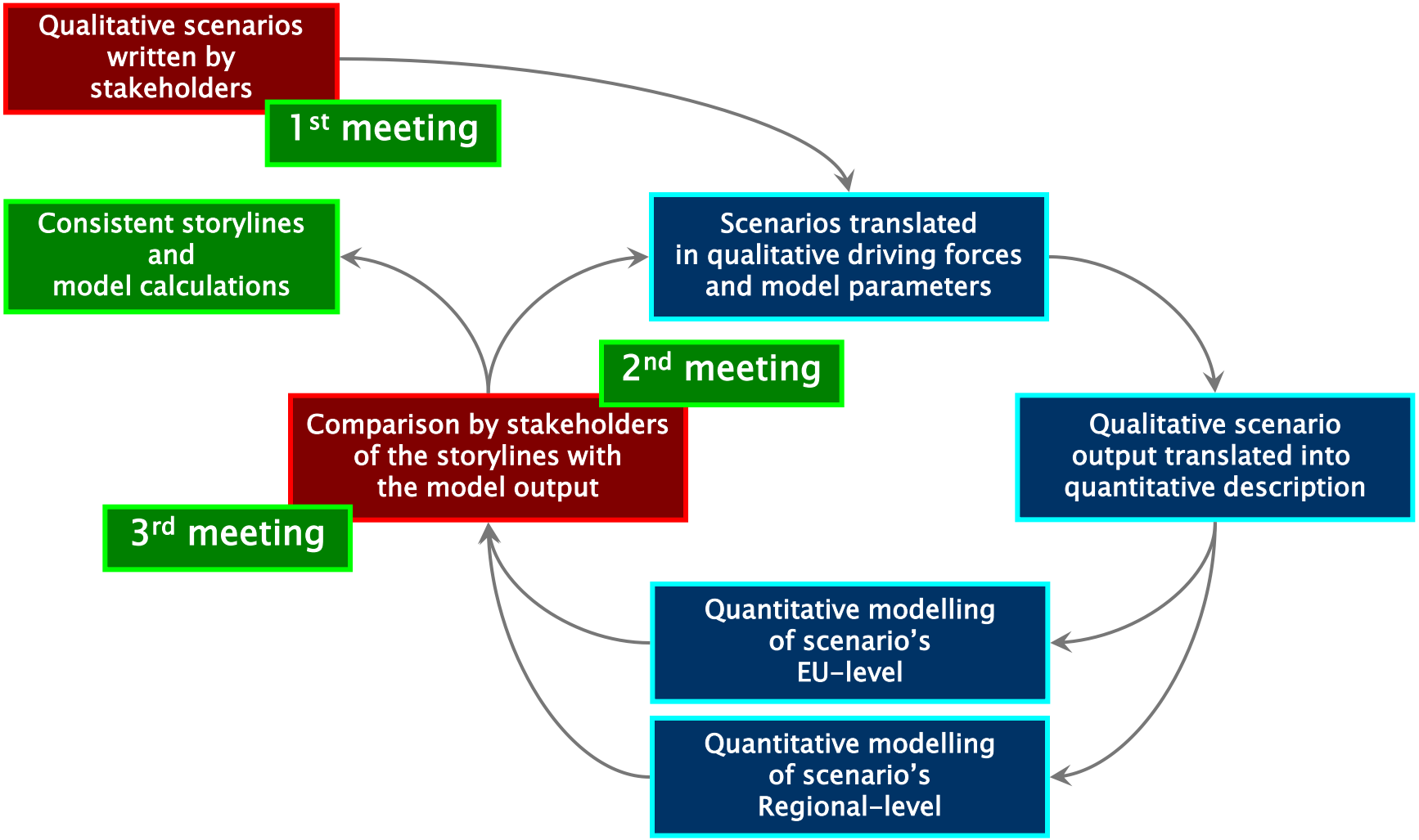
Support for storylines and scenarios

- **Goal: development of 5 different land use scenarios for Europe to answer the questions**
  - How will people live and work in Europe?
  - How will the landscape evolve?
  - What will be the environmental consequences?
- **Regional interpretation and simulation modelling of 5 European storylines developed by stakeholders**

Qualitative scenario development

- The goal is to develop *qualitative scenarios*, or ***narrative storylines*** in a ***group process*** with ***stakeholders***.
- Thus, we expand our mental model beyond conventional thinking and trend extrapolation, and include more surprising developments.
- The relevant question that scenarios can answer is not whether an event is *likely to happen*, but if it is *plausible*.

Practical case 2: Support for storylines and scenarios



Two different plausible futures

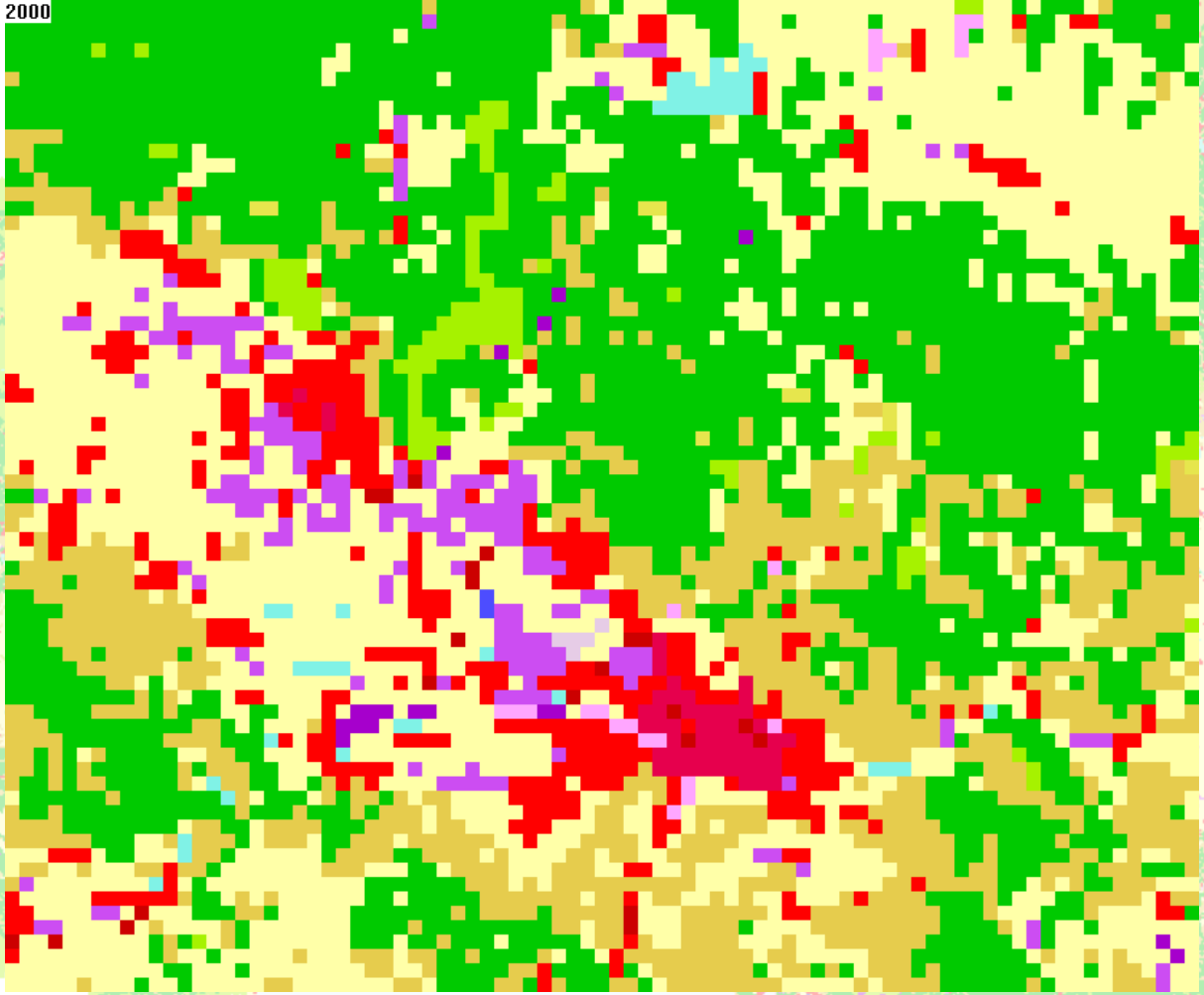
- **The Great Escape**
  - Economic growth due to strong focus on market economy
  - Intensification of agriculture and overexploitation
  - Pollution and environmental decay
  - Large social inequity

- **Evolved Society**
  - Climate change
  - Migration from the city to countryside
  - Focus on self-sufficiency: food and bio-fuels
  - Small economic growth
  - Environmental friendly, hover-rail, but fragmentation grows

From qualitative storyline to quantitative model input

Quantification of Storylines

- **Process involving 5 steps:**
  - Step A: Setting the boundaries;
  - Step B: Regional interpretation of European scenarios;
  - Step C: Quantification of narratives;
  - Step D: Model runs and Analysis of results;
  - Step E: Feedback with stakeholder group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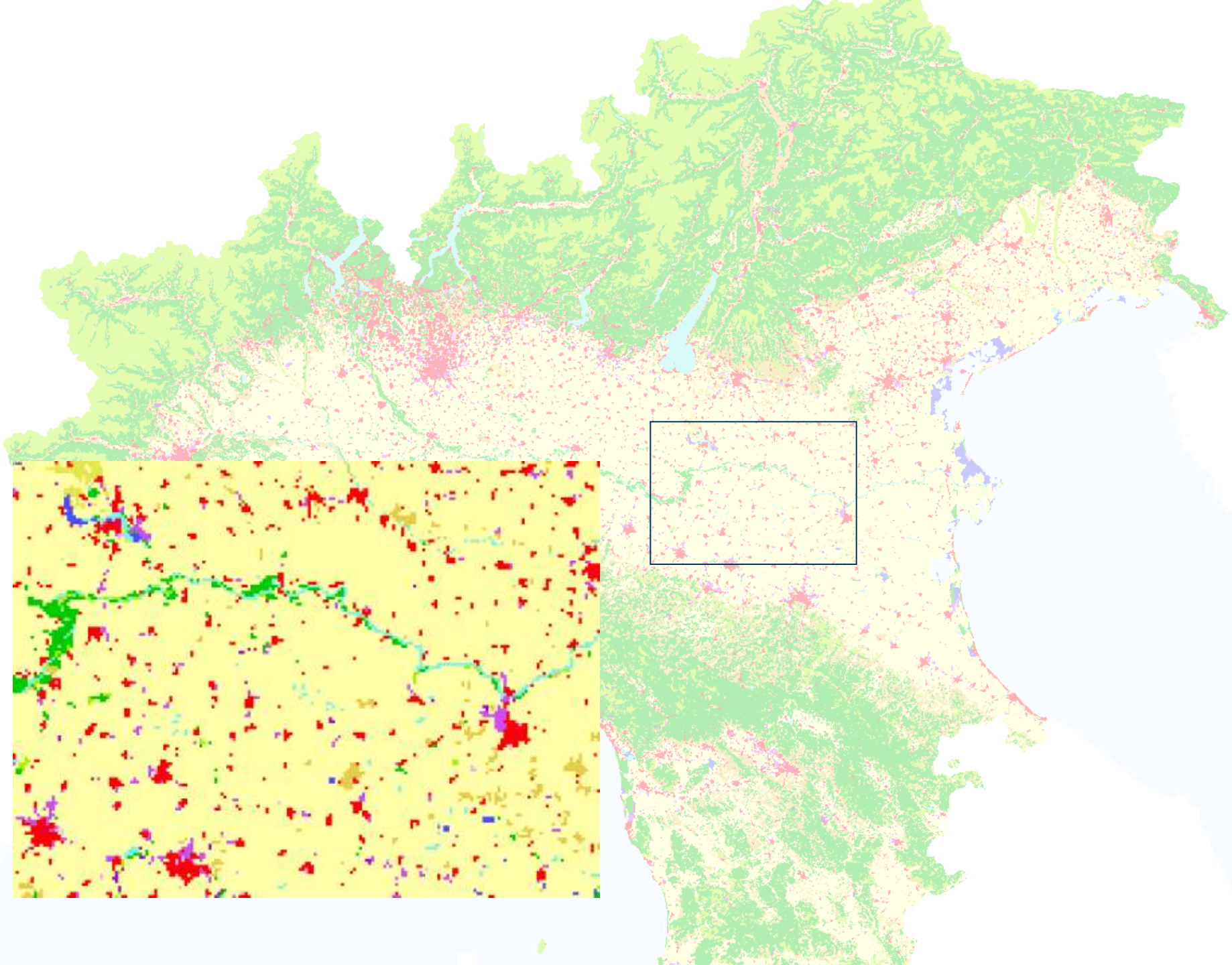
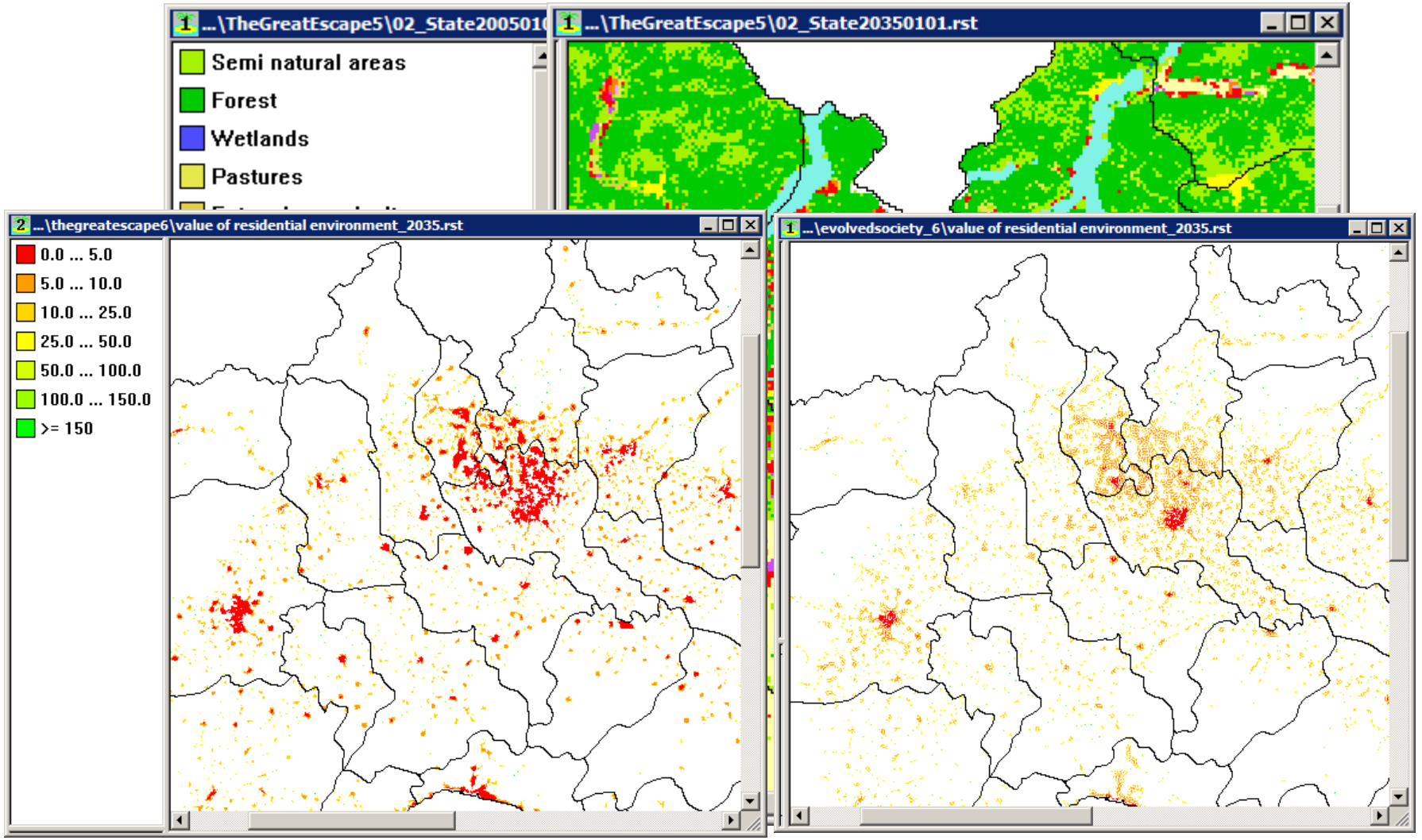


Quality of Residential Environmental



Discussion EEA PRELUDE

- **Combination of two very different approaches**
  - Storylines: creativity and flexibility
  - Model: consistent, coherent integration and visualisation
- **Vivid and open discussion between stakeholders and modellers led to improved storylines and model results and creative consistent scenarios**
- **Main challenges**
  - Flexibility of Decision Support System
  - Translation from qualitative to quantitative

Comparing both exercises

- **Similarities**
  - Integration of opinions, visions and data
  - Combination of participatory processes and modelling
- **Differences in type of scenarios**
  - Type of scenarios
  - Process
  - Different types of scenarios have different modelling demands

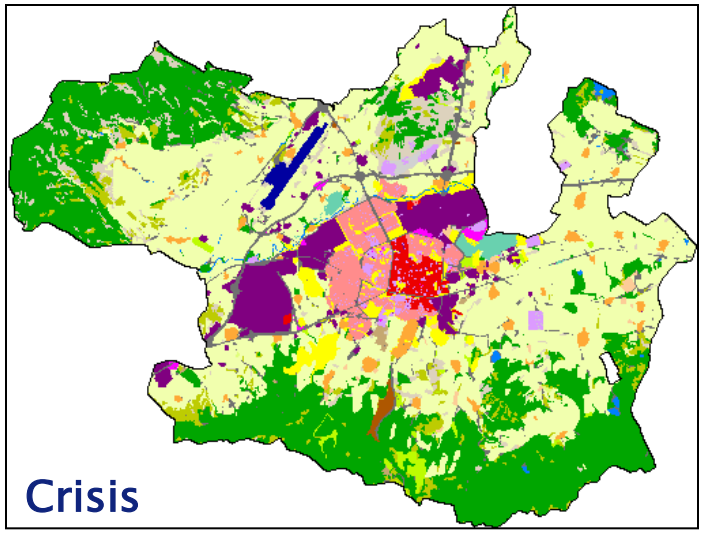
City of Vitoria-Gasteiz (Spain)

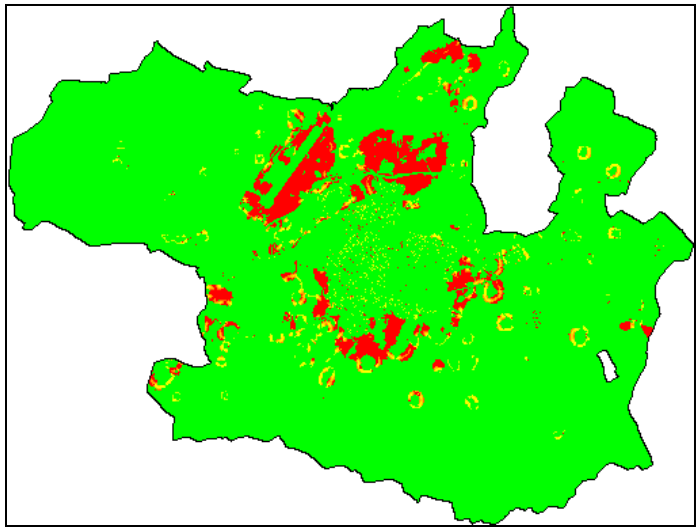
Three scenarios

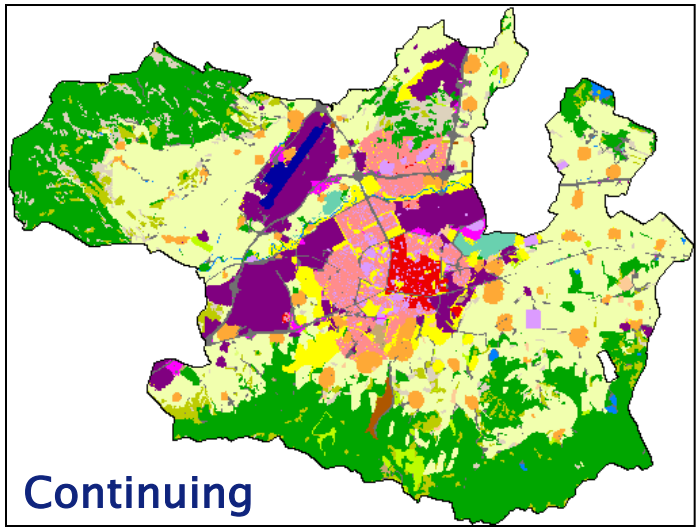
- Continuing
- Crisis
- Super growth

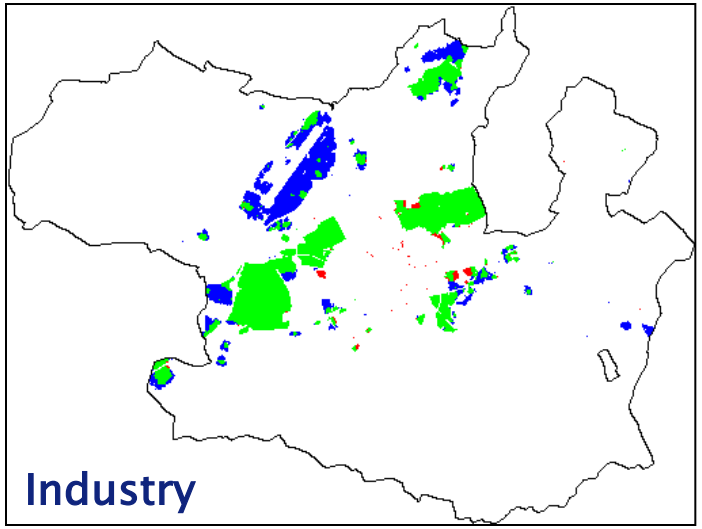
- Different in:
  - Land use demands
  - Zoning regulations
  - Infrastructure

Comparing scenarios: Crisis vs Continuing

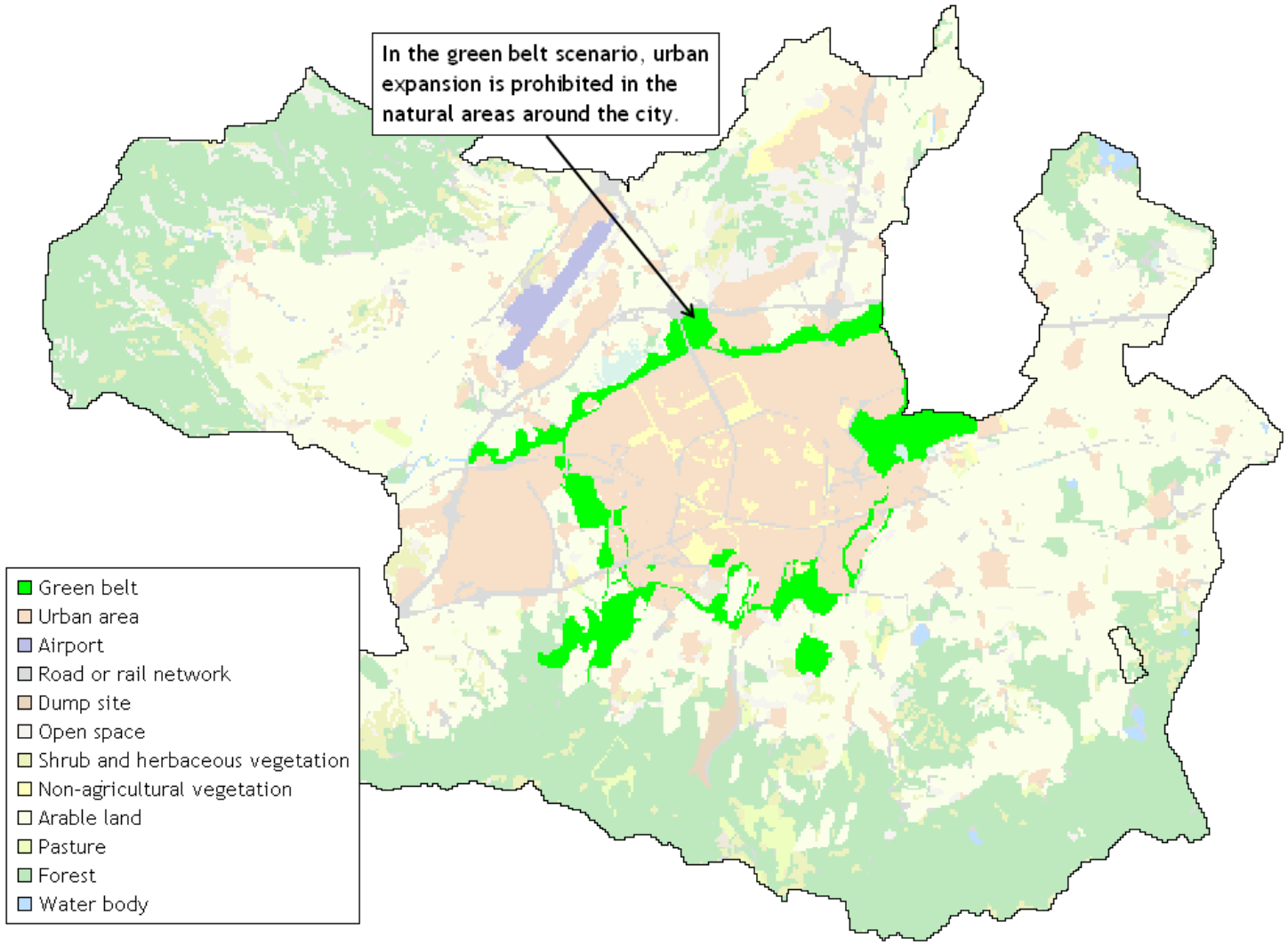




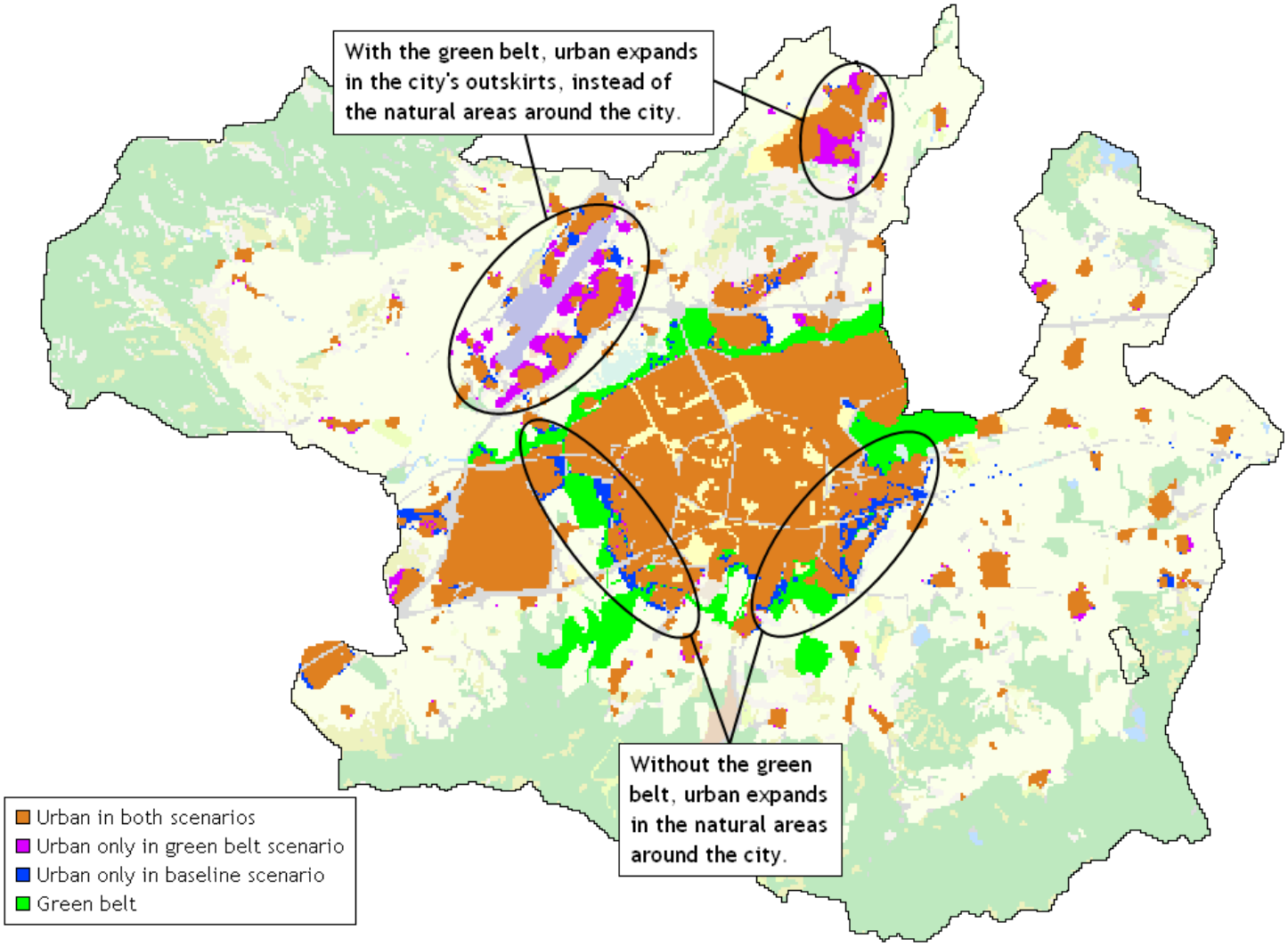




Policy option – green belt



Green belt – results



Road construction

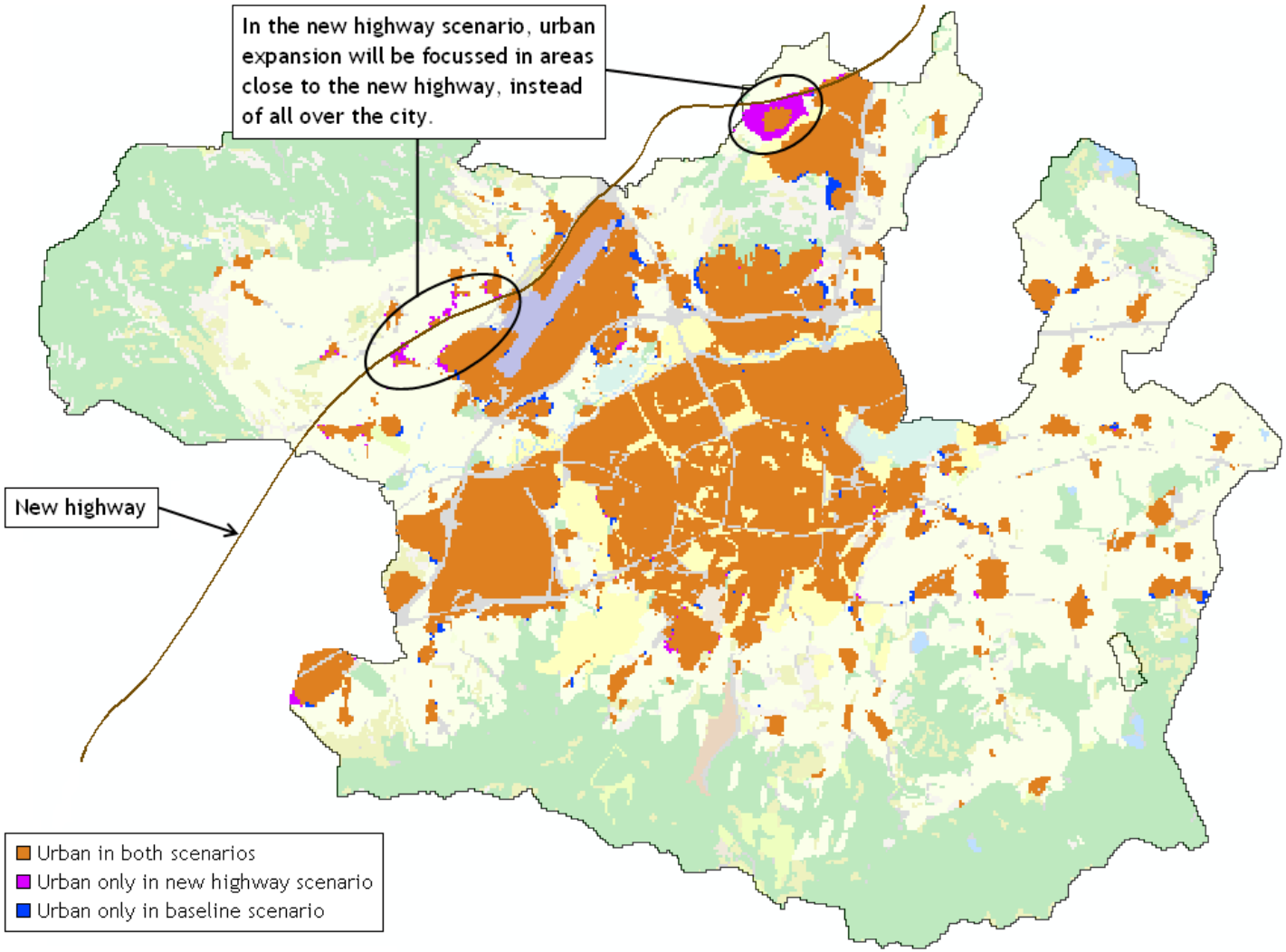
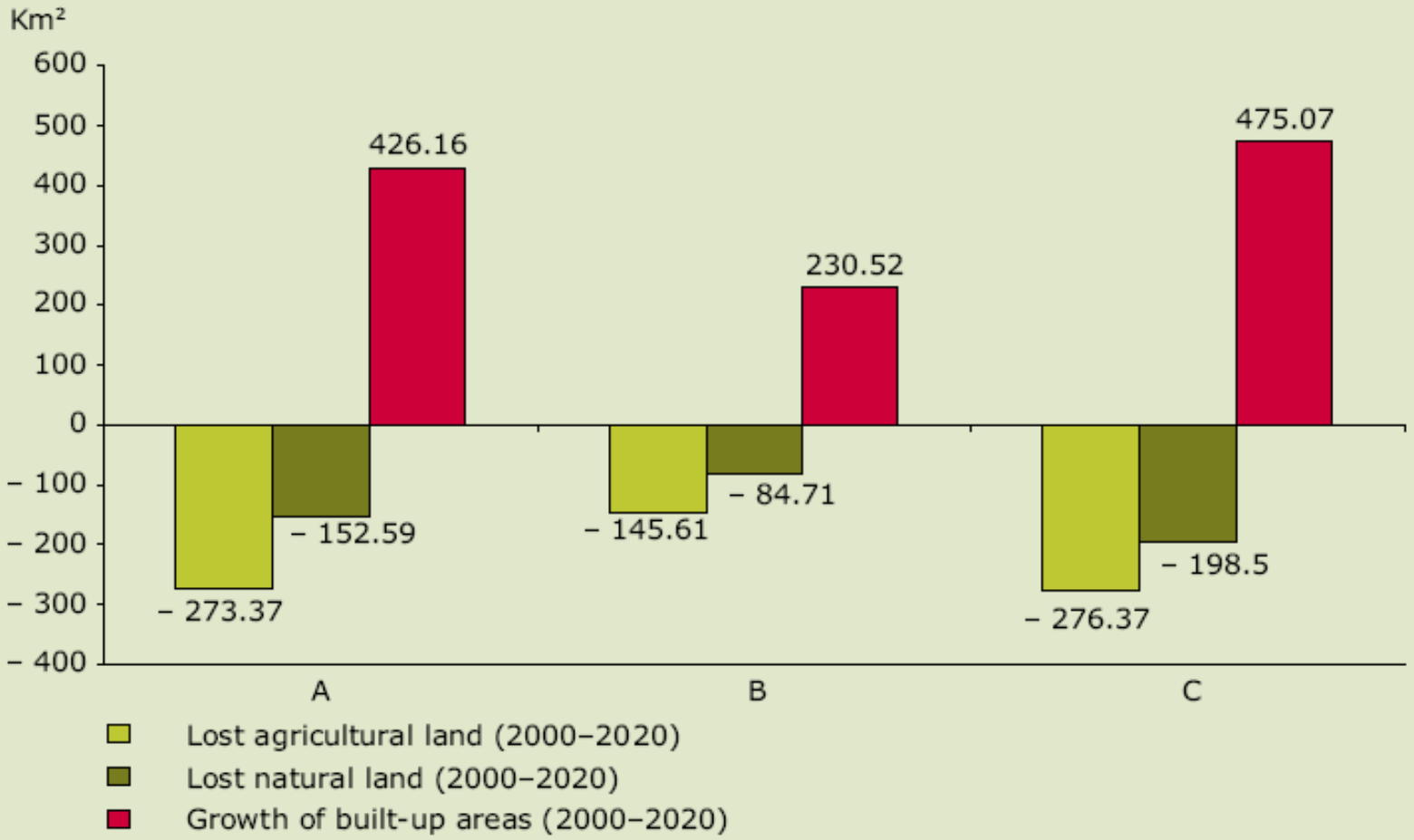


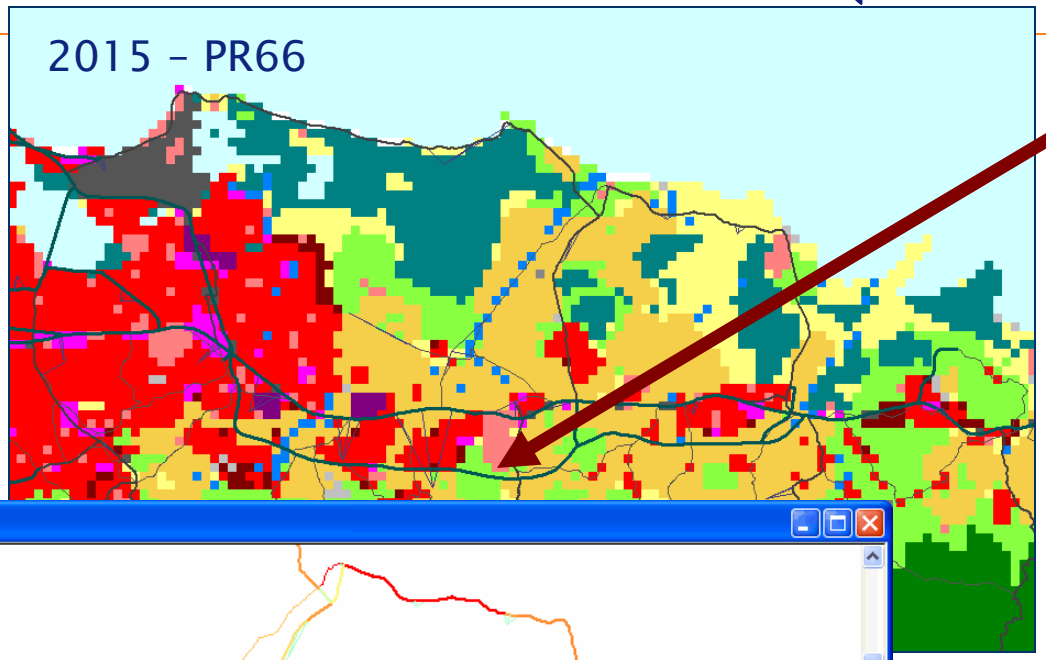
Figure Land use changes for the Madrid region 2020

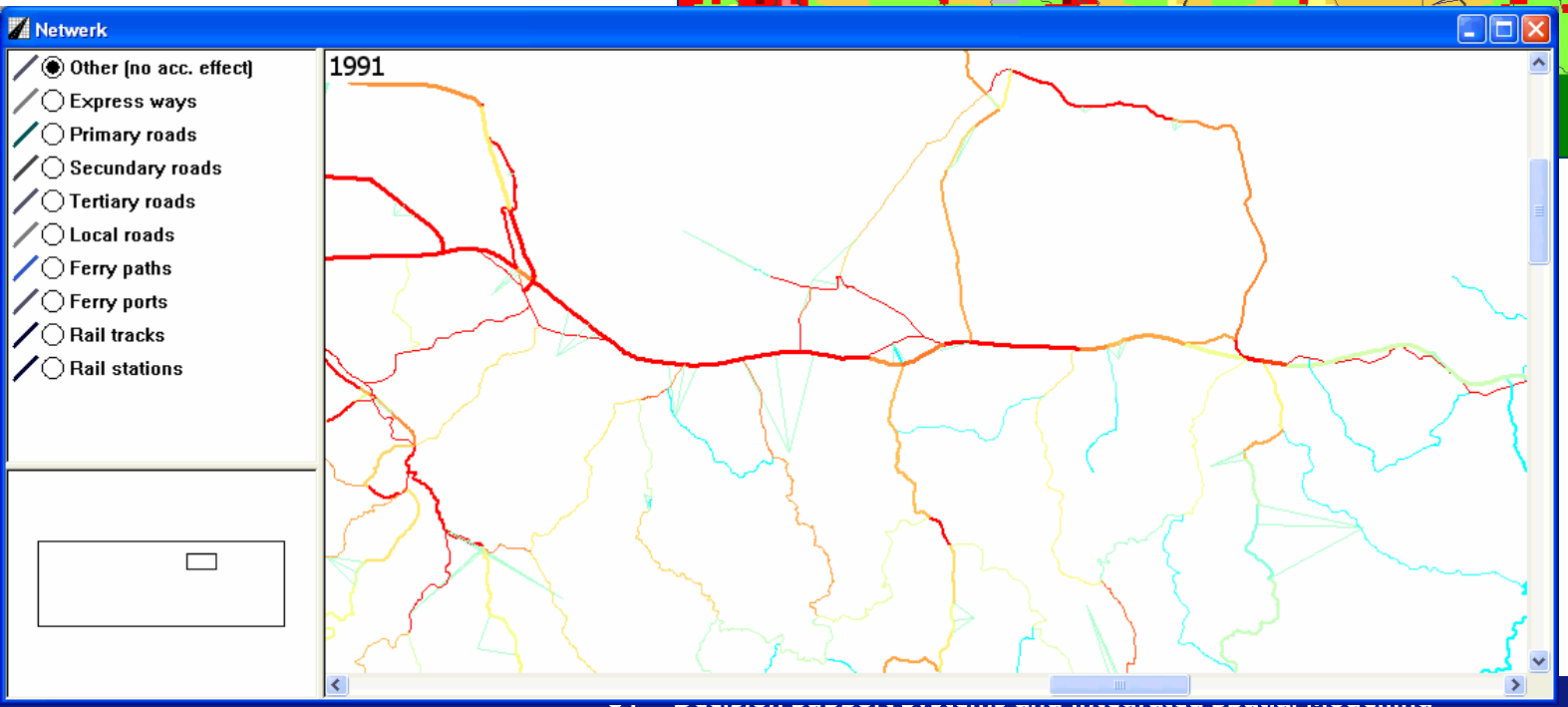
A: Business-as-usual B: Compact development C: Scattered development



Source: MOLAND (JRC).

Ex. Xplorah: Construction PR66 (2005)





Using the MedAction PSS

External fact

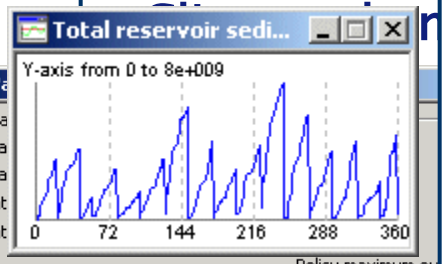
External factor

olicy options

ent crops;

Indicators:

- Land use changes;
- Natural vegetation changes;
- Erosion rates and soil depth;
- Soil salinity;
- Soil moisture;
- Suitability of the land;
- Water resources;
- Water use of different f
- Water use from differer
- Irrigation water usage;
- Crop type changes;
- Profit for farmers;
- …



Policy maximum ou

[m³/month]

Aquifer	500000000
Reservoirs	60000000
Desalinated sea water	20000000

Outputs

Cumulative over current month

	Replenishment [m³]	Extraction [m³]
Aquifer	7592704	2164158
Reservoirs	1465307	863868
Desalinated sea water	3000000	0
Total	12058010	3028025

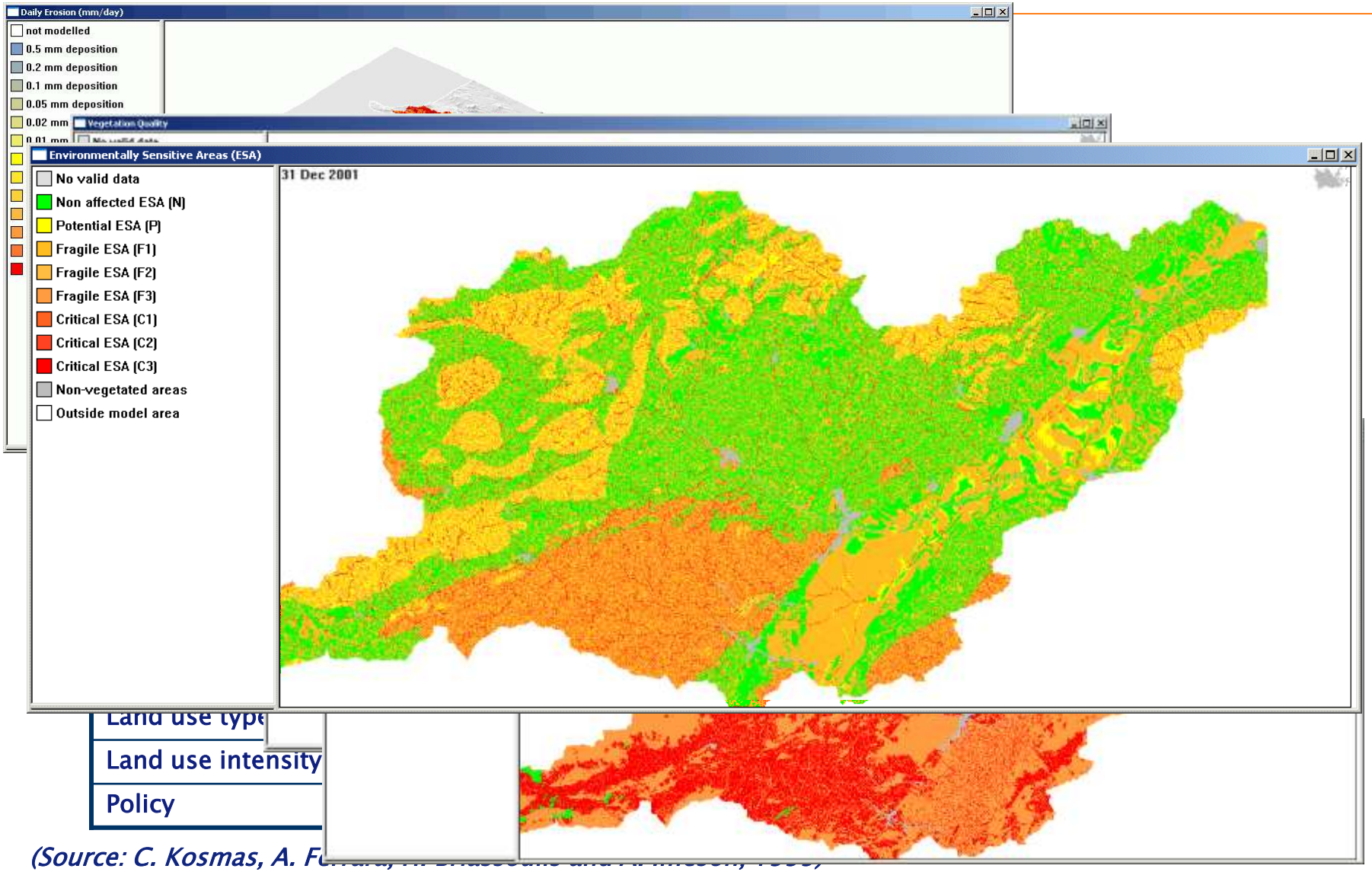
Profit & crop choice; Profit table

Outputs

Crop description	Average profit per cell	Number of covered cells	Total profit
	€/cell	cell	€
No Crop	0.00	578.00	0.00
Almonds [dryland]	42824.37	42916.00	1837850772.74
Almonds [irrigated]	13998.76	3.00	41996.28
Cereal [dryland]	32466.16	58778.00	1908296191.35
Cereal [irrigated]	8727.68	10525.00	91858876.31
Citrus [irrigated]	30989.40	2.00	61978.80
Fruit [dryland]	118545.46	33516.00	3973169483.62
Fruit [irrigated]	52207.01	820.00	42809745.69
Vegetables [irrigated]	98427.75	6010.00	591550793.98
Vegetables [greenhouse]	362965.29	81.00	29400188.76
Olives [dryland]	121113.51	36305.00	4397025807.88
Olives [irrigated]	15709.50	363.00	5702549.91
Vineyard [dryland]	76816.25	40792.00	3133488367.56
Vineyard [irrigated]	15534.65	187.00	2904978.74
All dryland crops	71829.15	212307.00	15249830623.16
All irrigated crops	41034.67	17910.00	734930919.72
All greenhouse crops	362965.29	81.00	29400188.76
Total agriculture	69362.61	230876.00	16014161731.63

Compound Dynamic Indicators:

Environmentally Sensitive Areas (ESA's)

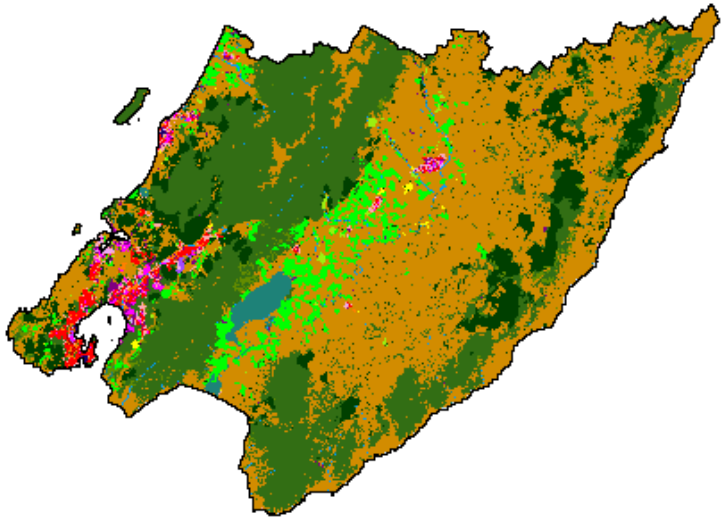


(Source: C. Kosmas, A. Ferrara, M. Briasouli and A. Imeson, 1999)

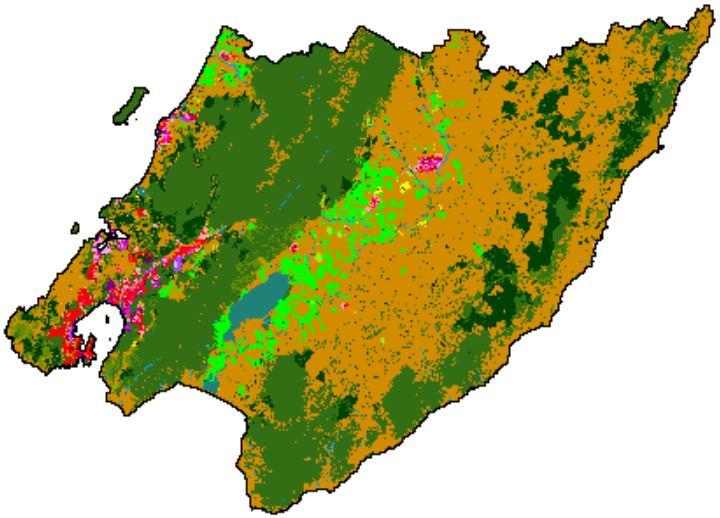
Test case Wellington region

- **How does the region change over time under the baseline scenario?**
  - Taking into account land as a limiting resource
  - Using a purely demand-driven approach
- **What would be the impact of protecting the current areas of indigenous vegetation**
  - On land use?
  - On economic development?

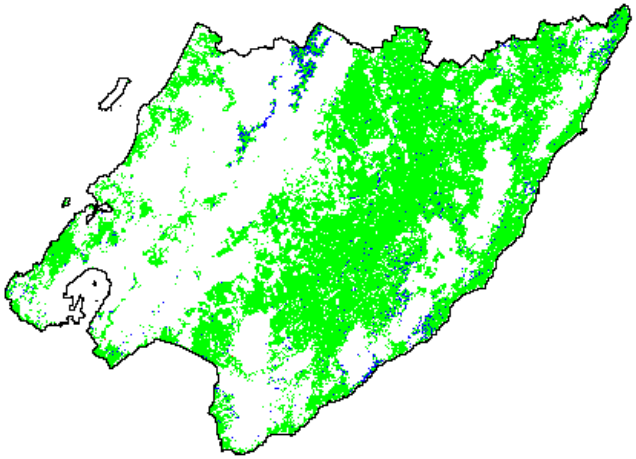
- Indigenous forest and vegetation
- Other exotic vegetation
- Horticulture and fruit growing
- Livestock farming and cropping
- Dairy cattle farming
- Other farming
- Exotic forest
- Industrial
- Hospitality
- Commercial
- Central government
- Residential - low density
- Residential - medium density
- Residential - high density
- Education
- Culture and recreation
- Mines, quarries and dumps
- Aquaculture
- Freshwater
- Wetlands
- Marine
- Airports and ports
- Motorway
- Open space (urban parkland/grassland)
- Coastal and estaurine areas
- Bare land
- Land outside of study area



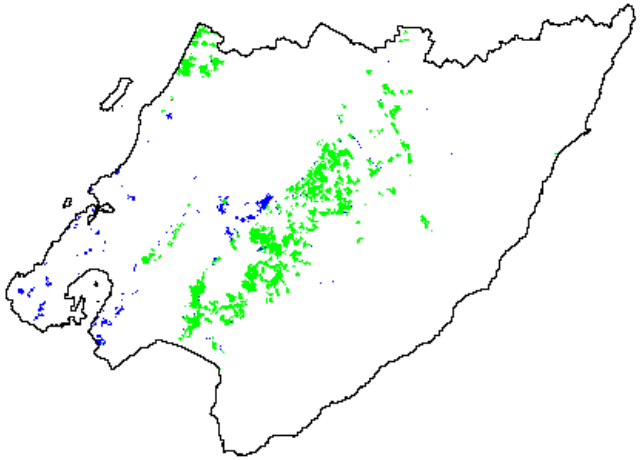
2005



2025



Increase in livestock farming



Increase in dairy cattle farming

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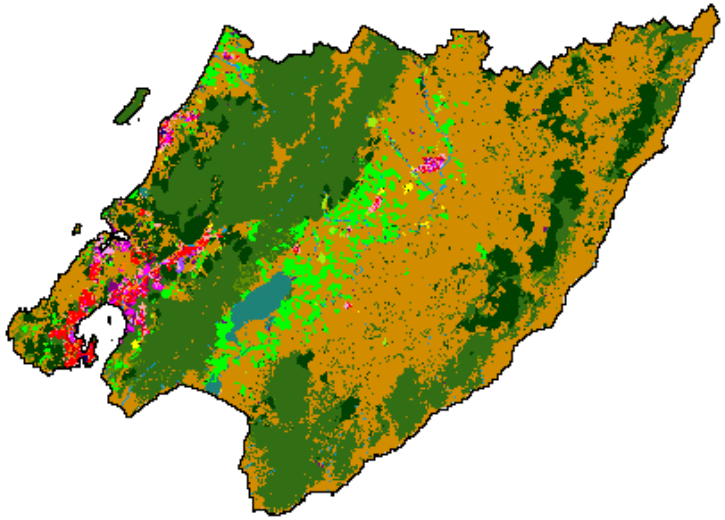

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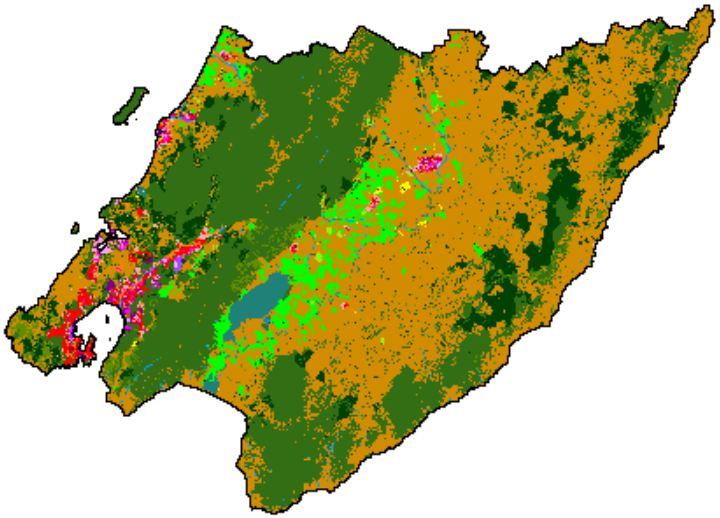
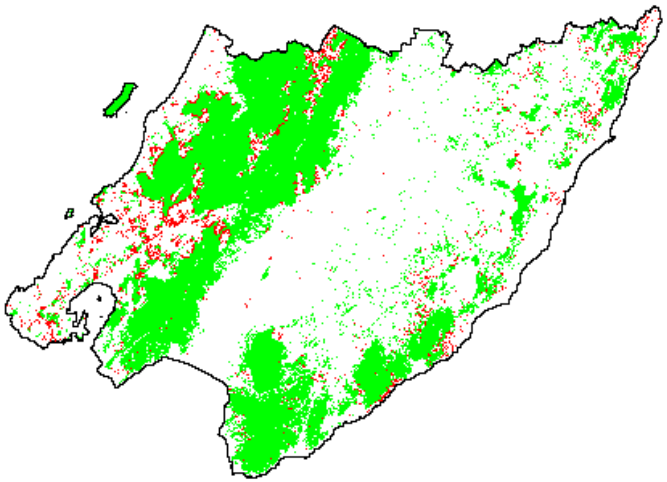
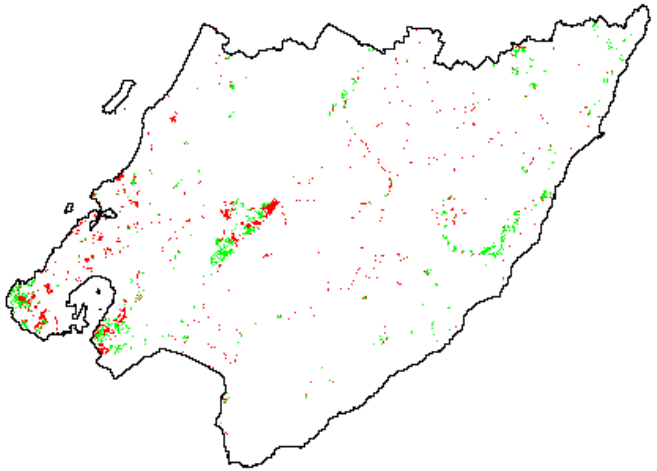


2025

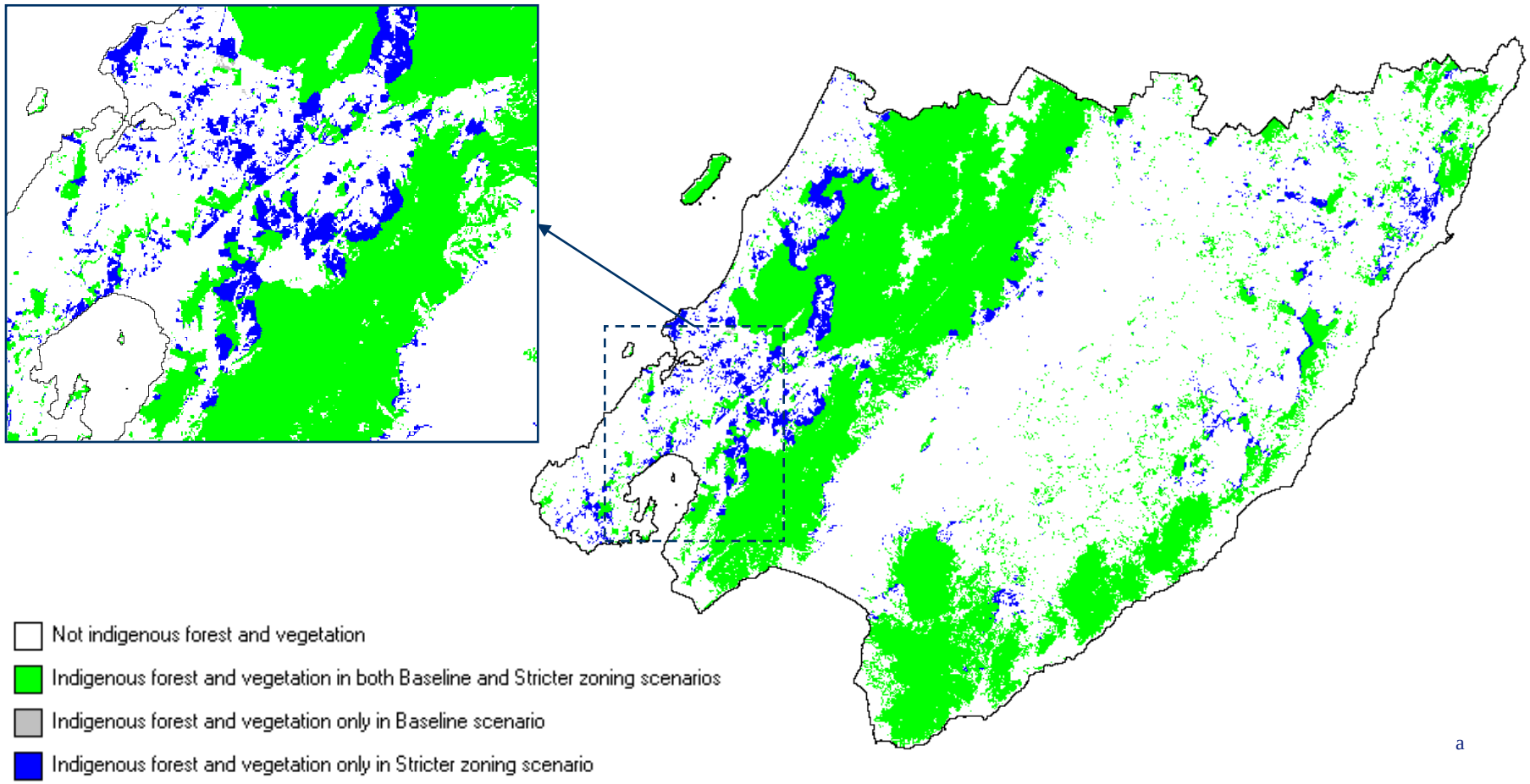


Decrease in indigenous vegetation



Decrease in other exotic vegetation

Results: difference between scenarios



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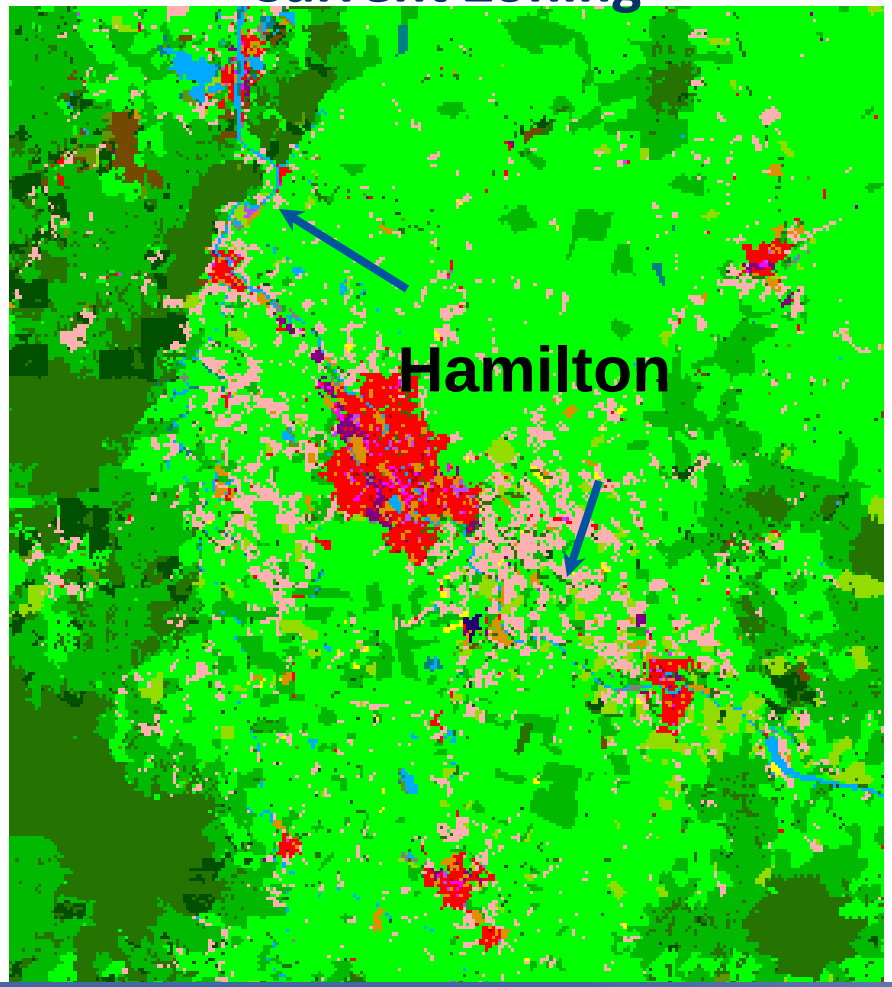
Impact on economic developments

- Overall economic growth in the baseline scenario over the period 2005-2025 is ~38%
- An unconstrained supply would give ~2% higher growth, stricter zoning ~0.5% less growth
- Impact on the agricultural sector, in particular dairying and livestock farming is much larger, in the order of 10-15%

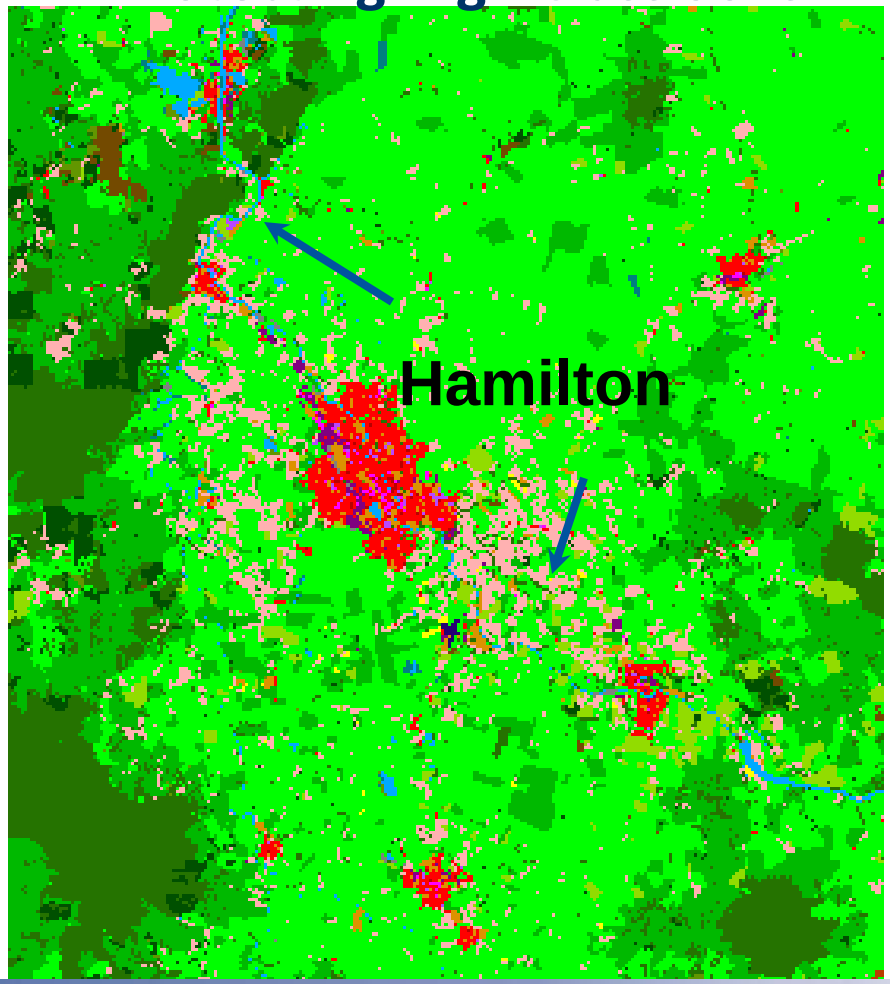
- Spatial planning, interesting locational characteristics and competition between land uses determines what economic sectors will be most affected by limiting land resources

Future Proof: Land Use Change – 2006 to 2050

Current Zoning



Protecting High Class Soils

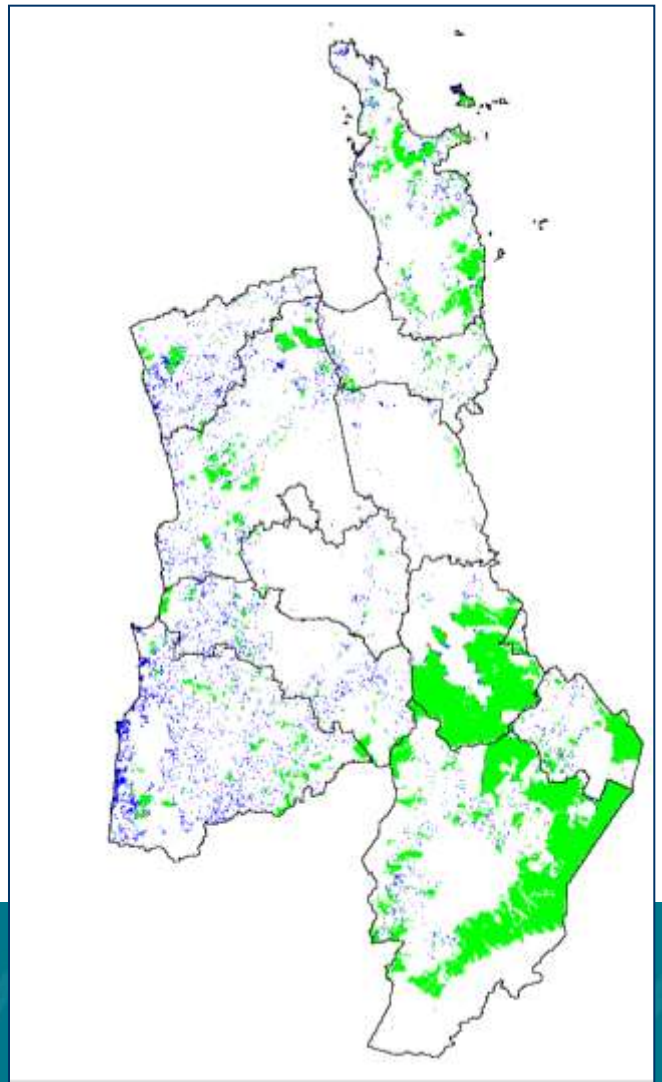


WISE Carbon Forestry

Forestry Land Use in 2050:

Comparing reference and carbon forestry scenarios

- Not forestry in either scenario
- Forestry in both scenarios
- Only forestry in the reference scenario
- Only forestry in the carbon forestry scenario



WISE Carbon Forestry (2)

Location of new Carbon Forestry land use

Impacts on economy

- ✓Land owners profits up
- ✓Carbon Farming sector: output & jobs up
- ✓Overall (all sectors): no significant change

Environmental co-benefits:

- ✓ Less runoff (flooding)
- ✓ Enhanced biodiversity
- ✓ Reduced erosion (sedimentation)
- ✓ Reduced phosphate and nitrogen loads to waterways

Use of Policy Support Systems

- **Capabilities**
  - Explore dynamic spatial developments using 'what-if-analysis'
  - Visualise consequences of trends, shocks and policy interventions
- **Limitations**
  - Overall strategic development, not detailed planning
  - Limited knowledge on links between models
- **Stimulates and facilitates**
  - Learning
  - Awareness building
  - Discussion

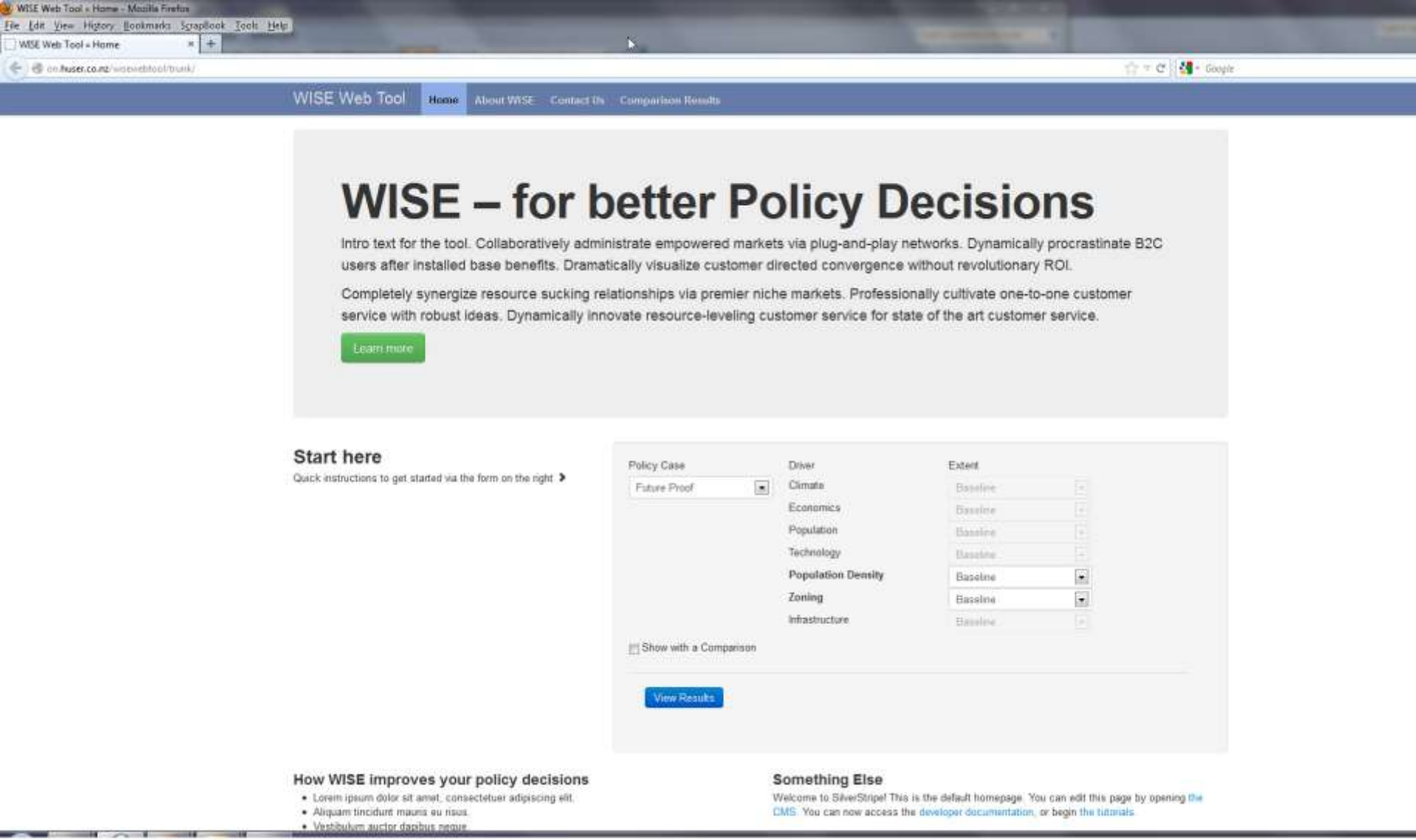
Prior to decision-making!

Success factors

- Availability of models, data and knowledge
- Credibility – assumptions, calibration, validation
- Institutional embedment – willingness, adoption, commitment, champions and implementation
- Ease of use – user-friendly interface
- Strategic value – usefulness, application, added value
- Ongoing support – training, capability building, technical support, maintenance and cost

WISE Implementation Plan

- WISE User Group – planners supported by technical experts – modelers, spatial analysts, scientists, economists
- Training to understand WISE, build capability and capacity
- Continue with collaborative real-life case studies
- Identify and prioritise improvements
- Maintain/up-date data and model components
- Add functionality – transport, marine, natural hazards, ecosystem services…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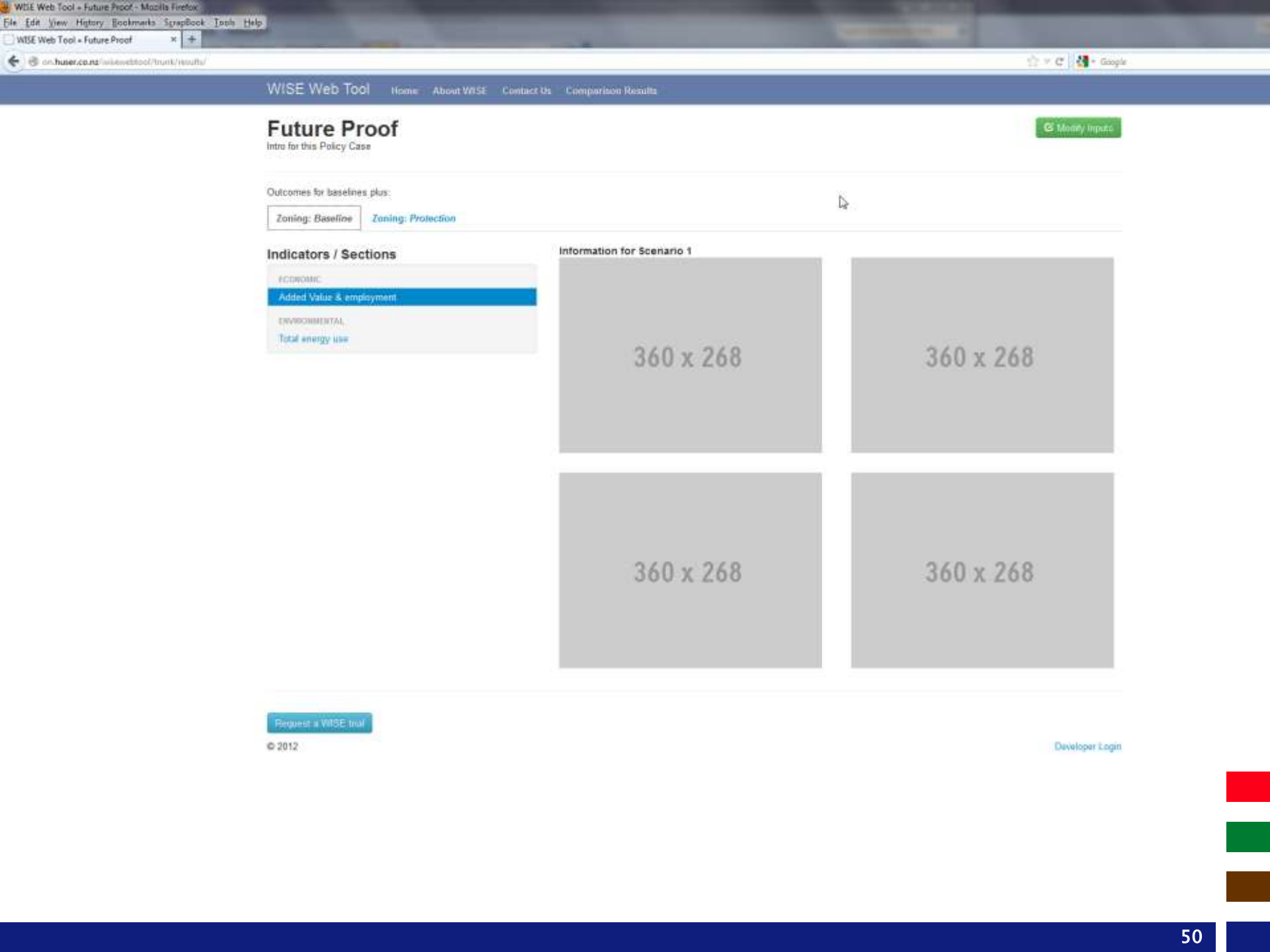
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Zoning: Protection
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Added Value & employment
ENVIRONMENTAL
Total energy use
Information for Scenario 1
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Request a WISE trial
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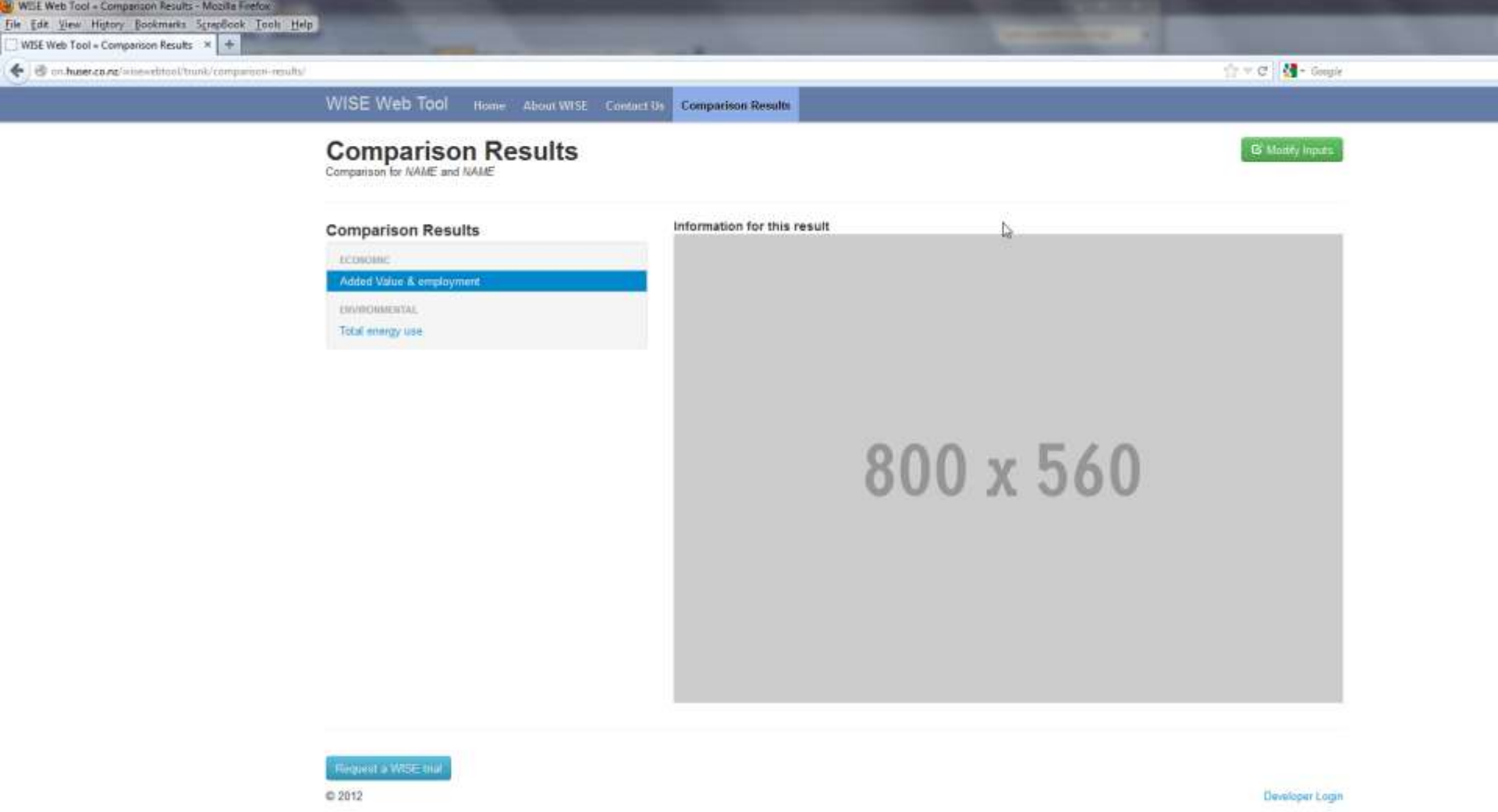
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